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CLERK OF THE BOARD
OF COUNTY COMMISSIONERS
MIAMI-DADE COUNTY, FLORIDA

Memorandum

MIAMI-DADE COUNTY

Agenda Item No. 8(N)(1)

Date: November 8, 2012

To: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

From: Carlos A. Gimenez
Mayor

Subject: Executive Summary for the Contract Award Recommendation for Purchase of New Heavy Rail Vehicles

Resolution No. R-924-12

It is recommended that the Board of County Commissioners (Board) approve award of this contract to AnsaldoBreda S.p.A. (AnsaldoBreda) for purchase of 136 new Metrorail replacement vehicles and the decommissioning of the old fleet. The vehicles will be designed and built by AnsaldoBreda to provide 30 years of useful life to the County. The contract is compliant with the commercial and technical requirements of the Request for Proposals (RFP) and all applicable federal requirements.

Fiscal Impact

The total required funding for this contract is $313,832,000, inclusive of a 5% contingency allowance of $14,944,800. Total Project funding, including this contract, project management, oversight and other support costs is $375,746,000. This amount is $25,705,000 less than the not to exceed ceiling of $401,451,000 for total project costs approved by the Board through Resolution R-488-08 on May 6, 2008. The $375,746,000 will be funded through the issuance of Transit System Sales Surtax Revenue Bonds. Net Transit System Sales Surtax revenues will be the sole pledge for repayment of the bonds. The Bond Ordinance and corresponding Series Resolution authorizing the Bonds was approved by the Board on June 5, 2012.

Background/Solicitation Process

On March 31, 2009, the County issued a solicitation (RFP No. 654) for the purchase of new heavy rail vehicles to replace the existing fleet. The solicitation included a price cap of $2.419 million per vehicle. The County included two Federal Transit Administration (FTA) required practices, and an industry recommended practice during development of the solicitation: 1) a comprehensive Peer Review (FTA) of the solicitation prior to issuing the RFP in which the County invited a panel of transit experts, assembled by the American Public Transit Association (APTA), to conduct a thorough review of the solicitation documents, 2) a Value Engineering Study (FTA/MDC) of the technical provisions performed by Lea+Elliott, Inc., an independent engineering consultant and 3) an industry review of the specifications by seven major carbuilders. Proposals were received from three rail carbuilders on September 25, 2009: Alstom Transportation Inc., (Alstom), AnsaldoBreda S.p.A, (AnsaldoBreda), and CAF USA, Inc. (CAF). The Alstom proposal was deemed non-responsive by the County Attorney's Office because the proposal did not meet the price cap requirement. Staff, through evaluations, concluded that AnsaldoBreda S.p.A. and CAF USA, Inc. provided technically compliant proposals. The former County Manager directed staff to conduct negotiations with AnsaldoBreda S.p.A. and CAF USA, Inc. Negotiations commenced on June 2, 2010. During the week of August 1, 2010, County staff visited the final assembly facility of CAF in Elmira, New York, and AnsaldoBreda's vehicle final assembly facility in Pittsburg, California. The Pittsburg facility will be used to assemble the six pilot vehicles and serves as a model for the vehicle final assembly facility to be constructed in Miami-Dade County. On August 9, 2010, Best and Final Offers (BAFO) for price were received from the two proposers. BAFO prices were as follows:

- AnsaldoBreda $ 298,887,200 or $2,197,700 per car
- CAF USA, Inc $ 303,566,408 or $2,232,106 per car

AnsaldoBreda's BAFO price represents a reduction of $30,096,800 when compared to the County's price cap of $328,984,000. AnsaldoBreda's BAFO price is $4,679,208 less than the CAF BAFO price. The Negotiations Team met on August 10, 2010 to consider the BAFOs and to carefully review and evaluate which competitive offer represented the best value to the County. On February 18, 2011, the former County Manager signed an award recommendation for AnsaldoBreda. On February 24, 2011, CAF filed a protest of the former County Manager's award recommendation. The protest was heard on March 14, 2011 by a Hearing Examiner, the Honorable Judge Phillip Cook, who upheld the County Manager's recommendation to award to AnsaldoBreda.

On March 24, 2011, CAF filed an appeal with the FTA, asserting that the County did not comply with FTA procurement rules by considering a local vehicle final assembly facility proposed by AnsaldoBreda, local jobs, and the impact on the local economy. In its decision dated November 23, 2011, FTA stated that the County did not comply with Federal procurement requirements as FTA concluded the County considered the location of the final assembly facility as an evaluation selection factor without specifically including this factor in the RFP, and FTA also concluded the County considered local geographic preference as a selection factor. The FTA recommended that MDT reevaluate the proposers' BAFOs without considering local preference, the effect of a local assembly facility on the local economy, or the potential project cost savings based upon the location of the final assembly facility. The Mayor sent a November 28, 2011 memorandum to the Board, rescinding the February 18, 2011 award recommendation by the former County Manager. On November 29, 2011, the Mayor directed that the Committee be reconvened to reevaluate the BAFO proposals, and comply with the FTA's opinion. On December 6, 2011, the Committee reconvened, at a publicly noticed meeting, and reevaluated the BAFOs. The Committee concluded that the offer from AnsaldoBreda represents the best value to the county.

Due Diligence

Staff reviewed information from several recognized sources, including review of Dunn & Bradstreet reports, PACER (Public Access to Court Electronic Records) to determine if there was any pending litigation, Excluded Parties List System to determine if the company is excluded from participating on federal contracts, the State of Florida Suspended Vendor List, and reports from existing County systems, including the Finance Department's Delinquent Vendor List, and the County's Debarred Contractors List. Staff also met with AnsaldoBreda to address past performance, production capacity, contract resources, and financial viability. Staff determined there are no issues of concern, and that AnsaldoBreda is fully capable of meeting the financial, logistical and technical requirements of the contract. AnsaldoBreda continues to hold its BAFO price, and has re-stated its commitment to all contract obligations should it be awarded a contract by the Board.

Alina T. Hudak
Deputy Mayor/County Manager

Memorandum

MIAMI-DADE COUNTY

Date: November 8, 2012

To: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

From: Carlos A. Gimenez
Mayor

Subject: Recommendation for Approval to Award: New Heavy Rail Vehicles

CLERK OF THE BOARD
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MIAMI-DADE COUNTY, FLA.

RECOMMENDATION

It is recommended that the Board of County Commissioners (Board) approve award of this contract to AnsaldoBreda S.p.A (AnsaldoBreda) for purchase of 136 new heavy rail replacement vehicles and the decommissioning of the existing Metrorail fleet. The vehicles will be designed and built by AnsaldoBreda to provide 30 years of useful life to the County. The contract is compliant with the commercial, and technical requirements of the Request for Proposals (RFP), and all the applicable federal requirements.

This contract award recommendation is placed for Committee review pursuant to Miami-Dade County Code Section 29-124(f). This contract award recommendation may only be considered by the Board if the Citizens' Independent Transportation Trust (CITT) has forwarded a recommendation to the Board prior to the date scheduled for Board consideration or forty-five (45) days have elapsed since the filing with the Clerk of the Board of this contract award recommendation. If the CITT has not forwarded a recommendation and forty-five (45) days have not elapsed since the filing of this award recommendation, I will request a withdrawal of this item.

CONTRACT NO: Contract No. 654

CONTRACT TITLE: Purchase of 136 New Heavy Rail Vehicles

DESCRIPTION: Purchase of 136 new Heavy Rail Vehicles (HRV) inclusive of spare parts, staff training, training simulator, vehicle testing and test equipment, technical and training manuals and drawings. The Contractor shall furnish all bonds and insurances, labor, materials, tools, equipment, transportation and supervision, and shall perform all design, engineering, systems integration, manufacturing, testing, repairs, retrofits, and provide technical support necessary to perform the work. The Contractor will decommission the existing fleet of vehicles in accordance with all federal, state, and local regulations.

TERM: Ten years and seven months inclusive of a five-year warranty period per vehicle.

Note: The RFP required a base vehicle warranty of three years. The County negotiated a five-year base vehicle warranty at no additional cost. Notice to Proceed (NTP) is anticipated in the fourth quarter of 2012 with a scheduled delivery and acceptance rate of six vehicles per month starting the second quarter of 2015. The final six vehicles are scheduled to be delivered and accepted during the last quarter of 2017.

APPROVAL TO ADVERTISE: March 31, 2009

CONTRACT AMOUNT: $313,832,000, inclusive of a 5% contingency allowance. The contract amount is based on the negotiated price of $298,887,200, plus $14,944,800 for the contingency.

PREVIOUS CONTRACT AMOUNT: $83,808,368 in 1979, through a joint purchase with Baltimore, Maryland for the existing fleet.

USING/MANAGING AGENCY AND FUNDING SOURCE:

Department	Allocation	Funding Source	Contract Manager
Transit	$313,832,000	Charter County Transportation Surtax Funds (Surtax): Bond Receipts	Jerry Blackman
The allocation and funding source have been reviewed and approved by the Office of Management and Budget. There is no fiscal impact beyond what is stated in this recommendation.			

The procurement process was conducted in accordance with all Federal Transit Administration (FTA) requirements and guidelines. A Letter of No Prejudice (LONP) for $300 million, that is valid until November 19, 2014, has been received from the FTA. The LONP allows the County to apply for federal funding after contract award.

The total required funding for the Project, including this contract, project management, oversight and other support costs is $375,746,000. This amount is $25,705,000 less than the not to exceed ceiling of $401,451,000 for total project costs approved by the Board through Resolution R-488-08 on May 6, 2008. The $375,746,000 will be funded through the issuance of Transit System Sales Surtax Revenue Bonds. Net Transit System Sales Surtax revenues will be the sole pledge for repayment of the Bonds. The Bond Ordinance and corresponding Series Resolution authorizing the Bonds was approved by the Board on June 5, 2012.

This project funding request includes engineering services to be provided under an existing consultant services contract with Washington Infrastructure Services, Inc. (WIS). The existing contract (No. TA02-MR26) will require an extension of the term, and an increase in funding of approximately $4.4 million (included in the project funds of $375,746,000 above) and is being presented as a separate agenda item.

SENIOR PROCUREMENT CONTRACTING OFFICER: Fred Simmons, Jr.

METHOD OF AWARD: To the recommended responsive, responsible vendor based on the evaluation criteria established in the solicitation. A full and open competitive Request for Proposals process was used. The vendor whose offer was determined to represent best value, and most advantageous to the County, is recommended for award.

VENDOR RECOMMENDED FOR AWARD:

Vendor	Address	Principal
AnsaldoBreda S.p.A.	Via Argine N. 425 Naples, Italy 80147	Maurizio Manfellotto

VENDORS NOT RECOMMENDED FOR AWARD:

Alstom Transportation Inc.: Found non-responsive by the County Attorney's Office as their proposal did not meet the County's "not to exceed per vehicle" price cap of $2.419 million per vehicle.

CAF USA, Inc.: Was not recommended by the Negotiations Team as their offer did not provide the best value to the County.

PERFORMANCE DATA: Please refer to the Responsibility Review section of this memorandum.

COMPLIANCE DATA: There are no compliance issues with the recommended firm.

CONTRACT MEASURES: The Review Committee of April 1, 2009 determined that no measures would be applied due to the inclusion of federal provisions in the solicitation.

LIVING WAGE: The services being provided are not covered under the Living Wage Ordinance.

USER ACCESS PROGRAM: The User Access Program provision is not included.

INSPECTOR GENERAL FEE: The Inspector General fee does not apply.

LOCAL PREFERENCE: The Local Preference Ordinance does not apply.

ESTIMATED CONTRACT COMMENCEMENT DATE: Ten days after date adopted by the Board of County Commissioners, unless vetoed by Mayor.

DELEGATED AUTHORITY: If this item is approved, the County Mayor or designee will have the authority to exercise, at their discretion, contract modifications, subsequent options-to-renew and other extensions in accordance with the terms and conditions of the contract.

BACKGROUND

On September 9, 2004, the Board approved Resolution No. R-1097-04 authorizing a Request to Advertise (RTA) the MDT Heavy Rail Vehicle Rehabilitation project (RFP No. 439).

The selection process included negotiations and consideration of a Best and Final Offer (BAFO) process with the top ranked proposer resulting in a final price offer of $274,495,000, or $2.018 million per vehicle. A careful review of the negotiations results was conducted, along with a thorough assessment of the rail industry marketplace, evaluation of MDT's existing rail service performance, and future requirements for rail vehicles, including planned Metrorail extensions, and a life cycle cost

analysis to ascertain whether it was more cost effective to rehabilitate or purchase new replacement vehicles. The results of these analyses, detailed in a memorandum to the Board on September 27, 2007, resulted in the Board's approval on March 18, 2008 to reject all bids for RFP 439. Subsequently, on May 6, 2008, the Board approved a PTP Amendment to purchase new replacement vehicles.

On March 31, 2009, the County issued a solicitation (RFP No. 654) for a base purchase of 144 new heavy rail vehicles to replace the existing fleet. The County included two significant standard industry practices during development of the solicitation: 1) a comprehensive Peer Review of the solicitation prior to issuing the RFP in which the County invited a panel of transit experts, assembled by the American Public Transportation Association (APTA), to conduct a thorough review of the solicitation documents including a review of the technical provisions, general provisions, and the solicitation and 2) a Value Engineering Study of the technical provisions, which was performed by Lea+Elliott, Inc., an independent engineering consultant and 3) an industry review of the specifications by seven major carbuilders. The Peer Review panel made recommendations regarding contract administration, contractor performance, inspections and reviews, and risk reduction to the County. Specific recommendations focused on indemnification, bonding, insurance, product warranties, management of claims and disputes, and promotion of quality assurance. The Value Engineering Study provided recommendations for improving the technical provisions that would allow proposers to offer vehicles that will be cost effective, energy efficient, improve performance, lower cost of maintenance, and provide maximum reliability and safety.

PROPOSAL EVALUATIONS

Proposals were received from three railcar builders on September 25, 2009: Alstom Transportation Inc., (Alstom), AnsaldoBreda S.p.A, (AnsaldoBreda), and CAF USA, Inc. (CAF). The proposals were evaluated by an Evaluation/Selection Committee who received assistance from a team of technical and commercial experts appointed by the former County Manager. Points were allocated in accordance with the RFP documents as follows:

Technical Proposal	50 points
Commercial Proposal	10 points
- Staffing, Resources and Qualifications	
Base Vehicle Price	38 points
Options Price	2 points

The RFP required that proposers not exceed a price cap of $2.419 million established by the County for each of the base and option vehicles. Various sections in the RFP conveyed this requirement. Section 1.1 of the RFP notes the consequences of non-compliance with this requirement, "Proposals that include a per unit price in excess of the $2.419 million will be considered non-responsive and will not be considered for award." Additionally, Section 4.5 of the RFP (Price Evaluation) indicates that after the evaluation of commercial and technical proposals, in light of oral presentations, if any, the County will conduct a subjective evaluation of price proposals of those Proposers remaining in the zone of consideration. Proposers were required to submit Form A-7 Affidavit of Miami-Dade County Acknowledgement of Proposed Price, attesting to the Proposer's compliance with the price cap. The information on Form A-7 submitted by Alstom resulted in uncertainty regarding Alstom's responsiveness to the County's price cap requirement.

The County requested clarification from Alstom of its Form A-7 submission and received a response that did not clearly state if the price cap was met as required by the RFP. Based on the legal opinion rendered by the County Attorney's Office (attached), Alstom's commercial and technical proposals were

evaluated, but its price proposal was not considered once it was determined to be non-responsive. In its May 18, 2010 letter to the County, Alstom formally requested return of its Proposal Guarantee Deposit, removing itself from consideration for contract award in accordance with RFP Section 1.3.2.

The Evaluation/Selection Committee completed its evaluation and scoring of the proposals on March 15, 2010. The final composite score for each proposer is detailed below.

Proposer	Commercial Score	Technical Score	Price Score	Price Submitted for 144 cars	Total Combined Score
Alstom	6.94	29.15	N/A	$501,229,475 $3.481M per vehicle	**36.09**
AnsaldoBreda	5.12	31.61	35.30	$344,387,868 $2.392M per vehicle	**72.03**
CAF	6.59	30.95	34.80	$348,334,704 $2.419M per vehicle	**72.34**

NEGOTIATIONS

The County Manager at the time approved the Evaluation/Selection Committee's recommendation that the County enter into negotiations with the two proposers remaining in the zone of consideration (AnsaldoBreda and CAF). The memorandum also approved a four member negotiations committee. Negotiations commenced on June 2, 2010.

The FTA, through its Best Practices Manual, encourages agencies to visit the facilities of proposers prior to award, to assess their capabilities to meet the requirements for vehicle production. During the week of August 1, 2010, County staff visited the proposed final assembly facility of CAF in Elmira, New York. During the visit, CAF advised of its intention to take advantage of the large rail car manufacturing labor pool in the region. This labor pool, along with CAF's staff, provides the human resources necessary to assemble and deliver the vehicles. County staff also visited AnsaldoBreda's existing vehicle final assembly facility in Pittsburg, California. The Pittsburg facility will be used to assemble the six pilot cars and serves as a model for the vehicle final assembly facility to be constructed in Miami-Dade County. County staff concluded that both firms have the capacity to complete final assembly of the vehicles.

On August 9, 2010, Best and Final Offers (BAFO) for price were received from the two proposers. BAFO prices were as follows:

- AnsaldoBreda $ 298,887,200 or $2,197,700 per car
- CAF USA, Inc $ 303,566,408 or $2,232,106 per car

AnsaldoBreda's BAFO price of $298,887,200 represents a reduction of $30,096,800 when compared to the County's price cap of $328,984,000 ($2,419,000 per vehicle). AnsaldoBreda's BAFO price is $4,679,208 less than the CAF BAFO price.

The Negotiations Team met on August 10, 2010 to consider BAFOs and to carefully review and evaluate which competitive offer represented the best value. In determining best value, the Negotiations Team considered FTA procurement guidelines and County procurement policies.

The FTA specifically states, "The recipient should base its determination of which proposal represents the "best value" on an analysis of the tradeoff of qualitative technical factors and price or cost factors."

The County considered qualitative factors such as the proposer's technical design, technical approach, length of delivery schedule, quality of proposed personnel, past performance, technical and commercial offerings, and management plan.

County staff negotiated offers with both proposers that met the requirements of the RFP. County staff also negotiated significant technical enhancements and commercial terms into each agreement. The County sent each proposer a list of technical enhancements that were discussed during negotiations. The list was customized to the particular proposer based on discussions during negotiations of their specific offer. In its BAFO to the County, each proposer returned its list, indicating if a particular item would be included in its final offer to the County under the price cap. AnsaldoBreda and CAF offered similar enhancements in their offers. For example, both proposers offered bicycle racks, Baultar flooring, a full operator's cab in the second car of the married pair, Mitsubishi roof mounted HVAC system, LED lighting, WiFi Wireless connectivity, the latest mobile communications connectivity at the time of assembly, an integrated passenger information system, a simulator for operator training, and a 5-year vehicle warranty. Additionally, AnsaldoBreda's offer included animated air and electronic schematics that will be used as a training aid by Transit staff for orientation, and repair of the new vehicles. This item was not offered by CAF.

BEST VALUE

In making a determination of best value, the County considered a) the negotiated technical provisions, b) the negotiated terms and conditions, c) the BAFO prices, and d) the items on the list of enhancements each proposer submitted to the County. Based on these factors, the County determined that the offer from AnsaldoBreda represents the best value, and as such is most advantageous to the County. The AnsaldoBreda offer is compliant with all of the RFP requirements, offers several significant technical enhancements and favorable commercial terms, and was the lowest priced. FTA Circular 4220.1F outlines third party contracting requirements of the FTA in the procurement process. FTA guidelines state in part, "The evaluation factors for a specific procurement should reflect the subject matter and the elements that are most important to the recipient." These procedures, include guidance regarding determination of best value were communicated to County staff during the August 10, 2010 negotiation meeting.

The recommended negotiated contract with AnsaldoBreda includes a number of provisions that reduces the County's risk and enhances contract administration. A performance bond that spans the scope of the work, and ranges from 12% to 30% of the contract amount depending on the level of the County's exposure is included. The performance bond requires various levels of coverage commensurate with the work effort.

The levels of coverage increase and decrease as work progresses through various phases. For example, the performance bond requirement starts at contract award at 12% of the contract sum, increases to 25% of the contract sum as the work progresses to completion of the final design review through delivery of the first three married pairs also called pilot vehicles (2 vehicles per married pair), and completion of testing. The bond coverage peaks at 30% of the contract sum, and starts to decline at a rate of 1/68 upon acceptance of each married pair. This bond structure serves to reduce cost while maintaining the coverage required for the work being performed. Additionally, the contract includes liquidated damages of $1,653 per day per married pair (two vehicles permanently connected), based on the delivery of vehicles in the contract schedule. As added financial protection, a payment bond in the amount of 2% ($5,977,744) is required, and a milestone payment of 3% ($8,966,616) will be held by the County until the end of the vehicle warranty. The contract also includes a number of general provisions to support effective contract administration.

These include the ability to stop work, suspend work, approve Contractor personnel, and make changes. These provisions provide essential controls to managing the Contractor's performance and adherence to the contract schedule.

On February 18, 2011, the former County Manager signed an award recommendation for AnsaldoBreda. On February 24, 2011, CAF filed a timely Intent to Protest, followed on March 1, 2011, by a timely filed protest of the former County Manager's award recommendation. The protest was heard by a Hearing Examiner on March 14, 2011. The County Manager's recommendation to award was upheld by the Honorable Judge Phillip Cook, the Hearing Examiner.

On February 25, 2011, the County requested from the FTA a review of AnsaldoBreda's plan for final assembly in-plant testing, and the plan's compliance with FTA Buy America requirements. On April 2, 2012, the FTA concluded that the approach outlined by AnsaldoBreda for final assembly in-plant testing of the county's new rail vehicles will comply with the Buy America minimum final assembly requirements outlined in Appendix D to 49 C.F.R. 661.11.

On March 24, 2011, CAF filed a Protest Appeal with the FTA, asserting that the County did not comply with the FTA procurement rules by considering a local vehicle final assembly facility proposed by AnsaldoBreda, local jobs, and the impact on the local economy. On July 14, 2011, the FTA notified the County of its intent to consider the protest submitted by CAF. In its decision dated November 23, 2011, FTA stated that based on its review of the record, including documents and arguments submitted by MDT, CAF, and AnsaldoBreda, the County did not follow Federal procurement requirements when it considered the location of the final assembly facility as an evaluation selection factor without specifically including this factor in the RFP, and when it considered local geographic preference as a selection factor. The FTA recommended that MDT reevaluate the proposers' Best and Final Offers without considering local preference, the effect of a local assembly facility on the local economy, or the potential project cost savings based upon the location of the final assembly facility (see attached).

In my November 28, 2011 memorandum to the Board, I rescinded the February 18, 2011 award recommendation by the former County Manager. In consideration of the FTA findings, and consistent with the County Attorney's Office's consultations with FTA Counsel, on November 29, 2011, I reconvened the same Committee to re-evaluate the BAFO proposals to comply with FTA's recommendation.

On December 6, 2011, the Committee re-convened at a publicly noticed meeting and re-evaluated the BAFOs and factors such as the company's financial capacity, technical offer and capability, delivery capability, testing capabilities, and technical enhancements like animated air schematics. In accordance with the recommendation from the FTA and my directive, the Committee did not consider local preference, the effect of a local assembly facility on the local economy, or the potential project cost savings based upon the location of the final assembly facility. The Committee, after re-evaluating the BAFOs, forwarded an award recommendation for AnsaldoBreda (see Committee Report attached).

A majority of the Committee members found that the two offers were comparable from a technical standpoint, and that AnsaldoBreda's BAFO was $4.6 million less than the BAFO from CAF, which led the Committee to recommend AnsaldoBreda.

DUE DILIGENCE

During negotiations, the past performance of AnsaldoBreda and CAF was reviewed in detail by County staff. Staff conferred directly with other transit agencies, conducted internet and market research, reviewed financials and legal reports for AnsaldoBreda and CAF and held discussions with both railcar builders regarding their past performance. In particular, the Evaluation/Selection Committee (Committee), during the evaluation process, considered the reference from Los Angeles County

Metropolitan Transportation Authority regarding product and management services. The results of these efforts were discussed with the Negotiations Team at the August 10, 2010 meeting. The Negotiations Team weighed the information and findings in making a decision regarding each proposer's ability to perform the work required by the solicitation, including its ability to deliver the vehicles in accordance with the negotiated schedule.

AnsaldoBreda is fully owned by Finmeccanica S.p.A., Italy's largest manufacturing investor in high technology products with approximately 73,400 employees, and is Italy's second largest manufacturing group with approximately $21.5 billion in revenues, and orders of $61.5 billion. More than 60% of Finmeccanica's shares are publicly traded on the Milan Stock Exchange with the remaining shares owned by the Italian Ministry of Economics and Finance. AnsaldoBreda has built and delivered heavy rail vehicles for agencies in Italy and Spain for over 30 years. They have supplied complete rail systems and manufactured transit vehicles for over 150 years. AnsaldoBreda has built and delivered heavy rail transit vehicles for the following United States transit agencies:

- Los Angeles County Metropolitan Transportation Authority (LACMTA) (1988-Base Order-30 Heavy Rail Vehicles (HRVs) Contract options in 1994-42 HRVs, and 1996-32 HRVs)
- Washington Metropolitan Area Transit Authority (WMATA) (1979-Base Order-94 HRVs, Contract options in 1981-200 HRVs, 1985-46 HRVs, 1986-26 HRVs, 1989-68 HRVs, and 1990-32 HRVs)
- Metropolitan Atlanta Rapid Transit Authority (MARTA) (1998-100 HRVs, and Rehabilitation of 118 HRVs)
- San Francisco Municipal Transit Agency 1991-2010;151Light Rail Vehicles (LRVs), rehabilitation of 143 LRVs, Rehabilitation of 34 LRV Trucks, and Repair of 7 wrecked LRVs

County staff conducted extensive reviews to determine the proposer's responsibility with specific focus on its capability from a commercial and logistical standpoint to perform and manage the County contract. Staff has reviewed information from several recognized sources, including Dunn & Bradstreet reports; a risk analysis indication of the proposers' business practices regarding how they meet financial obligations, and their payment practices compared to other companies in the rail industry. Staff also reviewed PACER (Public Access to Court Electronic Records) reports to determine if there was any pending litigation for either company. PACER reports show that neither company had a match for pending litigation. Staff reviewed the federal Excluded Parties List System to determine if either company is excluded from participating on federal contracts. Reports were run on countries in which AnsaldoBreda is registered as a foreign corporation and doing business: U.S., France, Norway, Denmark, Greece, Spain, Taiwan, and Morocco. Reports show that AnsaldoBreda is not excluded from participating on federal contracts.

The company is not listed on the State of Florida Suspended Vendor List. Finally, staff ran reports from existing County systems, including the Finance Department's Delinquent Vendor List, and the County's Debarred Contractors List. Neither company was listed on either report. AnsaldoBreda is a registered County vendor and is registered in active status with the State of Florida.

The County also reviewed the circumstances surrounding the Metropolitan Transit Authority of Harris County, Texas (Houston METRO) solicitation in which the FTA, in its October 1, 2010 letter to CAF, upheld its September 7, 2010 decision, finding that Houston METRO violated FTA's procurement rules, and that Houston METRO and CAF violated FTA's Buy America requirements.

County staff reviewed newspaper articles regarding AnsaldoBreda's performance on contracts in Los Angeles, Buffalo, Cleveland, San Francisco, Boston, Chicago, Washington, DC, the Netherlands, Denmark, and Norway. These articles report delivery delays and performance issues with vehicles provided by AnsaldoBreda. Staff also reviewed November and December 2010 news articles

surrounding the AnsaldoBreda contract with the Niagara Frontier Transportation Authority (NFTA), in which 27 subway cars are to be refurbished for the Buffalo, New York subway system.

As a result of media based information regarding the NFTA contract in Buffalo, New York, staff conducted a detailed review of the circumstances surrounding AnsaldoBreda's performance on the rail rehabilitation project. A publicly noticed meeting was held with AnsaldoBreda's top US officials on January 13, 2011 in Miami. Senior management staff of Miami-Dade Transit and Procurement Management Services, as well as the County Attorney's Office discussed with AnsaldoBreda the news reports, along with a number of capacity and performance matters. Staff has reviewed documents received from NFTA in regard to the historical data surrounding the contract and its current status, reviewed references for various properties that have been the beneficiaries of new rail and rehab rail procurements with AnsaldoBreda, as well as financial and legal reports. A thorough examination of documentation, including the NFTA contract with AnsaldoBreda, and documents received from NFTA depicting related communications between NFTA and AnsaldoBreda has taken place. A review of AnsaldoBreda's track record was considered, along with other information collected during the solicitation process, to determine the firm's responsibility (integrity and capacity) to successfully carry out the Miami-Dade County rail contract requirements.

Since a significant amount of time has passed since the responsibility review was performed for the initial recommendation of this contract, County staff conducted another comprehensive responsibility review of AnsaldoBreda after the re-evaluation of BAFOs on December 6, 2011 Sources like Dunn and Bradstreet, PACER (Public Access to Court Electronic Records), federal Excluded Parties List System, and the State of Florida Suspended Vendor List were checked. Staff also ran reports from existing County systems, including: the Finance Department's Delinquent Vendor List, and the County's Debarred Contractors List.

On December 28, 2011, another publicly noticed responsibility review meeting was held with top executives from AnsaldoBreda to discuss the firm's financial and technical capacity, including its plants and workload, administrative support, and testing capability to meet its contractual obligations. The County was also able to obtain updates on projects that raised concerns during the initial responsibility review. Mike Bykowski, Director of Engineering for the NFTA in Buffalo, New York reports that the contract with AnsaldoBreda is proceeding well. Initially, NFTA asked AnsaldoBreda to subcontract out some of the assembly work to local firms. This approach was not successful and resulted in AnsaldoBreda subsequently assuming full responsibility for carrying out the project scope without the local subcontractors. The foregoing was done with NFTA's concurrence and the use AnsaldoBreda's own staff to complete the work. Director Bykowski stated that since AnsaldoBreda changed Project Managers, communications between NFTA and AnsaldoBreda's staff members are positive, AnsaldoBreda's staff is responsive to requests and inquiries, work to start vehicle deliveries is on schedule, and the project is moving in the right direction. The director reports that the previous issues with the subcontractors are resolved, as AnsaldoBreda's staff has taken over the work.

Additionally, AnsaldoBreda demonstrated that all its engineering, manufacturing and production facilities are capable of managing the Miami-Dade contract. Plant workload layouts provided detail regarding current workload and showed sufficient plant capacity when the Miami-Dade project was included. Staff determined there are no issues of concern and that AnsaldoBreda is fully capable of meeting the financial, logistical and technical requirements of the contract. AnsaldoBreda continues to hold its BAFO price, and has re-stated its commitment to all contract obligations should it be awarded a contract by the Board.

The second responsibility review determined that AnsaldoBreda continues to be backed financially by its parent company Finmeccanica, a viable financial firm whose revenues exceeded $26 billion in 2010, with over $68.6 billion in order backlog, $31.6 billion in new orders, and has generated over $3 billion in sales since entering the U.S. market in 1978. In 2011, Finmeccanica reported total assets of $43.8 billion. AnsaldoBreda in the United States is headquartered in California. In addition to the Washington, D.C., Atlanta, and Los Angeles contracts, in 2011 AnsaldoBreda contracted with: Honolulu to supply 80 new driverless light rail vehicles (LRVs); Milan, Italy for 30 heavy rail vehicles (HRV), 36 driverless LRVs and 188 driverless LRVs; Copenhagen, Denmark for 84 driverless LRVs; and Genoa, Italy for 28 cars (LRVs).

Subsequent to my November 28, 2011 memorandum to the Board, I reviewed correspondence from a representative of CAF which maintained that the approximately $4.67 million in savings from the AnsaldoBreda proposal was improperly calculated. CAF asserts that its total proposal cost using FTA "best value" guidelines actually amounts to a savings of almost $17 million making its proposal best value because its overall cost to the County is lower. CAF asserted that a best value determination, which would include consideration of the cost of a test track, quality control efforts by the County, the County's consultant, and the use of a test track by the recommended firm, yields a higher price for the recommended carbuilder. The chart below compares the costs, as determined by the County to the costs detailed in the CAF letters. The figures clearly show that the difference in the price from CAF is not overcome by any higher costs resulting from the CAF best value analysis.

ITM	COST COMPONENTS	CAF CORRESPONDENCE			COSTS DEVELOPED BY COUNTY	
		ANSALDOBREDA	CAF, USA		ANSALDOBREDA	CAF, USA
1	PRICE PROPOSAL	$298,887,200	$303,566,408		$298,887,200	$303,566,408
2	QUALITY CONTROL (QC) INSPECTIONS (INCLUDING CONSULTANT TRAVEL)	$9,442,598	$6,784,237		$9,442,599	$8,801,944
3	ESTIMATED MDT PERSONNEL TRAVEL	$2,335,278	$1,535,885		$410,000	$404,870
4	BUILDING PROPOSED COUNTY TEST TRACK TO BE USED BY ANSALDOBREDA	$16,800,000			$0	$0
5	USE OF COUNTY TEST TRACK BY ANSALDOBREDA FOR PRE-DELIVERY TESTING	$1,250,000			$0	$0
	TOTAL COST TO MIAMI-DADE COUNTY	**$328,715,076**	**$311,886,530**		**$308,739,799**	**$312,773,222**

I find CAF's assertions unpersuasive. Specifically, approximately $18 million of the savings CAF claims is related to the construction of the test track. This test track must be built regardless of which of the two firms is awarded; and therefore, a proposer cannot legitimately claim a savings to the County based on the construction or use of the test track.

CAF also claims oversight and travel expenses for AnsaldoBreda (lines 2 plus 3 in the table above) are roughly $3.45 million more than CAF's. This figure is inaccurate. The amount shown on line 3 as MDT personnel travel for AnsaldoBreda in CAF's letter ($2,335,278) was the estimated consultant travel cost already included in the line 2 total of $9,442,598. Travel estimate for MDT personnel was $410,000. The MDT personnel travel cost of $1,535,885 in CAF's letter was developed by CAF. Moreover, my direction to staff and the Committee to pursue strict adherence to FTA guidance and recommendations rendered a decision that excluded the consideration of travel expenses associated with oversight as it was not an evaluation factor stated in the RFP. However, even if I were to consider such travel expenses, I would strongly recommend AnsaldoBreda for this contract award as it offers the best value to Miami-Dade County and the taxpayers we serve.

Alina T. Hudak
Deputy Mayor/County Manager

MEMORANDUM

(Revised)

TO: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

DATE: November 8, 2012

FROM: R. A. Cuevas, Jr.
County Attorney

SUBJECT: Agenda Item No. 8(N)(1)

Please note any items checked.

_____ **"3-Day Rule" for committees applicable if raised**

_____ **6 weeks required between first reading and public hearing**

_____ **4 weeks notification to municipal officials required prior to public hearing**

_____ **Decreases revenues or increases expenditures without balancing budget**

_____ **Budget required**

_____ **Statement of fiscal impact required**

_____ **Ordinance creating a new board requires detailed County Manager's report for public hearing**

_____ **No committee review**

_____ **Applicable legislation requires more than a majority vote (i.e., 2/3's ____, 3/5's ____, unanimous_____) to approve**

✓ **Current information regarding funding source, index code and available balance, and available capacity (if debt is contemplated) required**

Approved _____ Mayor
Veto _____
Override _____

Agenda Item No. 8(N)(1)
11-8-12

RESOLUTION NO. R-924-12

RESOLUTION AUTHORIZING EXECUTION OF AN AGREEMENT IN THE AGGREGATE AMOUNT OF $313,832,000 WITH ANSALDOBREDA S.P.A. FOR NEW HEAVY RAIL VEHICLES; AUTHORIZING THE COUNTY MAYOR OR COUNTY MAYOR'S DESIGNEE TO EXECUTE THE CONTRACT FOR AND ON BEHALF OF MIAMI-DADE COUNTY AND TO EXERCISE ANY CANCELLATION AND RENEWAL PROVISIONS; TO EXERCISE ALL OTHER RIGHTS CONTAINED THEREIN; AND AUTHORIZING THE USE OF CHARTER COUNTY TRANSPORTATION SURTAX FUNDS

WHEREAS, this Board desires to accomplish the purposes outlined in the accompanying memorandum, a copy of which is incorporated herein by reference,

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF MIAMI-DADE COUNTY, FLORIDA, that this Board approves the execution of an agreement in the aggregate amount of $313,832,000 with AnsaldoBreda S.p.A. in substantially the form attached hereto and made a part hereof, and authorizes the County Mayor or County Mayor's designee to execute same for and on behalf of Miami-Dade County and to exercise cancellation and renewal provisions, and any other rights contained therein, and authorizes the use of Charter County Transportation Surtax Funds.

The foregoing resolution was offered by Commissioner **Dennis C. Moss**, who moved its adoption. The motion was seconded by Commissioner **Barbara J. Jordan** and upon being put to a vote, the vote was as follows:

Joe A. Martinez, Chairman			**nay**
Audrey M. Edmonson, Vice Chairwoman			**aye**
Bruno A. Barreiro	**aye**	Lynda Bell	**aye**
Esteban L. Bovo, Jr.	**aye**	Jose "Pepe" Diaz	**aye**
Sally A. Heyman	**aye**	Barbara J. Jordan	**aye**
Jean Monestime	**aye**	Dennis C. Moss	**aye**
Rebeca Sosa	**aye**	Sen. Javier D. Souto	**aye**
Xavier L. Suarez	**aye**		

The Chairperson thereupon declared the resolution duly passed and adopted this 8th day of November, 2012. This resolution shall become effective ten (10) days after the date of its adoption unless vetoed by the Mayor, and if vetoed, shall become effective only upon an override by this Board.

MIAMI-DADE COUNTY, FLORIDA
BY ITS BOARD OF
COUNTY COMMISSIONERS

HARVEY RUVIN, CLERK

By: **Christopher Agrippa**
Deputy Clerk

Approved by County Attorney as
to form and legal sufficiency.

Bruce Libhaber

Memorandum

MIAMI-DADE COUNTY

Date: MAR 3 1 2009

To: Honorable Chairman Dennis C. Moss
and Members, Board of County Commissioners

From: George M. Burgess
County Manager

Subject: Advertisement of RFP No. 654: Purchase of New Heavy Rail Vehicles

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I wish to advise the Board that a Request For Proposals was issued for purchase of up to 198 new heavy rail vehicles. The County anticipates a base purchase of 144 vehicles that will consist of 136 vehicles to replace the existing fleet, approved by the Board on May 6, 2008, and 8 vehicles to support the Miami Intermodal Center-Earlington Heights (MIC/EHT) extension. The solicitation includes optional purchase(s) of up to 54 vehicles that will support two rail expansion projects: the North Corridor (28 vehicles) and the East-West (26 vehicles) lines. Proposals will be solicited under full and open competition. Award will be made to the firm offering the best value to the County. The Contractor is also required to provide vehicle warranty services and training to specified Miami-Dade Transit staff.

BACKGROUND

On April 14, 2008, the Citizens' Independent Transit Trust (CITT) convened a special meeting where they reconsidered an earlier decision not to approve a People's Transportation Plan (PTP) amendment to purchase new Metrorail vehicles. As a result of the CITT's reconsideration of their earlier action, a favorable recommendation to purchase new Metrorail vehicles was forwarded to the Board. On May 6, 2008, the Board approved an amendment to the PTP which includes the purchase of new Metrorail vehicles.

FISCAL IMPACT/FUNDING SOURCE

Charter County Transit Systems Surtax (Surtax) funds are anticipated to purchase the 136 rail vehicles that will replace the existing fleet. A combination of Surtax and state funds are anticipated to fund the purchase of eight rail vehicles for the MIC/EHT extension. The estimated cost is $2.54 million per vehicle; including a five percent contract contingency for an approved total of $366 million for the base (144) vehicle purchase. A combination of local, state, and federal funding sources is anticipated for the 54 optional vehicles. Funding required for option vehicles total approximately $137 million. Total estimated funding required for the 198 vehicles is $503 million, including the five percent contingency.

Vehicle Purchases	Number of Vehicles	Anticipated Funding Sources:
Base Purchase	**144**	Surtax (PTP), State and FTA
▪Replacement of Existing Fleet	136	100% PTP
▪MIC/EHT	8	PTP and State
Optional Vehicle Purchases	**Up to 54**	Surtax (PTP), State and FTA
▪North Corridor	28	
▪East-West	26	

Since the option purchase(s) may not be exercised for several years after the contract is executed, contract pricing for the options will need to be adjusted for escalation factors including material and labor costs, market conditions, and inflation. The Producer Price Index (PPI) will be used to calculate pricing for the option purchase(s).

On May 6, 2008, the Board approved Charter County Transit Surtax funds of approximately $401 million for purchase of 136 new heavy rail vehicles and support costs. Surtax funds to purchase the 136 vehicles were estimated at $345 million. Approved support costs for the vehicle purchase totaled $56 million: $17 million for engineering support, $6 million for contracted quality control inspection services, $18 million for Miami Dade Transit (MDT) projected oversight, and $15 million to maintain the current fleet until the new vehicles arrive.

Additional project management and oversight costs will be required when the optional purchase(s) are exercised. Support costs for the optional vehicles include project administration and oversight, factory quality control and inspection services, a resident factory engineer, vehicle acceptance testing and support services, and warranty support. Until the specific quantity and schedule for optional vehicles can be determined, funding is identified, and a firm schedule is determined for the Orange line extensions, optional support costs can not be determined.

The solicitation incorporates procurement principles of best value through a full and open competitive process. It places a cap on the cost of each vehicle of $2.419 million. A proposed vehicle cost can not exceed $2.419 million per vehicle. The vehicle price cap is inclusive of vehicle decommissioning and disposal of the existing fleet, spare parts and special tools, training and manuals, program management, testing, and reliability and maintainability. A contract contingency of five percent will be included in the contract sum, resulting in a per vehicle contract cost of $2.54 million. The per vehicle cap price was developed by Miami-Dade Transit staff in September 2007. They considered a detailed analysis of the costs for the vehicle shell and subsystems at that time, and cost factors related to rail service delivery.

All purchase(s) will be based on Federal Transit Administration (FTA) requirements to allow for potential federal funding in future years for all vehicles purchased. In that the purchases will be made using FTA provisions, local provisions like Local Preference, the User Access Program and the County's Small Business Enterprise Program will not apply. Federal provisions such as, Buy America and Fly America, the use of Disadvantaged Business Enterprise's in meeting the proposer's Transit Vehicle Manufacturers goal, and US Cargo Preference, are included.

The solicitation includes the requirement for proposers to submit a Proposal Guarantee Deposit. All proposals shall be accompanied by a Certified Check, Cashier's Check, Irrevocable Letter of Credit or Proposal Bond in the amount of $3.48 million (approximately 1% of the projected contract value for the base vehicle purchase).

Technical provisions developed for the new heavy rail vehicles have been carefully prepared and reviewed. Comments have been provided by DMJM Harris, now AE COM Transportation, Miami-Dade Transit's Project Management Consultant; Shaw Environmental & Infrastructure, Federal Transit Administration's (FTA) Project Management Oversight Consultant (PMOC); and Miami-Dade Transit Engineering and Maintenance staff. Value added comments and recommendations from these reviews, in addition to those presented by a Value Engineering (VE) Study completed by Lea+Elliot, Inc., a Peer Review administered by the American Public Transportation Association

(APTA), and an Industry Review by transit industry vehicle manufacturers conducted to enhance and verify of the specifications for this procurement are included.

The solicitation, including the technical and general provisions, were developed by Miami-Dade Transit and the Department of Procurement Management, in consultation with the County Attorney's Office, the Department of Small Business Development, and General Services Administration-Risk Management Division. Please be advised that pursuant to Administrative Order 3-27, the solicitation is now under the Cone of Silence.

Should you need additional information, please do not hesitate to contact Ms. Miriam Singer, Department of Procurement Management Director, or me directly.

c: Honorable Carlos Alvarez, Mayor
Denis Morales, Chief of Staff, Office of the Mayor
Bruce Libhaber, Assistance County Attorney
Alina T. Hudak, Assistant County Manager
Ysela Llort, Assistant County Manager
Harpal Kapoor, Director, Miami-Dade Transit
Miriam Singer, Director, Department of Procurement Management

Memorandum

MIAMI-DADE COUNTY

Date: March 4, 2010

To: Miriam Singer, Director, Procurement
Fred Simmons, Procurement Contract Office

From: Hugo Benitez
Assistant County Attorney

Subject: Railcar Procurement Responsiveness - Alstom Transportation, Inc.

You have asked us to determine whether the proposal of Alstom Transportation, Inc. ("Alstom") is responsive to the referenced Request for Proposals for the purchase of Metrorail vehicles (the "RFP"). For the reasons set forth below, we conclude that Alstom's proposal is not responsive.

BACKGROUND

The County issued the RFP on or about March 30, 2009. The RFP was for the County to purchase for Miami-Dade Transit one hundred and forty-four (144) Metrorail Vehicles with options for up to fifty-four (54) additional vehicles. RFP, Section 1.1.

The RFP contained several clear and unambiguous provisions regarding the pricing of the proposed cars. Section 1.1 stated: "The County's per unit price of the vehicles, including all Contract requirements, shall not exceed $2.419M. Proposals that include a price unit in excess of $2.419M will be considered non-responsive and will not be considered for award". The summary of items to be included in the proposal included a statement acknowledging that "the price submitted is compliant with the price cap of $2.419 million per vehicle established for this solicitation". RFP Section 3.2 contained the same requirement, and further required that the proposer execute an affidavit in which the proposer affirms that "the proposed per unit vehicle price, including all Contract requirements, does not exceed $2.419M for either the base vehicle or option vehicle". Finally, Section 3.4 entitled Price Proposal, sets forth the following admonition in bold type: No exceptions may be taken to the $2.419 Million per vehicle cap.

Together with its technical submittal on or about September 2009, Alstom included the price affidavit with the following qualification: "Pricing for only the Option vehicles does not exceed $2.419M." Based on that qualification, you requested previously that our office determine Alstom's responsiveness. On December 3, 2009 we issued a written opinion that the determination of Alstom's responsiveness based only on the irregularity in the affidavit was premature, as the RFP contained no clear indication of the effect of qualifying the affidavit, and suggested that the matter be revisited following review of the complete submittal, including Alstom's.

Following that advice, the County proceeded to open and evaluate all price proposals. Your request for legal opinion indicates that Alstom's price is $3.48 million, exceeding the County's

announced maximum by more than one million dollars per vehicle.

OPINION

Based on the facts set forth above, and the clear and unambiguous requirements of the RFP, it is our opinion that Alstom's proposal is not responsive and should be rejected. The RFP by its express terms required Alstom to submit a price within the cap.

We disagree with Alstom's argument contained in its letter of November 11, 2009 that the RFP allowed proposers to submit a higher price and then negotiate a price under the stated maximum. Read in the context of the clear and unambiguous requirements of the RFP set forth above, the statement contained in Section 4.7 that "the final negotiated price shall not exceed" the stated price cap, does not mean that proposers were allowed to submit a higher price. Significantly, Alstom in qualifying the clear provisions of the required affidavit, has in fact acknowledged that it understood the County requirement and chose to deviate from it.

In expressing this opinion we also caution you that the remaining proposers, to remain eligible, must furnish a rail car in compliance with the requirements set forth in the RFP. In other words, providing less than the car required is not better than providing the required at a price higher than the cap. Alstom has indicated that the other proposals contain "exceptions and qualifications" and the RFP invites future exceptions to be considered in negotiations. There are, of course, limits to a proposer's ability to depart from the express requirements of an RFP, and to the County's ability to consider them. We are not in a position to evaluate any of those departures at this juncture. For these reasons, it would be in the County's best interest to retain the sealed "alternatives" package, and other submissions of Alstom, until final resolution of these matters through contract award.

Please call me if you have any questions.

Hugo Benitez

HB/es

214423

Memorandum

MIAMI-DADE COUNTY

Date: April 16, 2010

To: George M. Burgess
County Manager

Thru: Miriam Singer, CPPO
Director
Department of Procurement Management

From: Fred Simmons, Jr., CPPO
Senior Procurement Contracting Officer
Chairperson, Evaluation/Selection Committee

Subject: Report of Evaluation/Selection Committee for RFP No. 654: Purchase of New Heavy Rail Vehicles

---

The County issued a solicitation to obtain proposals from qualified firms to design, manufacture, deliver, test, safety certify, and commission 144 new transit heavy rail vehicles, with an option to purchase up to an additional 54 new heavy rail vehicles. The solicitation also requires the Selected Proposer to decommission the existing fleet of 136 heavy rail vehicles.

The Evaluation/Selection Committee has completed the evaluation of proposals submitted in response to the Request for Proposals (RFP), following the published guidelines.

Committee meeting dates
June 16, 2009 (Initial Evaluation/Selection Committee Meeting
August 7, 2009 (Site visit Lehman Center-Selection Committee Members
August 21, 2009 (Joint Technical and Selection Committee Meeting)
September 3, 2009 (2nd site visit Lehman Center-Selection Committee Members)
September 25, 2009 (Proposals-3 received)
November 9, 2009 (Commercial Evaluation)
November 10, 2009 (Commercial Evaluation)
November 23, 2009 (Technical Evaluation)
November 24, 2009 (Technical Evaluation)
December 4, 2009 (Technical Evaluation)
December 10, 2009 (Technical Evaluation)
December 16, 2009 (Technical Evaluation)
January 6, 2010 (Technical Evaluation)
January 7, 2010 (Technical Evaluation)
January 13, 2010 (Technical Evaluation)
January 14, 2010 (Technical Evaluation)
January 19, 2010 (Technical Evaluation)
January 20, 2010 (Technical Evaluation and Review of Proposer Questions for Oral Presentations
January 21, 2010 (Technical Evaluation)
January 25, 2010 (Technical Evaluation)
February 18, 2010 (Oral Presentations)
February 19, 2010 (Oral Presentations)
March 15, 2010 (Price Scoring and Final Scoring (Commercial, Technical and Price)

Verification of Compliance with Contract Measures:
Since the County is pursuing federal funding for the vehicle purchases, this solicitation was issued with federal provisions based on the requirements of Federal Transit Administration (FTA) Circular 4220.F. Proposers are required to meet their federal Transit Vehicle Manufacture (TVM) goal for Disadvantage Business Enterprise participation. The FTA issued a Letter of No Prejudice (LONP), which allows the County to seek federal funding for this procurement, even after contract award. The application of local provisions is not permitted by FTA for this solicitation, and is not included.

Verification of Compliance with Minimum Qualification Requirements:
The solicitation had minimum qualification requirements which were reviewed by the Chairperson and the Project Manager of the client department. All proposers met the minimum qualification requirements.

Local Certified Service-Disabled Veteran's Business Enterprise Preference:
The FTA does not allow for geographical preferences. In accordance with FTA guidelines, Veteran's Preference was not considered since Local Certified Service-Disabled Veteran's Business Enterprise Preference is afforded to local companies.

Summary of Scores:
Pre-Oral Scores

Proposer	Commercial Score (Max 10 Points/Member)	Technical Score (Max 50 Points/Member)	Total Combined Score (Max 60 Points/Member)
Alstom Transportation, Inc.	6.34	28.88	**35.22**
AnsaldoBreda S.p.A.	4.82	31.51	**36.33**
CAF USA, Inc.	6.40	28.15	**34.55**

The Evaluation/Selection Committee decided to hold oral presentations. After oral presentations, scoring of the Commercial and Technical proposals was finalized. Price proposals were reviewed and scored for those proposers remaining in consideration. Post oral presentation scores, final scores, and pricing are as follows:

Post-Oral Scores

Proposer	Commercial Score (Max 10 Points / Member)	Technical Score (Max 50 Points / Member)	Price Score (Max 40 Points / Member)	Total Combined Score (Max 100 Points /Member)	Price Submitted(Base order of 144 Vehicles)
Alstom Transportation Inc.	6.94	29.15	N/A	**36.09**	$501,229,475.00 **$3.480M/vehicle**
AnsaldoBreda S.p.A.	5.12	31.61	35.30	**72.03**	$344,387,867.63 **$2.392M/vehicle**
CAF USA, Inc.	6.59	30.95	34.80	**72.34**	$348,334,704.00 **$2.419M/vehicle**

Detailed Commercial, Technical and Price, scores are attached, as well as the proposal evaluation procedure.

Local Preference:
Federal Transit Administration (FTA) guidelines do not allow geographical preferences in solicitations. In compliance with FTA guidelines, Local Preference was not included in this solicitation.

Other Information:
The Request for Proposals (RFP) required that proposers not exceed the price cap of $2.419 million for each of the base and option vehicles. Various sections in the RFP conveyed this requirement. In accordance with Section 1.1 of the RFP "Proposals that include a per unit price in excess of $2.419M will be considered non-responsive and will not be considered for award." Additionally, Proposers were required to submit Form A-7: Affidavit of Miami-Dade County Acknowledgement of Proposed Price (see form attached), which attests to the Proposer's compliance with the price cap.

A threshold question regarding Alstom's responsiveness to the County's price cap requirement is whether the price submitted by Alstom exceeds the price cap. The Form A-7 submitted by Alstom was not clear. Alstom's Form A-7 states the cap was met on the 54 option vehicles but was not clear as to whether the per vehicle cap was met for the base purchase of 144 vehicles. After consultation with the County Attorney's Office (CAO), a letter of clarification was sent to Alstom requesting confirmation in writing that Alstom's sealed Price Proposal does not exceed $2.419 million for either each base vehicle or each option vehicle, as required by the RFP (letter to Alstom is attached). The response from Alstom did not resolve the ambiguity (Alstom's response is attached). After further consultation with the CAO, it was determined that Alstom's price envelope would be opened after the oral presentations in accordance with Section 4.5 of the RFP.

The County proceeded with the evaluation of all proposals. When price proposals were opened, the vehicle price for Alstom was $3.480 million per vehicle. This exceeds the per vehicle cap price of $2.419 million.

Section 4.5 of the Request for Proposals (Price Evaluation) states that, "After the evaluation of commercial and technical proposals, in light of oral presentations, if any, the County will evaluate the price proposals of those Proposers remaining in the zone of consideration." Based on the legal opinion provided by the County Attorney's Office, the Alstom proposal is deemed non-responsive (legal opinion is attached). Its price proposal was therefore not considered.

Negotiations:
The Evaluation/Selection Committee recommends that the County enter into negotiations with the two proposers remaining in the zone of consideration (AnsaldoBreda S.p.A. and CAF USA, Inc.). The following individuals will participate in the negotiations:

Fred Simmons, Jr., Senior Procurement Contracting Officer, Department of Procurement Management
Richard Snedden, Assistant Director, Miami-Dade Transit
George Navarrete, Assistant Director, Office of Capital Improvement
Ivor Myers, Chief of Rail and Mover New Vehicle Acquisitions

Transit technical staff will be used on an as needed basis.

Consensus Statement: The Evaluation/Selection Committee recommends that negotiations be held with AnsaldoBreda S.p.A. and CAF USA Inc., the two Proposers remaining in the zone of consideration.

The AnsaldoBreda S.p.A. and CAF USA, Inc. proposals demonstrated a thorough understanding of the County's requirements and provided evidence of proven capability to provide the vehicles specified in

the solicitation. The qualifications of both companies are comparable in terms of experience and technical competence. Simultaneous negotiations with AnsaldoBreda and CAF will afford the County the best opportunity to achieve the greatest value at the lowest possible price.

Attachments

Approved

George M. Burgess
County Manager

5/4/10
Date

Not Approved

George M. Burgess
County Manager

Date

[illegible] Presentations

RFP Section	No.	Evaluation Criteria	Maximum Score	Badulescu	Elliott	Myers	Navarrete	Snedden	Average
[illegible]									
TP	1	Technical Proposal	50	33.700	29.700	24.559	29.600	26.850	28.88
[illegible]									
4.2	2A	Price (Base Vehicles; LCCA)	38						
4.2	2B	Price for Vehicle Options	2						
[illegible]									
3.3.2 3.3.5	3	Proposer Staffing, Resources, Experience and Qualifications	10	6.900	6.800	4.700	7.200	6.100	6.64
		Total	100						35.22

Price Summary
Lowest Proposed Price
Proposer's Proposed Price
Lowest Proposed Option Price
Proposer's Proposed Option Price

Experience Record & Qualifications

Section	RFP Ref		Weight	Badulescu Score (0 - 10)	Badulescu Weighted Score	Elliott Score (0 - 10)	Elliott Weighted Score	Myers Score (0 - 10)	Myers Weighted Score	Navarette Score (0 - 10)	Navarette Weighted Score	Snedden Score (0 - 10)	Snedden Weighted Score
A	RFP3.3.5	Staffing	3	8.00	24.00	8.00	24.00	3.00	9.00	9.00	27.00	8.00	24.00
B	RFP3.3.1	Resources	1	9.00	9.00	8.00	8.00	6.00	6.00	10.00	10.00	8.00	8.00
C	RFP3.3.2	Experience and Qualifications	2	7.00	14.00	8.00	16.00	5.00	10.00	8.00	16.00	6.00	12.00
D	RFP3.3.5	Project Schedule	2	7.00	14.00	8.00	16.00	8.00	16.00	8.00	16.00	8.00	16.00
E	RFP3.3.2	References	1	3.00	3.00	0.00	0.00	3.00	3.00	3.00	3.00	0.00	0.00
F	RFP3.3.1	Financial Strength	1	5.00	5.00	4.00	4.00	3.00	3.00	0.00	0.00	1.00	1.00
Total Weighted Score					69.00								
Experience Record & Qualification Score*					6.900		6.800		4.700		7.200		6.100

*Experience Record & Qualifications Score =
(Total weigthed score/100) *10
(10 Points Max)

Reviewed By Fred Simmons Jr. Date 3/29/10

Reviewed By [illegible] Date 3/29/10

Ansaldobreda - Pre Oral Presentations

RFP Section	No.	Evaluation Criteria	Maximum Score	Badulescu	Elliott	Myers	Navarrete	Snedden	Average
Technical - 50%									
TP	1	Technical Proposal	50	33.000	30.800	31.385	36.100	26.275	31.51
Price - 40%									
4.2	2A	Price (Base Vehicles; LCCA)	38						
4.2	2B	Price for Vehicle Options	2						
Commercial - 10%									
3.3.2 3.3.5	3	Proposer Staffing, Resources, Experience and Qualifications	10	5.600	4.400	5.300	5.800	3.000	4.82
		Total	100						36.33

Price Summary
Lowest Proposed Price
Proposer's Proposed Price
Lowest Proposed Option Price
Proposer's Proposed Option Price

Experience Record & Qualifications

Section	RFP Ref		Weight	Badulescu Score (0 - 10)	Badulescu Weighted Score	Elliott Score (0 - 10)	Elliott Weighted Score	Myers Score (0 - 10)	Myers Weighted Score	Navarette Score (0 - 10)	Navarette Weighted Score	Snedden Score (0 - 10)	Snedden Weighted Score
A	RFP3.3.5	Staffing	3	6.00	18.00	3.00	9.00	4.00	12.00	5.00	15.00	2.00	6.00
B	RFP3.3.1	Resources	1	3.00	3.00	6.00	6.00	3.00	3.00	3.00	3.00	3.00	3.00
C	RFP3.3.2	Experience and Qualifications	2	6.00	12.00	6.00	12.00	7.00	14.00	8.00	16.00	4.00	8.00
D	RFP3.3.5	Project Schedule	2	8.00	16.00	5.00	10.00	8.00	16.00	8.00	16.00	4.00	8.00
E	RFP3.3.2	References	1	3.00	3.00	2.00	2.00	3.00	3.00	5.00	5.00	2.00	2.00
F	RFP3.3.1	Financial Strength	1	4.00	4.00	5.00	5.00	5.00	5.00	3.00	3.00	3.00	3.00
Total Weighted Score					56.00		44.00		53.00		58.00		30.00
Experience Record & Qualification Score*					5.600		4.400		5.300		5.800		3.000

*Experience Record & Qualifications Score =
(Total weigthed score/100) *10
(10 Points Max)

Reviewed By Fred Simmons Jr. Date 3/29/10

Reviewed By [illegible] Date 3/28/10

RFP Section	No.	Evaluation Criteria	Maximum Score	Badulescu	Elliott	Myers	Navarrete	Snedden	Average
TP	1	Technical Proposal	50	29.300	26.675	26.232	33.350	25.175	28.15
4.2	2A	Price (Base Vehicles; LCCA)	38						
4.2	2B	Price for Vehicle Options	2						
3.3.2 3.3.5	3	Proposer Staffing, Resources, Experience and Qualifications	10	6.700	6.100	7.000	7.400	4.800	6.40
		Total	100						34.55

Price Summary
Lowest Proposed Price
Proposer's Proposed Price
Lowest Proposed Option Price
Proposer's Proposed Option Price

Experience Record & Qualifications

Section	RFP Ref.		Weight	Badulescu Score (0 - 10)	Badulescu Weighted Score	Elliott Score (0 - 10)	Elliott Weighted Score	Myers Score (0 - 10)	Myers Weighted Score	Navarrete Score (0 - 10)	Navarrete Weighted Score	Snedden Score (0 - 10)	Snedden Weighted Score
A	RFP3.3.5	Staffing	3	6.00	18.00	7.00	21.00	8.00	24.00	8.00	24.00	6.00	18.00
B	RFP3.3.1	Resources	1	7.00	7.00	7.00	7.00	8.00	8.00	8.00	8.00	6.00	6.00
C	RFP3.3.2	Experience and Qualifications	2	8.00	16.00	7.00	14.00	8.00	16.00	9.00	18.00	4.00	8.00
D	RFP3.3.5	Project Schedule	2	6.00	12.00	4.00	8.00	3.00	6.00	5.00	10.00	3.00	6.00
E	RFP3.3.2	References	1	7.00	7.00	5.00	5.00	7.00	7.00	7.00	7.00	4.00	4.00
F	RFP3.3.1	Financial Strength	1	7.00	7.00	6.00	6.00	9.00	9.00	7.00	7.00	6.00	6.00
Total Weighted Score					67.00		61.00		70.00		74.00		48.00
Experience Record & Qualification Score*					6.700		6.100		7.000		7.400		4.800

*Experience Record & Qualifications Score =
(Total weigthed score/100) *10
(10 Points Max)

Reviewed By Fred Simmons Jr. Date 3/29/10

Reviewed By Andrew Zaeff Date 3/29/10

			Bad Iascu					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score		
2	System Requirements	2	4	8	6	12	6	12
3	Carbody	5	6	30	6	30	5	25
4	Coupler and Draft Gear	4	7	28	7	28	7	28
5	Operator's Cab	3	5	15	6	18	5	15
6	Doors	6	8	48	7	42	7	42
7	Air Comfort System	8	8	64	8	64	7	56
8	Lighting	5	7	35	7	35	5	25
9	Auxiliary Electrical Equip.	4	7	28	6	24	6	24
10	Propulsion System	10	7	70	6	60	6	60
11	Truck Assemblies	5	7	35	7	35	6	30
12	Friction Braking	6	8	48	8	48	7	42
13	Communications	7	5	35	6	42	4	28
14	Train Control	8	6	48	6	48	6	48
15	System Support	5	7	35	6	30	5	25
16	Management Program	4	7	28	7	28	4	16
17	Testing and Inspection	4	7	28	6	24	7	28
18	System Assurance	5	6	30	7	35	7	35
19	Materials & Workmanship	2	6	12	7	14	6	12
20	Vehicle Monitoring System (VMS)	3	7	21	6	18	4	12
21	Compatibility	1	7	7	7	7	7	7
22	Software Systems	2	7	14	6	12	5	10
23	CDRLs	1	7	7	6	6	6	6
Total Weighted Score				674.000		660.000		586.000
Technical Proposal Score*				33.700		33.000		29.300

*Technical Proposal Score
(Total weigthed score/1,000) * 50
(50 Points Max)

			Elliott					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score		
2	System Requirements	2	3.5	7	6	12	5	10
3	Carbody	5	6	30	6	30	6.5	32.5
4	Coupler and Draft Gear	4	6	24	6	24	6	24
5	Operator's Cab	3	5	15	6	18	5	15
6	Doors	6	8	48	7	42	6	36
7	Air Comfort System	8	7	56	7	56	6	48
8	Lighting	5	6	30	6	30	5	25
9	Auxiliary Electrical Equip.	4	5	20	5	20	5	20
10	Propulsion System	10	5	50	5	50	6	60
11	Truck Assemblies	5	6	30	6	30	6	30
12	Friction Braking	6	7	42	7	42	7	42
13	Communications	7	6	42	7	49	2	14
14	Train Control	8	5	40	6	48	5	40
15	System Support	5	7	35	5	25	7	35
16	Management Program	4	7	28	6	24	2	8
17	Testing and Inspection	4	6	24	7	28	6	24
18	System Assurance	5	6	30	6	30	7	35
19	Materials & Workmanship	2	2	4	6	12	2	4
20	Vehicle Monitoring System (VMS)	3	5	15	6	18	2	6
21	Compatibility	1	7	7	6	6	7	7
22	Software Systems	2	5	10	7	14	5	10
23	CDRLs	1	7	7	8	8	8	8
	Total Weighted Score			594.000		616.000		533.500
	Technical Proposal Score*			29.700		30.800		26.675

*Technical Proposal Score
(Total weigthed score/1,000) * 50
(50 Points Max)

			Myers					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score		
2	System Requirements	2	2.5	5	6.2	12.4	6.5	13
3	Carbody	5	4.6	23	5.9	29.5	5.6	28
4	Coupler and Draft Gear	4	5	20	5.3	21.2	5.2	20.8
5	Operator's Cab	3	5.5	16.5	5.7	17.1	5.3	15.9
6	Doors	6	5.57	33.42	5.6	33.6	5.56	33.36
7	Air Comfort System	8	4.67	37.36	6.17	49.36	5.67	45.36
8	Lighting	5	7	35	6	30	5	25
9	Auxiliary Electrical Equip.	4	4	16	6	24	4.3	17.2
10	Propulsion System	10	4.8	48	6.1	61	4.6	46
11	Truck Assemblies	5	5.5	27.5	7.2	36	5.6	28
12	Friction Braking	6	5.5	33	6.25	37.5	5.75	34.5
13	Communications	7	3.8	26.6	8.6	60.2	5.2	36.4
14	Train Control	8	5	40	5.5	44	4.5	36
15	System Support	5	5	25	5.6	28	6	30
16	Management Program	4	5.55	22.2	7.11	28.44	4.33	17.32
17	Testing and Inspection	4	5.6	22.4	4.6	18.4	5.5	22
18	System Assurance	5	5.2	26	7	35	7.2	36
19	Materials & Workmanship	2	1	2	8	16	3	6
20	Vehicle Monitoring System (VMS)	3	3.9	11.7	6.8	20.4	2.6	7.8
21	Compatibility	1	7	7	6	6	7	7
22	Software Systems	2	4.25	8.5	7.3	14.6	5	10
23	CDRLs	1	5	5	5	5	9	9
	Total Weighted Score			491.180		627.700		524.640
	Technical Proposal Score*			24.559		31.385		26.232

*Technical Proposal Score
(Total weigthed score/1,000) * 50
(50 Points Max)

			Navarrete					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score		
2	System Requirements	2	3	6	7	14	6	12
3	Carbody	5	7	35	6	30	8	40
4	Coupler and Draft Gear	4	6	24	7	28	7	28
5	Operator's Cab	3	4	12	6	18	7	21
6	Doors	6	8	48	8	48	8	48
7	Air Comfort System	8	6	48	7.5	60	7.5	60
8	Lighting	5	6	30	7	35	6	30
9	Auxiliary Electrical Equip.	4	4	16	6	24	7	28
10	Propulsion System	10	5	50	6	60	8.5	85
11	Truck Assemblies	5	7	35	6	30	8	40
12	Friction Braking	6	8	48	8	48	7.5	45
13	Communications	7	5	35	9	63	3	21
14	Train Control	8	6.5	52	8	64	8	64
15	System Support	5	7	35	5	25	7	35
16	Management Program	4	8	32	9	36	3	12
17	Testing and Inspection	4	6	24	6	24	6	24
18	System Assurance	5	4	20	8	40	7	35
19	Materials & Workmanship	2	0	0	9	18	0	0
20	Vehicle Monitoring System (VMS)	3	7	21	8	24	2	6
21	Compatibility	1	8	8	7	7	8	8
22	Software Systems	2	3	6	9	18	8	16
23	CDRLs	1	7	7	8	8	9	9
Total Weighted Score				592.000		722.000		667.000
Technical Proposal Score*				29.600		36.100		33.350

*Technical Proposal Score
(Total weigthed score/1,000) * 50
(50 Points Max)

			Snedden					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score		
2	System Requirements	2	4	8	4.5	9	3.5	7
3	Carbody	5	5.5	27.5	5	25	5	25
4	Coupler and Draft Gear	4	5.5	22	5.5	22	5.5	22
5	Operator's Cab	3	6	18	6	18	6	18
6	Doors	6	6	36	6	36	6	36
7	Air Comfort System	8	5.5	44	5	40	5	40
8	Lighting	5	8	40	6.5	32.5	6	30
9	Auxiliary Electrical Equip.	4	4.5	18	4.5	18	5	20
10	Propulsion System	10	4	40	4.5	45	5	50
11	Truck Assemblies	5	6	30	6	30	6	30
12	Friction Braking	6	5.5	33	5.5	33	5.5	33
13	Communications	7	5	35	5	35	3.5	24.5
14	Train Control	8	5	40	5	40	5	40
15	System Support	5	6.5	32.5	6	30	7	35
16	Management Program	4	7	28	4.5	18	2	8
17	Testing and Inspection	4	6	24	3.5	14	4.5	18
18	System Assurance	5	5	25	7	35	7.5	37.5
19	Materials & Workmanship	2	0	0	6	12	0	0
20	Vehicle Monitoring System (VMS)	3	5	15	5	15	3.5	10.5
21	Compatibility	1	5	5	5	5	5	5
22	Software Systems	2	4.5	9	4.5	9	4.5	9
23	CDRLs	1	7	7	4	4	5	5
Total Weighted Score				537.000		525.500		503.500
Technical Proposal Score*				26.850		26.275		25.175

*Technical Proposal Score
(Total weigthed score/1,000) * 50
(50 Points Max)

Alstom - Post Oral Presentation

RFP Section	No.	Evaluation Criteria	Maximum Score	Badulescu	Elliott	Myers	Navarrete	Snedden	Average
Technical									
TP	1	Technical Proposal	50	33.700	29.750	24.804	29.850	27.550	29.15
Price									
4.2	2.A	Price (Base Vehicles; LCCA)	38	0	0	0	0	0	0
4.2	2.B	Price for Vehicle Options	2	0	0	0	0	0	0
Contract Qualifications									
3.3.2 3.3.5	3	Proposer Staffing, Resources, Experience and Qualifications	10	6.900	7.300	5.100	8.000	7.400	6.94
		Total	100						36.09

Price Summary		
Lowest Proposed Base Price	$344,387,867.63	$2,391,582.41 Per Car
Proposer's Proposed Base Price	$501,229,475.00	$3,480,760.24 Per Car
Lowest Proposed Option Price	$116,527,410.00	$2,157,915.00 Per Car
Proposer's Proposed Option Price	$116,527,410.00	$2,157,915.00 Per Car

Experience Record & Qualifications				Badulescu		Elliott		Myers		Navarrete		Snedden	
Section	RFP Ref.		Weight	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score	Score (0 - 10)	Weighted Score
A	RFP3.3.5	Staffing	3	8.00	24.00	8.00	24.00	3.00	9.00	9.00	27.00	8.00	24.00
B	RFP3.3.1	Resources	1	9.00	9.00	8.00	8.00	6.00	6.00	10.00	10.00	8.00	8.00
C	RFP3.3.2	Experience and Qualifications	2	7.00	14.00	8.00	16.00	7.00	14.00	8.00	16.00	8.00	16.00
D	RFP3.3.5	Project Schedule	2	7.00	14.00	8.00	16.00	8.00	16.00	8.00	16.00	8.00	16.00
E	RFP3.3.2	References	1	3.00	3.00	3.00	3.00	3.00	3.00	7.00	7.00	4.00	4.00
F	RFP3.3.1	Financial Strength	1	5.00	5.00	6.00	6.00	3.00	3.00	4.00	4.00	6.00	6.00
Total Weighted Score					69.00		73.00		51.00		80.00		74.00
Experience Record and Qualifications Score*					6.900		7.300		5.100		8.000		7.400

* Experience Record & Qualifications Score =
(Total weighted score/100) *10
(10 Points Max)

Reviewed By Fred Simmons Jr. Date 3/29/10

Reviewed By [illegible] Date 3/29/10

Ansaldobreda - Post Oral Presentations

RFP Section	No.	Evaluation Criteria	Maximum Score	Badulescu	Elliott	Myers	Navarrete	Snedden	Average
Technical - 50%									
TP	1	Technical Proposal	50	33.000	30.800	31.615	36.350	26.275	31.61
Price - 40%									
4.2	2A	Price (Base Vehicles; LCCA)	38	19	38	37.5	35	38	33.50
4.2	2B	Price for Vehicle Options	2	2	2	2	1	2	1.80
Commercial - 10%									
3.3.2 3.3.5	3	Proposer Staffing, Resources, Experience and Qualifications	10	5.900	5.100	5.700	5.900	3.000	5.2
		Total	100						72.03

Price Summary		
Lowest Proposed Base Price	$344,387,867.63	$2,391,582.41 Per Car
Proposer's Proposed Base Price	$344,387,867.63	$2,391,582.41 Per Car
Lowest Proposed Option Price	$116,527,410.00	$2,157,915.00 Per Car
Proposer's Proposed Option Price	$116,841,032.44	$2,280,759.86 Per Car

Experience Record & Qualifications

Section	RFP Ref		Weight	Badulescu Score (0 - 10)	Badulescu Weighted Score	Elliott Score (0 - 10)	Elliott Weighted Score	Myers Score (0 - 10)	Myers Weighted Score	Navarrete Score (0 - 10)	Navarrete Weighted Score	Snedden Score (0 - 10)	Snedden Weighted Score
A	RFP3.3.5	Staffing	3	6.00	18.00	4.00	12.00	4.00	12.00	5.00	15.00	2.00	6.00
B	RFP3.3.1	Resources	1	3.00	3.00	6.00	6.00	5.00	5.00	4.00	4.00	3.00	3.00
C	RFP3.3.2	Experience and Qualifications	2	6.00	12.00	6.00	12.00	7.00	14.00	8.00	16.00	4.00	8.00
D	RFP3.3.5	Project Schedule	2	8.00	16.00	6.00	12.00	8.00	16.00	8.00	16.00	4.00	8.00
E	RFP3.3.2	References	1	4.00	4.00	4.00	4.00	3.00	3.00	5.00	5.00	2.00	2.00
F	RFP3.3.1	Financial Strength	1	6.00	6.00	5.00	5.00	7.00	7.00	3.00	3.00	3.00	3.00
Total Weighted Score					59.00		51.00		57.00		59.00		30.00
*Experience Record and Qualifications Score					5.900		5.100		5.700		5.900		3.000

* Experience Record & Qualifications Score =
(Total weigthed score/100) *10
(10 Points Max)

Reviewed By Fred Simmons Jr. Date 3/29/10

Reviewed By [illegible] Date 3/29/10

[illegible]tions

RFP Section	No.	Evaluation Criteria	Maximum Score	Badulescu	Elliott	Myers	Navarrete	Snedden	Average
TP	1	Technical Proposal	50	31.850	28.975	27.172	34.500	32.275	30.95
4.2	2A	Price (Base Vehicles; LCCA)	38	23	35	36	33	38	33.00
4.2	2B	Price for Vehicle Options	2	2	2	1	2	2	1.80
3.3.2 3.3.5	3	Proposer Staffing, Resources, Experience and Qualifications	10	6.800	6.150	7.200	7.400	5.400	6.59
		Total	100						72.34

Price Summary		
Lowest Proposed Base Price	$344,387,867.63	$2,391,582.41 Per Car
Proposer's Proposed Base Price	$348,334,704.00	$2,418,991.00 Per Car
Lowest Proposed Option Price	$116,527,410.00	$2,157,915.00 Per Car
Proposer's Proposed Option Price	$122,580,000.00	$2,270,000.00 Per Car

Experience Record & Qualifications

Section	RFP Ref.		Weight	Badulescu Score (0 - 10)	Badulescu Weighted Score	Elliott Score (0 - 10)	Elliott Weighted Score	Myers Score (0 - 10)	Myers Weighted Score	Navarrete Score (0 - 10)	Navarrete Weighted Score	Snedden Score (0 - 10)	Snedden Weighted Score
A	RFP3.3.5	Staffing	3	6.00	18.00	7.00	21.00	8.00	24.00	8.00	24.00	6.00	18.00
B	RFP3.3.1	Resources	1	7.00	7.00	7.00	7.00	8.00	8.00	8.00	8.00	6.00	6.00
C	RFP3.3.2	Experience and Qualifications	2	8.00	16.00	7.00	14.00	8.00	16.00	9.00	18.00	6.00	12.00
D	RFP3.3.5	Project Schedule	2	6.00	12.00	4.00	8.00	4.00	8.00	5.00	10.00	4.00	8.00
E	RFP3.3.2	References	1	7.00	7.00	5.00	5.00	7.00	7.00	7.00	7.00	4.00	4.00
F	RFP3.3.1	Financial Strength	1	8.00	8.00	6.50	6.50	9.00	9.00	7.00	7.00	6.00	6.00
Total Weighted Score					68.00		61.50		72.00		74.00		54.00
Experience Record and Qualifications Score*					6.800		6.150		7.200		7.400		5.400

* Experience Record & Qualifications Score =
(Total weigthed score/100) *10
(10 Points Max)

Reviewed By Fred Simmons Jr Date 3/29/16

Reviewed By [illegible] Date 3/29/16

RFP 654 Technical Score Sheet Post Oral Presentations			Badulescu					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0-10)	Weighted Score	Score (0-10)	Weighted Score		
2	System Requirements	2	4	8	6	12	6	12
3	Carbody	5	6	30	6	30	6	30
4	Coupler and Draft Gear	4	7	28	7	28	7	28
5	Operator's Cab	3	5	15	6	18	6	18
6	Doors	6	8	48	7	42	7	42
7	Air Comfort System	8	8	64	8	64	7	56
8	Lighting	5	7	35	7	35	6	30
9	Auxiliary Electrical Equip.	4	7	28	6	24	6	24
10	Propulsion System	10	7	70	6	60	7	70
11	Truck Assemblies	5	7	35	7	35	7	35
12	Friction Braking	6	8	48	8	48	7	42
13	Communications	7	5	35	6	42	6	42
14	Train Control	8	6	48	6	48	6	48
15	System Support	5	7	35	6	30	5	25
16	Management Program	4	7	28	7	28	4	16
17	Testing and Inspection	4	7	28	6	24	7	28
18	System Assurance	5	6	30	7	35	7	35
19	Materials & Workmanship	2	6	12	7	14	6	12
20	Vehicle Monitoring System (VMS)	3	7	21	6	18	7	21
21	Compatibility	1	7	7	7	7	7	7
22	Software Systems	2	7	14	6	12	5	10
23	CDRLs	1	7	7	6	6	6	6
Total Weighted Score				674.00		660.00		637.00
Technical Proposal Score *				33.70		33.00		31.85

* Technical Proposal Score =
(Total weigthed score/1,000) * 50
(50 Points Max)

RFP 654 Technical Score Sheet Post Oral Presentations			Elliott					
			Alstom		Ansaldo Breda			
	Technical Provisions Section	Weight	Score (0-10)	Weighted Score	Score (0-10)	Weighted Score		
2	System Requirements	2	4	8	6	12	5	10
3	Carbody	5	6	30	6	30	6.5	32.5
4	Coupler and Draft Gear	4	6	24	6	24	6	24
5	Operator's Cab	3	5	15	6	18	5	15
6	Doors	6	8	48	7	42	6	36
7	Air Comfort System	8	7	56	7	56	6	48
8	Lighting	5	6	30	6	30	5	25
9	Auxiliary Electrical Equip.	4	5	20	5	20	5	20
10	Propulsion System	10	5	50	5	50	7	70
11	Truck Assemblies	5	6	30	6	30	6	30
12	Friction Braking	6	7	42	7	42	7	42
13	Communications	7	6	42	7	49	4	28
14	Train Control	8	5	40	6	48	5	40
15	System Support	5	7	35	5	25	7	35
16	Management Program	4	7	28	6	24	5	20
17	Testing and Inspection	4	6	24	7	28	6	24
18	System Assurance	5	6	30	6	30	7	35
19	Materials & Workmanship	2	2	4	6	12	4	8
20	Vehicle Monitoring System (VMS)	3	5	15	6	18	4	12
21	Compatibility	1	7	7	6	6	7	7
22	Software Systems	2	5	10	7	14	5	10
23	CDRLs	1	7	7	8	8	8	8
Total Weighted Score				595.00		616.00		579.50
Technical Proposal Score *				29.75		30.80		28.98

* Technical Proposal Score =
(Total weigthed score/1,000) * 50
(50 Points Max)

RFP 654 Technical Score Sheet Post Oral Presentations			Myers					
			Alstom		Ansaldo Breda			
	Technical Provisions Section	Weight	Score (0-10)	Weighted Score	Score (0-10)	Weighted Score		
2	System Requirements	2	2.5	5	7	14	6.5	13
3	Carbody	5	4.6	23	6.5	32.5	5.6	28
4	Coupler and Draft Gear	4	5	20	5.3	21.2	5.2	20.8
5	Operator's Cab	3	5.5	16.5	5.7	17.1	5.3	15.9
6	Doors	6	5.57	33.42	5.6	33.6	5.56	33.36
7	Air Comfort System	8	4.67	37.36	6.17	49.36	5.67	45.36
8	Lighting	5	7	35	6	30	5	25
9	Auxiliary Electrical Equip.	4	4	16	6	24	5	20
10	Propulsion System	10	4.8	48	6.1	61	5	50
11	Truck Assemblies	5	5.5	27.5	7.2	36	5.6	28
12	Friction Braking	6	5.5	33	6.25	37.5	5.75	34.5
13	Communications	7	4.5	31.5	8.6	60.2	5.2	36.4
14	Train Control	8	5	40	5.5	44	6	48
15	System Support	5	5	25	5.6	28	6	30
16	Management Program	4	5.55	22.2	7.11	28.44	4.33	17.32
17	Testing and Inspection	4	5.6	22.4	4.6	18.4	5.5	22
18	System Assurance	5	5.2	26	7	35	7.2	36
19	Materials & Workmanship	2	1	2	8	16	3	6
20	Vehicle Monitoring System (VMS)	3	3.9	11.7	6.8	20.4	2.6	7.8
21	Compatibility	1	7	7	6	6	7	7
22	Software Systems	2	4.25	8.5	7.3	14.6	5	10
23	CDRLs	1	5	5	5	5	9	9
Total Weighted Score				496.08		632.30		543.44
Technical Proposal Score *				24.80		31.62		27.17

* Technical Proposal Score =
(Total weigthed score/1,000) * 50
(50 Points Max)

RFP 654 Technical Score Sheet Post Oral Presentations			Navarrete					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0-10)	Weighted Score	Score (0-10)	Weighted Score		
2	System Requirements	2	6	12	7	14	6	12
3	Carbody	5	5	25	6	30	8	40
4	Coupler and Draft Gear	4	6	24	7	28	7	28
5	Operator's Cab	3	5	15	6	18	7	21
6	Doors	6	8	48	8	48	8	48
7	Air Comfort System	8	6	48	7.5	60	7.5	60
8	Lighting	5	6	30	7	35	6	30
9	Auxiliary Electrical Equip.	4	4	16	6	24	7	28
10	Propulsion System	10	5	50	6	60	8.5	85
11	Truck Assemblies	5	7	35	6	30	8	40
12	Friction Braking	6	8	48	8	48	7.5	45
13	Communications	7	5	35	9	63	3	21
14	Train Control	8	6.5	52	8	64	8	64
15	System Support	5	7	35	6	30	7	35
16	Management Program	4	8	32	9	36	5	20
17	Testing and Inspection	4	6	24	6	24	6	24
18	System Assurance	5	4	20	8	40	7	35
19	Materials & Workmanship	2	3	6	9	18	3	6
20	Vehicle Monitoring System (VMS)	3	7	21	8	24	5	15
21	Compatibility	1	8	8	7	7	8	8
22	Software Systems	2	3	6	9	18	8	16
23	CDRLs	1	7	7	8	8	9	9
Total Weighted Score				597.00		727.00		690.00
Technical Proposal Score *				29.85		36.35		34.50

* Technical Proposal Score =
(Total weigthed score/1,000) * 50
(50 Points Max)

RFP 654 Technical Score Sheet Post Oral Presentations			Snedden					
			Alstom		AnsaldoBreda			
	Technical Provisions Section	Weight	Score (0-10)	Weighted Score	Score (0-10)	Weighted Score		
2	System Requirements	2	6	12	4.5	9	3.5	7
3	Carbody	5	5.5	27.5	5	25	6	30
4	Coupler and Draft Gear	4	5.5	22	5.5	22	5.5	22
5	Operator's Cab	3	6	18	6	18	6	18
6	Doors	6	6	36	6	36	6	36
7	Air Comfort System	8	5.5	44	5	40	9	72
8	Lighting	5	8	40	6.5	32.5	6	30
9	Auxiliary Electrical Equip.	4	4.5	18	4.5	18	9	36
10	Propulsion System	10	4	40	4.5	45	9	90
11	Truck Assemblies	5	6	30	6	30	6	30
12	Friction Braking	6	5.5	33	5.5	33	6	36
13	Communications	7	5	35	5	35	6	42
14	Train Control	8	5	40	5	40	6	48
15	System Support	5	6.5	32.5	6	30	7	35
16	Management Program	4	7	28	4.5	18	4	16
17	Testing and Inspection	4	6	24	3.5	14	4.5	18
18	System Assurance	5	5	25	7	35	7.5	37.5
19	Materials & Workmanship	2	6	12	6	12	4	8
20	Vehicle Monitoring System (VMS)	3	5	15	5	15	5	15
21	Compatibility	1	5	5	5	5	5	5
22	Software Systems	2	4.5	9	4.5	9	4.5	9
23	CDRLs	1	7	7	4	4	5	5
Total Weighted Score				553.00		525.50		645.50
Technical Proposal Score *				27.65		26.28		32.28

* Technical Proposal Score =
(Total weigthed score/1,000) * 50
(50 Points Max)

Information submitted in the proposal related to each of the evaluation criteria on the Evaluation Worksheets were scored on a scale of 0 to 10. Scoring the proposal content under each criterion will be based on the evaluator's determination of the degree of compliance with the RFP, potential risks and benefits, and strengths and weaknesses. The following guidelines were used by the Evaluation/Selection Committee for scoring:

Rating	Criteria
9-10	**Exceptional** – Outstanding strengths; no risks, no weaknesses, and no omissions.
6-8	**Good** – Proposal is above the specification requirements. No risks, no weaknesses and no omissions.
4-5	**Compliant**– Minor risks, weaknesses or minor omissions, which do not affect form, fit or function. Acceptable as offered.
1-3	**Poor** – Major errors, risks, weaknesses, or omissions.
0	**Unacceptable** – Totally deficient.

Technical and Commercial Evaluation Worksheets were developed to identify the evaluation criteria against which the proposals were to be evaluated. Each technical and commercial criterion was given a weight pre-determined in advance of receipt of the proposal. Each criterion for each proposal was evaluated by each member of the Evaluation/Selection Committee using the rating or score identified above. In order to record their score, the evaluator filled out the appropriate Technical and Commercial Evaluation Worksheets (see the attached) during the valuation process.

For each criterion, the weight was subsequently multiplied by the "Rating" or "Score" provided by the committee member resulting in a "Weighted Score" for each criterion. The "Weighted Scores" were then summed to obtain the "Total Weighted Score" for both the Technical and Commercial elements of the proposal. The Total Weighted Scores were prorated based upon the "Maximum Score" that a Proposer could receive for each element, Technical or Commercial. The Final Proposer scores were calculated by taking an average of all Evaluation/Selection Committee member scores.

Commercial Example: Commercial Section – 10 Points Maximum

Evaluation Criteria	Weight	X	Rating/Score	=	Total Weighted Scored
Staffing	3	x	8	=	24
Resources	1	x	7	=	7
Experience and Qualifications	2	x	9	=	18
Project Schedule	2	x	5	=	10
References	1	x	6	=	6
Financial Strength	1	x	8	=	8
Total Weighted Score					73
Total Points = (Total Weighted Score)/100*10					7.3

Technical scoring follows the same format as above.

Price scores provided by the Evaluation/Selection Committee for a particular Proposer are averaged to reach a final score for a Proposer.

APPENDIX B
SELECTION COMMITTEE PROPOSAL EVALUATION
TECHNICAL PROPOSAL EVALUATION WORKSHEET
Request for Proposal No. 654

1. Point Summary for Technical Proposal

Proposer:_____

TP Section	Title	Alloc Pts	Rating (0-10)	Weighted Score
2	System Requirements	2		
3	Carbody	5		
4	Coupler and Draft Gear	4		
5	Operator's Cab	3		
6	Doors	6		
7	Air Comfort System	8		
8	Lighting	5		
9	Auxiliary Electrical Equip.	4		
10	Propulsion System	10		
11	Truck Assemblies	5		
12	Friction Braking	6		
13	Communications	7		
14	Train Control	8		
15	System Support	5		
16	Management Program	4		
17	Testing and Inspection	4		
18	System Assurance	5		
19	Materials & Workmanship	2		
20	Vehicle Monitoring System	3		
21	Compatibility	1		
22	Software Systems	2		
23	CDRLs	1		
	TOTAL	100		

TECHNICAL PROPOSAL SCORE (Total weighted score/1,000) X 50 (50 Points Max)	

APPENDIX B
SELECTION COMMITTEE PROPOSAL EVALUATION
PRICE PROPOSAL EVALUATION WORKSHEET
Request for Proposal No. 654

2. Point Summary for Price Proposal		
Proposer:_____		
Evaluation Criteria	**Allocated Points**	**Score**
2A. Price (Base Vehicles; Life Cycle Cost) (RFP4.2B1 & B3)	38	
2B. Price for Vehicle Options (RFP4.2B2)	2	
Total	**40**	
PRICE PROPOSAL SCORE (40 Points Max)		

Comments on Subjective Price Evaluation

APPENDIX B
SELECTION COMMITTEE PROPOSAL EVALUATION
COMMERCIAL PROPOSAL EVALUATION WORKSHEET
Request for Proposal No. 654

3. Point Summary for Commercial Proposal			
Proposer:_____	Ratings must be between 10 (high) to 0 (low) Weighted Score = Alloc. Pts. * Rating		
Rating Criteria	**Allocated Pts.**	**Rating (0-10)**	**Weighted Score**
A. Staffing (RFP3.3.5A&G)	3		
B. Resources (RFP3.3.2.A5)	1		
C. Experience and Qualifications (RFP3.3.2A)	2		
D. Project Schedule (RFP3.3.5B)	2		
E. References (RFP3.3.2B)	1		
F. Financial Strength (RFP3.3.1B)	1		
Total	**10**		
COMMERCIAL PROPOSAL SCORE **(Total weighted score/100) X 10** **(10 Points Max)**			

APPENDIX B
SELECTION COMMITTEE PROPOSAL EVALUATION
EVALUATION SUMMARY SHEET
Request for Proposal No. 654

Proposer:_____

No.	RFP Section	Evaluation Criteria	Allocated Points	Score
Technical Proposal – 50%				
1.	TPs	Technical	50	
Price Proposal – 40%				
2A.	4.2	Price (Base Vehicles; Life Cycle Cost Analysis)	38	
2B	4.2	Price for Vehicle Options	2	
Commercial Proposal – 10%				
3.	3.3.2 3.3.5	Proposer Staffing, Resources, Experience and Qualifications, Financial Strength and References	10	
		Total	**100**	

Rating	Criteria
9 – 10	**Exceptional** – Outstanding strengths; no risks, no weaknesses, and no omissions.
6 – 8	**Good** – Proposal is above the specification requirements. No risks, no weaknesses and no omissions.
4 – 5	**Compliant** – Minor risks, weaknesses or minor omissions, that do not affect form, fit or function. Acceptable as offered.
1 – 3	**Poor** – Major errors, risks, weaknesses, or omissions.
0	**Unacceptable** – Totally deficient.

Memorandum

MIAMI-DADE COUNTY

Date: March 4, 2010

To: Miriam Singer, Director, Procurement
Fred Simmons, Procurement Contract Office

From: Hugo Benitez
Assistant County Attorney

Subject: Railcar Procurement Responsiveness - Alstom Transportation, Inc.

You have asked us to determine whether the proposal of Alstom Transportation, Inc. ("Alstom") is responsive to the referenced Request for Proposals for the purchase of Metrorail vehicles (the "RFP"). For the reasons set forth below, we conclude that Alstom's proposal is not responsive.

BACKGROUND

The County issued the RFP on or about March 30, 2009. The RFP was for the County to purchase for Miami-Dade Transit one hundred and forty-four (144) Metrorail Vehicles with options for up to fifty-four (54) additional vehicles. RFP, Section 1.1.

The RFP contained several clear and unambiguous provisions regarding the pricing of the proposed cars. Section 1.1 stated: "The County's per unit price of the vehicles, including all Contract requirements, shall not exceed $2.419M. Proposals that include a price unit in excess of $2.419M will be considered non-responsive and will not be considered for award". The summary of items to be included in the proposal included a statement acknowledging that "the price submitted is compliant with the price cap of $2.419 million per vehicle established for this solicitation". RFP Section 3.2 contained the same requirement, and further required that the proposer execute an affidavit in which the proposer affirms that "the proposed per unit vehicle price, including all Contract requirements, does not exceed $2.419M for either the base vehicle or option vehicle". Finally, Section 3.4 entitled Price Proposal, sets forth the following admonition in bold type: No exceptions may be taken to the $2.419 Million per vehicle cap.

Together with its technical submittal on or about September 2009, Alstom included the price affidavit with the following qualification: "Pricing for only the Option vehicles does not exceed $2.419M." Based on that qualification, you requested previously that our office determine Alstom's responsiveness. On December 3, 2009 we issued a written opinion that the determination of Alstom's responsiveness based only on the irregularity in the affidavit was premature, as the RFP contained no clear indication of the effect of qualifying the affidavit, and suggested that the matter be revisited following review of the complete submittal, including Alstom's.

Following that advice, the County proceeded to open and evaluate all price proposals. Your request for legal opinion indicates that Alstom's price is $3.48 million, exceeding the County's

announced maximum by more than one million dollars per vehicle.

OPINION

Based on the facts set forth above, and the clear and unambiguous requirements of the RFP, it is our opinion that Alstom's proposal is not responsive and should be rejected. The RFP by its express terms required Alstom to submit a price within the cap.

We disagree with Alstom's argument contained in its letter of November 11, 2009 that the RFP allowed proposers to submit a higher price and then negotiate a price under the stated maximum. Read in the context of the clear and unambiguous requirements of the RFP set forth above, the statement contained in Section 4.7 that "the final negotiated price shall not exceed" the stated price cap, does not mean that proposers were allowed to submit a higher price. Significantly, Alstom in qualifying the clear provisions of the required affidavit, has in fact acknowledged that it understood the County requirement and chose to deviate from it.

In expressing this opinion we also caution you that the remaining proposers, to remain eligible, must furnish a rail car in compliance with the requirements set forth in the RFP. In other words, providing less than the car required is not better than providing the required at a price higher than the cap. Alstom has indicated that the other proposals contain "exceptions and qualifications" and the RFP invites future exceptions to be considered in negotiations. There are, of course, limits to a proposer's ability to depart from the express requirements of an RFP, and to the County's ability to consider them. We are not in a position to evaluate any of those departures at this juncture. For these reasons, it would be in the County's best interest to retain the sealed "alternatives" package, and other submissions of Alstom, until final resolution of these matters through contract award.

Please call me if you have any questions.

Hugo Benitez

HB/es

Memorandum

MIAMI-DADE COUNTY

Date: February 25, 2010

To: Hugo Benetiz, Assistant County Attorney
County Attorneys Office
Miami-Dade County

From: Fred Simmons, Jr., CPPO
Senior Procurement Contracting Officer
Department of Procurement Management

Subject: Request for Legal Opinion
RFP No. 654: Purchase of New Heavy Rail Vehicles

This is to request a legal opinion regarding the ALSTOM Transportation Inc., proposal submitted in response to the subject Request For Proposals (RFP).

The RFP required that Proposers not exceed the price cap of $2.419 million for each of the base and option vehicles. Various sections in the RFP conveyed this requirement. Section 1.1 of the RFP, also notes the consequences of non-compliance with this requirement: "Proposals that include a per unit price in excess of the $2.419M will be considered non-responsive and will not be considered for award." Additionally, Proposers were required to submit Form A-7 Affidavit of Miami-Dade County Acknowledgement of Proposed Price, which attests to the Proposer's compliance with the price cap.

A threshold question regarding Alstom's responsiveness to the County's price cap requirement is whether the price submitted by Alstom exceeds the price cap. The Form A-7 submitted by Alstom is unclear. The County asked for a clarification from Alstom of its Form A-7 submission, and received a response that did not clearly state if the price cap is met as required by the RFP. On February 19, 2010, the County opened prices submitted by Proposers. ALSTOM's price for the base vehicles is $501, 229,475 ($3.480M per vehicle) which exceeds the cap price of $2.419 per vehicle. The price cap was met for the option vehicles.

Thank you in advance for your review of this matter.

Respectfully Submitted,

Fred Simmons, Jr., CPPO
Department of Procurement Management

CC: File

ALSTOM

TRANSPORT

November 11, 2009

Mr. Fred Simmons, Jr., CPPO
Senior Procurement Contracting Officer
MDC Department of Procurement Management
111 NW 1st Street, Suite 1300
Miami, FL 33128-1974

Subject: Request for Proposals No. 654 – Purchase of New Heavy Rail Vehicle

Dear Mr. Simmons:

Alstom Transportation Inc. (Alstom) is in receipt of your letter of November 9, 2009 requesting that we confirm that our sealed proposal complies with the RFP specifications. We believe that it does.

Alstom's proposal accurately reflects its interpretation of the requirements of the RFP. It is our understanding that the requirement for a price cap reflects the County's desire to obtain vehicles whose unit price meets the cap through a competitive, negotiated procurement. The language of the RFP confirms this. See e.g. RFP §. 4.7, ("*final negotiated* price shall not exceed the $2.419 [million] cap," [emphasis supplied] *accord*§ 4.5. The RFP clearly indicates that the final price will be established through the process of soliciting best and final offers or negotiations with the proposers.

Given the exceptions and qualifications included in the other proposals, it appears that neither of them could be deemed to unequivocally comply with an absolute requirement that the sealed price proposal meet the $2.419 million cap. Accordingly, a responsiveness determination as to the vendors' price proposals is not possible at this stage of the evaluation, and all exceptions and qualifications must be quantified in order to make a determination as to which, if any proposals, are responsive.

Moreover, the RFP contains ambiguous and contradictory provisions regarding responsiveness and evaluation of exceptions[1]. See e.g. addendum 11, as well as §§ 4.2, 4.5, 4.7,. Clearly however, under the RFP and under Florida law, the county has wide discretion to interpret the RFP requirements as it sees fit and to waive any perceived defects, deviations, informalities or irregularities. See RFP §1.3.[2]

---

[1] Nevertheless, Alstom's proposal complies with the RFP requirement that no exceptions may be taken with respect to the price cap.

[2] The County may, at its sole and *absolute* discretion, reject and all parts of any of all responses, accept parts of any and all responses, further negotiate project scope and fees, or waive any irregularities in this Solicitation or in the responses received as a result of this process. [emphasis supplied]

ALSTOM Transportation Inc.
One Transit Drive
Horsehead, NY 14863
Tel: 607-324-4565
Fax: 607-281-2951

ALSTOM

TRANSPORT

As stated above, Alstom believes its proposal is materially compliant with the express intent of the RFP. We are ready to negotiate with the County to provide vehicles that meet the County's operational and budgetary needs. Accordingly, it is in the best interest of the County and its Metrorail customers to exercise your discretion to continue the evaluation of all proposals.

Very truly yours,

Keith Stentiford
Vice President and Customer Director
Alstom Transportation Inc.

Electronic and Hard Copy:

Libhaber, Bruce
111 N.W. 1st Street
Suite 2810
Miami, Florida 33128
Bus: (305) 375-2150
E-mail: bruce2@miamidade.gov

Clerk of the Board of County Commissioners
ATTN: Fara
111 N.W. 1st Street 17th Floor, Suite 202 Miami, Florida 33128
Contact: Renee or Liz, Soto
United States of America
Bus: (305) 375-5126
E-mail: clerkbcc@miamidade.gov

MIAMI-DADE COUNTY

Carlos Alvarez, Mayor

Transit
6601 NW 72nd Avenue
Miami, Florida 33166
T 305-884-7581 F 305-805-5409

miamidade.gov

November 9, 2009

Keith Stentiford, Customer Director/VP
Alstom Transportation Inc.
1 Transit Drive
Hornell, NY 14843

Dear Mr. Stentiford:

Miami-Dade County is in receipt of Alstom's proposal in response to RFP #654 for the purchase of new heavy rail vehicles. As you are aware, RFP #654 mandated that, in order to be considered for award, the price per vehicle may not exceed $2.419 million. Form A-7 required Proposers to certify under oath that "the proposed per unit vehicle price, including all Contract requirements, **does not exceed $2.419M for either the base vehicle or option vehicle.**" (emphasis added) Alstom's Form A-7 includes a footnote that states "Pricing for **only** the Option Vehicles does not exceed $2.419M." (emphasis added)

In order to remain under consideration for a possible award recommendation, please confirm in writing to the Contracting Officer (Fred Simmons, Jr.) within 72 hours of receipt of this letter that Alstom's sealed Price Proposal does not exceed $2.419 million for either each base vehicle or each option vehicle.

Thank you for your attention concerning this matter.

Sincerely,

Fred Simmons Jr., CPPO
Senior Procurement Contracting Officer

Cc:
Miriam Singer, Director, Department of Procurement Management
Bruce Libhaber, Assistant County Attorney
Clerk of the Board
File

ALSTOM

TRANSPORT

The signed and notarized MDC affidavit Form A-7, Acknowledgement of Proposed Price, is included in the Proposal Booklet. In order to significantly reduce project cost in an effort to meet the aggressive price cap, which has been achieved for the option cars, several commercial and technical exceptions are necessitated. The specific commercial exceptions are included herein as Attachment (1). Technical exceptions are identified in the Technical Proposal.

Alstom stands ready to discuss each commercial and technical exception in order to provide the greatest overall value to the riding public, Miami-Dade Transit, and Miami-Dade County. It may well be that jointly exploring a specific set of candidate trade-offs in a given area will result in greater value to MDC. We are prepared to jointly review every area of the RFP requirements and of this Offer in order to achieve our shared objective of a contract for vehicle supply that is acceptable to both parties.

Included in the Price Proposal Appendix "C" is a table of additional savings categories, which we offer as a basis for discussion to further reduce the face value of the Offer. These would have to be mutually agreed to and priced. We hold ourselves available to discuss these options if of interest to Miami Dade.

Alstom will assign very qualified personnel to the MDC project. Our Project Manager will be Mr. Michael Feenaughty, who has successfully managed Alstom Hornell's California Department of Transportation (Caltrans), Amtrak Surfliner and Washington WMATA Metro rail car projects. Mr. Feenaughty experience includes supervisory positions in Manufacturing Engineering and Quality Management. Resumes for Mr. Feenaughty and other key members of the Alstom-MDC Project Team can be found in Organization and Management Plan of the Proposal Booklet. Alstom Transportation Inc. guarantees that the identified members of the project management team and key technical personnel identified shall be assigned to the Work, unless their employment is terminated or with prior written approval by MDC.

Included with this Letter of Transmittal as Attachment (2) is the Proposal Guarantee Deposit, in the amount of $3,480,000.

We at Alstom Transportation thank MDT and MDC for the opportunity to present our proposal for this project. This project is of the utmost importance to Alstom, and we are totally and unequivocally committed to MDC and the project's success. This project will receive the highest priority within Alstom Transportation. We look forward to being MDC's supplier in this project and partnering with MDC and Miami Dade County to make this project a complete success.

Sincerely,

Keith Stentiford

Keith Stentiford

Vice President and Customer Director
Alstom Transportation Inc.

Attachment 1 – Commercial Proposal Exceptions
Attachment 2 – Proposal Guarantee

ALSTOM Transportation Inc.
One Transit Drive
Hornell, NY 14843
Tel.: 607-324-4595
Fax: 607-281-2951

1.0 Project Overview and General Terms and Conditions

1.1 INTRODUCTION

Miami-Dade County ("County"), as represented by Miami-Dade Transit requests proposals from experienced rail vehicle manufacturers for the procurement of one hundred forty-four (144), Heavy Rail (Metrorail) Vehicles (HRVs) with options for up to fifty-four (54) additional vehicles. The New Vehicles shall conform to the Technical Provisions included in this RFP.

The Work to be performed shall include, but not be limited to, project management and administration, designing, manufacturing, factory testing, furnishing, delivery, acceptance testing, safety certification, commissioning, as well as the delivery of data, manuals, drawings, training, support services, spare parts, special tools, and test equipment of the quantity and quality indicated in the Contract Documents. The Work shall also include fleet decommissioning and disposal of Miami-Dade Transit's Existing 136 HRVs and all remaining spare parts.

Proposers are advised to completely review, and explicitly follow the instructions in the solicitation documents. Each Proposal shall comply with the requirements of this RFP as stated herein, and shall be executed by an individual legally authorized to bind the Proposer to a contract. Proposals not in compliance with the requirements of the RFP may be deemed non-responsive.

The Contractor is encouraged to use every effort to ensure that certified DBEs have the greatest opportunity to participate in the performance of the Work under the Agreement.

The County may require Proposers to give oral presentations in support of their proposals or to or otherwise demonstrate the information contained therein.

~~The County's per unit price of the vehicles, including all Contract requirements, shall not exceed $2.419M. Proposals that include a per unit price in excess of $2.419M will be considered non-responsive and will not be considered for award.~~

The County anticipates awarding a contract for a nine year period, that will cover manufacturing, testing and delivery, and the three year vehicle warranty period.

The anticipated procurement schedule for this Solicitation is as follows:

Solicitation issued:	March 30, 2009.
Pre-Proposal Conference:	See front cover for date, time and place. Attendance is recommended but not mandatory. If you need a sign language interpreter or materials in accessible format for this event, please call the DPM ADA Coordinator at (305) 375-1564 at least five days in advance.
Deadline for receipt of questions:	July 10, 2009

CLERK OF THE BOARD
2011 FEB 18 AM 10: 23
CLERK, CIRCUIT & COUNTY COURT
DADE COUNTY, FLA.
#1

Date February 18, 2011

All Responding Proposers (See Distribution List)

SUBJECT: RFP Number 654
Purchase of New Heavy Rail Vehicles

Dear Proposers:

In accordance with the above referenced solicitation, and Section 2-8.4 of the Code of Miami-Dade County, you are hereby notified that the County Manager or designee recommends award of this contract to:

AnsaldoBreda S.p.A.

Proposer(s) not recommended for award for reasons other than ranking:
Please see Award Recommendation Memo attached.

Our provision of this notice also serves to confirm the lifting of the Cone of Silence from this procurement action as dictated by Section 2-11.1(t) of the County Code. We appreciate the participation of all vendors who responded to the subject action.

If you have questions, please contact me at 305-375-4259 or please email me at fred@miamidade.gov.

Sincerely,

Fred Simmons, Jr. CPPO
Senior Procurement Contracting Officer

Distribution: AnsaldoBreda S.p.A.
CAF USA, Inc.
Alstom Transportation, Inc.

Attachment (1): County Manager Award Recommendation

cc: Clerk of the Board
Bruce Libhaber, Assistant County Attorney
File

Memorandum

MIAMI-DADE COUNTY

CLERK OF THE BOARD
2011 FEB 18 AM 10: 22
CLERK, CIRCUIT & COUNTY COURTS
DADE COUNTY, FLA.
#1

Date:

To: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

From: George M. Burgess
County Manager

Subject: Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles

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RECOMMENDATION

It is recommended that the Board of County Commissioners approve award of this contract to AnsaldoBreda S.p.A, (AnsaldoBreda) Naples, Italy for purchase of 136 new heavy rail vehicles to replace the existing Metrorail fleet, and decommissioning of the existing fleet. The vehicles will be designed and built by AnsaldoBreda to provide 30 years of useful life to the County. The contract is compliant with the commercial, and technical requirements of the Request For Proposals (RFP), and all the applicable federal requirements.

CONTRACT NO:	Contract No. 654
CONTRACT TITLE:	Purchase of 136 New Heavy Rail Vehicles
DESCRIPTION:	Purchase of one hundred and thirty six (136) new Heavy Rail Vehicles (HRV) inclusive of spare parts, staff training, training simulator, vehicle testing and test equipment, technical and training manuals and drawings. The Contractor shall furnish all labor, materials, tools, equipment, transportation and supervision, and shall perform all design, engineering, systems integration, manufacturing, testing, repairs, retrofits, and provide technical support necessary to perform the Work. The Contractor will decommission the existing fleet of vehicles in accordance with all federal, state and local regulations.
TERM:	Eleven years inclusive of a five-year warranty period per vehicle Note: The RFP required a base vehicle warranty of three years. The County negotiated a five-year base vehicle warranty at no additional cost. Notice To Proceed (NTP) is anticipated in mid-2011, with a scheduled delivery and acceptance rate of six vehicles per month starting the last quarter of 2013. The final six vehicles are scheduled to be delivered and accepted during the third quarter of 2016.
APPROVAL TO ADVERTISE:	March 31, 2009
CONTRACT AMOUNT:	$313,832,000, inclusive of a 5% contingency allowance. The amount is based on the negotiated price of $298,887,200, plus $14,944,800 for the contract contingency.
PREVIOUS CONTRACT (Y911) AMOUNT:	$83,808,368 in 1979 with the Budd Company, through a joint purchase with Baltimore, Maryland for the existing fleet.

USING/MANAGING AGENCY AND FUNDING SOURCE:

Department	Allocation	Funding Source	Contract Manager
Miami-Dade Transit	$313,832,000	Charter County Transportation Surtax Funds (Surtax)	Richard Snedden, Assistant Director, Rail Services

The procurement process was conducted in accordance with all Federal Transit Administration (FTA) requirements and guidelines. A Letter of No Prejudice (LONP) for $300 million, that is valid until November 19, 2014, has been received from the FTA. The LONP allows the County to apply for federal funding after contract award. It is important to note that the FTA, in its recent site visit to Miami-Dade County, reviewed the entire railcar procurement solicitation file, and found them to be in compliance with applicable federal guidelines.

The total required funding for the Project, including this contract, project management, oversight and other support costs is $375,746,000. This amount is $25,705,000 less than the not to exceed ceiling of $401,451,000 for total project costs approved by the Board in Resolution R-488-08 on May 6, 2008.

This project funding request includes engineering services to be provided under an existing consultant services contract with United Research Services (URS), formerly Washington Group International. The existing contract (No. TA02-MR26) will require an extension of the term, and an increase in funding of approximately $4.4 million (included in the project funds of $375,746,000 above) and is being presented as a separate agenda item.

The average annual cost of repairs and maintenance for the new fleet of vehicles, including periodic systems overhaul but excluding the midlife overhaul costs, is estimated at approximately $15,000,000. The department will include the Operations and Maintenance (O&M) costs of the new rail vehicles in the operating budget starting in FY 2014 - 2015. Funding for future O&M costs will be through MDT's operations funding sources to include proprietary, local, state and federal funds.

DPM AGENT/OFFICER: Fred Simmons, Jr., Department of Procurement Management

METHOD OF AWARD: To the recommended responsive, responsible vendor based on the evaluation criteria established in the solicitation. A full and open competitive Request for Proposals process was used. The vendor whose offer was determined to represent best value, and most advantageous to the County is recommended for award.

VENDOR RECOMMENDED FOR AWARD:

Vendor	Address	Principal
AnsaldoAnsaldoBreda S.p.A. (Non-local vendor)	Via Argine N. 425 Naples, Italy 80147	Salvatore Bianconi

VENDORS NOT RECOMMENDED FOR AWARD: Alstom Transportation Inc.: Found non-responsive by the County Attorney's Office as their proposal did not meet the County's "not to exceed per vehicle" price cap. (See legal opinion attached)
CAF USA, Inc.: Was not recommended by the Negotiations Team as their offer did not provide the best value to the County.

PERFORMANCE DATA: Please refer to the Responsibility Review section of this memorandum.

COMPLIANCE DATA: There are no compliance issues with the recommended firm.

CONTRACT MEASURES:	The Review Committee of April 1, 2009 determined that no measures would be applied due to the inclusion of federal provisions in the solicitation.
LIVING WAGE:	The services being provided are not covered under the Living Wage Ordinance.
USER ACCESS PROGRAM:	The User Access Program provision is not included.
INSPECTOR GENERAL FEE:	The Inspector General fee does not apply.
LOCAL PREFERENCE:	The Local Preference Ordinance does not apply.
ESTIMATED CONTRACT COMMENCEMENT DATE:	Ten business days after date adopted by the Board of County Commissioners, unless vetoed by Mayor.

BACKGROUND

On September 9, 2004, the Board approved Resolution No. R1097-04 authorizing a Request to Advertise (RTA) the MDT Heavy Rail Vehicle Rehabilitation project (RFP No. 439). The selection process included negotiations with the top ranked proposer to obtain a Best and Final Offer (BAFO), which concluded in 2006 with a final price offer of $274,495,000, or $2.018 million per vehicle. A careful review of the negotiations results was conducted, along with a thorough assessment of the rail industry marketplace. County staff also conducted an evaluation of Miami-Dade Transit's (MDT) existing rail service performance, and future requirements for rail vehicles for the planned Metrorail extensions. A life cycle cost analysis was conducted to ascertain whether it was more cost effective to continue the rehabilitation or purchase new replacement vehicles. The results of these analyses, detailed in a memorandum to the Board on September 27, 2007, resulted in the Board's approval, on March 18, 2008, to reject all bids for RFP 439. Subsequently, on May 6, 2008 the Board approved a PTP Amendment to purchase new replacement vehicles.

The County included two significant standard industry processes during development of the solicitation. A comprehensive Peer Review of the solicitation specifications prior to issuing the RFP was conducted. The County invited a panel of transit experts, assembled by the American Public Transit Association (APTA), to conduct a review of the solicitation documents, including a review of the technical provisions, general provisions, and the solicitation. Additionally, a Value Engineering Study of the technical provisions was performed by Lea+Elliott, Inc, an independent engineering consultant. These efforts provided valuable feedback. The review panel made general provision recommendations regarding contract administration, in the areas of Contractor performance, inspections and reviews, and risk reduction to the County. These included indemnification, bonding, insurance, warranties, management of claims and disputes, and promotion of quality assurance. The Value Engineering Study provided recommendations for improving the technical provisions that would allow proposers to offer vehicles that will be cost effective, energy efficient, improve performance, lower cost of maintenance, and provide maximum reliability and safety.

On March 31, 2009, DPM issued a solicitation (RFP No. 654) for a base purchase of 144 new heavy rail vehicles to replace the existing fleet of 136 vehicles, and eight additional vehicles that were anticipated to support the service requirements for the new Airport Link Line. The solicitation also included options to purchase up to 54 vehicles to provide service when the North and East-West Extensions of Metrorail would be built. The County re-assessed its needs and concluded that the option vehicles and eight vehicles for the Airport Link were not needed. Therefore, this contract does not include the vehicles for the Airport Link, or the optional vehicles contemplated for the North Corridor and East-West extensions.

PROPOSAL EAVALUATIONS

Proposals were received from three carbuilders on September 25, 2009; Alstom Transportation Inc., (Alstom) AnsaldoBreda S.p.A, and CAF USA Inc. The proposals were evaluated by an Evaluation/Selection Committee who received assistance from a team of technical and commercial

experts appointed by the County Manager. Points were allocated in accordance with the RFP documents as follows:

Technical Proposal	50 points
Commercial Proposal	10 points
- Staffing, Resources and Qualifications	
Base Vehicle Price	38 points
Options Price	2 points

The RFP required that proposers not exceed the price cap of $2.419 million for each of the base and option vehicles. Various sections in the RFP conveyed this requirement. Section 1.1 of the RFP notes the consequences of non-compliance with this requirement, "Proposals that include a per unit price in excess of the $2.419M will be considered non-responsive and will not be considered for award." Additionally, Section 4.5 of the RFP (Price Evaluation) indicates that after the evaluation of commercial and technical proposals, in light of oral presentations, if any, the County will conduct a subjective evaluation of price proposals of those Proposers remaining in the zone of consideration. Proposers were required to submit Form A-7 Affidavit of Miami-Dade County Acknowledgement of Proposed Price, attesting to the Proposer's compliance with the price cap. The information on Form A-7 submitted by Alstom resulted in uncertainty regarding Alstom's responsiveness to the County's price cap requirement. The County requested clarification from Alstom of its Form A-7 submission and received a response that did not clearly state if the price cap was met as required by the RFP. Based on the legal opinions rendered by the County Attorney's Office (attached), Alstom's commercial and technical proposals were evaluated, but its price proposal was not considered once it was ascertained it was non-responsive.

In its May 18, 2010, letter to the County, Alstom Transportation, Inc. formally requested return of its Proposal Guarantee Deposit, removing itself from consideration for contract award in accordance with RFP Section 1.3.2.

The Evaluation/Selection Committee completed its evaluation and scoring of the proposals on March 15, 2010. The final composite score for each proposer is detailed below.

Proposer	Commercial Score	Technical Score	Price Score	Price Submitted for 144 cars	**Combined Score**
Alstom Transportation, Inc.	6.94	29.15	N/A	$501,229,475.00 $3.481M per/veh.	**36.09**
AnsaldoBreda S.p.A.	5.12	31.61	35.30	$344,387,867.63 $2.392M p/veh.	**72.03**
CAF USA, Inc.	6.59	30.95	34.80	$348,334,704.00 $2.419M p/veh.	**72.34**

NEGOTIATIONS

The County Manager approved the Evaluation/Selection Committee's recommendation that the County enter into negotiations with the two proposers remaining in the zone of consideration (AnsaldoBreda S.p.A. and CAF USA Inc.). The memorandum also approved a four member negotiating committee.

Negotiations commenced on June 2, 2010. During negotiations, MDT re-evaluated its fleet requirements and determined that 136 vehicles would be sufficient to meet operating requirements, including the new Airport Link. The reduction in the number of required vehicles were communicated to the proposers on July 16, 2010, prior to the submission of final technical and commercial offers, BAFO submissions, and the completion of negotiations.

The FTA, through its Best Practices Manual, encourages agencies to visit the facilities of proposers prior to award, to assess their capabilities to meet the requirement for vehicle production. During the week of August 1, 2010, county staff visited the proposed final assembly facility of CAF USA, Inc. in Elmira, New York. During the visit, CAF advised of its intention to take advantage of the large rail

vehicle manufacturing labor pool in the region. This labor pool, along with CAF's staff provides the human resources necessary to assemble and deliver the vehicles. Since AnsaldoBreda's vehicle final assembly facility is proposed to be constructed in Miami-Dade County after contract award, County staff visited AnsaldoBreda's existing vehicle final assembly facility in Pittsburg, California. The Pittsburg facility serves as a model for the vehicle final assembly facility that will be constructed in Miami-Dade County. AnsaldoBreda advised of its intention to take advantage of the local labor pool, e.g. mechanical and electrical engineers, technicians, and semi-skilled personnel, coupled with its own resources to complete vehicle final assembly in Miami-Dade County. County staff concluded that both companies' facilities have the capacity to complete final assembly of the vehicles.

The Negotiations Team met on August 10, 2010 to consider price offers and to carefully review and evaluate which competitive offer represents the best value. In determining best value, the Negotiations Team considered FTA procurement guidelines and County procurement policies. The FTA specifically states "The recipient should base its determination of which proposal represents the "best value" on an analysis of the tradeoff of qualitative technical factors and price or cost factors." The County considered qualitative factors such as the proposer's technical design, technical approach, and length of delivery schedule, quality of proposed personnel, past performance, technical and commercial offerings, and management plan. The BAFO price from each proposer was also considered.

County staff negotiated offers received from both proposers that met the requirements of the RFP. Staff also negotiated significant technical enhancements and commercial terms into agreements with the proposers. The County sent each proposer a list of technical enhancements that were discussed during negotiations. The list was customized to the particular proposer based on discussions during negotiations of their specific offer. In its BAFO to the County, each proposer submitted its list, indicating if a particular item would be included in its final offer to the County under the price cap. AnsaldoBreda and CAF offered similar enhancements in their offers. For example, both proposers offered bicycle racks, Baultar flooring, a full operator's cab in the second car of the married pair, Mitsubishi roof mounted HVAC system, LED lighting, WiFi Wireless connectivity, the latest mobile communications connectivity at the time of assembly, an integrated passenger information system, a simulator for operator training, and a 5-year vehicle warranty. AnsaldoBreda's offer included animated air and electronic schematics that will be used as a training aid by Transit staff for orientation to, and repair of, the new vehicles. This item was not offered by CAF.

On August 9, 2010, Best And Final Offers (BAFO) for price were received from the two proposers. BAFO price offers were as follows:

- AnsaldoBreda S.p.A. $ 298,887,200, or $2,197,700 per car
- CAF USA, Inc. $ 303,566,408, or $2,232,106 per car

AnsaldoBreda's BAFO price of $298,887,200 represents a reduction of $30,096,800 when compared to the County's price cap of $328,984,000 ($2,419,000 per vehicle). AnsaldoBreda's BAFO price is $4,679,208 less than the CAF BAFO price.

BEST VALUE

The County complied with all FTA guidelines in its best value assessment. Procurement procedures discussed in FTA C4220.1F; VI-II (2) (f) include guidance regarding determinations of best value. Those guidelines were communicated to County staff during the August 10, 2010 Negotiations Team meeting. The guidelines state, in part:

If permitted under its State or local law, the recipient may award the contract to the offeror whose proposal provides the greatest value to the recipient. To do so, the recipient's solicitation must inform potential offerors that the award will be made on a "best value" basis, and identify what factors will form the basis for award. The evaluation factors for a specific procurement should reflect the subject matter and the elements that are most important to the recipient. Those evaluation factors may include, but need not be limited to, technical design, technical approach, length of delivery schedules, quality of proposed personnel, past performance, and management plan. The recipient should base its determination of which proposal represents the "best value" on an analysis of the tradeoff of qualitative technical factors and price or cost factors. Apart from the statutory requirement that the contract must

support the recipient's public transportation project consistent with applicable Federal laws and regulations, FTA does not require any specific factors or analytic process.

As stated above, "The evaluation factors for a specific procurement should reflect the subject matter and the elements that are most important to the recipient." AnsaldoBreda's offer to include performing vehicle final assembly at a facility located in Miami-Dade County received favorable consideration from County staff. Since AnsaldoBreda's proposed facility will be local, project oversight efforts by MDT are improved, inspections can be more frequent, and travel costs that would be incurred to conduct oversight of final vehicle assembly activities will be significantly reduced. Efforts to review drawings, project plans for testing, schedule, and progress meetings can be more effectively coordinated locally, allowing faster reviews and better communications in resolving project issues.

The County did not include local preference in the solicitation, did not give extra points in evaluating proposals for having a local vehicle final assembly facility, or require proposers to have a local vehicle final assembly facility. Favorable consideration regarding advantages of having vehicle final assembly performed in Miami-Dade County did not constitute a local preference, and cannot be construed as providing a geographical preference. Consideration by the County of AnsaldoBreda's offer is consistent with federal guidelines.

In making a determination of best value, the County considered a) the negotiated technical provisions, b) the negotiated terms and conditions, c) the BAFO prices, d) the items on the list of enhancements each proposer submitted to the County, and e) the transit benefits of the local vehicle final assembly facility offered by AnsaldoBreda. Based on these factors, the County determined that the offer from AnsaldoBreda S.p.A. represents the very best value, is compliant with applicable FTA guidelines, and as such is most advantageous to the County. The AnsaldoBreda offer is compliant with all of the RFP requirements, offers several significant technical enhancements and favorable commercial terms, and was the lowest priced.

The recommended contract includes a number of provisions that reduces the County's risk and enhances contract administration. A performance bond that spans the Scope of the Work, and ranges from 12% to 30% of the contract sum is included in the contract. The performance bond requires various levels of coverage commensurate with the work effort. The levels of coverage increase and decrease as work progresses through various phases. For example, the performance bond requirement starts at contract award at 12% of the contract sum, increases to 25% of the contract sum as the work progresses to completion of the final design review through delivery of the three married pair (2 vehicles per married pair) pilot vehicles, and completion of testing. The bond coverage peaks at 30% of the contract sum, and starts to decline at a rate of 1/68 upon acceptance of each married pair. This bond structure serves to reduce cost while maintaining the coverage required by the work being performed. Additionally, the contract includes liquated damages ($1,653 per day per married pair), based on the delivery of vehicles in the contract schedule. As added financial protection, a payment bond in the amount of 2% ($5,977,744) is required, and a milestone payment of 3% ($8,966,616) will be held by Miami-Dade County until the end of the vehicle warranty. The contract also includes a number of general provisions to support effective contract management. These include the ability to stop work, suspend work, approve Contractor personnel, and make changes. These provisions provide essential controls to managing the vendor's performance and adherence to the contract schedule.

VEHICLE ACCEPTANCE TESTING

A track for testing the pilot and series vehicles is required at numerous points following delivery in order to accept the vehicles. The purpose of acceptance testing is to qualify the new vehicles on the property of the agency where the vehicles will operate – on MDT's system. Due to safety concerns, operational realities, and timing, acceptance testing should not take place on the mainline during normal operating hours. The failure of a vehicle being tested during service hours could result in a train accident. Currently, there are only five non-service hours available per day on our MDT Metrorail System. This is insufficient to meet the delivery/acceptance schedule. Acceptance of six railcars per month is a requirement of the RFP. Without a test track, testing must be performed on the mainline. This will drastically affect MDT's ability to accept six vehicles per month, as acceptance of the new rail vehicles

would take approximately 12 months longer. In addition, more shop space will be needed to perform vehicle maintenance and repairs.

The County's need for a test track is essential to its overall rail operations, and not necessitated by the purchase of the new vehicles. The County first identified the need for a test track in the early 1980s. The original design for the Lehman Yard maintenance facility included a test track which was not built due to budget constraints. The County has issued a solicitation to purchase a test track, a siding track, an inspection building, five storage tracks, two maintenance-of-way tracks, and a train control and communication house. MDT needs this test track and facilities as part of its regular operations and maintenance activities. The Airport Link will increase future vehicle requirements to provide the number of rail vehicles needed for revenue service. A test track significantly improves operational capability for maintaining the rail vehicles, and meeting the demand for rail vehicles during peak service hours. A MDT test track will be used to perform trouble-shooting on the existing fleet without conflicting with maintenance facility operations and train mainline operations. It will allow 24/7 testing for the existing fleet before and after delivery of the new fleet. Testing can be accomplished during the day (quick turn-around) rather than overnight (Midnight to 5:00 A.M.). This will expedite the return of rail vehicles to service following repair, and/or maintenance, therefore improving customer service and operational efficiency.

The solicitation did not require a proposer to have a test track. The solicitation specified that vehicle qualification tests, post-shipment tests, and vehicle acceptance tests would be performed at the MDT location regardless of whether the contractor had its own test track. The only tests required to be conducted at the contractor's facility are pre-shipment and production acceptance tests. AnsaldoBreda committed, in its agreement with the County, to be compliant with all test requirements of RFP.

RESPONSIBILITY REVIEW

The past performance of AnsaldoBreda and CAF has been reviewed in detail. The Evaluation/Selection Committee (Committee), during the evaluation process, considered the references from Los Angeles County Metropolitan Transportation Authority regarding product and management services. During negotiations, County staff carefully reviewed the past performance of AnsaldoBreda and CAF. Staff conferred directly with other transit agencies, conducted internet and market research, reviewed financials and legal reports for AnsaldoBreda, and held discussions with both carbuilders regarding their past performance. The results of these efforts were discussed with the Negotiations Team at the August 10, 2010 meeting. The Negotiations Team weighed the information and findings in making a decision regarding each proposer's ability to perform the work required by the solicitation, including its ability to deliver the vehicles in accordance with the negotiated schedule.

AnsaldoBreda is fully owned by Finmeccanica S.p.A., Italy's largest manufacturing investor in high technology products, with approximately 73,400 employees, and Italy's second largest manufacturing group, with approximately $21.5 billion in revenues, and orders of $61.5 billion. More than 60% of Finmeccanica's shares are publicly traded on the Milan Stock Exchange, with the remaining shares owned by the Italian Ministry of Economics and Finance. AnsaldoBreda has built and delivered heavy rail vehicles for agencies in Italy and Spain for over 30 years. They have supplied complete rail systems and manufactured transit vehicles for over 150 years. AnsaldoBreda has built and delivered heavy rail transit vehicles for the following United States transit agencies:

- Los Angeles County Metropolitan Transportation Authority (LACMTA) (1988-Base Order-30 Heavy Rail Vehicles (HRVs) Contract options in 1994-42 HRVs, and 1996-32 HRVs)
- Washington Metropolitan Area Transit Authority (WMATA) (1979-Base Order-94 HRVs, Contract options in 1981-200 HRVs, 1985-46 HRVs, 1986-26 HRVs, 1989-68 HRVs, and 1990-32 HRVs)
- Metropolitan Atlanta Rapid Transit Authority (MARTA) (1998-100 HRVs, and Rehabilitation of 118 HRVs)
- San Francisco Municipal Transportation Agency (MUNI) 1991-2010;151Light Rail Vehicles (LRVs), rehabilitation of 143 LRVs, Rehabilitation of 34 LRV Trucks, and Repair of 7 wrecked LRVs

County staff has conducted extensive reviews to determine the proposer's responsibility, with specific focus on its capability, from a commercial and logistical standpoint, to perform and manage the Miami-Dade County contract. Staff has reviewed information from several well-known sources, including review of Dunn & Bradstreet (D&B) reports, a risk analysis and indication of the proposers' business practices, regarding how they meet financial obligations, and their payment practices compared to other companies in the rail industry. Staff also reviewed PACER (Public Access to Court Electronic Records) reports to determine if there was any pending litigation for either company. PACER reports show that neither company had a match for pending litigation. Staff reviewed the federal Excluded Parties List System (EPLS) to determine if either company is excluded from participating on federal contracts. Reports were run on Countries in which AnsaldoBreda is registered as a foreign corporation and doing business: US, France, Norway, Denmark, Greece, Spain, Taiwan, and Morocco. Reports show that AnsaldoBreda is not excluded from participating on federal contracts.

The company is not listed on the State of Florida Suspended Vendor List. Finally, staff ran reports from existing Miami Dade County systems, including: the Finance Department's Delinquent Vendor List, and the County's Debarred Contractors List. Neither company was listed on either report. AnsaldoBreda is a registered County vendor and is registered in active status with the State of Florida.

The County also reviewed the circumstances surrounding the Metropolitan Transit Authority of Harris County, Texas (Houston Metro) solicitation in which the FTA, in its October 1, 2010 letter to CAF, upheld its September 7, 2010 decision, finding that the Metropolitan Transit Authority of Harris County, Texas (Houston METRO) violated FTA's procurement rules, and that Houston METRO and CAF violated FTA's Buy America requirements.

County staff reviewed newspaper articles regarding AnsaldoBreda's performance on contracts in Los Angeles, Buffalo, Cleveland, San Francisco, Boston, Chicago, Washington, DC, the Netherlands, Denmark, and Oslo. Some articles date back to 1997, and some are as recent as 2009. These articles report delivery delays and performance issues with vehicles provided by AnsaldoBreda. Staff also reviewed November and December 2010 news articles surrounding the AnsaldoBreda contract with the Niagara Frontier Transportation Authority (NFTA), in which 27 subway cars are to be refurbished for the Buffalo, New York subway system.

As a result of numerous responsibility reviews, and media based information regarding the Niagara Frontier Transportation Authority contract in Buffalo, New York, staff conducted a detailed review of the circumstances surrounding AnsaldoBreda's performance. A publicly noticed meeting was held with the firm's top US officials on January 13, 2011 in Miami. Senior management staff of Transit and Procurement Management, as well as the County Attorney's Office discussed with AnsaldoBreda the news reports, along with a host of capacity and performance matters. Staff has reviewed documents from NFTA in regard to the historical data surrounding the contract and its current status, reviewed references for various properties that have been the beneficiaries of new rail and rehab rail procurements with AnsaldoBreda, as well as financial and legal reports. Senior management staff from the Department of Procurement Management and Miami-Dade Transit had detailed discussions with AnsaldoBreda officials regarding the NFTA (Buffalo) rail rehabilitation project. A thorough examination of documentation, including the NFTA contract with AnsaldoBreda, and documents received from NFTA depicting related communications between NFTA and AnsaldoBreda has taken place. A review of AnsaldoBreda's track record was considered, along with other information collected during the solicitation process, to determine the firm's responsibility (integrity and capacity) to successfully carry out the rail contract requirements. The County is satisfied that AnsaldoBreda is fully capable to meet the financial, logistical, and technical requirements of the contract.

Assistant County Manager

FINMECCANICA

AMD/AT/se

The Honorable Carlos A. Gimenez
Mayor
Miami-Dade County
Stephen P. Clark Center, Suite 2910
111 NW First Street
Miami, FL 33128

Rome,

Re: Contract Award Recommendation – RFP 654 Purchase of New Heavy Rail Vehicles.

Dear Mayor Gimenez,

As you know, Finmeccanica is the parent company of AnsaldoBreda, the recommended proposer on the RFP 654 for New Heavy Rail Vehicles. In response to recent media reports regarding Finmeccanica's potential restructuring and reports of our intention to consider strategic partners for AnsaldoBreda, I write to renew our assurances that AnsaldoBreda's commitment to provide Miami-Dade County with state-of-the-art vehicles for its Metrorail system remains unwavering, including posting all bonds required in connection with the proposed contract. For your convenience, here are the relevant facts regarding Finmeccanica and AnsaldoBreda:

1. You will find enclosed a letter from our bonding partners re-confirming their commitment to stand behind AnsaldoBreda and Finmeccanica for the Miami-Dade Heavy Rail Car Project.
2. Finmeccanica's recently announced third-quarter earnings were negative only due to a one-time, extraordinary charge, mainly consequence of our contract for the Boeing Dreamliner.
3. Finmeccanica continues to maintain an "investment grade" rating by Fitch, Moody's, and Standard and Poor's, three of the world's major credit rating agencies.
4. Finmeccanica maintains a very solid financial position, with more than 3 Billion Euros of un-utilized cash lines of credit as of September 30, 2011.
5. There are no financial covenants or rating triggers on any of Finmeccanica's credit facilities.
6. In addition to that, the outstanding debts on Finmeccanica's books have an average life of more than 10 years.
7. Finmeccanica has embarked on an effort to restructure AnsaldoBreda, which includes consideration of strategic partners. Any restructuring will take time and completed only if it helps AnsaldoBreda expand its worldwide industrial capacity for the long-term.

Finmeccanica – Società per azioni
Sede legale:
Piazza Monte Grappa, 4 - 00195 Roma
Tel. +39 06 324731 - Fax +39 06 3208621

Cap. Soc. € 2.543.861.738,00 i.v.
Iscrizione nel Registro Imprese di Roma
C.F. 00401990585 - P.I. 00881841001

8. However, the Mass Transit Business Unit of AnsaldoBreda, responsible for HRV production, is performing well and has acquired contracts for more than €1.1BN in the past three years.
9. Finmeccanica will further strengthen its commitment to AnsaldoBreda at the end of this month by converting approximately 203 Million Euros of outstanding debt to AnsaldoBreda into capital shares.

In sum, Finmeccanica enjoys a strong financial structure and AnsaldoBreda continues to have the technical and financial capacity to fully perform its contractual obligations to Miami-Dade County. Both companies are absolutely committed to the timely delivery of the new Metrorail vehicles, regardless of any future improvements to their respective corporate structures.

Sincerely,

Chief Executive Officer
(Giuseppe Orsi)

Enclosures:1

c.c. Alina Hudak – Deputy Mayor and County Manager – Miami-Dade County
Ysela Llort – Interim Director – Miami-Dade Transit Department
Robert Cuevas, Esquire – County Attorney
Bruce Libhaber – Assistant County Attorney
Fred Simmons – Contracting Officer

THOMPSON AGENCY
Insurance / Surety

Thompson Risk Management Corporation
1 Dupont Street, Plainview, New York 11803
(516) 349-5910 • (212) 421-1622 • FAX # (516) 349-5916

Miami-Dade Transit, Clerk of the Board
Stephen P. Clark Center
111 NW 1st Street, 17th Floor, Suite 202
Miami, Florida 33128-1983

Principal: *Ansaldobreda, S.p.A.* Via Argine 425 80147 Napoli, ITALY

Project: Miami-Dade Transit, RFP 654 - Purchase of New Heavy Rail Vehicles.

Zurich American Insurance Company, Fidelity and Deposit Company of Maryland and Liberty Mutual Insurance Company, being Surety Companies duly authorized to do business in the State of Florida and meeting the surety company requirements specified in Section GP3.3.2 of the above referenced RFP 654, hereby certify their ability to issue a Performance Bond and a Payment Bond to Miami-Dade Transit on behalf of Ansaldobreda, SpA, to which an aggregate bonding capacity of $ 500,000,000 can be provided for supporting contract awards.

Liberty Mutual Insurance Company has an A.M. Best Rating of A and a US treasury listing of $610,791,000. Zurich American Insurance Company has an A.M. Best Rating of A and a US treasury listing of $461,129,000. Fidelity and Deposit Company of Maryland has an A.M. Best Rating of A and a US treasury listing of $16,970,000.

It is our understanding that surety bonds will be required from Ansaldobreda, S.p.A. for the captioned Project should they be awarded this contract. Upon the request of Ansaldobreda, S.p.A., we are committed to provide the necessary Performance and Payment Bonds. Our commitment to execute the bonds is subject to our acceptable review of the final contract terms and conditions, bond forms, appropriate contract funding and any other underwriting considerations at the time of the request.

Of course, any arrangement for final bond(s) is a matter between the Ansaldobreda, S.p.A. and the Surety and issuance of the Bonds will be subject to our review of the contract documents and the bond form(s) required, and other normal underwriting requirements.

If we can provide any further assistance, please do not hesitate to call upon us.

Signed this 18th day of November 2011.

Liberty Mutual Insurance Company

Christopher Thompson, Attorney-In-Fact

Zurich American Insurance Company

Christopher Thompson, Attorney-In-Fact

Fidelity and Deposit Company of Maryland

Christopher Thompson, Attorney-In-Fact

U.S. Department
Of Transportation
**Federal Transit
Administration**

Chief Counsel

1200 New Jersey Avenue S.E.
Washington DC 20590

November 23, 2011

Ms. Ysela Llort
Assistant County Manager, Transportation
Miami-Dade County
111 NW 1st Street, Suite 2910
Miami, Florida 33128

Re: Decision—Protest Appeal of CAF USA, Inc.
Request for Proposals No. 654, Purchase of New Heavy Rail Vehicles

Dear Ms. Llort:

This is the decision of the Federal Transit Administration (FTA) on the March 24, 2011 protest appeal filed by CAF USA, Inc. (CAF). CAF's appeal became ripe for FTA review on July 29, 2011.

CAF appeals Miami-Dade County's denial of CAF's protest that challenged Miami-Dade Transit's (MDT) decision to award a contract to Ansaldo Breda, S.p.A. (AnsaldoBreda) pursuant to Request for Proposals (RFP) for Purchase of New Heavy Rail Vehicles, No. 654. Based on FTA's review of the record, including additional documents and arguments submitted by MDT, CAF, and AnsaldoBreda, FTA finds that MDT violated Federal procurement requirements when it considered the location of the final assembly facility as an evaluation or selection factor without specifically including this factor in the RFP, and when it considered local geographic preference as a selection factor.

I. Statement of Facts

On March 30, 2009, MDT issued a solicitation for the procurement of new heavy rail vehicles under RFP No. 654.[1] The RFP provided that evaluation of the proposals and the determination of award to a proposer would be based upon "best value" to MDT and to the proposal that would be "most advantageous to the County."[2]

[1] RFP No. 654 for Purchase of New Heavy Rail Vehicles (HRV) originally called for 144 HRVs with options to purchase up to fifty-four additional vehicles. MDT later reduced the quantity to 136 vehicles without the options. *See* Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 4 (Feb. 18, 2011).
[2] *See* RFP No. 654 for Purchase of New HRVs § 4.0 (Evaluation Process).

The RFP originally required all proposers to complete a Local Business Preference Form that would have provided a preference to businesses located in Miami-Dade County. On April 29, 2009, MDT issued Addendum No. 3 that deleted from the RFP the Local Business Preference Form as well as all references to the form and any local business preference requirements.

By September 29, 2009, three companies had submitted responses to the RFP: Alstom Transportation, Inc. (Alstom), AnsaldoBreda, and CAF. In accordance with the evaluation factors set forth in the RFP, MDT's Evaluation/Selection Committee (Selection Committee) rated the three proposers as follows:

	Commercial[3] (out of 10)	Technical (out of 50)	Price (out of 40)	Total Score (out of 100)
Alstom	6.94	29.15	N/A	36.09
AnsaldoBreda	5.12	31.61	35.30	72.03
CAF	6.59	30.95	34.80	72.34

On March 15, 2010, the MDT Evaluation/Selection Committee recommended to the County Manager that the County negotiate with both AnsaldoBreda and CAF. MDT also determined that Alstom was non-responsive because its price exceeded the RFP's maximum per unit vehicle price limit. MDT did not advance Alstom to the BAFO stage.[4]

On May 4, 2010, the County Manager approved the appointment of a four-member negotiating committee and approved the Evaluation/Selection Committee's recommendation that MDT enter into negotiations with AnsaldoBreda and CAF.[5]

During the negotiations, MDT's team visited the final assembly facilities of CAF and AnsaldoBreda. Both proposers stated in their offers that their final vehicle assembly facilities would be located within the United States. CAF proposed to perform final assembly in its Elmira, New York facility and AnsaldoBreda proposed to perform final assembly in two locations, at its facility in Pittsburg, California, and at a facility to be established in Miami-Dade County. Because AnsaldoBreda's final assembly facility in Miami-Dade County, Florida, did not yet exist, the MDT team visited AnsaldoBreda's Pittsburg, California facility.[6]

The two offerors submitted their best and final offers (BAFO) to MDT on August 9, 2010. The next day, August 10, 2010, the negotiating committee met and held a public hearing to reveal the BAFO pricing, to evaluate all other factors relevant to the

[3] The term "Commercial" includes staffing, resources, and qualifications. *See* Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 4 (Feb. 18, 2011).
[4] *See* Memorandum from the Assistant County Attorney to the Director of Procurement and the Procurement Contract Office, on Railcar Procurement Responsiveness – Alstom Transportation, Inc. (Mar. 4, 2010).
[5] *See* Memorandum from Chairperson of the Evaluation/Selection Committee to County Manager on the Report of Evaluation/Selection Committee for RFP No. 654: Purchase of New Heavy Rail Vehicles 3 (April 16, 2010).
[6] *See* Hearing p. 7, 36.

procurement based upon the criteria established in the RFP, and to make its final recommendation for award to the County Manager (who would then recommend a proposer to the Board of County Commissioners).

The proposers' BAFOs were revealed as follows: $298,887,200, or $2,197,700 per car by AnsaldoBreda; $303,566,408, or $2,232,106 per car by CAF.[7] During this hearing, the committee discussed various factors including the final assembly facility locations of both CAF and AnsaldoBreda.[8] The negotiating committee concluded that, while most aspects of the two proposals were "pretty much the same," based upon the "two factors of the final assembly by AnsaldoBreda here in Miami-Dade County and the price," the AnsaldoBreda proposal was the "best value to the county."[9] The committee recommended that the County Manager recommend awarding the contract to AnsaldoBreda.

By letter dated January 26, 2011, CAF notified FTA of a potential violation by MDT of Federal requirements prohibiting the use of local preference in the determination of contract award, and expressed its intention to file a protest appeal with FTA. CAF alleged that MDT considered local preference when evaluating the two proposals, and ultimately made its recommendation based in large part upon this factor, notwithstanding the Federal prohibition on considering local preference and the fact that MDT specifically excluded local preference from the RFP as an evaluation factor.

In a February 18, 2011 recommendation memorandum to the Board of County Commissioners, the County Manager stated that:

> AnsaldoBreda advised of its intention to take advantage of the local labor pool [in Miami-Dade County], e.g.[,] mechanical and electrical engineers, technicians, and semi-skilled personnel, coupled with its own resources to complete vehicle final assembly in Miami-Dade County.[10]

The recommendation memorandum further states that,

> [t]he County did not include local preference in the solicitation, did not give extra points in evaluating proposals for having a local vehicle final assembly, or require proposers to have a local vehicle final assembly facility. Favorable consideration regarding advantages of having vehicle final assembly performed in Miami-Dade did not constitute a local preference, and cannot be construed as providing a geographical preferences.[11]

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[7] Hearing of the Evaluation Committee in re: RFP-654, CAFUSA and AnsaldoBreda 30 (Aug. 10, 2010) (pp. 118-119).
[8] *Id.* at 19-24 (pp. 76-96).
[9] *Id.* at 47 (pp. 187-88).
[10] Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 5 (Feb. 18, 2011).
[11] *Id.* at 6.

On February 24, 2011, CAF filed a Formal Written Intent to Protest MDT's award recommendation. On March 23, 2011, a Hearing Examiner appointed in accordance with local procedures to adjudicate CAF's protest determined that MDT made its award decision properly, and recommended that the Board deny CAF's protest. CAF formally filed its appeal to FTA by letter dated March 24, 2011.[12]

By letter dated July 14, 2011, FTA informed the parties that it intended to accept CAF's protest appeal as soon as CAF had exhausted its administrative remedies with MDT. This would normally require the Board's action on the Hearing Examiner's recommendation to deny the protest.[13] However, because MDT procedures typically require the Board to make this decision concurrent with an action to award the contract, MDT informed FTA by telephone that it was reluctant to require the Board to act before FTA considered CAF's protest appeal. Thus, to avoid awarding a contract that might be found by FTA to be ineligible for Federal assistance, MDT waived its right to oppose the appeal based upon CAF's failure to exhaust its administrative remedies.[14] Thereafter FTA began its review of CAF's protest appeal.

II. FTA PROTEST APPEAL AUTHORITY

When deciding a protest appeal, FTA applies its third party contracting requirements as set forth in 49 U.S.C. § 5325, the "Common Grant Rule" at 49 C.F.R. § 18.36, FTA's Circular 4220.1F entitled "Third Party Contracting Guidance," and Section 15 of FTA's Master Agreement. Pursuant to Circular 4220.1F, FTA's review is limited to: (1) a recipient's failure to have or comply with its protest procedures, or its failure to review a protest; or (2) violations of Federal law or regulations.[15]

Here, FTA has determined that the following issues are of significant Federal interest:

(1) Whether MDT violated Federal requirements by failing to disclose in its RFP that local preference or the establishment of a local assembly facility and the creation of local jobs would be factors for determining best value; and

(2) Whether MDT violated Federal restrictions on the use of local preferences by considering AnsaldoBreda's proposal to establish a local assembly facility.

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[12] In both its August 29, 2011, and September 6, 2011, letters, AnsaldoBreda argued that CAF's appeal was untimely. FTA Circular 4220.1F requires that the protestor file an appeal with FTA within five working days "when the protester has received actual or constructive notice of the recipient's decision." However, AnsaldoBreda's argument is without merit because, under 49 C.F.R. § 18.36(b)(12), a protester is first required to exhaust all administrative remedies prior to appeal to FTA, and CAF notified FTA on March 24, 2011, of its appeal—one day after the Hearing Examiner's decision.

[13] *See* Miami-Dade County Code, § 2-8.4(g)-(h).

[14] See Miami-Dade County's Cert. Reply in Opposition to CAF USA Inc.'s Appeal to the Federal Transit Administration at 4, n. 4 (July 29, 2011).

[15] FTA Circular 4220.1F, "Third Party Contracting Guidance," § VII.1.b(2)(a)-(b) (Feb. 15, 2011).

III. DISCUSSION

a. MDT failed to state in the RFP that location of the vehicle final assembly facility would be a factor in determining award of the contract.

CAF alleges that MDT improperly considered the location of AnsaldoBreda's proposed final assembly facility in Miami-Dade County as an evaluation or award factor.

When procuring through the use of competitive proposals, the Common Grant Rule requires, among other things, that "[r]equests for proposals will be publicized and identify all evaluation factors and their relative importance."[16] Furthermore, when awarding a contract to an offeror based upon best value, "the recipient's solicitation must inform potential offerors that the award will be made on a 'best value' basis and *identify what factors will form the basis for award.*"

In evaluating bids or proposals:

> FTA expects the recipient to consider all evaluation factors specified in its solicitation documents, and *evaluate the bids or offers only on the evaluation factors included in those solicitation documents.* The recipient may not modify its evaluation factors after bids or proposals have been submitted without re-opening the solicitation.[17]

Facts from the MDT hearing transcripts and memoranda indicate that MDT based its decision to recommend awarding a contract to AnsaldoBreda, at least in part, on the location of its final assembly location in Miami-Dade County despite failing to disclose in the RFP that the location of the final assembly facility would be a selection factor.

During the August 10, 2010 public hearing, members of the MDT negotiating committee, discussed AnsaldoBreda's proposed local final assembly plant at length. It was "item number eight" out of eleven items discussed at the hearing.[18]

Similarly, the County Manager's Recommendation to the Board for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles, indicates that MDT considered the location of AnsaldoBreda's final assembly facility in Miami-Dade county as a selection factor:

> AnsaldoBreda's offer to include performing vehicle final assembly at a facility located in Miami-Dade County received favorable consideration from County staff. Since AnsaldoBreda's proposed facility will be local,

[16] 49 C.F.R. § 18.36(d)(3)(i).
[17] FTA Circular 4220.1F. § VI.7.a. (emphasis added).
[18] The other items discussed were price; financial capacity; decommissioning; reliability of the proposers; subcontracting, effects on integration, and risks associated with deliveries; test track; car shells; technical aspects (*e.g.*, propulsion and animated air schematics for training); project manager experience; and weight management program. *See* Transcript of the Hearing in re: RFP-654, CAFUSA and AnsaldoBreda Conducted on Tuesday, August 10, 2010, at 27-47 (pp. 108-188).

> project oversight efforts by MDT are improved, inspections can be more frequent, and travel costs that would be incurred to conduct oversight of final vehicle assembly activities will be significantly reduced. Efforts to review drawings, project plans for testing, schedule, and progress meetings can be more effectively coordinated locally, allowing faster reviews and better communications in resolving project issues.[19]

In its July 29, 2011 response and September 6, 2011 reply to CAF's protest appeal, MDT presents two arguments. First, MDT argues that it provided notice to the proposers, through Section 3.3.5 of the RFP, that the location of the final assembly facility would be an evaluation factor. Second, MDT claims to have followed the advice of an FTA Regional Counsel when it considered the location of the final assembly facility as an evaluation factor. Neither argument is persuasive.

The only reference in the RFP to the location of the vehicle final assembly facility is contained in Section 3.3.5, Organization and Management Plan, and requires offerors to submit, as part of their Organization and Management Plan, *inter alia*:

> (f) A list of locations for the major engineering, manufacturing and installation portions of the Work and how the Proposer plans to handle local coordination of the Work. In particular, each Proposer shall identify the facility to be used for final assembly of the Vehicles.

Contrary to MDT's assertion that Section 3.3.5 provides a basis for considering the location of the final assembly location as an evaluation factor, the foregoing language merely states that the proposer must list the locations of the facilities to be used, including the final assembly facility. However, there is no indication that a *local* facility would be given greater weight in the evaluation process. I do not find that this provision adequately put offerors on notice that location of the final assembly facility would be a significant factor in evaluating the proposals.

Moreover, in Addendum No. 3, dated April 29, 2009, Form A-4: Local Business Preference was deleted, "as well as any reference to the form and any requirement regarding local preference."[20]

I find that Section 3.3.5 of the RFP did not clearly articulate that the location of the final assembly facility was to be considered as an evaluation or selection factor. Thus, it was improper for MDT to consider it as such.

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[19] Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 6 (Feb. 18, 2011).

[20] Although Addendum No. 14, dated July 31, 2009, includes the deleted Form A-4, FTA believes that this form was mistakenly included in that addendum. Moreover, MDT specifically stated that it "did not include local preference in the solicitation." *See* Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 6 (Feb. 18, 2011).

MDT also argues that it considered the location of the final assembly facility as an evaluation factor based on guidance from Paul Jensen who at that time was an FTA Regional Counsel. The following is an excerpt from a March 16, 2009 e-mail from Mr. Jensen:

> [I]ts [sic] important that the solicitation avoids any implication that points are being awarded for local preference. Total points should be awarded based upon the factors listed in the solicitation. If locating a facility in the area is one of those factors, its [sic] ok because the solicitation would state that having a facility in the Miami area would create economies of scale and would reduce project costs. As a result, you could award more points to a bidder who agreed to provide a local plant. That's different than local preference since there's a valid basis for awarding the points. I hesitate to use the term "extra points". Its [sic] just that a bidder locating a facility in the local area would be awarded more points than one who doesn't due to cost savings, etc. FTA would participate in the award of a contract as outlined above.[21]

Mr. Jensen followed with additional guidance on March 23, 2009:

> [L]et me reiterate that local preference is prohibited but the location of the facility can be a consideration in the ranking process so long as it is quantifiable in that economies of scale may be realized in having the facility located locally. Thus, a company assembling vehicles locally might present favorable opportunities for purposes of lower shipping costs, inspection costs, ease of inspection, etc.

It is important to note that MDT did not, in fact, follow Mr. Jensen's guidance when developing the RFP. His advice was that MDT could consider the location of the final assembly facility (as it related to quantifiable reduction in projects costs) only if it listed the factor in the solicitation. MDT did not list the location of the final assembly facility as an evaluation factor in the RFP. Therefore, MDT's reliance on Mr. Jensen's emails is misplaced.

Based on the foregoing, I find that MDT improperly considered the location of AnsaldoBreda's proposed final assembly facility in Miami-Dade County as an evaluation factor.

b. *MDT violated Federal restrictions on the use of local preferences.*

CAF asserts that MDT violated the Federal prohibition against imposing local geographic preferences in the evaluation of bids or proposals.

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[21] Miami-Dade County's Response in Opposition to CAF USA Inc's Bid Protest to the Federal Transit Administration 6 (July 29, 2011).

Federal law, 49 U.S.C. § 5325(h), prohibits use of FTA funding for procurements that use of exclusionary or discriminatory specifications. In addition, the Common Grant Rule provides that:

> Grantees and subgrantees will conduct procurements in a manner that prohibits the use of statutorily or administratively imposed in-State or local geographical preferences in the evaluation of bids or proposals, except in [cases not applicable here].[22]

In this procurement, MDT originally included provisions explicitly providing for local preference. While it later deleted all reference to local preferences from the RFP, the record demonstrates that MDT applied local preference nonetheless.

FTA found evidence of this fact in the transcript of the Hearing of the Evaluation Committee, dated August 10, 2010. The following statements by members of the Evaluation Committee indicate that AnsaldoBreda's proposal to build a final assembly facility in Miami was a major factor in MDT's decision to recommend award of the contract to AnsaldoBreda:

- MR. NAVARRETE: ...We forget [sic] to ask you about the jobs created in the final assembly here in Miami-Dade County.
  MR. CARTER: Right. I didn't address the jobs that were created here. Fred has asked me to confine my comments to the project itself and the direct relation to the project. Jobs that will be created here I think were in the vicinity of--I think it--
  MR. SIMMONS: Of 95 jobs here.
  MR. CARTER: Basically 95 jobs here.[23]

  * * *

- MR. NAVARRETE: "It's hard not to think about the 95 – potentially 95 jobs created in Miami-Dade County at this time, you know, good paying jobs, and the impact to the local economy, a significant impact to the local economy. How do you guys feel about that?"
  MR. SIMMONS: "You can't overlook that. I mean, that's a big factor here . . ."[24]

  * * *

- MR. CARTER: "You've got to compare, I mean . . . the jobs in Miami, the local assembly plant. I mean, you got to weigh that all in."[25]

  * * *

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[22] 49 C.F.R. § 18.36(c)(2).
[23] Transcript of the Hearing in re: RFP-654, CAFUSA and AnsaldoBreda Conducted on Tuesday, August 10, 2010, at 23 (p. 91).
[24] *Id.* at 36 (p. 141-42).
[25] *Id.* at 38 (p. 151).

- MR. NAVARRETE: "The question is when you look at the advantages and disadvantages do you say that the value or the deal . . . you're getting from CAF is better than the one from Breda to overcome the –what I see as a significant advantage of the final assembly locally and the jobs . . . ."[26]

* * *

- MR. NAVARRETE: We have considered these 11 factors. We have deliberated. We've thought about the advantages and disadvantages, the risks. We've also looked at price being one of the factors, although not the only one, probably not the most important one, and the consensus of the committee is that we believe that the AnsaldoBreda proposal or deal is the best value to the county.

  We believe that the final assembly here in Miami-Dade County has significant advantages. It would make it easier to manage the project. We talked about the savings in travel, easier to visit the plant. We cannot ignore the impact to the local economy directly in jobs and other spin-off benefits to the economy."[27]

* * *

- MR. NAVARRETE: "There were some other minor advantages, but in the end we kept coming back to the two factors of the final assembly by AnsaldoBreda here in Miami-Dade County and the price."[28]

* * *

- MR. SIMMONS: "Unfortunately somebody's got to win and somebody's got to lose. It's a tough decision, but hopefully we'll move on and get the cars built for Miami-Dade County and create some jobs. That's it."[29]

These discussions show that MDT's Evaluation Committee considered, as an undisclosed evaluation factor, the location of the final assembly facility in Miami-Dade County. This is a clear violation of the Federal prohibition against local geographical preferences found at 49 U.S.C. § 5325, the "Common Grant Rule" at 49 C.F.R. § 18.36(c)(2); FTA Circular 4220.1F § VI.4.2.a(4)(g); and Section 15 of FTA's Master Agreement.

MDT cites as support for its selection decision, the Hearing Examiner's conclusion that,

> [t]he manner in which the County Manager considered AnsaldoBreda's proposed final assembly facility in Miami-Dade County is consistent with all federal, state and county guidelines and procurement requirements.[30]

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[26] *Id.* at 44 (p. 175).
[27] *Id.* at 47 (p. 187).
[28] *Id.* (p. 188).
[29] *Id.* at 48 (p. 191).

The Hearing Examiner's rationale for this conclusion is that the County Manager, in his recommendation, stated that, "'[t]he County did not include local preference in the solicitation, did not give extra points in evaluating proposals for having a local vehicle final assembly facility, or require proposers to have a local final assembly.'"[31]

I respectfully disagree with the Hearing Examiner's conclusions. The Hearing Examiner failed to take into account the negotiating committee's deliberations during the August 10, 2010 hearing in determining which proposer to recommend for award, and thus overlooked the extensive discussion on AnsaldoBreda's proposed local final assembly facility and the number of comments made by the Committee with respect to the jobs the local final assembly facility would create.

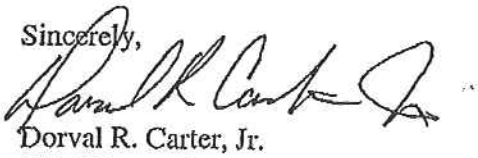
Despite the fact that MDT deleted all reference to local preferences from the RFP, I find that MDT officials nonetheless considered local geographic preferences in the evaluation of CAF's and AnsaldoBreda's proposals.

CONCLUSION

Based upon the foregoing, I find that MDT violated Federal procurement rules when it considered the location of the final assembly facility as an evaluation factor without disclosing this factor in the RFP, and when it applied a local geographic preference when making its selection decision. Accordingly, this procurement is currently ineligible to receive Federal funding. In order to regain eligibility for Federal funding, I recommend that MDT reevaluate the proposers' Best and Final Offers without considering local preference the effect of a local assembly facility on the local economy, or the potential project cost savings based upon the location of the final assembly facility.

If you have any questions, you may contact Kerry L. Miller at (202) 366-0942 or kerry.miller@dot.gov.

Sincerely,



Dorval R. Carter, Jr.
Chief Counsel

Cc: Virginia Verdeja, CAF USA, Inc.
Albert E. Dotson, Jr., Esq.
Bruce Libhaber, Esq.
Steven M. Polan, Esq.

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[30] Hearing Examiner's Recommendation, Findings of Fact and Conclusions of Law re Bid Protest—RFP No. 654—Purchase of New Heavy Rail Vehicles 6.
[31] *Id.* at 5.

Memorandum

MIAMI-DADE COUNTY

Date: November 29, 2011

To: Distribution Listed Below

From: Carlos A. Gimenez
Mayor

Subject: Re-evaluate of Best And Final Offers (BAFOs)
RFP No. 654: Purchase of New Heavy Rail Vehicles

On February 18, 2011, the County Manager signed a recommendation to award a contract to AnsaldoBreda, S.p.A. (AnsaldoBreda) for the referenced solicitation. On February 24, 2011, CAF USA, Inc. (CAF) filed a formal written intent to protest the Miami-Dade County Manager's contract award recommendation. The protest was heard by a Hearing Examiner on March 14, 2011. The Hearing Examiner issued Findings of Fact, Conclusions of Law and Recommendations on March 23, 2011. The Hearing Examiner upheld the County Manager's recommendation to award to AnsaldoBreda.

On March 24, 2011, CAF filed a formal appeal of the County's procurement process with the Federal Transit Agency (FTA) asserting that the County violated FTA regulations. FTA's review included whether: 1) the County violated Federal requirements by failing to disclose in the solicitation that local preference or the establishment of a local facility and the creation of local jobs would be factors for determining best value, and 2) the County violated Federal restrictions on the use of local preference by considering AnsaldoBreda's proposal to establish a local assembly facility.

On November 23, 2011, the FTA issued its "Decision-Protest Appeal of CAF USA, Inc." (copy attached). The FTA found that the County violated federal procurement rules when it considered the location of the final assembly facility without disclosing this factor in the solicitation, and that it applied a local geographic preference when making its recommendation. The FTA has advised the County that in order for this procurement to be eligible for federal funding, the County would need to re-evaluate the Best And Final Offers (BAFOs) submitted by CAF and AnsaldoBreda.

I am hereby appointing Fred Simmons, Jr., as non-voting Chair of the Committee that will re-evaluate the BAFOs. The voting members shall be: Richard Snedden, Retired Assistant Director of Rail Operations of the Miami-Dade Transit; George Navarrete, Deputy Director of the Parks, Recreation and Open Spaces Department; and Ivor Myers, Chief of Rail and Mover New Vehicle Acquisitions of the Miami-Dade Transit; and Alberto Parjus, Budget Coordinator of the Office of Management and Budget, as a non-voting Technical Advisor. You are hereby directed to reconvene, carefully review the attached decision from FTA General Counsel Dorval Carter, Jr., and to comply with the recommendations of the FTA regarding the re-evaluation of the BAFOs from the two companies.

Specifically, consistent with the FTA decision, you may not consider local preference, a vehicle final assembly facility located in Miami-Dade County, and any economic benefits of a local vehicle final assembly facility.

You are required to observe the Cone of Silence until an award recommendation is signed.

DISTRIBUTION:

Ivor Myers, Chief of Rail and Mover New Vehicle Acquisitions, Miami-Dade Transit
George Navarrete, Deputy Director, Parks, Recreation and Open Spaces Department
Fred Simmons, Jr., Senior Procurement Contracting Officer, Procurement Management, Internal Services Department
Richard Snedden, Retired Assistant Director, Rail Operations, Miami-Dade Transit
Alberto Parjus, Budget Coordinator, Office of Management and Budget

Attachment

c: Alina T. Hudak, Deputy Mayor/County Manager
Robert A. Cuevas, Jr., County Attorney
Ysela Llort, Acting Director, Miami Dade Transit
Lester Sola, Director, Internal Services Department
Miriam Singer, Assistant Director, Internal Services Department
Clerk of the Board

U.S. Department
Of Transportation
**Federal Transit
Administration**

Chief Counsel

1200 New Jersey Avenue S.E.
Washington DC 20590

November 23, 2011

Ms. Ysela Llort
Assistant County Manager, Transportation
Miami-Dade County
111 NW 1st Street, Suite 2910
Miami, Florida 33128

Re: Decision—Protest Appeal of CAF USA, Inc.
Request for Proposals No. 654, Purchase of New Heavy Rail Vehicles

Dear Ms. Llort:

This is the decision of the Federal Transit Administration (FTA) on the March 24, 2011 protest appeal filed by CAF USA, Inc. (CAF). CAF's appeal became ripe for FTA review on July 29, 2011.

CAF appeals Miami-Dade County's denial of CAF's protest that challenged Miami-Dade Transit's (MDT) decision to award a contract to Ansaldo Breda, S.p.A. (AnsaldoBreda) pursuant to Request for Proposals (RFP) for Purchase of New Heavy Rail Vehicles, No. 654. Based on FTA's review of the record, including additional documents and arguments submitted by MDT, CAF, and AnsaldoBreda, FTA finds that MDT violated Federal procurement requirements when it considered the location of the final assembly facility as an evaluation or selection factor without specifically including this factor in the RFP, and when it considered local geographic preference as a selection factor.

I. Statement of Facts

On March 30, 2009, MDT issued a solicitation for the procurement of new heavy rail vehicles under RFP No. 654.[1] The RFP provided that evaluation of the proposals and the determination of award to a proposer would be based upon "best value" to MDT and to the proposal that would be "most advantageous to the County."[2]

[1] RFP No. 654 for Purchase of New Heavy Rail Vehicles (HRV) originally called for 144 HRVs with options to purchase up to fifty-four additional vehicles. MDT later reduced the quantity to 136 vehicles without the options. *See* Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 4 (Feb. 18, 2011).
[2] *See* RFP No. 654 for Purchase of New HRVs § 4.0 (Evaluation Process).

The RFP originally required all proposers to complete a Local Business Preference Form that would have provided a preference to businesses located in Miami-Dade County. On April 29, 2009, MDT issued Addendum No. 3 that deleted from the RFP the Local Business Preference Form as well as all references to the form and any local business preference requirements.

By September 29, 2009, three companies had submitted responses to the RFP: Alstom Transportation, Inc. (Alstom), AnsaldoBreda, and CAF. In accordance with the evaluation factors set forth in the RFP, MDT's Evaluation/Selection Committee (Selection Committee) rated the three proposers as follows:

	Commercial[3] (out of 10)	Technical (out of 50)	Price (out of 40)	Total Score (out of 100)
Alstom	6.94	29.15	N/A	36.09
AnsaldoBreda	5.12	31.61	35.30	72.03
CAF	6.59	30.95	34.80	72.34

On March 15, 2010, the MDT Evaluation/Selection Committee recommended to the County Manager that the County negotiate with both AnsaldoBreda and CAF. MDT also determined that Alstom was non-responsive because its price exceeded the RFP's maximum per unit vehicle price limit. MDT did not advance Alstom to the BAFO stage.[4]

On May 4, 2010, the County Manager approved the appointment of a four-member negotiating committee and approved the Evaluation/Selection Committee's recommendation that MDT enter into negotiations with AnsaldoBreda and CAF.[5]

During the negotiations, MDT's team visited the final assembly facilities of CAF and AnsaldoBreda. Both proposers stated in their offers that their final vehicle assembly facilities would be located within the United States. CAF proposed to perform final assembly in its Elmira, New York facility and AnsaldoBreda proposed to perform final assembly in two locations, at its facility in Pittsburg, California, and at a facility to be established in Miami-Dade County. Because AnsaldoBreda's final assembly facility in Miami-Dade County, Florida, did not yet exist, the MDT team visited AnsaldoBreda's Pittsburg, California facility.[6]

The two offerors submitted their best and final offers (BAFO) to MDT on August 9, 2010. The next day, August 10, 2010, the negotiating committee met and held a public hearing to reveal the BAFO pricing, to evaluate all other factors relevant to the

[3] The term "Commercial" includes staffing, resources, and qualifications. *See* Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 4 (Feb. 18, 2011).
[4] *See* Memorandum from the Assistant County Attorney to the Director of Procurement and the Procurement Contract Office, on Railcar Procurement Responsiveness – Alstom Transportation, Inc. (Mar. 4, 2010).
[5] *See* Memorandum from Chairperson of the Evaluation/Selection Committee to County Manager on the Report of Evaluation/Selection Committee for RFP No. 654: Purchase of New Heavy Rail Vehicles 3 (April 16, 2010).
[6] *See* Hearing p. 7, 36.

procurement based upon the criteria established in the RFP, and to make its final recommendation for award to the County Manager (who would then recommend a proposer to the Board of County Commissioners).

The proposers' BAFOs were revealed as follows: $298,887,200, or $2,197,700 per car by AnsaldoBreda; $303,566,408, or $2,232,106 per car by CAF.[7] During this hearing, the committee discussed various factors including the final assembly facility locations of both CAF and AnsaldoBreda.[8] The negotiating committee concluded that, while most aspects of the two proposals were "pretty much the same," based upon the "two factors of the final assembly by AnsaldoBreda here in Miami-Dade County and the price," the AnsaldoBreda proposal was the "best value to the county."[9] The committee recommended that the County Manager recommend awarding the contract to AnsaldoBreda.

By letter dated January 26, 2011, CAF notified FTA of a potential violation by MDT of Federal requirements prohibiting the use of local preference in the determination of contract award, and expressed its intention to file a protest appeal with FTA. CAF alleged that MDT considered local preference when evaluating the two proposals, and ultimately made its recommendation based in large part upon this factor, notwithstanding the Federal prohibition on considering local preference and the fact that MDT specifically excluded local preference from the RFP as an evaluation factor.

In a February 18, 2011 recommendation memorandum to the Board of County Commissioners, the County Manager stated that:

> AnsaldoBreda advised of its intention to take advantage of the local labor pool [in Miami-Dade County], e.g.[,] mechanical and electrical engineers, technicians, and semi-skilled personnel, coupled with its own resources to complete vehicle final assembly in Miami-Dade County.[10]

The recommendation memorandum further states that,

> [t]he County did not include local preference in the solicitation, did not give extra points in evaluating proposals for having a local vehicle final assembly, or require proposers to have a local vehicle final assembly facility. Favorable consideration regarding advantages of having vehicle final assembly performed in Miami-Dade did not constitute a local preference, and cannot be construed as providing a geographical preferences.[11]

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[7] Hearing of the Evaluation Committee in re: RFP-654, CAFUSA and AnsaldoBreda 30 (Aug. 10, 2010) (pp. 118-119).
[8] *Id.* at 19-24 (pp. 76-96).
[9] *Id.* at 47 (pp. 187-88).
[10] Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 5 (Feb. 18, 2011).
[11] *Id.* at 6.

On February 24, 2011, CAF filed a Formal Written Intent to Protest MDT's award recommendation. On March 23, 2011, a Hearing Examiner appointed in accordance with local procedures to adjudicate CAF's protest determined that MDT made its award decision properly, and recommended that the Board deny CAF's protest. CAF formally filed its appeal to FTA by letter dated March 24, 2011.[12]

By letter dated July 14, 2011, FTA informed the parties that it intended to accept CAF's protest appeal as soon as CAF had exhausted its administrative remedies with MDT. This would normally require the Board's action on the Hearing Examiner's recommendation to deny the protest.[13] However, because MDT procedures typically require the Board to make this decision concurrent with an action to award the contract, MDT informed FTA by telephone that it was reluctant to require the Board to act before FTA considered CAF's protest appeal. Thus, to avoid awarding a contract that might be found by FTA to be ineligible for Federal assistance, MDT waived its right to oppose the appeal based upon CAF's failure to exhaust its administrative remedies.[14] Thereafter FTA began its review of CAF's protest appeal.

II. FTA PROTEST APPEAL AUTHORITY

When deciding a protest appeal, FTA applies its third party contracting requirements as set forth in 49 U.S.C. § 5325, the "Common Grant Rule" at 49 C.F.R. § 18.36, FTA's Circular 4220.1F entitled "Third Party Contracting Guidance," and Section 15 of FTA's Master Agreement. Pursuant to Circular 4220.1F, FTA's review is limited to: (1) a recipient's failure to have or comply with its protest procedures, or its failure to review a protest; or (2) violations of Federal law or regulations.[15]

Here, FTA has determined that the following issues are of significant Federal interest:

(1) Whether MDT violated Federal requirements by failing to disclose in its RFP that local preference or the establishment of a local assembly facility and the creation of local jobs would be factors for determining best value; and

(2) Whether MDT violated Federal restrictions on the use of local preferences by considering AnsaldoBreda's proposal to establish a local assembly facility.

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[12] In both its August 29, 2011, and September 6, 2011, letters, AnsaldoBreda argued that CAF's appeal was untimely. FTA Circular 4220.1F requires that the protestor file an appeal with FTA within five working days "when the protester has received actual or constructive notice of the recipient's decision." However, AnsaldoBreda's argument is without merit because, under 49 C.F.R. § 18.36(b)(12), a protester is first required to exhaust all administrative remedies prior to appeal to FTA, and CAF notified FTA on March 24, 2011, of its appeal—one day after the Hearing Examiner's decision.

[13] *See* Miami-Dade County Code, § 2-8.4(g)-(h).

[14] See Miami-Dade County's Cert. Reply in Opposition to CAF USA Inc.'s Appeal to the Federal Transit Administration at 4, n. 4 (July 29, 2011).

[15] FTA Circular 4220.1F, "Third Party Contracting Guidance," § VII.1.b(2)(a)-(b) (Feb. 15, 2011).

III. DISCUSSION

a. *MDT failed to state in the RFP that location of the vehicle final assembly facility would be a factor in determining award of the contract.*

CAF alleges that MDT improperly considered the location of AnsaldoBreda's proposed final assembly facility in Miami-Dade County as an evaluation or award factor.

When procuring through the use of competitive proposals, the Common Grant Rule requires, among other things, that "[r]equests for proposals will be publicized and identify all evaluation factors and their relative importance."[16] Furthermore, when awarding a contract to an offeror based upon best value, "the recipient's solicitation must inform potential offerors that the award will be made on a 'best value' basis and *identify what factors will form the basis for award.*"

In evaluating bids or proposals:

> FTA expects the recipient to consider all evaluation factors specified in its solicitation documents, and *evaluate the bids or offers only on the evaluation factors included in those solicitation documents.* The recipient may not modify its evaluation factors after bids or proposals have been submitted without re-opening the solicitation.[17]

Facts from the MDT hearing transcripts and memoranda indicate that MDT based its decision to recommend awarding a contract to AnsaldoBreda, at least in part, on the location of its final assembly location in Miami-Dade County despite failing to disclose in the RFP that the location of the final assembly facility would be a selection factor.

During the August 10, 2010 public hearing, members of the MDT negotiating committee, discussed AnsaldoBreda's proposed local final assembly plant at length. It was "item number eight" out of eleven items discussed at the hearing.[18]

Similarly, the County Manager's Recommendation to the Board for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles, indicates that MDT considered the location of AnsaldoBreda's final assembly facility in Miami-Dade county as a selection factor:

> AnsaldoBreda's offer to include performing vehicle final assembly at a facility located in Miami-Dade County received favorable consideration from County staff. Since AnsaldoBreda's proposed facility will be local,

[16] 49 C.F.R. § 18.36(d)(3)(i).
[17] FTA Circular 4220.1F. § VI.7.a. (emphasis added).
[18] The other items discussed were price; financial capacity; decommissioning; reliability of the proposers; subcontracting, effects on integration, and risks associated with deliveries; test track; car shells; technical aspects (*e.g.*, propulsion and animated air schematics for training); project manager experience; and weight management program. *See* Transcript of the Hearing in re: RFP-654, CAFUSA and AnsaldoBreda Conducted on Tuesday, August 10, 2010, at 27-47 (pp. 108-188).

> project oversight efforts by MDT are improved, inspections can be more frequent, and travel costs that would be incurred to conduct oversight of final vehicle assembly activities will be significantly reduced. Efforts to review drawings, project plans for testing, schedule, and progress meetings can be more effectively coordinated locally, allowing faster reviews and better communications in resolving project issues.[19]

In its July 29, 2011 response and September 6, 2011 reply to CAF's protest appeal, MDT presents two arguments. First, MDT argues that it provided notice to the proposers, through Section 3.3.5 of the RFP, that the location of the final assembly facility would be an evaluation factor. Second, MDT claims to have followed the advice of an FTA Regional Counsel when it considered the location of the final assembly facility as an evaluation factor. Neither argument is persuasive.

The only reference in the RFP to the location of the vehicle final assembly facility is contained in Section 3.3.5, Organization and Management Plan, and requires offerors to submit, as part of their Organization and Management Plan, *inter alia*:

> (f) A list of locations for the major engineering, manufacturing and installation portions of the Work and how the Proposer plans to handle local coordination of the Work. In particular, each Proposer shall identify the facility to be used for final assembly of the Vehicles.

Contrary to MDT's assertion that Section 3.3.5 provides a basis for considering the location of the final assembly location as an evaluation factor, the foregoing language merely states that the proposer must list the locations of the facilities to be used, including the final assembly facility. However, there is no indication that a *local* facility would be given greater weight in the evaluation process. I do not find that this provision adequately put offerors on notice that location of the final assembly facility would be a significant factor in evaluating the proposals.

Moreover, in Addendum No. 3, dated April 29, 2009, Form A-4: Local Business Preference was deleted, "as well as any reference to the form and any requirement regarding local preference."[20]

I find that Section 3.3.5 of the RFP did not clearly articulate that the location of the final assembly facility was to be considered as an evaluation or selection factor. Thus, it was improper for MDT to consider it as such.

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[19] Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 6 (Feb. 18, 2011).

[20] Although Addendum No. 14, dated July 31, 2009, includes the deleted Form A-4, FTA believes that this form was mistakenly included in that addendum. Moreover, MDT specifically stated that it "did not include local preference in the solicitation." *See* Memorandum from the County Manager to the Board of County Commissioners on the Recommendation for Approval to Award Contract No. 654: Purchase of New Heavy Rail Vehicles 6 (Feb. 18, 2011).

MDT also argues that it considered the location of the final assembly facility as an evaluation factor based on guidance from Paul Jensen who at that time was an FTA Regional Counsel. The following is an excerpt from a March 16, 2009 e-mail from Mr. Jensen:

> [I]ts [sic] important that the solicitation avoids any implication that points are being awarded for local preference. Total points should be awarded based upon the factors listed in the solicitation. If locating a facility in the area is one of those factors, its [sic] ok because the solicitation would state that having a facility in the Miami area would create economies of scale and would reduce project costs. As a result, you could award more points to a bidder who agreed to provide a local plant. That's different than local preference since there's a valid basis for awarding the points. I hesitate to use the term "extra points". Its [sic] just that a bidder locating a facility in the local area would be awarded more points than one who doesn't due to cost savings, etc. FTA would participate in the award of a contract as outlined above.[21]

Mr. Jensen followed with additional guidance on March 23, 2009:

> [L]et me reiterate that local preference is prohibited but the location of the facility can be a consideration in the ranking process so long as it is quantifiable in that economies of scale may be realized in having the facility located locally. Thus, a company assembling vehicles locally might present favorable opportunities for purposes of lower shipping costs, inspection costs, ease of inspection, etc.

It is important to note that MDT did not, in fact, follow Mr. Jensen's guidance when developing the RFP. His advice was that MDT could consider the location of the final assembly facility (as it related to quantifiable reduction in projects costs) only if it listed the factor in the solicitation. MDT did not list the location of the final assembly facility as an evaluation factor in the RFP. Therefore, MDT's reliance on Mr. Jensen's emails is misplaced.

Based on the foregoing, I find that MDT improperly considered the location of AnsaldoBreda's proposed final assembly facility in Miami-Dade County as an evaluation factor.

b. *MDT violated Federal restrictions on the use of local preferences.*

CAF asserts that MDT violated the Federal prohibition against imposing local geographic preferences in the evaluation of bids or proposals.

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[21] Miami-Dade County's Response in Opposition to CAF USA Inc's Bid Protest to the Federal Transit Administration 6 (July 29, 2011).

Federal law, 49 U.S.C. § 5325(h), prohibits use of FTA funding for procurements that use of exclusionary or discriminatory specifications. In addition, the Common Grant Rule provides that:

> Grantees and subgrantees will conduct procurements in a manner that prohibits the use of statutorily or administratively imposed in-State or local geographical preferences in the evaluation of bids or proposals, except in [cases not applicable here].[22]

In this procurement, MDT originally included provisions explicitly providing for local preference. While it later deleted all reference to local preferences from the RFP, the record demonstrates that MDT applied local preference nonetheless.

FTA found evidence of this fact in the transcript of the Hearing of the Evaluation Committee, dated August 10, 2010. The following statements by members of the Evaluation Committee indicate that AnsaldoBreda's proposal to build a final assembly facility in Miami was a major factor in MDT's decision to recommend award of the contract to AnsaldoBreda:

- MR. NAVARRETE: ...We forget [sic] to ask you about the jobs created in the final assembly here in Miami-Dade County.
  MR. CARTER: Right. I didn't address the jobs that were created here. Fred has asked me to confine my comments to the project itself and the direct relation to the project. Jobs that will be created here I think were in the vicinity of--I think it--
  MR. SIMMONS: Of 95 jobs here.
  MR. CARTER: Basically 95 jobs here.[23]

  * * *

- MR. NAVARRETE: "It's hard not to think about the 95 – potentially 95 jobs created in Miami-Dade County at this time, you know, good paying jobs, and the impact to the local economy, a significant impact to the local economy. How do you guys feel about that?"
  MR. SIMMONS: "You can't overlook that. I mean, that's a big factor here . . ."[24]

  * * *

- MR. CARTER: "You've got to compare, I mean . . . the jobs in Miami, the local assembly plant. I mean, you got to weigh that all in."[25]

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[22] 49 C.F.R. § 18.36(c)(2).
[23] Transcript of the Hearing in re: RFP-654, CAFUSA and AnsaldoBreda Conducted on Tuesday, August 10, 2010, at 23 (p. 91).
[24] *Id.* at 36 (p. 141-42).
[25] *Id.* at 38 (p. 151).

- MR. NAVARRETE: "The question is when you look at the advantages and disadvantages do you say that the value or the deal . . . you're getting from CAF is better than the one from Breda to overcome the –what I see as a significant advantage of the final assembly locally and the jobs . . . ."[26]

* * *

- MR. NAVARRETE: We have considered these 11 factors. We have deliberated. We've thought about the advantages and disadvantages, the risks. We've also looked at price being one of the factors, although not the only one, probably not the most important one, and the consensus of the committee is that we believe that the AnsaldoBreda proposal or deal is the best value to the county.

  We believe that the final assembly here in Miami-Dade County has significant advantages. It would make it easier to manage the project. We talked about the savings in travel, easier to visit the plant. We cannot ignore the impact to the local economy directly in jobs and other spin-off benefits to the economy."[27]

* * *

- MR. NAVARRETE: "There were some other minor advantages, but in the end we kept coming back to the two factors of the final assembly by AnsaldoBreda here in Miami-Dade County and the price."[28]

* * *

- MR. SIMMONS: "Unfortunately somebody's got to win and somebody's got to lose. It's a tough decision, but hopefully we'll move on and get the cars built for Miami-Dade County and create some jobs. That's it."[29]

These discussions show that MDT's Evaluation Committee considered, as an undisclosed evaluation factor, the location of the final assembly facility in Miami-Dade County. This is a clear violation of the Federal prohibition against local geographical preferences found at 49 U.S.C. § 5325, the "Common Grant Rule" at 49 C.F.R. § 18.36(c)(2); FTA Circular 4220.1F § VI.4.2.a(4)(g); and Section 15 of FTA's Master Agreement.

MDT cites as support for its selection decision, the Hearing Examiner's conclusion that,

> [t]he manner in which the County Manager considered AnsaldoBreda's proposed final assembly facility in Miami-Dade County is consistent with all federal, state and county guidelines and procurement requirements.[30]

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[26] *Id.* at 44 (p. 175).
[27] *Id.* at 47 (p. 187).
[28] *Id.* (p. 188).
[29] *Id.* at 48 (p. 191).

The Hearing Examiner's rationale for this conclusion is that the County Manager, in his recommendation, stated that, "'[t]he County did not include local preference in the solicitation, did not give extra points in evaluating proposals for having a local vehicle final assembly facility, or require proposers to have a local final assembly.'"[31]

I respectfully disagree with the Hearing Examiner's conclusions. The Hearing Examiner failed to take into account the negotiating committee's deliberations during the August 10, 2010 hearing in determining which proposer to recommend for award, and thus overlooked the extensive discussion on AnsaldoBreda's proposed local final assembly facility and the number of comments made by the Committee with respect to the jobs the local final assembly facility would create.

Despite the fact that MDT deleted all reference to local preferences from the RFP, I find that MDT officials nonetheless considered local geographic preferences in the evaluation of CAF's and AnsaldoBreda's proposals.

CONCLUSION

Based upon the foregoing, I find that MDT violated Federal procurement rules when it considered the location of the final assembly facility as an evaluation factor without disclosing this factor in the RFP, and when it applied a local geographic preference when making its selection decision. Accordingly, this procurement is currently ineligible to receive Federal funding. In order to regain eligibility for Federal funding, I recommend that MDT reevaluate the proposers' Best and Final Offers without considering local preference the effect of a local assembly facility on the local economy, or the potential project cost savings based upon the location of the final assembly facility.

If you have any questions, you may contact Kerry L. Miller at (202) 366-0942 or kerry.miller@dot.gov.

Sincerely,

Dorval R. Carter, Jr.
Chief Counsel

Cc: Virginia Verdeja, CAF USA, Inc.
Albert E. Dotson, Jr., Esq.
Bruce Libhaber, Esq.
Steven M. Polan, Esq.

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[30] Hearing Examiner's Recommendation, Findings of Fact and Conclusions of Law re Bid Protest—RFP No. 654—Purchase of New Heavy Rail Vehicles 6.
[31] *Id.* at 5.

Memorandum

MIAMI-DADE COUNTY

Date: November 28, 2011

To: Honorable Chairman Joe A. Martinez and Members
Board of County Commissioners

From: Carlos A. Gimenez
Mayor

Subject: Federal Transit Agency Decision related to CAF USA, INC. USA's Protest Appeal
RE: RFP654, New Heavy Rail Vehicles

On November 24, 2011, I received the attached communication from Mr. Dorval Carter, Jr., the Federal Transit Agency's (FTA) Chief Counsel advising of his decision to uphold the protest filed by CAF USA, Inc (CAF) in response to the County's recommendation to award the referenced solicitation to AnsaldoBreda, S.p.A. (AnsaldoBreda).

Following a competitive Request for Proposals (RFP) process, a recommendation to award a contract to AnsaldoBreda was filed with the Clerk of the Board. CAF subsequently filed a protest. The Hearing Officer upheld the recommendation to award. Both proposers submitted best and final offers (BAFO) to the County. AnsaldoBreda's BAFO price was $298,887,200 ($2,197,700 per car), and CAF USA, Inc.'s price was $303,566,408 ($2,232,106 per car). Since the County is purchasing 136 cars, the AnsaldoBreda proposal is $4.6 million less than CAF's.

CAF appealed the decision to the Federal Transit Administration (FTA), citing a violation of federal requirements prohibiting the use of local preference.

FTA advised that it intended to accept CAF's protest appeal as soon as CAF exhausted its administrative remedies with the County. The County informed FTA that it was reluctant to present the award recommendation to the Board of County Commissioners (Board) before the FTA considered CAF's protest appeal. To avoid awarding a contract that might be found ineligible for federal assistance by FTA, the County waived its right to oppose the appeal based upon CAF's failure to exhaust its administrative remedies. This allowed the FTA to review CAF's protest appeal before presenting the recommendation to the Board.

The FTA was to determine whether: 1) the County violated Federal requirements by failing to disclose in the RFP that local preference or the establishment of a local facility and the creation of local jobs would be factors for determining best value, and 2) the County violated Federal restrictions on the use of local preference by considering AnsaldoBreda's proposal to establish a local assembly facility.

The FTA's Chief Counsel concluded that, based on transcripts from Evaluation Committee (Committee) discussions, the Committee's decision to recommend to AnsaldoBreda was partially based on the final assembly location in Miami-Dade County. He asserts the solicitation did not clearly articulate the location of final assembly as a selection factor. Mr. Carter concludes the Committee violated federal procurement rules when it discussed the location of the final assembly facility, and the local job creation benefits in its discussions. In order to gain eligibility for federal funding, Mr. Carter recommends the Committee reevaluate the proposers' BAFOs without consideration of final assembly location. To this end, I will request written confirmation from both CAF and AnsaldoBreda that they wish to remain in consideration and will honor their BAFO proposal.

In accordance with the FTA decision, I will reconvene the Committee to consider the BAFO proposals, and instruct them to carefully review the guidance offered by the FTA to ensure there is no consideration of local preference, the effect of a local assembly facility on the local economy, or the potential project cost savings based on the location of the final assembly facility in the evaluation of the BAFOs received from the two firms. I will advise the Board of the recommendation to award the resultant contract following the implementation of the FTA guidance.

The then-County Manager's recommendation to award dated February 18, 2011 is hereby rescinded. As such, please be advised that the Cone of Silence is hereby reinstated.

Attachment

c: Alina T. Hudak, Deputy Mayor/County Manager
Robert A. Cuevas, Jr., County Attorney
Lester Sola, Director, Internal Services Department
Ysela Llort, Interim Director, Miami Dade Transit
Miriam Singer, Assistant Director, Procurement Management, Internal Services Department
Clerk of the Board

Memorandum

MIAMI-DADE COUNTY

Date: December 9, 2011

To: Carlos A. Gimenez
Mayor

Thru: Lester Sola, Director
Internal Services Department

Thru: Miriam Singer, CPPO
Assistant Director
Internal Services Department

From: Fred Simmons, Jr., CPPO
Senior Procurement Contracting Officer
Internal Services Department-Procurement Management

Subject: Re-evaluation of Best And Final Offers
RFP No. 654: Purchase of New Heavy Rail Vehicles

On February 18, 2011, the then County Manager recommended for award a contract to AnsaldoBreda S.p.A. (AnsaldoBreda) to provide 136 replacement heavy rail vehicles. CAF USA, Inc. (CAF) filed a bid protest on March 1, 2011. On March 23, 2011, the Hearing Examiner denied CAF's protest and concurred with the recommendation of the then County Manager. Subsequently, CAF filed a Protest Appeal with the Federal Transportation Administration (FTA) on March 24, 2011, which alleged the County incorrectly considered local preference by failing to disclose in the solicitation that local preference or the establishment of a local facility and the creation of jobs would be factors for determining best value.

On November 23, 2011, the FTA issued its "Decision-Protest Appeal of CAF USA, Inc." that found the County did not comply with federal procurement rules when it considered the location of the final assembly facility without disclosing this factor in the solicitation. The FTA also found that the County considered local preference when evaluating the proposals. The FTA advised the County that in order for this procurement to be eligible for federal funding, the County would need to re-evaluate the Best and Final Offers (BAFO) submitted by CAF and AnsaldoBreda.

Pursuant to your November 29, 2011 memorandum, a publically noticed "Sunshine" meeting of the Committee was held on December 6, 2011. A thorough explanation of the Committee's re-evaluation responsibilities was provided by Procurement Management staff, and an Assistant County Attorney. These instructions included direction to comply with the recommendation of the FTA, and the Mayor's directive, to re-evaluate the BAFOs without consideration of a local vehicle final assembly located in Miami-Dade County, and any economic benefits of a local vehicle final assembly facility. Each Committee member was polled to ensure no questions remained regarding their direction and purpose. Each Committee member indicated they had an understanding of the direction provided.

The Committee re-evaluated the BAFO and factors leading to its best value determination without consideration for local preference as recommended by the FTA and directed by you. The Committee considered numerous factors, including the BAFO prices, financial capability, test track, car shells, and several technical aspects like the inclusion by CAF of the propulsion system requested by the County, and the animated air schematics for training transit personnel offered by AnsaldoBreda. Each Committee member was polled to ensure all matters of interest regarding their re-evaluation had been discussed, and each member indicated that all issues had been discussed to their satisfaction. Subsequently, the Committee by a vote of two to one determined that AnsaldoBreda's offer constituted the best value to the

County. A majority of the Committee members found that the two proposals were comparable from a technical standpoint, and the fact that AnsaldoBreda's BAFO proposal was $4.6 million less than the BAFO proposal of CAF led the Committee to favor AnsaldoBreda.

The Committee has complied with the recommendation of the FTA and the direction of the County Mayor.

Cc: Alina T. Hudak, Deputy Mayor/County Manager
Ysela Llort, Director, Transit
Bruce Libhaber, Assistant County Manager

CONTRACT NO. 654

THIS AGREEMENT made and entered into as of this day of _____, 2012 by and between, AnsaldoBreda, S.p.A. a corporation organized and existing under the laws of Italy, having its principal office at Via Argine 425, Naples, Italy 80147 (hereinafter referred to as the "Contractor"), and Miami-Dade County, a political subdivision of the State of Florida, having its principal office at 111 N.W. 1st Street, Miami, Florida 33128 (hereinafter referred to as the "County"),

WITNESSETH:

WHEREAS, the Contractor has offered to provide 136 New Heavy Rail Transit Vehicles and related equipment, and professional service that shall conform to the Contract Documents; and,

WHEREAS, the Contractor has submitted a written proposal dated September 25, 2009, hereinafter referred to as the "Contractor's Proposal" which is incorporated herein; and,

WHEREAS, the Contractor shall deliver all Heavy Rail Transit Vehicles and related equipment, and all professional services; to be delivered per the delivery schedule in the general provisions documents herein, after the Notice to Proceed (NTP). All bonding required by the contract documents shall be delivered to the County after award and prior to NTP, and all insurance as required by the contract documents. The Contractor may provide either Bonds or Letters of Credit (LOC) for performance, payment, and warranty guarantees for the Work; and,

WHEREAS, the County and the Contractor have mutually agreed to these documents, hereinafter referred to as the "Contract Documents", which are incorporated herein. Payments will be made as provided in the Payment Schedule of the Contract Documents; and,

WHEREAS, the County desires to procure from the Contractor such Work for the County, in accordance with the Contract Documents; and,

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein contained, the parties hereto agree as follows:

County hereby agrees to pay to the Contractor for said Work, the total fixed price sum of TWO

HUNDRED NINETY EIGHT MILLION EIGHT HUNDRED EIGHTY SEVEN THOUSAND TWO HUNDRED DOLLARS ($298,887,200.00), which includes the costs associated with the Bonds or Letters of Credit, insurance, and all supporting agreements for the Work.

Signed by and on behalf of Miami-Dade County:

By: _____
(Signature)

_____
(Name and Title)

By: _____
(Signature)

_____
(Name and Title)

Signed by and on behalf of (Contractor):

By: _____
(Signature)

ANDREA PEPI
EXECUTIVE VICE PRESIDENT
(Name and Title)

By: _____
(Signature)

LORENZO REFFRESHER
VICE PRESIDENT
(Name and Title)

Approved as to Form and Legal Sufficiency

By: _____
(Signature)

Bruce Libhaber, Assistant County attorney
(Name and Title)

Corporate Seal

Corporate Seal

Table of Contents

Table of Contents **1**

SECTION GP1 – ABBREVIATIONS AND DEFINITIONS **7**

GP1.1 GENERAL 7

GP1.2 ABBREVIATIONS 7

GP1.3 TERMS 8

GP1.4 ADDITIONAL DEFINITIONS 15

GP1.5 REFERENCED STANDARDS 15

GP1.6 RULES OF INTERPRETATION 16

SECTION GP2 – PROPOSAL REQUIREMENTS AND CONDITIONS **17**

GP2.1 FEDERAL GRANT REQUIREMENTS 17

GP2.2 FLORIDA DEPARTMENT OF TRANSPORTATION 17

GP2.3 EXAMINATION OF MIAMI-DADE'S FACILITIES 17

GP2.4 BUY AMERICA REQUIREMENTS 18

SECTION GP3 – AWARD AND EXECUTION OF AGREEMENT **19**

GP3.1 AWARD OF AGREEMENT 19

GP3.2 CANCELLATION OF AWARD 19

GP3.3 CONTRACT BONDS/LETTERS OF CREDIT (LOC) 19

GP3.4 ADDITIONAL FINANCIAL SECURITY 23

GP3.5 EXECUTION OF AGREEMENT 23

GP3.6 FAILURE TO EXECUTE AGREEMENT 23

GP3.7 INSURANCE 24

GP3.8 INDEMNIFICATION 25

SECTION GP4 – SCOPE OF WORK 27

GP4.1 SCOPE 27

GP4.2 INTENT OF CONTRACT DOCUMENTS 27

GP4.3 USE AND POSSESSION PRIOR TO COMPLETION 28

GP4.4 OTHER CONTRACTS 29

GP4.5 INDEPENDENT CONTRACTOR 30

GP4.6 CHANGES 30

GP4.7 VALUE ENGINEERING INCENTIVE 33

GP4.8 CLAIMS AND DISPUTES 35

GP4.9 ASSIGNMENT OF MONIES OWED 39

GP4.10 FACILITIES FOR MIAMI-DADE/ENGINEER 40

GP4.11 OPERATIONS AND STORAGE AREAS 40

GP4.12 LIMITATIONS ON WORK 41

GP4.13 CONTRACTOR'S OFFICE 41

GP4.14 OPPORTUINTY RECOVERY COST (OCR) 42

SECTION GP5 – CONTROL OF MATERIALS 44

GP5.1 SOURCE OF SUPPLY AND QUALITY OF MATERIALS 44

GP5.2 WARRANTIES, REPRESENTATIONS AND COVENANTS 45

GP5.3 RELIABILITY DEFECTS 55

GP5.4 MIAMI-DADE FURNISHED MATERIALS 57

GP5.5 DEFECTIVE MATERIALS 58

GP5.6 USE OF BRAND NAME MATERIALS OR EQUAL 59

GP5.7 PLANT AND FACILITY INSPECTIONS....61

GP5.8 SAMPLES....61

GP5.9 CERTIFICATE OF COMPLIANCE FOR MATERIALS....63

GP5.10 QUALITY ASSURANCE....63

SECTION GP6 – CONTROL OF WORK....64

GP6.1 RESPONSIBILITIES OF ENGINEER....64

GP6.2 CONTRACTOR DOCUMENT CONTROL REQUIREMENTS....64

GP6.3 CONTRACT DOCUMENTS, DATA AND DRAWINGS....66

GP6.4 CAR HISTORY BOOK....67

GP6.5 PERSONNEL FOR THE WORK....68

GP6.6 INSPECTION....68

GP6.7 IDENTIFICATION OF EMPLOYEES....70

GP6.8 WORKING CONDITIONS AT WORKSITE....71

GP6.9 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT....71

SECTION GP7 – LEGAL RESPONSIBILITIES....73

GP7.1 LAWS TO BE OBSERVED....73

GP7.2 PERMITS....73

GP7.3 NONDISCRIMINATION....73

GP7.4 LABOR PROVISIONS – NONCONSTRUCTION CONTRACTS....74

GP7.5 ENVIRONMENTAL CONTROL....75

GP7.6 OFFICIALS NOT TO BENEFIT....77

GP7.7 GRATUITIES AND CONFLICT OF INTEREST....77

GP7.8 FEDERAL, STATE, LOCAL AND OTHER TAXES....80

GP7.9 PATENTS 80

GP7.10 TECHNICAL DATA AND COPYRIGHTED MATERIALS 81

GP7.11 ENTIRE AGREEMENT 85

GP7.12 AGENT TO ACCEPT SERVICE 85

GP7.13 ACCESS TO AND RETENTION OF DOCUMENTS 86

GP7.14 UTILIZATION OF DISADVANTAGED BUSINESS ENTERPRISES 86

GP7.15 AMERICANS WITH DISABILITIES ACT 87

GP7.16 PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS OR RELATED ACTS 88

GP7.17 USE OF MIAMI-DADE NAME IN CONTRACTOR ADVERTISING OR PUBLIC RELATIONS 88

GP7.18 CARGO PREFERENCE 88

GP7.19 FLY AMERICA 89

GP7.20 PRIVACY ACT 89

GP7.21 GOVERNING LAW 89

GP7.22 INSPECTOR GENERAL REVIEW 89

GP7.23 BUSINESS APPLICATION 90

GP7.24 LOCAL, STATE, AND FEDERAL COMPLIANCE REQUIREMENTS 91

GP7.25 CONFLICT OF INTEREST 92

GP7.26 PREVENTION OF DRUG AND ALCOHOL MISUSE 93

GP7.27 Incorporation of Federal Transit Administration (FTA) Terms: 96

GP7.28 Walsh – Healey Public Contracts Act (Dec 1996) 96

GP7.29 Davis – Bacon Act, as amended 97

SECTION GP8 – PROSECUTION AND PROGRESS 98

GP8.1 WORK TO BE PERFORMED BY CONTRACTOR 98

GP8.2 ASSIGNMENT 98

GP8.3 SUBCONTRACTS 98

GP8.4 NOTICE TO PROCEED 100

GP8.5 PRE–COMMENCEMENT CONFERENCE 100

GP8.6 TIME OF COMPLETION 100

GP8.7 LIQUIDATED DAMAGES 103

GP8.8 PROJECT SCHEDULE 104

GP8.9 PROGRESS REPORTS 108

GP8.10 PHOTOGRAPHS OR DIGITAL IMAGES 109

GP8.11 SUSPENSION OF WORK 109

GP8.12 TERMINATION FOR DEFAULT 110

GP8.13 TERMINATION FOR CONVENIENCE OF MIAMI-DADE 113

GP8.14 ACCEPTANCE, OWNERSHIP, AND RISK OF LOSS 116

GP8.15 TESTING 118

GP8.16 PRE-PRODUCTION (PILOT) VEHICLES 118

GP8.17 SHIPMENTS/DELIVERIES 119

GP8.18 MEETINGS AND REPORTS 120

GP8.19 TRAINING 121

GP8.20 CANCELLATION 121

SECTION GP9 – PAYMENT 122

GP9.1 SCOPE OF PAYMENT 122

GP9.2 PROGRESS PAYMENTS 122

GP9.3 AGREEMENT ADMINISTRATIVE CLOSE–OUT 131

GP9.4 FINAL PAYMENT 132

EXHIBIT 1 134

EXHIBIT 2 136

EXHIBIT 3 138

SECTION GP1 – ABBREVIATIONS AND DEFINITIONS

In determining the suitability of subsystems for the Project, the County will apply the principles of FAR subpart 1-1.11 "Qualified Products," as applicable.

GP1.1 GENERAL

Whenever the following abbreviations and terms appear or are referred to in the Contract Documents, they shall carry the definitions listed below unless otherwise expressly stated in the Contract Documents.

GP1.2 ABBREVIATIONS

ANSI	American National Standards Institute
APTA	American Public Transit Association
ASQC	American Society for Quality Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
CDRL	Contract Documents Requirements List
CFR	Code of Federal Regulations
CO	Contracting Officer
COR	Contracting Officer Representative
DBE	Disadvantaged Business Enterprise
DOL	United States Department of Labor
DOT	United States Department of Transportation
DPM	Department of Procurement Management
EEO	Equal Employment Opportunity
EPA	U.S. Environmental Protection Agency

FDOT	Florida Department of Transportation
FTA	Federal Transit Administration, an agency within the United States Department of Transportation, formerly known as UMTA
HRT	Heavy Rail Transit
IPSIG	Independent Private Sector Inspector General
MDC	Miami-Dade County
MDT	Miami-Dade Transit
MIS	Management Information System
MSDS	Material Safety Data Sheet
NEMA	National Electrical Manufacturers' Association
NTP	Notice to Proceed
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor
QAP	Quality Assurance Plan
TPN	Technical Provisions for the New Heavy Rail Vehicles
UL	Underwriters Laboratories, Inc.
UMTA	Urban Mass Transportation Administration, an agency within the United States Department of Transportation, presently known as FTA
USC	United States Code

GP1.3 TERMS

ACCEPTANCE – Formal written acceptance by the Miami-Dade County that the Work or a portion thereof has been completed according to the specifications and requirements of the Contract Documents.

ACCEPTANCE CERTIFICATE – The written document issued by Miami-Dade County to certify acceptance of all the Work at administrative close-out.

AGREEMENT (CONTRACT) – The negotiated, written agreement executed by

Miami-Dade County and the Contractor, in conformance with the Contract Documents, for the performance of the Work which incorporates and includes the remaining Contract Documents.

APPROVED – The endorsement or authorization by Miami-Dade County or the Engineer of a proposal, plan, procedure, action, document, report, specification, design, or any parts thereof, undertaken, promulgated, or developed by the Contractor in accordance with the requirements of the Contract Documents.

AWARD – The issuance of a Contract by the County.

BONDS – The executed Performance Bond and the Warranty Bond required to be supplied by the Contractor pursuant to the Contract Documents.

CALENDAR DAY – Each and every day shown on the calendar.

CERTIFICATE OF ACCEPTANCE OF FINAL INSPECTION – Certificate issued by Miami-Dade County certifying that a Vehicle or other portion of the Work has been substantially completed, including the completion of all required inspections, tests, Safety Certification, and rework as required by the Contract Documents, but subject to satisfactory completion of any outstanding Work items, the warranty, and reliability requirements of the Contract Documents. The Certificate of Acceptance of Final Inspection will be automatically provided to the Contractor if the vehicle is placed in revenue service. In such case, the Contractor shall still be responsible for any outstanding Work items, including the warranty and reliability requirements of the Contract Documents.

CERTIFICATE OF COMPLIANCE – Certificate issued by a Supplier, manufacturer or producer certifying that systems, subsystems, materials, parts or equipment furnished complies with the Contract Documents.

CERTIFICATE OF INSURANCE – Certificate for the required insurance specified by the Contract Documents.

CHANGE NOTICE – A written request issued by Miami-Dade County to the Contractor, requesting the scope, cost and schedule impact of a potential change to the Work.

CHANGE ORDER – A written order issued by Miami-Dade County to the Contractor, delineating changes in the Contract Documents and establishing the basis of payment and time adjustments, if any, for the portion of the Work affected by the changes.

COMPLETED WORK – The completion of all work on a contract item or milestone for which payment will include all material, equipment, labor, overhead and work incidental thereto, unless otherwise specified.

CONTRACT – See Agreement.

CONTRACT DATA REQUIREMENTS LIST (CDRL) – A matrix listing data, such as drawings, catalogs, reports, notices, and samples, required to be submitted by the Contractor by the Contract Documents. The matrix also establishes when and how often such submittals and revised submittals are required to be provided by the Contractor. In these Contract Documents, CDRLs are identified and tabulated at the beginning of each section and are called out within the specific text as (CDRL) in parentheses. A summary listing of all CDRLs is located in TPN23.

CONTRACT DOCUMENTS – The Advertisement, the RFP, the request for BAFO and any addendum(a) issued, the executed Agreement, the executed Contract Forms, the General Provisions, the Technical Provisions, the Contract Drawings, the Notice to Proceed, the Bonds, Change Orders, all required insurance and the Contractor's BAFO, all Letters of Credit, and the Proposal upon which the Agreement is awarded.

CONTRACT DRAWINGS – All diagrams, drawings and illustrations in the Contract Documents which describe or show the locations, character, dimensions and details of the Work.

CONTRACT ITEM – An item of Work for which a price is provided in the Contract Documents.

CONTRACT SPECIFICATIONS (SPECIFICATIONS) – The directions, provisions, and requirements contained, or referenced, in the General Provisions and Technical Provisions prescribing the manner of performing the Work, or to the quantities and qualities of materials to be furnished or incorporated into the Work.

CONTRACT SUM – The total amount which Miami-Dade County agrees to pay the Contractor and the Contractor agrees to accept from Miami-Dade County as full payment for the Work and as a complete discharge of Miami-Dade County's liability to make payment to the Contractor for the Contractor's performance of the Work which sum is set forth in the Agreement, subject to additions and deductions as provided in the Contract Documents, including modifications due to the exercise of options or modification to the Work.

CONTRACT TIME (TIME OF COMPLETION) – The total number of calendar days set forth in the Contract Documents for completion of the Work from Notice to Proceed, unless otherwise specified in the Contract Documents, as may be amended.

CONTRACTING OFFICER (DPM) – The individual designated by the

Department of Procurement Management Director, or designee, to perform Contract Management activities for the Contract.

CONTRACTOR – The individual, firm, partnership, corporation, joint venture or any combination thereof, who, as an independent contractor, has entered into the Agreement with the County.

COUNTY – Miami-Dade County (The County), as represented by the County Manager or its authorized designee. The term Owner as used in this Agreement shall exclude the regulatory departments of Planning, Development and Regulation (Building and Zoning); Department of Environmental Resources Management (DERM); Public Works (PW); the Fire Department (MDFRD) and Water & Sewer (WASD) or their successors.

CRITICAL PATH – In a schedule, a sequence of stages toward the achievement of a final task that allows for all other tasks that must be achieved on the way to achieving the final task.

DATA – Written presentations, including but not limited to, calculations and catalog cuts, prepared by the Contractor, its Subcontractors, or Suppliers in response to requests from Miami-Dade County, Miami-Dade Transit or the Engineer or to otherwise meet the requirements of the Contract Documents.

DAY(S) – Shall mean calendar day(s), unless otherwise designated.

DEFECT(S) / DEFECTIVE – A condition which does not meet the requirements of the Contract Documents; or causes a Vehicle or a portion of the Work to cease operating or operate in a degraded mode; or inflicts damage or harm on any other portion of a Vehicle or the Work.

DELIVERY (DELIVER OR DELIVERED) FOR ACCEPTANCE TESTING – The delivery of a New Metrorail Vehicle by the Contractor to Miami-Dade County's property for the performance of Acceptance Testing by the Contractor pursuant to TPN17, with all previously scheduled portions of the Work having been fully and properly completed by the Contractor for the Vehicle.

DRAWING – Any drawing or similar data which is: required to be submitted or prepared pursuant to the Contract Documents; prepared by the Contractor or others to supplement, detail, or describe the Work; and/or is a Contract Drawing, Engineering Design Drawing, and/or Manufacturing Drawing. These may also include, but are not limited to, electrical schematics and wiring diagrams, fabrication, erection, layout, assembly installation, test, maintenance, and repair drawings as well as instructions and manufacturer's catalog information.

ENGINEER – The County or its authorized representative acting within the

scope of the duties assigned to it, in accordance with GP6.1.
ENGINEERING DESIGN DRAWINGS – Drawings prepared by the Contractor, its Subcontractors or Suppliers to supplement or detail the Contract Documents, and which are required by the Contract Documents or drawings prepared by the Contractor to detail work not shown on the Contract Documents which will be incorporated in and become an integral part of the Work.

EXISTING HRV (Metrorail) – A Heavy Rail Metrorail Vehicle in the County's existing Metrorail Fleet.

FAILURE – Any detected inability of material or equipment, or any portion thereof, to function or perform in accordance with the Contract Documents.

FIELD ORDER – A written notice issued to the Contractor by the Engineer specifying an action required by the Contract Documents.

GENERAL PROVISIONS – Articles GP1 through GP9 inclusive.

GOVERNMENT – The Government of the United States of America.

INSPECTOR – The Engineer's or Miami-Dade County's authorized representative assigned to conduct inspections of the Work.

JOINT VENTURE – A legal association of entities formed for the purpose of proposing on the RFP.

LETTER OF CREDIT – The Performance, Payment, and Warranty financial security instruments issued by a financial institution with offices and authorized to do business in the State of Florida.

MANUFACTURING DRAWINGS – Drawings and instructions prepared by the Contractor, its Subcontractors or Suppliers to be used during manufacturing or assembly for purposes of describing manufacturing or assembly techniques.

MIAMI-DADE'S METRORAIL FLEET – Miami-Dade County's existing fleet of one–hundred–thirty–six (136) Budd Company Heavy Rail Vehicles.

MONTH – Calendar month.

NEW METRORAIL VEHICLES – The New Metrorail Vehicles whose configuration and performance are described in the Contract Documents and which are to be newly manufactured, assembled and delivered to Miami-Dade County by the Contractor as required by the Contract Documents.

NOTICE TO PROCEED (NTP) – A written notice from Miami-Dade County to

the Contractor directing the Contractor to proceed with the Work or alternatively, a portion thereof.

OTHERS – Individuals, partnerships, governmental bodies, corporate entities or agencies whose activities, services, facilities or equipment interfaces with or are impacted by the Work.

PAYMENT BOND or LETTER OF CREDIT – A form of surety that is used to insure timely payment to all of the Contractor's Subcontractors.

PERFORMANCE BOND or LETTER OF CREDIT – The Miami-Dade County approved form of security furnished by the Contractor and its Surety as a guaranty on the part of the Contractor to execute and complete the Work as required by the Contract Documents.

PRE–PRODUCTION (PILOT) VEHICLES – The first three Metrorail Married Pairs being procured under this Agreement.

PROCUREMENT – The furnishing of all the items, material, equipment, data, design, services, management, labor, and incidentals, specified or otherwise necessary for timely and properly designing, manufacturing, delivering and testing the New Metrorail Vehicles or otherwise completing the Work.

PROJECT – See Work.

PROJECT MANAGER – The Contractor's authorized representative in charge of the Work.

PROJECT RECORD DOCUMENTS – A copy of all Contract Drawings, Engineering Design Drawings, Manufacturing Drawings and data to be maintained by the Contractor during the Work.

PROJECT SCHEDULE – The schedule for the Work as prepared and maintained in accordance with the Contract Documents, as approved by the County.

PROPOSAL – The written submission, in response to the County request for a proposal, by a Proposer for the Work, properly signed, dated and completed and as may be amended or modified through a Best and Final Offer or direct negotiations.

PROPOSER – The individual, firm, partnership, corporation, joint venture or other legal entity which submits a Proposal to Miami-Dade County, in response to the RFP seeking to be selected as the Contractor.

PROVIDED – The Contractor's work is "provided" when it is timely furnished by

the Contractor and completed in accordance with the Contract Documents.
SAMPLES – Physical examples which illustrate material, equipment or workmanship and establish standards by which the Work will be judged.

REVENUE SERVICE – The utilization of a Vehicle, Replacement Part, spare part, or other portion of the Work by MDT in the collection of fares from Miami-Dade's customers.

SERVICE–PROVEN DESIGN – Refers to the design of any component, system or subsystem that has a proven history, as required by the Contract Documents, of successful operation in Service similar to that of the Metrorail System as defined in the Request for Proposal, Section 3.4.2.

SHOP DRAWINGS – See Engineering Design Drawings.

SPECIFICATIONS – See Contract Specifications.

STATE – The State of Florida.

SUBCONTRACTOR – Any individual, partnership, firm, corporation, joint venture or any combination thereof, who performs or installs, totally or partially, a Contract Item, or who performs other services for the Contractor as required to fulfill the Work, by virtue of an agreement with the Contractor.

SUPPLIER – Any individual, partnership, firm, corporation, joint venture or any combination thereof, who provides material or equipment, but not labor or services, to the Contractor and who is responsible to the Contractor by virtue of an agreement with the Contractor.

SURETY – A corporate body which is bound with and to the Contractor for the satisfactory performance of the Work by the Contractor, and for the remedy of any defects in the Work, as provided in the Bonds or Letters of Credit.

TECHNICAL PROVISIONS (TECHNICAL SPECIFICATIONS) – Specific requirements setting forth the descriptions of elements of the Work to be performed or supplied, the quality of required labor, material and equipment, and the method of measurement and payment for the identified elements of the Work.

TIME OF COMPLETION – See Contract Time.

VEHICLE(S) – New Metrorail Heavy Rail Vehicle(s).

WARRANTY BOND or LETTER OF CREDIT – The Miami-Dade County approved form of security furnished by the Contractor and its Surety as a guaranty on the part of the Contractor to execute and complete the Warranty as

required by the Contract Documents.
WEEK – A period of seven consecutive calendar days.

WORK (PROJECT) – All designs, engineering, manufacturing, operations, services, materials, equipment, parts and labor required to properly, timely and to the satisfaction of Miami-Dade County: provide the completed New Metrorail Vehicles; provide all other items of work indicated or referenced in the Contract Documents, including all alterations, amendments or extensions thereto made by Change Order; successfully complete all required tests and all reliability periods; remedy all defects which occur during, at least, the five (5) year warranty period for each of the New Metrorail Vehicle as set forth in GP5.2.4; and complete all necessary repairs and modifications resulting from the tests, the reliability periods and warranties as required by the Contract Documents. Nothing herein shall affect the period or duration of the Warranty Bond or Letter of Credit or the warranties set forth in or required by the Contract Documents.

WORKSITE – All areas obtained or used by the Contractor for use in connection with the Work, and any Miami-Dade County property authorized for use by the Contractor in the performance of the Work.

GP1.4 ADDITIONAL DEFINITIONS

GP1.4.1 Wherever in the Contract Documents the words "directed", "required", "ordered", "designated", "prescribed", or similar words are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription" of Miami-Dade County or the Engineer is intended unless otherwise expressly stated. Similarly, the words "approved", "satisfactory", or similar words, shall mean "approved by", or "satisfactory to" Miami-Dade County or the Engineer, unless otherwise expressly stated.

GP1.4.2 Where "as shown", "as indicated", "as detailed", or similar words are used, it shall be understood that the reference is made to the Contract Documents unless stated otherwise.

GP1.5 REFERENCED STANDARDS

GP1.5.1 Whenever the Contract Documents reference a standard, said standard shall be, unless otherwise indicated, the latest version or edition in effect on the date on which the Notice to Proceed is issued.

GP1.5.2 In the case of a conflict between referenced standards and the Contract Documents, the Contract Documents shall govern.

GP1.6 RULES OF INTERPRETATION

GP1.6.1 The titles, headings, captions and arrangements used in these General Provisions are for convenience only and shall not be deemed to limit, amplify or modify the terms of this Contract, nor affect the meaning thereof.

END OF SECTION

SECTION GP2 – PROPOSAL REQUIREMENTS AND CONDITIONS

GP2.1 FEDERAL GRANT REQUIREMENTS

The Work may be financed, in part, through an FTA Capital Grant contract between Miami-Dade County and the Federal Government; and is subject to the requirements of various federal authorities such as the DOL and DOT. Any action taken by Miami-Dade County in compliance with such agreements or requirements shall not be cause for any claim against Miami-Dade County or FTA by the Contractor.

GP2.2 FLORIDA DEPARTMENT OF TRANSPORTATION

The Work may be financed, in part, through a grant to Miami-Dade County from FDOT; and is subject to the requirements of FDOT and other State authorities. Any action taken by Miami-Dade County in compliance with such grant or requirements shall not be cause for any claim against Miami-Dade County, FDOT, the State, or any local government by the Contractor.

GP2.3 EXAMINATION OF MIAMI-DADE'S FACILITIES

The Contractor shall carefully examine and become familiar with the Contract Documents, Miami-Dade Transit's facilities, including the Metrorail System, the Metrorail Fleet, and any other conditions or facilities potentially affecting the Work. By submitting a Proposal, the Proposer acknowledges that it has carefully examined the RFP, the Contract Documents, and the County's facilities, including the HRT System and the County's HRV (Metrorail) Fleet, and has satisfied itself as to the contractual and technical requirements of the Work and all conditions potentially affecting the Work. Any failure by the Contractor to carefully and completely review the RFP, the Contract Documents, Miami-Dade Transit's facilities, including the Metrorail System and Miami-Dade Transit's Metrorail Fleet, and any other conditions or facilities potentially affecting the Work, or to acquaint itself with all available information, shall not relieve it from the responsibility for estimating properly the difficulty or cost of successfully performing the Work. Miami-Dade County assumes no responsibility for any conclusions or interpretations made by the Proposer on the basis of any representations made, or information provided by, Miami-Dade County, its Engineer or any of the County's or the Engineer's directors, officers, employees or agents prior to the execution of the Agreement. Any data or information provided to the Proposer is provided as a convenience only.

If requested, the County will make every effort to provide the most recent, complete and accurate information. The County will disclose if it believes that any provided information is incomplete or contains potential inaccuracies.

GP2.4 BUY AMERICA REQUIREMENTS

GP2.4.1 The Agreement and the Work are subject to the provisions of Section 165 of the Surface Transportation Assistance Act of 1982, and 49 CFR Part 661. Further, the Agreement and the Work are subject to the requirements of the Surface Transportation and Uniform Relocation Assistance Act of 1987 and any implementing regulations issued thereunder.

GP2.4.2 The Contractor shall have submitted a completed Buy America Certificate as required by the RFP (Appendix G).

GP2.4.3 The Contractor understands and agrees that, pursuant to 49 CFR Part 661.13, whether or not it certifies that it will comply with the applicable Buy America requirements, it is bound by its original certifications and is not permitted to change its certifications for the duration of the Contract. In addition, if the Contractor certifies that it will comply with the applicable Buy America requirements, the Contractor understands and agrees that it is not eligible for a waiver of those requirements.

GP2.4.4 The Contractor shall fully cooperate with Miami-Dade County in the performance of both a pre-award and a post–delivery audit by Miami-Dade County or its representative to ensure that the Work fully complies with the applicable requirements of Buy America; 49 U.S.C. § 5323(m) and FTA regulations, "Pre-Award and Post-Delivery Audits of Rolling Stock Purchases," 49 CFR Part 663 and any revisions thereto.

END OF SECTION

SECTION GP3 – AWARD AND EXECUTION OF AGREEMENT

GP3.1 AWARD OF AGREEMENT

GP3.1.1 The County, in its sole discretion, reserves the right to reject any and all Proposals and to waive informalities and irregularities in any Proposals, other provisions in the Contract Documents notwithstanding.

GP3.1.2 If the Proposer fails to submit all the requested information for the County's evaluation, the Proposal submitted by said Proposer will not be evaluated by the County.

GP3.1.3 The Agreement shall not be in effect until approved by the County.

GP3.2 CANCELLATION OF AWARD

Miami-Dade County reserves the right to cancel the award of the Agreement before the issuance of the Notice to Proceed when Miami-Dade County deems such cancellation to be in its best interests. In no event, will Miami-Dade County or the Engineer be liable, in any way, for the cancellation of the award or any expenses, costs or damages resulting therefrom with the exception of costs incurred for cancellation of bonding. The Contractor assumes sole risk and responsibility for any expenses or costs it incurs prior to the issuance of the Notice to Proceed and shall not commence the performance of the Work until receipt of the Notice to Proceed, which shall take place no later than 60 days after Contract Award.

GP3.3 CONTRACT BONDS/LETTERS OF CREDIT (LOC)

GP3.3.1 The Contractor shall furnish the following Bond(s)/LOC(s) at its own expense. All Bonds/LOC(s) shall be issued in accordance with the scope of work as modified by the exercising of options by the County.

(A) Performance Bond/LOC – In amounts as follows:

Time Period	Bond Amount
NTP through completion of the Final Design Review	12% of Contract Sum
Completion of the Final Design Review through Delivery of three (3) Pilot Married Pairs and completion of testing	25% of Contract Sum

Time Period	Bond Amount
Delivery of three (3) Pilot Married Pairs through issuance of the Certificate of Acceptance of Final Inspection for 68th Married Pair	30% of Contract Sum (To be reduced by 1/68 upon acceptance of each Married Pair)

The Performance Bond/LOC shall be accessible such that the County may, at its convenience, withdraw funds from the Bond/LOC in the event the Contractor fails to execute its performance obligations in a timely manner. The Performance Bond/LOC does not apply to the warranty obligations under the Contract.

(B) Warranty Bond/LOC – No Warranty Bond/LOC is required for this Contract.

(C) Payment Bond/LOC – In the amount of 2% of the Contract Value. The Payment Bond/LOC shall remain in effect from NTP until 120 days after issuance of the Certificate of Acceptance of Final Inspection for the final Married Pair.

GP3.3.2 Surety Bond Qualifications: The following specifications shall apply to bid, performance, payment, maintenance, and all other types of bonds.

(A) All bonds shall be written through surety insurers authorized to do business in the State of Florida as surety, with the following qualifications as to management and financial strength according to the latest edition of Best's Insurance Guide, published by A. M. Best Company, Oldwick, New Jersey:

Bond Amount			Best Rating	
$500,001	to	$1,500,000	B	V
$1,500,001	to	$2,500,000	A	VI
$2,500,001	to	$5,000,000	A	VII
$5,000,001	to	$10,000,000	A	VIII
Over		$10,000,000	A	IX

On bond amounts of $500,000 or less, the provisions of Section 287.0935, Florida Statutes (1991) shall be in

effect and surety companies not otherwise qualifying with this paragraph may optionally qualify by:

1. The Surety Company is licensed to do business in the state of Florida;

2. The Surety Company holds a certificate of authority authorizing it to write surety bonds in the state;

3. The Surety Company has twice the minimum surplus and capital required by the Florida Insurance Code at the time the invitation to bid is issued;

4. The Surety Company is otherwise in compliance with the provisions of the Florida Insurance Code; and

5. The Surety Company holds a currently valid certificate of authority issued by the United States Department of the Treasury under ss. 31 U.S.C. 9304-9308.

(B) Surety insurers shall be listed in the latest Circular 570 of the U.S. Department of the Treasury entitled "Surety Companies Acceptable on Federal Bonds", published annually. The bond amount shall not exceed the underwriting limitations as shown in this circular.

(C) The attorney in fact or other officer who signs a contract bond for a surety company must file with such bond a certified copy of his power of attorney authorizing him to do so. The Contract bond must be countersigned by the surety's resident Florida agent.

(D) Bonds shall be so worded as to make the Contract a part thereof and shall contain a clause providing the right of suit or action for those benefits said bond shall be executed as disclosed by the text of said Bonds and Contract to the same extent as if he or they were the obligee or obligee therein specifically mentioned, and all such persons shall be held or deemed to the obligee thereof.

The Contractor may, in lieu of a surety performance bond and surety payment bond submit two (2) cash bonds or bank letters of credit, conditioned upon the faithful performance of the work in strict accordance with this Contract and with the Plans,

Specifications and the completion of the same free from all liens and within the time limit herein specified.

The Contractor shall promptly make payments in accordance with County Ordinance 94.40 (Prompt Payment) to all subcontractors, or any other entity, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the Contract Documents, and in the times and manner prescribed in the Contract Documents; and

If the Contractor fails to make payments to any subcontractor, or any other entity, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the Contract Documents, and in the times and manner prescribed in the Contract Documents, then subcontractor, or any other entity shall have a right of action against the Contractor and the Surety for the amount it is due. Such action shall not involve the County in any expense. The Contractor shall pay the County for all losses, damages, costs, and attorney's fees, including appellate proceedings that the County sustains because of a failure by Contractor to make any such payments.

A subcontractor, or any other entity as identified above, except a laborer, who is not in privity with the Contractor and who has not received timely payment for its labor, materials, or supplies may, within 60 days after performance of the labor or after complete delivery of the materials or supplies, and issuance of a properly submitted invoice, deliver to the Contractor and to the Surety written claim advising of the performance of the labor or delivery of the materials or supplies and of the nonpayment. No action for labor, materials or supplies may be instituted against the Contractor or the Surety unless notice has been given. No action shall be instituted against the Contractor or the Surety on the bond after 120 days from the performance of the labor or completion of delivery of the materials or supplies. A claimant may not waive in advance its right to bring an action under the bond against the Surety.

GP3.3.3 The Bonds shall be in the form attached hereto as Exhibit 1 (Performance Bond), Exhibit 2 (Payment Bond), and Exhibit 3 (Warranty Bond) or on forms otherwise provided and approved by the County and shall be executed by a Surety or Sureties acceptable to the County, authorized to issue surety bonds in the State of Florida.

GP3.3.4 Provisions of the Bonds shall not limit, in any way, any liability of the Contractor to the County, unless otherwise provided by law or this Contract.

GP3.3.5 All alterations, extensions of time, extra and additional work, and other changes to the Contract Documents may be made without securing the consent of the Surety or Sureties for the Bonds. Such changes shall not, however, alter the Surety's or Sureties' responsibility relating to the Bonds.

GP3.3.6 The Contractor may substitute Letters of Credit for the Performance, Warranty, and/or Payment Bond(s). Letter(s) of Credit shall be in the form attached hereto as Exhibit 4 or on forms otherwise approved by Miami-Dade County. Said LOCs shall be drawn on a financial institution, authorized to do business in the State of Florida, and shall be issued by a financial institution acceptable to the County. Provisions of the LOCs shall not limit, in any way, any liability of the Contractor to Miami-Dade County in the performance of the Work.

GP3.4 ADDITIONAL FINANCIAL SECURITY

If any financial institution securing the Bonds/LOC furnished in connection with the Agreement becomes unacceptable to Miami-Dade County, the Contractor shall promptly furnish additional security acceptable to Miami-Dade County to protect its interests of Miami-Dade County and of persons or firms supplying labor or materials in the execution of the Work. The financial institution shall be deemed acceptable by Miami-Dade County so long as it continues to meet the criteria set forth in GP3.3.2.

GP3.5 EXECUTION OF AGREEMENT

After Award, but prior to NTP, the Contractor shall deliver the following, properly executed items: the Agreement; the Bonds and/or Letters of Credit; the Buy America Audit and certificate; and certificates of insurance to Miami-Dade County as directed by Miami-Dade County. Miami-Dade County will execute all copies of the Agreement, approve: insurance, bonding, and all licenses and escrow agreements, and will give one original of all executed forms to the Contractor.

GP3.6 FAILURE TO EXECUTE AGREEMENT

Failure of the Contractor to submit Bonds or Letters of Credit; the Buy America Audit and certificate; licensing agreements, and certificates of insurance to

Miami-Dade County, as provided herein, shall be just cause for the County not to issue a Notice to Proceed.

GP3.7 INSURANCE

Upon County's notification, the Contractor shall, furnish to Miami-Dade County, Department of Procurement Management, 111 N.W. 1st Street, 13th Floor, Miami, Florida 33128-1974, Certificates of Insurance that indicate that insurance coverage has been obtained, which meets the requirements as outlined below:

1. Worker's Compensation Insurance for all employees of the Contractor as required by Florida Statute 440.

2. Commercial General Liability Insurance on a comprehensive basis including products and completed operations in an amount not less than $5,000,000 combined single limit per occurrence for bodily injury and property damage. Miami-Dade County must be shown as an additional insured with respect to this coverage.

3. Automobile Liability Insurance covering all owned, non-owned, and hired vehicles used in connection with the Work, in an amount not less than $300,000 combined single limit per occurrence for bodily injury and property damage.

All insurance policies required above shall be issued by companies authorized to do business under the laws of the State of Florida with the following qualifications:

The company must be rated no less than "B" as to management, and no less than "Class V" as to financial strength, according to the latest edition of Best's Insurance Guide published by A.M. Best Company, Oldwick, New Jersey, or its equivalent, subject to the approval of the County Risk Management Division.

OR

The company must hold a valid Florida Certificate of Authority as shown in the latest "List of All Insurance Companies Authorized or Approved to Do Business in Florida", issued by the State of Florida Department of Insurance and are members of the Florida Guaranty Fund.

Certificates of Insurance must indicate that for any cancellation of coverage before the expiration date, the issuing insurance carrier will endeavor to mail thirty (30) day written advance notice to the certificate holder. In addition, the Contractor hereby agrees not to modify the insurance coverage without thirty (30) days written advance notice to the County.

NOTE: MIAMI-DADE COUNTY CONTRACT NUMBER AND TITLE MUST APPEAR ON EACH CERTIFICATE OF INSURANCE.

Compliance with the foregoing requirements shall not relieve the Contractor of this liability and obligation under this section or under any other section in this Agreement.

Award of this Contract is contingent upon the receipt of the insurance documents, as required, within fifteen (15) calendar days after County notification to Contractor to comply before the award is made. If the insurance certificate is received within the specified time frame but not in the manner prescribed in this Agreement, the Contractor shall be verbally notified of such deficiency and shall have an additional five (5) calendar days to submit a corrected certificate to the County. If the Contractor fails to submit the required insurance documents in the manner prescribed in this Agreement within twenty (20) calendar days after County notification to comply, the Contractor shall be in default of the contractual terms and conditions and award of the Contract will be rescinded, unless such time frame for submission has been extended by the County.

The Contractor shall be responsible for assuring that the insurance certificates required in conjunction with this Section remain in force for the duration of the contractual period of the Contract, including any and all option years or extension periods that may be granted by the County. If insurance certificates are scheduled to expire during the contractual period, the Contractor shall be responsible for submitting new or renewed insurance certificates to the County in advance of such expiration. In the event that expired certificates are not replaced with new or renewed certificates which cover the contractual period, the County may suspend the Contract until such time as the new or renewed certificates are received by the County in the manner prescribed herein; provided, however, that this suspended period does not exceed thirty (30) calendar days. Thereafter, the County may, at its sole discretion, terminate this contract.

GP3.8 INDEMNIFICATION

The Contractor shall, to the extent of the value of the Contract, indemnify and hold harmless the County and its officers, employees, agents and instrumentalities from any and all liability, losses or damages from any third-party, including attorney's fees, which the County or its officers, employees, agents or instrumentalities may incur as a result of claims, demands, suits, causes of actions or proceedings of any kind or nature arising out of, relating to or resulting from the performance of this Contract by the Contractor or its employees, agents, servants, partners principals or subcontractors, but excepting liability, losses or damages to the extent caused by the negligence of the County and its officers, employees, agents and instrumentalities. The

Contractor shall pay all claims and losses in connection therewith and shall investigate and defend all claims, suits or actions of any kind or nature in the name of the County, where applicable, including appellate proceedings, and shall pay all costs, judgments, and attorney's fees which may issue thereon. The Contractor expressly understands and agrees that any insurance protection required by this Contract or otherwise provided by the Contractor shall in no way limit the responsibility to indemnify, keep and save harmless and defend the County or its officers, employees, agents and instrumentalities as herein provided. It is explicitly understood and agreed to by the parties of this Contract that the County may recover from the Contractor for any amount, not to exceed the total value of the Contract, special, indirect, or consequential damages for costs of capital or construction caused by the Contractor's breach of this Contract and/or negligence and/or willful misconduct. Any funds provided by any insurance company or other third party which is paid on behalf of the Contractor shall be deemed to be funds recovered from the Contractor.

GP3.9 CONTRACT DOCUMENTS

Miami-Dade County will furnish the Contractor, for its use, the following Contract Documents:

(A) One original copy of the executed Contract Forms;

(B) Three (3) sets of the Technical Provisions and General Provisions; and

(C) Three (3) sets of any related addenda.

The Contractor shall maintain the applicable portions of the Contract Documents at all locations where the Work is being performed.

END OF SECTION

SECTION GP4 – SCOPE OF WORK

GP4.1 SCOPE

GP4.1.1 The Contractor shall furnish all labor, materials, tools, equipment, transportation and supervision, and perform all designing, engineering, manufacturing, testing, furnishing, training, repairs, technical support and other services necessary and incidental to the proper, timely and satisfactory completion of the Work, satisfactorily complete all reliability periods and to do all other tasks required by the Contract Documents.

GP4.1.2 The intent of the Contract Document is to provide Miami-Dade County with one hundred and thirty-six (136) complete Metrorail Vehicles, as required by the Contract Documents, ready for operation by Miami-Dade County, as well as the satisfactory completion of all other portions of the Work. Any item or work omitted from the Contract Documents which is necessary for the proper completion of the Vehicles or other portions of the Work, although not expressly specified in the Contract Documents, shall be furnished or performed by the Contractor.

GP4.2 INTENT OF CONTRACT DOCUMENTS

GP4.2.1 The order of precedence of the Contract Documents shall be as follows:

(A) Change Orders to the Contract.

(B) Notice to Proceed.

(C) Signed Agreement.

(D) General Provisions.

(E) Technical Provisions.

(F) Contract Drawings.

(G) Referenced codes and standards.

(H) Guarantees.

(I) Contractor's Proposal, including both the Summary of Costs and Technical Proposals, upon which the Agreement is awarded.

(J) The RFP.

(K) Other documents.

GP4.2.2 The Contract Documents describe the Work. Where the Contract Documents describe portions of the Work in general terms, but not in complete detail, generally accepted industry practice shall be followed and only new materials and workmanship of the highest quality shall be used.

GP4.2.3 The Contractor shall check all furnished Contract Documents immediately upon receipt and shall immediately notify the Engineer of any discrepancies therein.

GP4.2.4 Omissions from the Contract Documents of details of Work which are necessary to carry out the intent of the Contract Documents, or which are customarily performed, shall not relieve the Contractor from performing such omitted details of Work but such details shall be performed as if set forth and described in the Contract Documents.

GP4.2.5 Anything mentioned in the Technical Provisions and not shown on the Contract Drawings, or shown on the Contract Drawings and not mentioned in the Technical Provisions, shall be treated as if shown or mentioned in both. In case of a discrepancy in the figures or information mentioned in either the Contract Drawings or Technical Provisions, the Contractor shall promptly submit the matter to the Engineer, who will provide a written decision to the Contractor to resolve the discrepancy.

GP4.2.6 In case of differences between small and large scale drawings, the drawings showing greater detail shall govern. Schedules on drawings shall take precedence over conflicting notations on drawings. In the event of discrepancy between any scaled dimensions on drawings and the figures written thereon, the figures shall govern over the scaled dimensions, unless otherwise indicated.

GP4.3 USE AND POSSESSION PRIOR TO COMPLETION

GP4.3.1 Miami-Dade County has the right to take possession of or use any completed portion or partially completed portion of the Work. Such possession or use shall not be deemed as acceptance of the Work or any portion thereof. While Miami-Dade County is in possession of such portion of the Work, the Contractor shall be relieved of the responsibility for loss or damage to only that portion of the Work, except for loss or damage resulting from the Contractor's, Subcontractor's or

Supplier's fault or negligence. The Contractor shall, however, remain responsible for completion of such portion of the Work in accordance with Contract Documents.

GP4.3.2 Notwithstanding the use for Service and possession in excess of twenty-one (21) days by Miami-Dade County of any completed portion or partially completed portion of the Work, the applicable time period for the Contractor's guarantee, and warranties shall not commence until issuance of the Certificate of Acceptance of Final Inspection or the Vehicles are first used in Service as set forth in the Contract Documents.

GP4.4 OTHER CONTRACTS

GP4.4.1 Miami-Dade County may undertake or award contracts associated with this Agreement to others for additional work, and the Contractor shall fully cooperate with such other contractors, the Engineer and Miami-Dade County in the performance and scheduling of such additional work and vice versa. The Contractor shall not interfere with, hinder or delay the performance of Work by other contractors, the Engineer or Miami-Dade County.

If the Engineer anticipates that the additional work will result in an impact to the Contractor, then a Change Notice will be issued to the Contractor in accordance with GP4.6.

The Engineer or the County will not without cause interfere with, hinder or delay the performance of work by the Contractor.

GP4.4.2 When any contractor performing work under or pursuant to another Miami-Dade County contract is employed on work that interfaces with any portion of the Work, the Contractor shall provide to the Engineer all necessary drawings, dimensions, data and other information necessary to ensure the complete, integrated and proper design, manufacture, installation and operation of interfacing and connecting parts and systems as may be required by any contractor performing work under or pursuant to another County contract that interfaces with any portion of the Work. The exchange of information will be coordinated by the Engineer and five copies of all the Contractor's data, drawings and correspondence relating to the above shall be furnished to the Engineer.

The Contractor, if it deems certain documentation to be proprietary and/or exempt from Florida's Public Records Law, must, at the time of document(s) delivery, if it wishes not to have

said documentation publicly disclosed, identify as "proprietary" on the lower right hand corner of each page of said document(s) it maintains are proprietary. In the event the County receives a public records request for said document(s), the County will notify the Contractor of the request and provide a reasonable opportunity for the Contractor to obtain a court order prohibiting the release of said documents(s). The Contractor shall bear all responsibility and costs, including attorney's fees, for any court action arising out of Contractor's identification of document(s) as proprietary.

GP4.4.3 The other contracts of which Miami-Dade County is currently aware of, and for which the Contractor may have to interface are identified, but are not limited to those identified in the Contract Documents. The Contractor will be notified under separate cover of any additional such contracts.

GP4.5 INDEPENDENT CONTRACTOR

GP4.5.1 The Contractor shall be deemed at all times to be an independent contractor and shall be wholly responsible for the manner in which it performs the Work required under the terms of the Contract Documents. The Contractor shall be liable for its own acts and omissions as well as those of its employees, agents, Subcontractors and Suppliers. Nothing contained herein shall be construed as creating an employment or agency relationship between Miami-Dade County and the Contractor.

GP4.5.2 Terms in the Contract Documents referring to direction from Miami-Dade County or the Engineer shall be construed as providing direction as to policy and the result of the Work only, and not as to means by which such result is obtained.

GP4.6 CHANGES

GP4.6.1 Miami-Dade County may, at any time, without invalidating the Agreement and without notice to the Sureties, by a written Change Order, order modifications in the Work and/or the Contract Documents, including changes, modifications, additions or deletions.

GP4.6.2 The Contractor may, at any time, submit in writing to the Engineer proposed modifications to the Work. The Engineer will review such proposals and recommend the approval or denial of such proposed modifications to Miami-Dade County, and Miami-

Dade County, at its sole discretion, may either approve or deny such proposed modifications.

The Contractor shall issue the proposed modifications in a Change Notice, upon accepting the modifications proposed in the Change Notice, Miami-Dade County will execute and issue a Change Order. The denial by Miami-Dade County of the Contractor's proposed modification shall neither provide the Contractor with any basis for a claim for damages nor an adjustment of the Time of Completion, nor shall the denial release the Contractor from its contractual responsibilities under the Contract Documents.

GP4.6.3 Except as herein provided, no order, statement or conduct of Miami-Dade County or the Engineer shall be treated as a Change Order or entitle the Contractor to an equitable adjustment hereunder.

GP4.6.4 If any Change Order causes an increase or decrease in the Contract Sum, or the time required for the performance of any part of the Work, an equitable adjustment will be made and the Agreement will be accordingly modified in writing.

GP4.6.5 Within thirty (30) days, unless the County grants a time extension, of receiving a Change Notice from the Engineer or upon submission of a proposed modification pursuant to GP4.6.2, the Contractor shall submit, with each change, modification, addition or deletion, involving an increase or decrease in the cost of performing the Work, an itemized cost breakdown covering any Subcontractor's work as well as its own. The Contractor shall also indicate any increase or decrease in the Time of Completion as a result of the proposed modification. The itemized breakdown shall include, but is not limited to, the following:

(A) Material quantities and unit prices;

(B) Engineering costs;

(C) Labor costs (identified with the specific item manufactured or installed or operation performed; classification of employee(s) involved in the work and their labor rate);

(D) Equipment costs;

(E) Overhead as determined by an independent audit of the Contractor's overhead rates and approval by the County;

(F) Profit – not to exceed 10%; and

(G) Employment taxes under the Federal Insurance Contributions Act and Federal Unemployment Tax Act.

The Contractor shall also include, as part of its submission, a subnet schedule showing a complete breakdown of all of the tasks required to complete the proposed modification, including the impact of the modification on the Project Schedule. This subnet schedule shall be in the same format as, and fully integrated into, the Project Schedule.

GP4.6.6 At the sole discretion of Miami-Dade County, adjustments in the Contract Sum resulting from a change, modification, addition or deletion in the Work shall be determined by one or more of the following:

(A) By agreement.

(B) By Miami-Dade County on the basis of the Engineer's estimate of an equitable increase or decrease in the Contract Sum.

(C) Other consideration by the County. If adjustments in the Contract sum are implemented through GP4.6, the Contractor, if not in agreement may pursue the Dispute Resolution Procedures in accordance with GP4.8.

GP4.6.7 No allowance shall be made or recovery be allowed, to the Contractor for loss of anticipated profit or overhead recovery as a result of a portion of the Work not being performed by reason of a change, modification, addition or deletion in the Work.

GP4.6.8 Adjustments in the Time of Completion of the Work shall only be allowed if the Work included in the change, modification, addition or deletion falls on the critical path of the Project Schedule or alters such critical path so as to extend the time required for completion of the Work. The critical path will be determined from the latest approved version of the Contractor's Project Schedule required by GP8.8.

GP4.6.9 The Contractor's written acceptance of a Change Order shall constitute the Contractor's final and binding agreement to the

provisions thereof and a waiver by the Contractor of any claims, whether direct or consequential in nature, resulting therefrom. Disagreement with a Change Order shall in no way excuse the Contractor from complying with, and prosecuting, the work set forth in the Change Order. Should the Contractor disagree with any Change Order, it shall, within fifteen (15) days after receipt of the Change Order, submit to the Engineer a written statement specifically setting forth the nature and monetary extent of such disagreement. No such claim by the Contractor shall be considered if it is asserted after fifteen (15) days of Contractor's receipt of the Change Order or after final payment under the Agreement has been made.

GP4.7 VALUE ENGINEERING INCENTIVE

GP4.7.1 Value Engineering is defined as cost reduction proposals initiated and developed by the Contractor for changing the requirements of the Contract Documents. This provision does not apply to any such proposal unless the proposal is specifically identified by the Contractor, at the time of submission to the Engineer, as a proposal submitted pursuant to this provision. The cost reduction proposals contemplated are those that:

(A) Would result in less costly items than those specified in the Contract Documents without impairing any of their essential functions and characteristics such as service life, reliability, availability, economy of operation, ease of maintenance, and necessary standardized features; and

(B) Would require, in order to be applied to the Agreement, a Change Order to the Agreement.

GP4.7.2 Cost reduction proposals, as defined herein, will be processed in the same manner as prescribed for any other proposal which would likewise necessitate issuance of a Change Order. At a minimum, the following information shall be submitted by the Contractor with each such proposal:

(A) A description of the difference between the Contract Documents and the proposed change, and the comparative advantages and disadvantages of each;

(B) An itemization of the requirements of the Contract Documents which must be changed if the proposal is adopted and suggested wording for revisions required;

(C) An estimate of the reduction in costs that will result from adoption of the proposal taking into account the costs of implementation by the Contractor, and the basis for the estimate;

(D) A prediction of any effects the proposed change would have on other costs to Miami-Dade County such as Miami-Dade County–furnished property costs, costs of related items, and costs of maintenance and operation; and

(E) A statement of the time by which a Change Order adopting the proposal must be issued so as to obtain the maximum cost reduction during the remainder of the Agreement, noting any effect on maintaining the Project Schedule.

GP4.7.3 Miami-Dade County shall not be liable for any delays in acting upon, or for any failure to act upon, any proposal submitted pursuant to this provision. The decision of Miami-Dade County as to the acceptance or rejection of any such proposal shall be final and binding upon the Contractor and shall not be the basis for a claim pursuant to GP4.8. Unless and until a Change Order adding such proposal to the Agreement is issued, the Contractor shall remain obligated and continue to perform the Work in accordance with the Contract Documents. Miami-Dade County, at its sole discretion, may accept, in whole or in part, any cost reduction proposal submitted pursuant to this provision by issuing a Change Order which will identify the cost reduction on which it is based.

GP4.7.4 If a cost reduction proposal submitted pursuant to this provision, or any part thereof, is accepted as a value engineering change under the Agreement, an equitable adjustment in the Contract Sum and in any other affected provisions of the Contract Documents shall be made in accordance with this provision and GP4.6. If the equitable adjustment involves a reduction in the Contract Sum, it shall be established by determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from the adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and reducing the Contract Sum by fifty percent (50%) of such decrease.

GP4.8 CLAIMS AND DISPUTES

GP4.8.1 All actions, claims and disputes arising out of, under, or in connection with, the Agreement, the Contract Documents or for a breach thereof, except as provided in or limited by GP4.6.9 (written acceptance of a Change Order), GP4.8.2 (condition precedent); GP4.8.4 (limitation on commencement), GP4.8.6 (ninety day period) and GP9.4.5 (waiver by final payment), shall only be commenced in a court of competent jurisdiction in Miami-Dade County, Florida and the Contractor hereby consents and submits to the jurisdiction of such court.

GP4.8.2 As an express condition precedent to the Contractor's right to commence a court proceeding, as set forth in GP4.8.1, the Contractor shall provide to the Contracting Officer:

(A) A written claim which shall set forth, in detail, the amount of additional compensation or time claimed and the basis for the claim and the amount claimed;

(B) All materials utilized by the Contractor in preparation of its claim, including, but not limited to, all worksheets, quotations, calculations, pricing data, estimates and correspondence relating thereto;

(C) Written evidence of, and support for, any claim, including evidence regarding liability, causation and damages, sufficient to enable the Contracting Officer to render a decision with respect to such claim; and

(D) Such other information as the Contracting Officer may reasonably request.

Within thirty (30) days of the Contractor's first knowledge of an event giving rise to a claim, the Contractor shall provide written notice to Miami-Dade County of its intent to file a claim. The Contractor shall present such claim and supporting information and evidence to the County within forty-five (45) days of its notice to the County, or within such longer period of time as the County and the Contractor may mutually agree. Within ninety (90) days of receiving all such information and evidence, the County will render a written decision with respect to the claim.

In the event the CONTRACTOR and Contracting Officer are unable to resolve their differences concerning any determination made by the Engineer or any dispute or claim arising under or

relating to the Contract, either the CONTRACTOR or COUNTY may initiate a dispute in accordance with the procedure set forth in this Section. Exhaustion of these procedures shall be a precondition to any lawsuit permitted hereunder.

The parties to this contract hereby authorize the use of a mutually agreed upon arbitrator to assist in resolving any dispute. Such arbitration shall be in accordance with the provisions of GP4.8.3.

GP4.8.3 Resolution of Potential Claims:

MDC will give a formal response to a notice of potential claim within the following time limits after all data requested by MDC or MDC's Representative have been provided: a response to potential claims under $50,000 will be given within forty-five (45) Days; a response to potential claims from $50,000 through $375,000 will be given within sixty (60) Days; and a response to potential claims over $375,000 will be given within ninety (90) Days. These time limits may be extended only by mutual agreement in writing. If MDC fails or refuses to act on a potential claim within such time, the potential claim will be deemed to have been rejected by MDC on the last day of the period within which MDC was required to act upon the potential claim, and the Contractor may proceed as though the potential claim had not been resolved.

Nonbinding Arbitration: Within fifteen (15) Days after receipt of MDC's response, or within fifteen (15) Days after the applicable time limit for MDC's response set forth herein, whichever is earlier, the Contractor may file a written objection with MDC's Representative, stating clearly and in detail the basis for its objection to MDC's response. Within fifteen (15) Days of receipt of the Contractor's objection, the Contractor or MDC may request for Nonbinding arbitration of the potential claim in accordance with the following procedure:

Notice of Nonbinding arbitration: Either MDC or the Contractor may submit any remaining dispute to nonbinding arbitration by serving a written notice of Nonbinding arbitration ("Notice of Nonbinding arbitration") on the other. The Notice of Nonbinding arbitration shall be signed, on behalf of MDC, by MDC's Representative; and, on behalf of the Contractor, by an individual having authority as its representative. The Nonbinding arbitration shall proceed in accordance with rules promulgated by the arbitrator and shall be concluded within thirty (30) Days,

unless extended by mutual agreement of the parties. MDC will be represented by MDC's Representative(s) or such other higher-level representative of its choosing, and the Contractor shall be represented by an individual(s) having authority as its representative. The entire process shall be treated as a compromise negotiation for purposes of federal and state rules of evidence.

Selection of Arbitrator: Within fifteen (15) Days of the Notice of Nonbinding arbitration referred to herein, the parties shall meet and select a disinterested third person to act as arbitrator ("Arbitrator"). If the parties fail to agree, either party may request the American Arbitration Association in Miami to appoint the Arbitrator. The Arbitrator shall be replaced within fifteen (15) Days of receipt of a written request of either party, using the procedure outlined above; provided, however, that either party may only replace the Arbitrator once.

Cost of Arbitrator: The MDC, through MDC's Representative, shall provide to the Abitrator, at no cost to the Contractor, administrative services such as conference facilities and secretarial services, excluding transcription services, which will be borne equally by both parties. Fees and expenses of the Arbitrator shall be borne equally by MDC and the Contractor.

Change Order: If MDC and the Contractor are able to resolve their dispute through Nonbinding arbitration, MDC shall promptly process any appropriate Contract Change Order.

Filing of Claim: If the potential claim has not been resolved to the satisfaction of either party by the above procedures, either party may present the Claim to the MDC County Manager for resolution. The parties hereto further agree that, upon timely request under this Section, both the Contractor and County are entitled to a hearing before the County Manager, or his designee, at which both Contractor and the County may present evidence and live testimony, in accordance with the Florida Rules of Evidence, and the right to cross-examine each other's witnesses.

Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract and in accordance with the directions of the Engineer.

GP4.8.4 No court proceeding arising from any such claim, dispute, or other matter shall or may be commenced by the Contractor until the earlier of:

(A) The date on which the Miami-Dade County Manager, or his designee, has rendered his written decision provided for in GP4.8.3; or

(B) The ninetieth (90th) day after the Contractor has provided Miami-Dade County with all the materials and evidence required by GP4.8.2, if the Contracting Officer has not rendered his written decision by that date.

Failure by the Contractor to commence a court proceeding within said thirty (30) days of the County Manager, or designee's written decision, shall result in Miami-Dade County's decision becoming final and binding upon the Contractor.

GP4.8.5 Unless otherwise agreed in writing by Miami-Dade County, the Contractor shall carry on and maintain progress of the Work pending any claim or court proceeding.

GP4.8.6 No claim may be raised by the Contractor later than ninety (90) days following the issuance by Miami-Dade County of the Acceptance Certificate.

GP4.8.7 Any court proceeding or action arising out of, under, or in connection with, the Agreement, the Contract Documents, a breach thereof, or GP4.8 shall be conducted in accordance with, and governed by, the laws of the State of Florida.

GP4.8.8 Should the Contractor sustain any damage or costs through any act or omission of any other contractor having a contract with Miami-Dade County, a subcontractor of such a contractor or any other person or entity, the Contractor shall have no claim against Miami-Dade County or the Engineer for such damage or costs, but instead, shall only have the right to recover such damage or costs from the other contractor, subcontractor, entity or person.

GP4.8.9 Notwithstanding any concurrence by the FTA, other Governmental agencies, or the State in or approval of the award of the Agreement, absent the express written consent by the FTA, other Governmental agencies, or the State, none of these entities is a party to the Agreement and shall not be subject to any claims, obligations or liabilities by the Contractor.

The Contractor agrees to include the above clause in each subcontract to the Agreement.

GP4.8.10 The Contractor's maximum liability to Miami-Dade County arising out of, or in connection with, the Agreement, including liquidated damages incurred pursuant to GP8.7, shall not exceed the total of the Contract Sum, as it may be or have been changed from time to time in accordance with the Contract Documents, provided that this limitation shall not apply to or affect, in any way: any obligation of the Contractor to indemnify and/or hold harmless Miami-Dade County for claims of third parties (including employees of the Contractor, Miami-Dade County, or the Engineer); claims for personal injury and/or third–party property damage; recovery under any insurance provided or acquired by the Contractor or the Bonds or Letters of Credit; or the Contractor's liability resulting or arising from its gross negligence or willful or intentional misconduct.

GP4.8.11 Except for, and/or to the extent covered by, liquidated damages incurred pursuant to GP8.7, neither party to the Agreement shall be liable to the other party for the loss of profits or revenue. This limitation shall not apply to or affect, in any way: any obligation of the Contractor to indemnify and/or hold harmless Miami-Dade County for claims of third parties (including employees of the Contractor, Miami-Dade County, or the Engineer); third-party claims for bodily injury and/or third–party property damage; or the Contractor's liability resulting or arising from its gross negligence or willful or intentional misconduct.

GP4.9 ASSIGNMENT OF MONIES OWED

Monies owed, or which become owed, to the Contractor under the Agreement may only be assigned to a bank, trust company, or other financing institution, including any federal lending agency, and may thereafter be further assigned and reassigned to any such institution. Written notice of such an assignment or reassignment must be provided, however, to Miami-Dade County by certified mail within ten (10) days of the assignment or reassignment. Any such assignment or reassignment shall cover all amounts payable under the Contract Documents but not already paid, and shall not be made to more than one party, except that any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing.

GP4.10 FACILITIES FOR MIAMI-DADE/ENGINEER

GP4.10.1 The Contractor and each Subcontractor and Supplier whose subcontract, agreement, or purchase order with the Contractor that has a value in excess of $2,000,000 (aggregate) shall provide office space suitable to, and for use by, Miami-Dade County, the Engineer and their representatives for overseeing the Agreement, performing inspections, witnessing tests, maintaining records, auditing the quality assurance program and reviewing design and configuration changes. Such office space shall be adequate for the intended purposes and shall be fully and adequately equipped, utilities supplied, furnished, maintained, cleaned and security protected as necessary, to the satisfaction of Miami-Dade County, by the Contractor, its Subcontractors or Suppliers. The office space provided to Miami-Dade County shall include two (2) dedicated offices, with analog and high speed telephone lines, high speed internet access, and access to a conference room and fax machine, and a minimum of three (3) dedicated parking places for all Miami-Dade County's and Engineer's personnel assigned to the Contractor's, Subcontractor's or Supplier's facility. Access to the Work and office space shall be available on a 24–hour, 7 days a week basis, if required by the Work.

GP4.11 OPERATIONS AND STORAGE AREAS

GP4.11.1 To the extent that any portion of the Work is performed on Miami-Dade County's property, all operations of the Contractor, including storage of materials and equipment, shall be confined to areas authorized and approved by the Engineer.

GP4.11.2 Temporary buildings, storage sheds, shops, offices and the like, to be located on Miami-Dade County's property, may be provided and used by the Contractor only with the prior written approval of the Engineer, and shall be built with labor and materials furnished by the Contractor at no expense to Miami-Dade County. Such facilities shall remain the property of the Contractor and shall be removed by it at its expense prior to the completion of the Agreement or within fifteen (15) days notice from the Engineer.

GP4.11.3 Limited parking facilities for the Contractor's and its Subcontractor's and Supplier's personnel will be provided by Miami-Dade County, on its property, in an area(s) to be determined by Miami-Dade County. Additional parking facilities

for the Contractor's and any Subcontractor's or Supplier's personnel shall be the Contractor's responsibility.

GP4.11.4 The Contractor shall provide three (3) trailers, to be located on the County's property, to be used in performing the Work. The County will provide the Contractor with space(s) for the trailers on the County's property at the Lehman Rail Center or on other property as otherwise determined by the County. Throughout the performance of the Work, the trailers shall be utilized by the Contractor in the following manner:

(A) One (1) trailer shall be designated for use by the County and the Engineer.

(B) One (1) trailer shall be designated for use by the Contractor and Subcontractors and Suppliers.

(C) One (1) trailer shall be designated for use as a conference room and storage area for the Work.

The Contractor shall be responsible for all permits, cost of services to, maintenance for, and subsequent removal of the trailers including, but not limited to, electric, water, sewage, telephone, fax, cleaning and security.

GP4.12 LIMITATIONS ON WORK

GP4.12.1 At no time during the course of the Agreement, unless authorized by the County, shall there be more than eight (8) Rail Vehicles on the County's property that have not been issued a Certificate of Acceptance of Final Inspection or have been placed in revenue service. The County will not permit the delivery of additional Vehicles in the event that there are eight (8) Vehicles on the County's property that have not been issued a Certificate of Acceptance of Final Inspection or have not been placed in revenue service. Any impact resulting from this condition will be the responsibility of the Contractor.

GP4.13 CONTRACTOR'S OFFICE

At least one-hundred-eighty (180) days prior to the shipment of the first Vehicle or miscellaneous parts to the County's property and thereafter, until the issuance of the Acceptance Certificate by the County, the Contractor shall assume the office space provided by MDT in Miami-Dade County, Florida, to maintain close communication with the County.

GP4.14 OPPORTUINTY RECOVERY COST (OCR)

If the Contractor proposes to perform final assembly of the new Metrorail cars in Miami-Dade County, with the exception of the Pilot vehicles, the Contractor shall be subject to the following Opportunity Cost Recovery requirements.

GP4.14.1 The Contractor shall commit to performing the following Work Activities at a final assembly facility that shall be located in Miami-Dade County:

Work Activities:

1. Truck Assembly:
   Truck mounted sub-components installation
   Axle-wheel set-brake discs installation
   Suspensions installation
   Bolster beam installation
   Traction Pneumatic system installation
   Motors-gear boxes installation
   Other truck mounted equipment installation
   Truck press loading

2. Flooring:
   Floor panel installation

3. Wiring:
   Cable trays installation
   Cables drafting
   Cables/connector connections
   Terminal board installation
   Equipment wiring

4. Equipment Installation:
   Pneumatic system installation
   Passenger Doors installation
   Lighting system installation
   Couplers-draft gears installation
   Radio, ATC, VMS PIS installation
   Under frame equipment installation:
   - Battery
   - Traction Inverter
   - Air compressor
   - Aux Inverter
   - LVPS

5. Interiors Installation:

Windows installation
Interior linings installation
Stanchions, grab handles installation
Seats installation
Driver cab and partitions installation
Ceiling installation
Electrical lockers installation

6. Truck installation:
   Car body - truck mechanical coupling and
   Pneumatic - electrical connections

7. Testing:
   Routine Vehicle Tests
   Pre-Shipment Tests

GP4.14.2 If after committing to perform the work activities, the Contractor decides not to perform any or all of the work activities in Miami-Dade County, an OCR amount of ten percent (10%) of the Contract Sum will be paid by the Contractor as outlined in GP4.14.3. The OCR will be prorated based on the number of cars for which any or all of the work activities are not performed in Miami-Dade County.

GP4.14.3 The OCR shall be paid as follows:

1. If the Contractor decides not to perform final assembly of the new Metrorail cars in Miami-Dade County, with the exception of the Pilot vehicles, the Contractor shall notify the County and the OCR shall be paid in full immediately upon notification.
2. If the Contractor decides not to perform any or all of the above activities in Miami-Dade County on a per car basis, the prorated portion of the OCR for each applicable car is due immediately upon commencement of the work activity on the applicable car.
3. In the event that the Contractor does not pay the OCR within 30 days, then the County may deduct the OCR from any invoice amounts due the Contractor.

END OF SECTION

SECTION GP5 – CONTROL OF MATERIALS

GP5.1 SOURCE OF SUPPLY AND QUALITY OF MATERIALS

GP5.1.1 For the purposes of GP5.1 only, the term "materials" shall mean all material, equipment, systems, subsystems, components, hardware software, parts and products furnished for incorporation into, or necessary to complete the Vehicles or any other portion of the Work.

GP5.1.2 Any and all materials in the possession of the Contractor, its Subcontractors or its Suppliers and designed or intended for use in the Work shall be clearly marked or otherwise designated as a portion of the Work to which the Agreement refers and shall be segregated from other materials belonging to the Contractor, its Subcontractors or its Suppliers.

GP5.1.3 The Contractor shall furnish all materials except those materials which Miami-Dade County may, at its discretion, choose to provide.

GP5.1.4 Notwithstanding any prior inspection or approval, only materials conforming to the requirements of the Contract Documents shall be utilized by the Contractor.

GP5.1.5 The materials furnished by the Contractor shall be new and not used or refurbished except as otherwise provided in the Contract Documents. The materials shall be manufactured, handled, installed and used in a proper and workmanlike manner to ensure that the Work is completed in accordance with the Contract Documents.

The materials furnished shall conform to the requirements of the Contract Documents for the purposes specified, with properties necessary to withstand, safely and reliably, the strains and stresses to which they will be subjected in normal and/or expected operation.

All materials furnished under this Agreement, to the maximum extent possible, shall be compatible with Miami-Dade County's maintenance facilities, equipment and practices.

GP5.1.6 Upon request, the Contractor shall furnish to the Engineer samples of the materials.

GP5.1.7 In addition to inspection and testing performed by the Contractor, materials shall be subject to inspection and testing by the Engineer at the place of production or manufacture, at the shipping point and at the destination. Inspection and testing, or the lack thereof, of materials by Miami-Dade County or the Engineer does not relieve the Contractor from responsibility regarding any defect therein or other failure to meet the requirements of the Contract Documents and shall not be considered as a guarantee of acceptance of any materials furnished by the Contractor.

GP5.1.8 In determining the suitability of subsystems for the Project, the County will apply the principles of Federal Acquisition Regulations (FAR) subpart 1-1.11 "Qualified Products," as applicable.

GP5.2 WARRANTIES, REPRESENTATIONS AND COVENANTS

GP5.2.1 The Contractor warrants, affirmatively represents and covenants as follows:

(A) The Contractor shall utilize its best efforts in performing the Work;

(B) The Vehicles, the Work and all material, systems, subsystems, components, parts, equipment, products, hardware and software furnished pursuant to the Contract Documents are, shall be, and shall perform, in accordance and conformance with the requirements of the Contract Documents;

(C) Vehicles, material, systems, subsystems, components, parts, equipment, products, hardware and software delivered, or supplied to Miami-Dade County are and shall be free of all security interests or other liens, claims, or encumbrances whatsoever. The Contractor further warrants and agrees to defend all such Vehicles, material, systems, subsystems, components, parts, equipment, products, hardware and software against all persons claiming an interest therein or title thereto;

(D) The Vehicles, all material, systems, subsystems, components, parts, equipment, products, hardware and software furnished pursuant to the Contract Documents and all other portions of the Work are and shall be: free from defective and inferior, as defined in GP5.2.2,

materials, equipment and/or workmanship; fit, sufficient, and suitable for their intended purpose; merchantable and of good quality; properly manufactured, and in compliance with all applicable laws, codes, regulations, and standards;

(E) All software licenses and any software functions, including any required customization, do and shall meet the requirements of the Contract Documents are and shall be consistent with the Contractor's Proposal and any additional written or oral representations or warranties of the Contractor;

(F) The Vehicles, all material, systems, subsystems, components, parts, equipment, products, hardware and software furnished pursuant to the Contract Documents and all other portions of the Work are, and shall be, free of the rightful claim of any person or entity for patent or trademark infringement;

(G) With respect to any Contractor's proprietary software associated with the Vehicles that is to be licensed rather than purchased outright or developed as a new product ("Licensed Software"), Contractor grants to Miami-Dade County, or shall ensure that any third party vendor grants to Miami-Dade County, a perpetual, non-exclusive, irrevocable, paid-up, worldwide right and license to use, display and copy the Licensed Software in order for Miami-Dade County and its employees or agents to operate, maintain, repair and support the Vehicles provided per this Agreement;

(H) The Contractor shall ensure, consistent with applicable industry standards, that the Software including, without limitation, any and all customizations thereto, shall be documented in a manner consistent with Contract Documents and the best standards of the industry;

(I) During the performance of the Work, and, for a minimum of five (5) years after the issuance of the Acceptance Certificate, the Contractor shall provide Contractor/subcontractor-developed Software (e.g., brake/propulsion, ATO, and ATP software) and firmware upgrades and support to Miami-Dade County. The Contractor shall ensure that the latest, most up–to–date, version of application and operating software and

firmware that has been released is installed in the Work, which may require multiple upgrades by the Contractor. In the event that the Contractor should cease to support or repair the Software or firmware, the Contractor shall provide to Miami-Dade County, at no cost to Miami-Dade County, software and/or firmware of like features and functionality, as determined by Miami-Dade County and at no additional cost to the County;

(J) (1) The Contractor and all of its Subcontractors and Suppliers shall, at no expense to the County, enter into a software escrow agreement with Miami-Dade County and a nationally recognized software escrow agent acceptable to Miami-Dade County. The software escrow agreement shall contain terms acceptable to Miami-Dade County and pursuant to which the Contractor and all of its Subcontractors and Suppliers shall be obligated to deliver to the escrow agent thereunder, a copy of all source codes and the software libraries used or necessary for the creation or the design of the object code version of, and the operation of, the Software, together with any compilers, linkers, loaders, or other utilities, software libraries, the written documentation used or prepared in connection therewith, which documentation shall be reasonably sufficient to enable Miami-Dade County to recreate the object code version of the Software from such source code, compilers, linkers, loaders, and utilities, and anything else designated by the Engineer (collectively, the "Escrowed Materials"). Thereafter, during the term of the software escrow agreement, the Contractor shall supplement and replace the Escrowed Materials, as necessary, such that the Escrowed Materials collectively are consistent, at all times, with the form of the Software most recently provided or delivered by the Contractor to Miami-Dade County for the Work. The Contractor, on a yearly basis, shall certify to Miami-Dade County that the Contractor is fully in compliance with the foregoing escrow provisions. Miami-Dade County shall also be entitled, at its own cost and expense, to retain the escrow agent to verify, by whatever means are then available, the contents of the Escrowed Materials.

(2) The software escrow agreement shall commence when the Certificate of Acceptance of Final Inspection is issued for the first Vehicle and shall remain in effect for ten (10) years after acceptance of the last Vehicle. At the conclusion of said ten (10) year period, MDT may elect to keep the software escrow agreement in effect at MDT's expense. At the conclusion of the agreement all Escrowed Materials shall be returned to the Contractor. If during the operation of the software escrow agreement, the Contractor or any of its Subcontractors or Suppliers cease doing business, or the Contractor fails to perform its warranty or other obligations under the Contract Document, then the Software and other items held in escrow and delivered by said entity shall be immediately delivered to, and become the property of, Miami-Dade County, free of all costs or claims.

(3) If the Contractor does not or is not able to provide all of the final, as-built drawings required by TPN 15 of the Technical Provisions, then those drawings not provided shall be placed in escrow. The requirements for escrowing the drawings, including the escrow agreement, shall be the same as those identified for the software as detailed in items (1) and (2) above.

(K) The Vehicles, the Software and all other materials, systems, subsystems, components, parts, equipment, products, and hardware furnished pursuant to the Contract Documents, including, without limitation, any and all enhancements, upgrades, customizations, modifications and the like containing or calling on a calendar or date–related function, including, without limitation, any function indexed to a CPU clock, and any function, including any that translate century data received from interfacing applications, providing specific dates or days, or calculating spans of dates or days, or otherwise manipulating, calculating, comparing or sequencing dates or date–related or date–derived data, shall correctly record, store, process, provide, and, where applicable, insert true and accurate dates and correctly perform such manipulations, calculations, comparisons and sequencings for the dates. Without limiting the generality of the foregoing, the Vehicles, the

Software, and all other materials, systems, subsystems, components, elements, parts, equipment, products and hardware shall also correctly recognize leap years as any non–century year divisible by 4, and any century year divisible by 400.

GP5.2.2 For purposes of only GP5.2, unless otherwise expressly stated in the Contract Documents, "defective or inferior" shall mean any condition, malfunction, or failure, whatsoever the cause, whether patent or latent, whereby a Vehicle, system, subsystem, component, part, equipment, product, hardware, software, material, or other portion of the Work shall, in the opinion of the Miami-Dade County and/or Engineer: require repair, replacement, or other than routine maintenance; cause a Vehicle or other portion of the Work to cease operating or operate in a degraded mode; inflict damage or harm on any Vehicle, portion of a Vehicle or other portion of the Work; or otherwise fail to conform to the requirements of the Contract Documents.

GP5.2.3 In accordance with TPN15, the Contractor shall provide full-time, on-site, and qualified maintenance personnel to provide oversight and support of preventive and corrective maintenance performed by MDT, assist with testing, failure diagnostics , and to resolve operation and maintenance problems from the time the first Pre-Production Married Pair is delivered to MDT until the issuance of the Acceptance Certificate of the final vehicle. The County shall have the right to perform normal and routine maintenance in accordance with the manufacturer's recommended parts and maintenance procedures and periodic inspections of, or on, any portion of the Work without voiding any warranty, guaranty or covenant provided pursuant to the Contract Documents or otherwise.

GP5.2.4 Unless otherwise expressly stated in the Contract Documents, the period(s) for the warranties and guarantees set forth in, referenced in, included in, or required by, the Contract Documents or otherwise expressly made by the Contractor shall commence:

(A) For each New Metrorail Vehicle, when the Certificate of Acceptance of Final Inspection is issued for the New Metrorail Vehicle or the New Metrorail Vehicle is first used in Service by Miami-Dade Transit, whichever occurs first, and shall run for a period of:

(1) Ten (10) years for carbody structure, under floor equipment supports and truck structural parts for each New Metrorail Vehicle;

(2) Eight (8) years for propulsion drive train, including the drive motor, for each New Metrorail Vehicle;

(3) Five (5) years for couplers for each New Metrorail Vehicle; and

(4) Five (5) years for all remaining materials, systems, subsystems, components, parts, hardware, software, equipment and products furnished under this Agreement for each New Metrorail Vehicle.

(B) For each spare part provided pursuant to the Contract Documents, and all other equipment, material and products provided pursuant to the Contract Documents and the remaining portions of the Work, which are not warranted pursuant to GP5.2.4(A) or GP5.2.4(B), above, when the Acceptance Certificate is issued or when the spare part, the other equipment, material or product or remaining portion of the Work is first used in Service, whichever occurs first for each such item or portion of the Work, and shall run for a period of five (5)) years thereafter.

GP5.2.5 (A) Prior to the acceptance by Miami-Dade County of the corresponding portion of the Work, the Contractor shall cause any warranties and/or guarantees received from Subcontractors, Suppliers and manufacturers to be made directly to Miami-Dade County, or if made to the Contractor, the Contractor shall immediately assign the warranty and/or guaranty to Miami-Dade County and shall furnish Miami-Dade County with written evidence of such warranties and guarantees and any assignment thereof. As necessary, all such warranties and guarantees shall be promptly enforced by the Contractor for Miami-Dade County's benefit.

(B) The aforesaid warranties and/or guarantees are in addition to, and are not intended to be nor shall be substituted for, the Contractor's warranties and guarantees.

(C) If the maker of the aforesaid warranties or guarantees fails to fulfill its obligation thereunder, the Contractor shall fulfill such obligation of the warrantor or guarantor and reimburse Miami-Dade County for any costs incurred by Miami-Dade County in replacing defective or inferior Work, hardware, software, systems, subsystems, components, parts, equipment or other materials covered by any such warranty or guaranty.

GP5.2.6 If, within the applicable warranty period, Miami-Dade County determines, in its opinion, that warranted or guaranteed Work, Vehicles, systems, subsystems, components, parts, equipment, products, hardware, software, or other materials need to be repaired or replaced because of defective or inferior material, equipment, parts or workmanship, because of a failure to conform to the requirements of the Contract Documents or because of some other failure to adhere to an applicable warranty or guaranty, Miami-Dade County will so inform the Contractor in writing and the Contractor shall, within a time specified in GP5.2.7, and without additional expense to Miami-Dade County:

(A) Repair or replace all such warranted or guaranteed Work;

(B) Repair or replace all damage to equipment, any building or contents thereof, which results from such warranted or guaranteed Work; and

(C) Repair or replace materials, equipment and parts that are used in fulfilling the warranty or guaranty.

GP5.2.7 (A) Within seven (7) days after receipt of written notification from Miami-Dade County, pursuant to GP5.2.6, the Contractor shall either agree that the defective or inferior Work, Vehicle, subsystem, component, part, equipment, product, hardware, software, or other material is covered by warranty or guaranty, or reserve judgment, until the Work, Vehicle, system, subsystem, component, part, equipment, product, hardware, software, or other material is inspected and tested by the Contractor.

(B) If the Contractor reserves judgment, the Contractor shall perform any inspections and tests necessary to verify the existence of the defective or inferior Work, Vehicle, system, subsystem, component, part, equipment,

product, hardware, software, or other material, or other non–compliance with the applicable warranty or guaranty, within seven (7) days of receipt of Miami-Dade County's written notice.

(C) When the Contractor agrees that a portion of the Work is covered by warranty or guaranty and warranty repair or replacement is required, Miami-Dade County and the Contractor shall agree, within five (5) days of such decision, on the exact scope of the repair, replacement or other work to be performed under the warranty. If no agreement is obtained within the five (5) day period, Miami-Dade County reserves the right to commence the repair, replacement or other work in accordance with GP5.2.9.

(D) After the Contractor has agreed that a portion of the Work is covered by warranty or guaranty and has mutually resolved with Miami-Dade County the work necessary to properly complete the repairs or replacement, as defined in GP5.2.6, the Contractor shall commence, within ten (10) days thereafter, such work.

GP5.2.8 (A) Miami-Dade County, consistent with its operational needs, will make the defective, inferior or non–conforming portion of the Work, Vehicle, system, subsystem, component, part, equipment, product, hardware, software, or other materials available to enable timely completion of repairs, replacement or other work in accordance with GP5.2.

(B) The Contractor, its Subcontractor or its Supplier may be permitted to use Miami-Dade County's facilities to perform warranty work, provided that such work does not interfere with or potentially violate the requirements of any of Miami-Dade County's labor or other agreements, is conducted during normal business hours, does not interfere with other Miami-Dade County activities, and is performed in accordance with Miami-Dade County's operational needs, policies and directions. At Miami-Dade County's option, however, the Contractor may be required to remove the defective, inferior, or non–conforming portion of the Work, Vehicle, system, subsystem, component, part, product, hardware, software, or other material from Miami-Dade County's property while the repairs, replacement or other work is

being performed. The Contractor shall bear all costs of transporting the portion of the Work, Vehicle, system, subsystem, component, part, product, hardware, software, or other material.

(C) Any damage to Miami-Dade County property caused by the Contractor, its Subcontractor or its Supplier in performing such repair, replacement, or other work shall be the sole responsibility of the Contractor and shall be corrected at the Contractor's expense, in a mutually agreed upon time period.

(D) The Contractor shall provide, at its own expense, all parts, tools, and labor required to complete repairs, replacement or other work.

(E) Additionally, if the repair, replacement, or other work involves or requires the redesign or modification of any Vehicle, system, subsystem, component, part, product, hardware, software, or equipment, the Contractor, at its sole expense, shall revise and update all manuals, documents, and data affected thereby.

GP5.2.9 Should the Contractor fail to: agree that a defective, inferior, or non-conforming portion of the Work is covered by warranty or guaranty; proceed within the time specified by GP5.2; or proceed in accordance with the applicable warranty or guaranty, Miami-Dade County may have such work performed by itself or others and the costs of such work shall be the responsibility of the Contractor and may be deducted from monies due, or to become due to the Contractor under the Agreement or any other contract with Miami-Dade County. In the event that final payment under the Agreement has been made, the Contractor shall, within thirty (30) days of notification from Miami-Dade County, reimburse Miami-Dade County for such costs.

GP5.2.10 If warranty work, pursuant to GP5.2, is performed by or on behalf of Miami-Dade County, the following will apply:

(A) Miami-Dade County or its representative may use systems, subsystems, components, parts, products and equipment available from its own stock or those supplied by the Contractor specifically for the repairs or replacement. The Contractor shall replace each used system, subsystem, component, part, product or equipment with a new system, subsystem, component,

part, product or equipment, or, at the Miami-Dade County's option, reimburse Miami-Dade County for the costs of the replaced system, subsystem, component, part, product or equipment, within thirty (30) days of receiving each such request. All material costs associated with replacing or refurbishing the replaced system, subsystem, component, part, product or equipment shall be borne by the Contractor.

(B) Miami-Dade County or its representative may request, in writing, that the Contractor supply replacement systems, subsystems, components, parts, products or equipment for warranty–covered repairs or replacement being performed by, or on behalf of, Miami-Dade County. The Contractor shall commence replacement of these subsystems, components, parts, products or equipment to Miami-Dade County within seven (7) days after receipt of such a request. For any part with a delivery date in excess of thirty (30) days, the Contractor shall immediately notify Miami-Dade County of the reason for the delay and what efforts the Contractor is pursuing to expedite delivery.

(C) The Contractor may request that replaced systems, subsystems, components, parts, products and equipment covered by warranty be returned to the Contractor, with all shipping costs being borne by the Contractor.

(D) Miami-Dade County shall be fully reimbursed by the Contractor for all labor, parts and other costs for all such warranty repair or replacement work performed by, or on behalf of, the County.

(E) The performance of any warranty work by Miami-Dade County shall not relieve the Contractor of any responsibility or obligations under the Contract Documents, the applicable warranty or otherwise.

GP5.2.11 If any portion of the Work or any Vehicle, system, subsystem, component, part, product, hardware, software, or equipment is repaired, rebuilt, or replaced during the applicable warranty period, the properly repaired, rebuilt or replaced portion of the Work, Vehicle, system, subsystem, component, part, product, hardware, software, or equipment shall have the unexpired warranty period of the defective, inferior, or non–conforming

portion of the Work, Vehicle, system, subsystem, component, part, product, hardware, software, or equipment or shall be free of defect and warranted for a period of one (1) year from the date of the approved completion of the referenced work, whichever period is longer.

GP5.2.12 The Contractor shall provide in the Car History Book a record, for each Vehicle at the time of Delivery for Acceptance Testing to Miami-Dade County in accordance with TPN16.

GP5.2.13 Except as otherwise set forth in the Contract Documents, the guarantees, warranties and representations set forth in, referenced in, included in, or required by, the Contract Documents are in lieu of any implied warranties, whether statutory, regulatory or common law.

GP5.2.14 The rights and remedies of Miami-Dade County under GP5.2 are not intended to be exclusive and, except as set forth in GP5.2.13, do not preclude the exercise by Miami-Dade County of any other rights or remedies provided by the Contract Documents or by law with respect to warranties, guarantees, representations, unsatisfactory work performed by the Contractor or the failure by the Contractor to adhere to the Contract Documents.

GP5.3 RELIABILITY DEFECTS

GP5.3.1 Where defects in, or failures of, a system, subsystem, component, part, or equipment do not meet the reliability requirements set forth in TPN18, a reliability defect or failure shall be deemed to have occurred. The Contractor shall retrofit, correct, repair and/or replace, to the satisfaction of the County, all such systems, subsystems, components, parts or equipment provided pursuant to the Contract Documents regardless of whether all such systems, subsystems, components, parts or equipment provided pursuant to the Contract Documents have exhibited the defect or failure and regardless of the warranty status.

GP5.3.2 In the event of the occurrence of any reliability defect or failure, as described in GP5.3.1, the County shall have the right, at its sole discretion, to direct the Contractor to correct the defect or cause of the failure, including performance of any design or engineering studies or analyses, within sixty (60) days of receipt of written notice of the defect or failure from the County. If at any time and for any reason the Contractor cannot perform said

actions within the sixty (60) days, the Contractor shall immediately notify Miami-Dade County of the reason for the delay and what efforts the Contractor is pursuing to expedite completion. Should the Contractor fail to promptly and satisfactorily comply with the foregoing requirement, the County may:

(A) Perform any engineering or design studies or analyses reasonably necessary and may thereafter require the Contractor to correct, repair, replace or retrofit any system, subsystem, component, part or equipment which is necessary for correction of the defect or failure, in which event the Contractor shall perform all work necessary to correct, repair, replace and/or retrofit all such defective or failed items within sixty (60) days of such a written request from the County;

(B) Correct the defect or failure, including performance of any engineering or design studies or analyses reasonably necessary, by any other means; or

(C) Direct that no corrective measures be taken and, as appropriate, modify the Contract Documents as necessary to reflect such action, including an equitable adjustment (reduction) in the Contract Sum in accordance with the GP4.6.

GP5.3.3 The Contractor shall be liable to and shall reimburse the County for all costs incurred by the County in correcting, or obtaining the correction of, a defect or failure covered by GP5.3 including, without limitation, costs for studies, tests, materials, supplies, equipment, labor, labor fringes, engineering, transportation, overhead, and other costs reasonably necessary to perform the corrective work or analyses.

GP5.3.4 All costs incurred by the Contractor for performing studies, tests or the corrective work, or for delay incident thereto, pursuant to GP5.3, shall be solely the responsibility of the Contractor. The Contractor shall also prepare and furnish to the County all data and reports applicable to any correction required under GP5.3 (including revision and updating of all other affected data called for under the Contract Documents) at no increase in the Contract Sum. The County shall not be liable for any costs incurred by the Contractor in complying with GP5.3.

GP5.3.5 The Time of Completion shall not be extended nor shall the Contractor's liability for liquidated damages be reduced as a result of any delay in performance of the Work caused in whole or in part by compliance with GP5.3.

GP5.3.6 Any system, subsystem, component, part or equipment replaced by the County under GP5.3 will be disposed of by the County in the manner requested by the Contractor at the Contractor's expense. If the Contractor fails to furnish disposition instructions, after a written request, the County will dispose of such items, at the Contractor's expense, in such a manner which, in the County's sole judgment, is appropriate under the circumstances.

GP5.3.7 Risk of loss of a Vehicle, system, subsystem, component, part or equipment while in transit to or from the Contractor, or otherwise not located on the County's property, pursuant to GP5.3, shall be borne by the Contractor.

GP5.3.8 All Contractor, Subcontractor and Supplier personnel working on the County's property, pursuant to GP5.3, shall be required to comply with the County's operating rules and procedures and with any safety directive which may be in effect for that location as deemed necessary by the County.

GP5.3.9 The rights and remedies of the County pursuant to GP5.3 are not intended to be exclusive and do not preclude the exercise of any other rights or remedies provided by the Contract Documents or by law.

GP5.4 MIAMI-DADE FURNISHED MATERIALS

GP5.4.1 Miami-Dade County–furnished materials, if any, will be listed or described in the Contract Documents. Such materials will be available at locations designated in the Contract Documents, or if not designated therein, will be delivered to the Worksite.

GP5.4.2 Work such as unloading, transporting from the designated delivery point, handling, storing, protecting and installing such Miami-Dade County–furnished materials shall be performed by the Contractor at its expense. The Contractor shall give the Engineer thirty (30) days written notice in advance of the desired delivery date of Miami-Dade County furnished materials, except where delivery schedules are otherwise established in the Contract Documents.

GP5.4.3 The Contractor shall be responsible for all materials furnished to it by Miami-Dade County and shall pay all demurrage and storage charges which may be incurred on such items. The Contractor shall inspect such materials upon receipt and shall immediately notify the Engineer, in writing, of any damaged materials.

GP5.4.4 If any Miami-Dade County–furnished materials are lost, or damaged from any cause, after receipt by the Contractor, the Contractor shall be liable to Miami-Dade County for the cost of replacing or repairing such Miami-Dade County–furnished materials and the costs thereof may be deducted from monies due, or to become due, the Contractor.

GP5.4.5 County-furnished materials shall be excluded from the Warranties, Representations and Covenants provisions (Section GP5.2) and the Reliability Defects provisions (Section GP5.3).

GP5.5 DEFECTIVE MATERIALS

GP5.5.1 Systems, subsystems, components, parts or equipment for the Vehicles, spare parts or other portions of the Work which are defective or otherwise do not conform to the requirements of the Contract Documents, as determined by the Engineer, may be rejected by the Engineer, whether already installed or completed. If so directed by the Engineer, the Contractor shall promptly repair or remove and replace, in a manner acceptable to the Engineer, such system, subsystem, component, part, equipment, spare part, or portion of the Work. No compensation shall be allowed to the Contractor for such repair or removal and replacement.

GP5.5.2 Rejected systems, subsystems, components, parts or equipment or other portions of the Work, the defects in which have been subsequently corrected, shall not be used in the Vehicles unless approved, in writing, by the Engineer.

GP5.5.3 Upon failure of the Contractor to repair, remove or replace defective or non–conforming systems, subsystems, components, parts, equipment, spare parts, or other portions of the Work, after notice in writing from the Engineer, Miami-Dade County may cause the defective or non–conforming systems, subsystems, components, parts, equipment, spare parts, or other portions of the Work to be repaired, removed or replaced by others. Any costs incurred by Miami-Dade County in having defective or non–conforming systems, subsystems,

components, parts, equipment, spare parts, or other portions of the Work repaired, removed or replaced shall be borne by the Contractor and such costs may be deducted from any monies due, or which become due, the Contractor.

GP5.6 USE OF BRAND NAME MATERIALS OR EQUAL

GP5.6.1 Systems, subsystems, components, parts, equipment or other materials to be incorporated into the Work may be designated in the Contract Documents by their brand names, the names of manufacturers and their catalog information or otherwise. The use of an "equal item" which the Contractor represents to be of at least equal quality and to have the required characteristics for the purpose intended may be permitted by the Engineer to be utilized by the Contractor subject to the following requirements:

(A) "Equal items" may not be used where the systems, subsystems, components, parts, equipment or other materials are designated to match others in use in Miami-Dade County Vehicles or equipment or to match maintenance facilities, equipment or practices utilized by Miami-Dade County in servicing or repairing systems, subsystems, components, parts, equipment or other material in use in Miami-Dade County Vehicles and equipment;

(B) The burden of proof as to quality and suitability of an "equal item" shall be upon the Contractor and it shall furnish information necessary for such determination, as required by the Engineer, at no additional costs to Miami-Dade County. The Engineer shall be the sole judge as to the quality and suitability of "equal items" and the Engineer's decision shall be final and binding;

(C) Where use of an "equal item" involves redesign of, or changes to, other portions of the Work, or results in the need to use maintenance tools or equipment not in the possession of Miami-Dade County or procedures differing from those procedures currently used by Miami-Dade County, the cost and time required to effect such redesign, changes or provide any required maintenance equipment or tools in quantities determined by Miami-Dade County to be necessary shall be borne by the Contractor;

(D) No tests will be made, nor action taken, relating to approval of an "equal item", until the request for substitution is made in writing by the Contractor accompanied by complete data as to the equality of the item proposed. To permit approval without delaying the Work, such request shall be made no less than thirty (30) days prior to the scheduled start of the related work;

(E) The Contract Documents may require that items be classified, rated, or certified by an organization recognized for establishing standards in the industry, such as UL, NEMA and the like. Proposals for utilization of an "equal item" shall be accompanied by reports from the listed or equivalent independent testing laboratory indicating such items do comply with the requirements of the Contract Documents. If independent testing laboratories are used, they shall be subject to prior written approval of the Engineer;

(F) Approval of an "equal item" shall only be for the characteristics or use named in such approval and shall not be used to change or modify any other requirements of the Contract Documents. Further, each approval shall be limited to the portion of the Work for which it is given; and

(G) Any and all costs and/or delays associated with utilization of an "equal item" shall be borne by the Contractor.

GP5.6.2 The specification of a brand name, system, subsystem, component, part, equipment or other material in the Contract Documents shall not relieve the Contractor from its responsibility to complete the Work in accordance with the requirements of the Contract Document. The Contractor shall notify the Engineer of any brand name, system, subsystem, component, part, equipment or other material specified in the Contract Documents which the Contractor believes inappropriate, and/or no longer available, for performing the Work and shall propose a suitable substitute for consideration by the Engineer. Change notice(s) shall be negotiated as needed.

GP5.7 PLANT AND FACILITY INSPECTIONS

Miami-Dade County, the Engineer and/or their authorized representative, may inspect, the Contractor's plant(s) or facility(ies), any materials, parts or equipment procured or manufactured at said plant or facility, as well as, may inspect, at the source of supply, any materials, parts or equipment procured and/or manufactured by a Subcontractor or Supplier or other person, for installation into, or to be used for, a Vehicle or the Work. Miami-Dade County, or its authorized representative, shall have escorted entry at all times, during normal business hours, to such parts of the plants that pertain to the manufacture or production of the Vehicles or materials, parts or equipment to be installed into or used for a Vehicle or the Work. Adequate facilities to make the necessary inspection shall be furnished, at no cost, to Miami-Dade County. The responsibility for providing satisfactory Vehicles and materials, parts and equipment to install into, or use for, the Vehicles or the Work and properly completing the Work rests entirely with the Contractor, notwithstanding any prior inspections or tests by the Miami-Dade County, the Engineer or their authorized representative.

GP5.8 SAMPLES

GP5.8.1 The Contractor shall review, approve and submit to the Engineer samples required by the Contract Documents or otherwise requested by the Engineer. Samples shall be submitted without charge to Miami-Dade County and with shipping charges prepaid. Materials, for which samples are required or requested, shall not be used in the Work until approved in writing by the Engineer.

GP5.8.2 By approving and submitting samples, the Contractor represents that it has determined and verified the suitability for the Work of all such materials and that it has checked and coordinated the data submitted with such samples with the requirements of the Contract Documents.

GP5.8.3 Unless otherwise directed, samples shall be submitted in the number requested by the Engineer and no less than thirty (30) days prior to the scheduled start of the related portion of the Work. Samples shall be identified with a label, where practical, listing the following data:

(A) Name, number and location of Project;

(B) Name of the Contractor;

(C) Material represented and its location in the Work;

(D) Name of producer, brand or trade name, if applicable, and place of origin; and

(E) Date of submittal.

GP5.8.4 The Contractor shall forward a letter to the Engineer with each shipment of samples and such letter shall contain the information required in GP5.8.3.

GP5.8.5 Samples will be reviewed and approved by the Engineer. Such review and approval shall not relieve the Contractor from its responsibility to complete Work in a timely manner and in compliance with the requirements of the Contract Documents.

GP5.8.6 One sample will be returned to the Contractor by the Engineer. Returned samples will be noted as "Approved" or "Rejected" with the reasons for rejection. Rejected samples shall be corrected and resubmitted to the Engineer in the same manner as the first submittal of samples at no cost to Miami-Dade County.

GP5.8.7 Approval of a sample shall be only for the characteristics and use named in the submittal and shall not be construed to change or modify the requirements of the Contract Documents or relieve the Contractor from its responsibility to adhere to the requirements of the Contract Documents.

GP5.8.8 Before submitting samples, the Contractor shall verify that the materials will be available in the quantities required for the Work. No change or substitution will be permitted after a sample has been approved unless written approval to change or substitute has been given to the Contractor by the Engineer.

GP5.8.9 Rejection of any sample shall be sufficient cause for refusal to consider any further samples of the same brand, make or source.

GP5.8.10 Rejection of any sample shall not provide the Contractor with any claim or cause of action against Miami-Dade County or the Engineer, including, but not limited to, for delay, costs, or damages.

GP5.9 CERTIFICATE OF COMPLIANCE FOR MATERIALS

GP5.9.1 A Certificate of Compliance shall be furnished by the Contractor to the Engineer for each lot of systems, subsystems, components, parts, equipment or other materials supplied to or used by the Contractor for the Work and the Certificate shall clearly identify such materials. The Certificate of Compliance shall be in a form acceptable to the Engineer, shall include any test results pertaining to the materials, shall be signed by a representative of the Supplier, manufacturer or producer of the materials and shall certify that the materials comply in all respects with the requirements of the Contract Documents.

GP5.9.2 Upon the receipt of written permission from the Engineer, the Contractor may use materials prior to required sampling and testing if accompanied by a Certificate of Compliance. Miami-Dade County reserves the right to reject any materials on the basis of the Engineer's review of the Certificate of Compliance.

GP5.9.3 Materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that materials are used on the basis of such Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating materials into the Work which conform to the requirements of the Contract Documents. Materials not conforming to such requirements will be subject to rejection whether installed, completed or not.

GP5.10 QUALITY ASSURANCE

The Contractor shall develop a Quality Assurance Plan (QAP) to describe, establish and implement a quality system in accordance with the Project Quality Assurance Program Plan, the General Provisions herein, and provisions for Quality Assurance set forth in TPN18. The QAP shall be subject to Miami-Dade Transit approval prior to Work commencement. The implementation and maintenance of the QAP will be subject to MDT ongoing review and monitoring. The evaluation results will be considered during the progress payments process as identified in GP8.

END OF SECTION

SECTION GP6 – CONTROL OF WORK

GP6.1 RESPONSIBILITIES OF ENGINEER

GP6.1.1 The Engineer will be Miami-Dade County's representative for the Work until the issuance of the Acceptance Certificate.

GP6.1.2 The Engineer will act on behalf of Miami-Dade County to the extent provided in the Contract Documents, unless modified in writing by Miami-Dade County.

GP6.1.3 All instructions issued by the Engineer shall have the same force and effect as if issued by Miami-Dade County.

GP6.1.4 The Engineer shall have access to the Work at all times and the Contractor shall provide facilities required for safe access to enable the Engineer to perform the Engineer's functions and responsibilities under the Contract Documents.

GP6.1.5 The Engineer will be the interpreter of the requirements of the Contract Documents. The Engineer will, when required by the progress of the Work or at the request of Miami-Dade County, render such interpretations as are necessary for the proper execution of the Work. No provision of GP6.1 shall be found to be in conflict with the procedures for settling claims or disputes set forth in GP4.8, as GP4.8 shall govern.

GP6.1.6 Notwithstanding any provision of the Contract Documents, no contractual relationship exists between the Contractor and the Engineer.

GP6.1.7 The Engineer has the authority to issue a Stop Work Order to stop a specific work activity if, in the Engineer's opinion, the Work is not being executed by the Contractor in accordance with the Contract Documents. Any costs incurred by the Contractor as a result of the issuance of a Stop Work Order shall be paid by the Contractor. Should the Contractor disagree with the issuance of the Stop Work Order, it shall follow the procedures set forth in GP4.8.

GP6.2 CONTRACTOR DOCUMENT CONTROL REQUIREMENTS

GP6.2.1 The Contractor shall establish the necessary procedures to assure effective compliance with the document control

requirements of the Contract Documents or otherwise specified by the Engineer for the preparation, submission and retention of data, drawings, specifications, product data, transmittal letters, telephone log memoranda, meeting minutes, change orders, reports, schedules and other documents (hereinafter the "Contractors Document Control Program").

GP6.2.2 The Contractor's Document Control Program shall be sufficient to allow for Engineer's review and oversight in the following areas:

(A) Technical Documents – to assure car design integrity and a record of the as–built configuration for each Vehicle.

(B) Drawings – to assure car design integrity and to provide the basis for repair, overhaul and retrofit of each Vehicle.

(C) Production Specifications – to assure Contractor's concurrence regarding the manufacturing process which shall translate the Vehicle design from a paper–defined form into an operable Vehicle.

(D) Retrofit – to assure Miami-Dade County–approved modification of Vehicles provided under this Agreement as may be required during the warranty or reliability periods.

(E) Drawing Records – to assure that the Vehicle design shall be ultimately defined in its final as–built configuration.

(F) Design Reviews – to assure design concurrence between the Engineer and the Contractor, regularly scheduled design reviews shall be conducted, at a location to be determined by the Engineer, for the purpose of monitoring progress on a real–time basis. Such concurrence shall not relieve the Contractor from responsibility to comply with all the requirements of the Contract Documents. The Contractor shall submit a design review schedule in accordance with the Contract Documents. The design review schedule shall include the decision–issue subjects of each design review.

GP6.2.3 Prior to the first submission of a drawing to the Engineer, the Contractor shall submit the following procedures for the Engineer's written approval:

(A) Drawing preparation and control;

(B) Change control;

(C) Drawing and part number identification;

(D) Manufacturing control; and

(E) Repair control.

Product and technical data and other documents required by the Contract Documents shall be submitted for the Engineer's review in the same manner as drawings.

GP6.2.4 The Contractor shall employ a system of identifying numbers for data, specifications, drawings and other documents which shall identify all distinct systems, subsystems, components, parts and equipment.

GP6.2.5 The Contractor shall permanently identify all hardware components as specified in the Contract Documents. Such markings shall coincide with engineering data. Equipment nameplates or other identification methods approved by the Engineer shall provide space for several numbers to be added in accordance with the County identification requirements.

GP6.3 CONTRACT DOCUMENTS, DATA AND DRAWINGS

GP6.3.2 Prior to completion of the Work, the Contractor shall provide an approved, conformed final technical specification marked "FINAL CONTRACTOR AS-BUILT SPECIFICATION", with all approved changes and revisions identified and incorporated. The format shall be the same as for the data required to be furnished by the Contract Documents with the addition of:

(A) Drawing number references for systems, subsystems and components;

(B) List of required factory test procedures; and

(C) List of required factory inspection procedures.

GP6.3.3 For all systems, subsystems, equipment and components the Contractor shall provide design disclosure drawings and data,

acceptable to the Engineer, to the level of repairable and replaceable parts including complete system, subsystem, equipment and component and product identification, operating and test data together with drawings portraying the composition of any assembly in terms of subordinate part numbers and the next higher assembly number. The Contractor shall submit as design disclosure drawings, vehicle assembly and subassembly drawings to convey concept, overall assembly, interfaces, systems operations, floor plan, reflected ceiling plan, underfloor and roof equipment arrangement, inside longitudinal sections of both sides of the Vehicle, exterior side elevations of both sides of the Vehicle, elevation views of both ends of the Vehicle and sufficient transverse sections through the car to show all variations in cross section such as windows and at doors. One of the transverse sections shall show an outline of extreme movements permitted by the Vehicle suspension in a failed condition.

GP6.3.4 Prior to the manufacturing of, or the installation of parts in, a Vehicle, all manufacturing, assembly and subassembly drawings for all major systems, subsystems and components shall be submitted by the Contractor to the Engineer for approval. Within ninety (90) days after the issuance of the Notice to Proceed, the Contractor shall provide a list of proposed drawings to be submitted to the Engineer for approval.

GP6.3.5 Prior to Delivery for Acceptance Testing of the first New Metrorail Vehicle to Miami-Dade County, the Contractor shall provide Miami-Dade County with a written retrofit procedure for accomplishing the following work for the Vehicles:

(A) Correction or replacement of parts in accordance with the warranties set forth in the Contract Documents; and

(B) Rework and replacement of parts in accordance with approved changes.

GP6.4 CAR HISTORY BOOK

The Contractor shall provide Miami-Dade County with a Car History Book for each Vehicle at the time of Delivery for Acceptance Testing as required by TPN16.

GP6.5 PERSONNEL FOR THE WORK

GP6.5.1 The Contractor shall secure, at its own expense, all personnel required to perform the Work. Such personnel shall not be employees of MDT, Miami-Dade County, the State, the Federal Government, or the FTA.

GP6.5.2 All personnel engaged in performing the Work shall be fully qualified to perform such Work and all key personnel shall be fluent in English.

GP6.5.3 In the event the Contractor wishes to substitute personnel for the key personnel identified by the Contractor's Proposal, the Contractor must notify the County in writing and request written approval for the substitution at least ten (10) business days prior to effecting such substitution.

GP6.5.4 The Contractor shall remove from the performance of the Work any of its or its Subcontractor's or Supplier's personnel assigned to the performance of the Work if Miami-Dade County considers such removal necessary for cause and requests such removal in writing.

GP6.5.5 All key personnel identified in the Pilot Car Personnel Transition Plan (PCPTP) who are responsible for the production of the Pilot Vehicles shall be submitted to the Engineer for approval.

GP6.6 INSPECTION

GP6.6.1 Miami-Dade County and the Engineer shall, at all times, have the right to inspect, and shall have access to, the Work and any portion thereof and the Contractor shall furnish every reasonable facility for ascertaining that the Work is performed in accordance with the requirements of the Contract Documents. The Work and any portion thereof shall be subject to the Engineer's or Miami-Dade County's on–site and off–site inspection.

GP6.6.2 Federal and State governmental entities shall also have access to, and shall have the right to inspect, the Work. State and local officials shall have the right to inspect those portions of the Work that are subject to their jurisdiction. The Contractor shall cooperate with these federal, state and local representatives in the same manner as any Miami-Dade County representative.

GP6.6.3 Inspection, or lack of inspection, approval or acceptance of any portion of the Work shall not relieve or release the Contractor from its obligations to adhere to, and fulfill the requirements of, the Contract Documents, including, but not limited to, the Contractor's warranty, reliability and guaranty obligations. Work not meeting the requirements of the Contract Documents shall be made acceptable to the Engineer. Any portion of the Work may be rejected by the Engineer, notwithstanding that such portion of the Work may have been previously inspected, approved, or accepted or that payment therefore may have been included in a prior pay estimate.

GP6.6.4 Re–inspection of any portion of the Work may be ordered by the Engineer at any time before issuance of the Acceptance Certificate. If such portion of the Work is found to be in accordance with the Contract Documents, Miami-Dade County will pay all costs incurred to perform this inspection, and an equitable adjustment of time, to the extend such re-inspection was not caused by the Contractor. If such portion of the Work is not in accordance with the Contract Documents, Contractor shall pay all costs incurred, including Miami-Dade County costs, to perform this inspection; no adjustment of time will be allotted.

GP6.6.5 The Contractor shall provide for the inspection of all incoming systems, subsystems, components, parts, equipment and other materials to insure their correctness and condition. The Engineer shall be given notice of, and shall have the right to observe, such inspections. Such inspections may utilize statistical sampling per ANSI/ASQC Z1.4 and/or ANSI/ASQC Z1.9, or Contractor shall submit alternative standards which it has verified to be equivalent to those specified herein to the Engineer for approval. Items being inspected shall be identified with corresponding drawing, specification, or other pertinent technical documents. All material certifications and test reports used as the basis for acceptance shall be retained by the Contractor.

GP6.6.6 The Contractor shall assure that all manufacturing processes, fabrication, and other production operations are accomplished under an effective production control system. In–process inspection shall be used to monitor the production control system. Miami-Dade County shall be given notice of, and shall have the right to observe such inspections. The Contractor shall maintain a system for identifying the progressive inspection status of materials, components, subassemblies and assemblies, so that such status is known throughout the

manufacturing, installation, and testing phases. The Contractor's inspection program shall also provide for surveillance to ensure proper handling, storage, preserving, packaging and marking of items during the production process.

GP6.6.7 The Contractor's inspection program shall provide for proper inspection prior to shipment of a Vehicle and other items deliverable to Miami-Dade County in accordance with the Contract Documents. The Engineer shall be given notice of, and shall have the right, to observe the inspection of each Vehicle and other items.

GP6.6.8 The Contractor shall monitor Subcontractor's inspection programs to ensure that services and materials being supplied conform to the Contract Documents.

GP6.6.9 The Contractor shall provide and maintain an inspection program acceptable to the Engineer as specified in TPN17. Records of all inspection work performed by the Contractor shall be kept complete and available to Miami-Dade County and the Engineer during the performance of the Agreement, for a period of four (4) years after the issuance of the Acceptance Certificate. Upon the issuance of the Certificate of Acceptance of Final Inspection for each Vehicle, all sign–off, inspection and test records, changes, reports, orders, modifications and quality assurance data for the Vehicle shall be provided to Miami-Dade County.

GP6.7 IDENTIFICATION OF EMPLOYEES

GP6.7.1 Photo identification badges, which shall be issued by the Contractor and which shall be subject to the Engineer's approval, shall be worn at all times by all Contractor, Subcontractor, and Supplier personnel when on Miami-Dade County's property. The badges shall show the employer's name and employee's name and identification number. Also, all other visitors, when on Miami-Dade County's property, must wear identification badges issued by the Contractor and approved by the Engineer. Such identification must be displayed in a prominent manner on each person while on Miami-Dade County's property. Access to Miami-Dade County's property will be granted only to properly identified representatives of the Contractor, Subcontractors, and Suppliers.

GP6.7.2 The size, complexity and critical nature of Miami-Dade Transit (MDT) necessitates the need to regulate and control access to

numerous departmental facilities in order to protect MDT passengers, employees and property. These regulations involve the issuance of identification badges issued by the Office of Safety and Security for MDT contractor employees performing any service on MDT property. Contractors performing work for more than one (1) day shall be required to display an MDT issued photo identification badge. This identification shall be displayed on their outer most clothing above their waistline.

Applications may be obtained from the Office of Safety and Security located at 111 N.W. 1st Street, 4th Floor, Miami, FL 33128. To obtain additional information regarding contractor identification badges, please contact the Office of Safety Security at (305) 375-4240, Monday through Friday between the hours of 8:00 AM and 5:00 PM local time.

GP6.8 WORKING CONDITIONS AT WORKSITE

GP6.8.1 A portion of the Work may be performed on or along operating Metrorail routes and in performing any such portions of the Work, the Contractor shall follow all applicable Miami-Dade County procedures, rules and instructions. Also, prior to doing any such portions of the Work, the Contractor shall notify, in writing, the Engineer of the proposed nature and schedule for such Work and receive the Engineer's approval to do such Work.

GP6.8.2 The Contractor's attention is directed to the fact that the Work may, of necessity, be performed at times near high voltage feeder cables, signal cables and other wires which may be energized. The Contractor shall always assume that such wires and cables are energized. The Contractor shall take all precautions necessary to avoid in any way contacting or damaging any of these wires, cables or their insulators and supporting structures. The Contractor shall be responsible for the protection of its and any Subcontractor's or Supplier's employees, Miami-Dade County personnel, and the general public from injury due to contact of any person, equipment or materials with such wires and cables, and shall be responsible for the costs incurred in repairing facilities damaged as a result of the performance of the Work.

GP6.9 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

GP6.9.1 The Contractor agrees to comply with section 107 of the Contract Work Hours and Safety Standards Act, 40 U.S.C. section 333, and

applicable DOL regulations, " Safety and Health Regulations for Construction " 29 C.F.R. Part 1926. Among other things, the Contractor agrees that it will not require any laborer or mechanic to work in unsanitary, hazardous, or dangerous surroundings or working conditions.

GP6.9.2 Subcontracts – The Contractor also agrees to include the requirements of this section in each subcontract. The term "subcontract" under this section is considered to refer to a person who agrees to perform any part of the labor or material requirements of a contract for construction, alteration or repair. A person who undertakes to perform a portion of a contract involving the furnishing of supplies or materials will be considered a "subcontractor" under this section if the work in question involves the performance of construction work and is to be performed: (1) directly on or near the construction site, or (2) by the employer for the specific project on a customized basis. Thus, a supplier of materials which will become an integral part of the construction is a "subcontractor" if the supplier fabricates or assembles the goods or materials in question specifically for the construction project and the work involved may be said to be construction activity. If the goods or materials in question are ordinarily sold to other customers from regular inventory, the supplier is not a "subcontractor." The requirements of this section do not apply to contracts or subcontracts for the purchase of supplies or materials or articles normally available on the open market.

END OF SECTION

SECTION GP7 – LEGAL RESPONSIBILITIES

GP7.1 LAWS TO BE OBSERVED

The Contractor shall be responsible for keeping itself informed of, and shall comply with all applicable requirements of law, including but not limited to, all applicable international, federal, state and local laws, codes, rules and regulations and any changes thereto which in any manner affect persons engaged or employed in the Work, affect the materials used in the Work, or affect, in any way, the Work, and all such orders and decrees of bodies or tribunals having jurisdiction or authority over the same. The Contractor and its officers, directors, employees, agents, Subcontractors and Suppliers shall indemnify and hold harmless Miami-Dade County and the Engineer, and all of their officers, directors, agents and employees against all claims and liabilities arising from or based upon the violation of any such requirements whether by the Contractor or its officers, directors, employees, agents, Subcontractors or Suppliers. If any discrepancy or inconsistency is discovered in the Contract Documents in relation to any requirements of law, the Contractor shall immediately report the same to Miami-Dade County in writing. However, any increase in price or time or change in the Contract requirements resulting from a change-in-law after Contract award will be negotiated accordingly.

GP7.2 PERMITS

The Contractor shall, without additional expense to Miami-Dade County, be responsible for obtaining any and all licenses and permits necessary for the proper and timely completion of the Work.

GP7.3 NONDISCRIMINATION

During the performance of this Contract, Contractor agrees to: not discriminate against any employee or applicant for employment because of race, religion, color, sex, sexual orientation, handicap, marital status, age or national origin, and will take affirmative action to ensure that they are afforded equal employment opportunities without discrimination. Such action shall be taken with reference to, but not limited to: recruitment, employment, termination, rates of pay or other forms of compensation, and selection for training or retraining, including apprenticeship and on the job training.

By entering into this Contract with the County, the Contractor attests that it is not in violation of the Americans with Disabilities Act of 1990 (and related Acts) or Miami-Dade County Resolution No. R-385-95. If the Contractor or any owner, subsidiary or other firm affiliated with or related to the Contractor is found by the responsible enforcement agency or the County to be in violation of

the Act or the Resolution, such violation shall render this Contract void. This Contract shall be void if the Contractor submits a false affidavit pursuant to this Resolution or the Contractor violates the Act or the Resolution during the term of this Contract, even if the Contractor was not in violation at the time it submitted its affidavit.

GP7.4 LABOR PROVISIONS – NONCONSTRUCTION CONTRACTS

GP7.4.1 The Contractor shall comply with section 102 of the Contract Work Hours and Safety Standards Act, as amended, 40 U.S.C. §§ 327–332 and U.S. DOL regulations, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction (also Labor Standards Provisions Applicable to Nonconstruction Contracts Subject to the Contract Work Hours and Safety Standard Act)," 29 C.F.R., Part 5.

GP7.4.2 Neither the Contractor nor any Subcontractor shall require or permit, for any part of the Work which may require or involve the employment of laborers or mechanics, any such laborer or mechanic in any work week in which he or she is employed on such portion of the Work to work in excess of eight (8) hours in any calendar day or in excess of forty (40) hours in such work week unless such laborer or mechanic receives compensation at a rate not less than one and one–half times the basic rate of pay for all hours worked in excess of eight (8) hours in any calendar day or in excess of forty (40) hours in such work week, whichever is greater.

GP7.4.3 In the event of any violation of the requirements set forth in subparagraph (b) (1) of 29 C.F.R. Section 5.5, the Contractor and any Subcontractor responsible therefore shall be liable for the unpaid wages. In addition, the Contractor and any such Subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards employed in violation of the clause set forth in subparagraph (b)(1) of 29 C.F.R. Section 5.5 in the sum of $10 for each calendar day on which such individual was required to work or permitted to work in excess of eight (8) hours or in excess of the standard work week of forty (40) hours without payment of the overtime wages required by subparagraph (b)(1) of 29 C.F.R. Section 5.5.

GP7.4.4 DOT or Miami-Dade County shall, upon their own action, or upon written request of an authorized representative of DOL,

withhold or cause to be withheld, from any monies payable on account of work performed by the Contractor or Subcontractor under the Agreement or any other federal contract with the Contractor, or any other federally–assisted contract subject to the Contract Work Hours and the Safety Standards Act which is held by the Contractor, such sums as may be determined to be necessary to satisfy any liabilities of the Contractor or any Subcontractor for unpaid wages and liquidated damages as provided in subparagraph (b)(2) of 29 C.F.R. Section 5.5.

GP7.4.5 The Contractor or Subcontractor shall maintain payrolls and basic payroll records during the course of the Work and shall preserve such documents for a period of three (3) years from the issuance of the Acceptance Certificate for all laborers and mechanics, including guards and watchmen working on the Work. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly numbers of hours worked, deductions made and actual wages paid. Furthermore, said documents shall be made available by the Contractor or its Subcontractors for inspection, copying or transcription by authorized representatives of Miami-Dade County, FTA, DOT and DOL, and the Contractor or its Subcontractors shall permit such representatives to interview employees during normal working hours.

GP7.4.6 The Contractor and its Subcontractors shall insert in any subcontracts the provisions set forth in GP7.4 and also, a clause requiring the Subcontractors to include said clauses in any lower tier subcontracts. The Contractor shall be responsible for compliance by its Subcontractors and lower tier subcontractors with the provisions of GP7.4.

GP7.5 ENVIRONMENTAL CONTROL

GP7.5.1 The Contractor shall comply with all applicable environmental, wildlife and noise law standards, orders or requirements issued pursuant to federal, state or local statute, regulation or ordinance.

GP7.5.2 Hazardous Substances – The Contractor shall bear sole responsibility for, and pay all costs for, the proper and lawful removal, transportation, treatment, storage and disposal of "hazardous substances" and "contaminants", as these terms are defined by the Comprehensive Environmental Response, Compensation and Liability Act, as amended, ("CERCLA"), 42

U.S.C. §§ 9601, et seq., and petroleum and petroleum products. Also, the Contractor shall bear responsibility for the selection of the treatment, and/or the storage or disposal facility, utilized therefore. The Contractor shall provide all certifications for removal and disposal of any hazardous substance.

The Contractor shall fully comply with CERCLA and all state, county or local counterparts to CERCLA. Before providing any notice required under CERCLA, or under any state, county or local counterpart to CERCLA, however, the Contractor shall immediately provide written notice to the Engineer.

GP7.5.3 Water Pollution Control – The Contractor shall comply with all applicable standards, orders and regulations issued pursuant to the Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251, et seq.

GP7.5.4 Air Pollution Control – The Contractor shall comply with all applicable standards, orders and regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401, et seq.

GP7.5.5 Noise Control – The Contractor shall comply with all applicable OSHA, federal, state, county and local laws and regulations regarding the prevention, control and abatement of noise.

GP7.5.6 Solid and Hazardous Waste – The Contractor shall comply with all applicable requirements of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. §§ 6901, et seq., and any other applicable federal, state, county or local laws and regulations regarding any activities involving or associated with hazardous or solid wastes.

GP7.5.7 Energy Conservation – The Contractor shall comply with all applicable standards and policies relating to energy efficiency which are contained in the State energy conservation plan issued in compliance with the Energy Policy and Conservation Act, 42 U.S.C. §§ 6321, et seq.

GP7.5.8 Recycled Products – The Contractor shall comply with all applicable requirements of Section 6002 of the Resource Conservation and Recovery Act, (as amended), 42 U.S.C. § 6962, including but not limited to, the regulatory provisions of 40 C.F.R. Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 C.F.R. Part 247.

GP7.6 OFFICIALS NOT TO BENEFIT

GP7.6.1 No member of or delegate to the Congress of the United States shall be given any share or part of the Agreement or any benefit arising therefrom.

GP7.6.2 No Board member, officer, or employee of Miami-Dade County or of a local public body during his or her tenure or for one year thereafter shall have any interest, direct or indirect, in the Agreement or the proceeds thereof.

GP7.7 GRATUITIES AND CONFLICT OF INTEREST

GP7.7.1 The County may, by written notice to the Contractor, terminate the right of the Contractor to proceed under this Contract if it is found that gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by the Contractor, or any agent or representative of the Contractor to any director, officer or employee of the County or its Engineer with a view toward securing a Contract or securing favorable treatment with respect to the awarding or amending, or the making of any determinations with respect to the performance of such contract. The County's determination shall be final subject only to judicial review.

GP7.7.2 In the event this Contract is terminated as provided in the contract documents, MDC (Miami-Dade County) shall be entitled to pursue the same remedies against the Contractor as it could pursue in the event of a breach of the Contract by the Contractor.

GP7.7.3 No member, officer or employee of MDC or of a local public body during his tenure or for one year thereafter shall have any interest, direct or indirect, in this Contract or the proceeds thereof, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit. "Local public body" means the State, any political subdivision of the State or any agency of the State or any political subdivision thereof.

GP7.7.4 No member of or delegate to the Congress of the United States of America shall be admitted to any share or part of this Contract or to any benefit arising therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

GP7.7.5 The Contractor or its employees shall not enter into any Contract involving services or property with a person or business prohibited from transacting such business with Miami-Dade County pursuant to Section 2-11.1 of the Code of Miami-Dade County, Florida, known as the "Miami-Dade County Conflict of Interest and Code of Ethics Ordinance."

GP7.7.6 In the event the Contractor, or any of its officers, partners, principals or employees are convicted of a crime arising out of, or in connection with, the work to be done or payment to be made under this Contract, this Contract, in whole or any part thereof may, at the discretion of MDC, be terminated.

GP7.7.7 The rights and remedies of MDC provided in this article are not exclusive and are in addition to any other rights and remedies provided by law or under the Contract.

GP7.7.8 In the event the Contract is terminated as provided in GP7.7, Miami-Dade County shall be entitled to:

(A) Pursue the same remedies against the Contractor as it could pursue in the event of a breach of the Agreement by the Contractor; and

(B) As a penalty, in addition to any other damages to which it may be entitled by law, exemplary damages in an amount (as determined by the County) which shall not be less than three nor more than ten times the costs incurred by the Contractor in providing gratuities to a board member, officer, agent or employee.

GP7.7.9 The rights and remedies of the County, as set forth in GP7.7, shall not be exclusive and are in addition to any other rights and remedies provided by law or under the Agreement.

GP7.7.10 The Contractor represents that:

(A) No officer, director, employee, agent, or other consultant of the County or a member of the immediate family or household of the aforesaid has directly or indirectly received or been promised any form of benefit, payment or compensation, whether tangible or intangible, in connection with the grant of this Agreement.

(B) There are no undisclosed persons or entities interested with the Contractor in this Agreement. This Agreement

is entered into by the Contractor without any connection with any other entity or person making a proposal for the same purpose, and without collusion, fraud or conflict of interest. No elected or appointed officer or official, director, employee, agent or other consultant of the County, or of the State of Florida (including elected and appointed members of the legislative and executive branches of government), or a member of the immediate family or household of any of the aforesaid:

(a) Is interested on behalf of or through the Contractor directly or indirectly in any manner whatsoever in the execution or the performance of this Agreement, or in the services, supplies or work, to which this agreement relates or in any portion of the revenues; or

(b) Is an employee, agent, advisor, or consultant to the Contractor or to the best of the Contractor's knowledge any subcontractor or supplier to the Contractor.

(C) Neither the Contractor nor any officer, director, employee, agency, parent, subsidiary, or affiliate of the Contractor shall have an interest which is in conflict with the Contractor's faithful performance of its obligation under this Agreement; provided that the County, in its sole discretion, may consent in writing to such a relationship, provided the Contractor provides the County with a written notice, in advance, which identifies all the individuals and entities involved and sets forth in detail the nature of the relationship and why it is in the County's best interest to consent to such relationship.

(D) The provisions of this Article are supplemental to, not in lieu of, all applicable laws with respect to conflict of interest. In the event there is a difference between the standards applicable under this Agreement and those provided by statute, the stricter standard shall apply.

(E) In the event Contractor has no prior knowledge of a conflict of interest as set forth above and acquires information which may indicate that there may be an actual or apparent violation of any of the above, Contractor shall promptly bring such information to the

attention of the County's Project Manager. Contractor shall thereafter cooperate with the County's review and investigation of such information, and comply with the instructions Contractor receives from the Project Manager in regard to remedying the situation.

GP7.8 FEDERAL, STATE, LOCAL AND OTHER TAXES

GP7.8.1 Except as may be otherwise provided by the Agreement, the Contract Sum shall include all federal, state, local, and foreign taxes, fees and duties, and the Contractor shall be solely responsible for the payment thereof. The Contractor's attention is directed to the fact that materials and supplies necessary for the completion of this Contract are subject to the Florida Sales and Use Tax, in accordance with Section 212.08, Florida Statutes, as amended. The Contractor shall not collect taxes upon making delivery to the County.

GP7.8.2 Miami-Dade County, upon request of the Contractor, and where appropriate, will furnish to the Contractor appropriate evidence to establish exemption from any taxes, fees or duties which may be applicable to the Agreement and from which Miami-Dade County is exempt. Appropriate evidence to establish exemption from any taxes, fees or duties will be furnished only at the discretion of Miami-Dade County.

GP7.9 PATENTS

GP7.9.1 The Contractor shall assume all costs arising from the use of patented materials, equipment, devices, or processes, not furnished by Miami-Dade County, which are used on or incorporated in the Work and shall bear all responsibility for use of such materials and shall indemnify and hold harmless Miami-Dade County, the Engineer, FTA and their duly authorized representatives, officers, directors, employees, and agents, from all suits at law, actions, cost, damage and expense (including reasonable attorney's fees), of every kind or nature, arising from, for, or on account of, the use of any patented materials, equipment, devices or processes.

GP7.9.2 If such materials, equipment, devices or processes are held to constitute an infringement and their use enjoined, the Contractor, at its expense, shall, without prejudice to any other rights of Miami-Dade County or the Engineer:

(A) Secure for Miami-Dade County the right to continue using such materials, equipment, devices or processes by suspension of the injunction or by procuring a license or licenses; or

(B) Replace such materials, equipment, devices or processes with materials, equipment, devices or processes acceptable to Miami-Dade County; or

(C) Modify such materials, equipment, devices or processes so that they become non–infringing, which modification shall not adversely affect the functionality of such materials, equipment, devices or processes, as determined by Miami-Dade County.

GP7.9.3 If any invention, improvement or discovery of the Contractor, any Subcontractor or any Supplier is conceived or first actually reduced to practice during the course of the Agreement, which invention, improvement or discovery may be patentable under the laws of the United States or any foreign country, the Contractor shall immediately notify Miami-Dade County and provide a detailed written report to Miami-Dade County. Miami-Dade County will advise FTA accordingly. The rights and responsibilities of the Contractor, any Subcontractor, any Supplier, Miami-Dade County and FTA, with respect to such invention, improvement or discovery, will be determined in accordance with all applicable federal laws, regulations, policies and any waiver thereof.

GP7.9.4 Nothing contained in GP7.9 shall imply a license to Miami-Dade County or FTA under any patent or be construed as affecting the scope of any license or other right otherwise granted to Miami-Dade County or FTA under any patent.

GP7.10 TECHNICAL DATA AND COPYRIGHTED MATERIALS

GP7.10.1 Miami-Dade County shall have the right to use, duplicate, or disclose Technical Data, as defined in GP7.10.5, in whole or in part, for the sole purposes of operating, maintaining and repairing the Vehicles.

GP7.10.2 With respect to data which is specified to be delivered under the Contact Documents and which is data other than that enumerated in GP7.10.5, the Contractor may seek to protect such data as Limited Rights Data, as defined in GP7.10.6. In order to do so, the Contractor, prior to disclosure, shall identify

to Miami-Dade County, in writing, all such data being proposed by it to be Limited Rights Data, along with sufficient evidence to support such proposal. Miami-Dade County will, within twenty (20) days of receipt of the Contractor's proposal, inform the Contractor, in writing, of the identified data which Miami-Dade County agrees to designate as Limited Rights Data. As to designated Limited Rights Data, Miami-Dade County shall have the right to use, duplicate or disclose Limited Rights Data, in whole or in part, with the express limitation that such Limited Rights Data shall not, without the written permission of the party furnishing such data:

(A) Be released or disclosed, in whole or in part, outside Miami-Dade County, except as may be required under applicable law, regulation or rule or by order of court.

(B) Be used by a party other than Miami-Dade County except for emergency repair, overhaul work or safety purposes; provided that such party shall not further use, release or disclose such Limited Rights Data. Miami-Dade County shall not, however, be liable to the Contractor or others for any action, claim or injury arising out of, or as a result of, a third party's use, release or disclosure of Limited Rights Data disclosed to Miami-Dade County by the Contractor or others.

GP7.10.3 As to the data which is approved by Miami-Dade County as Limited Rights Data, the Contractor shall mark all such data with a legend which suitably recites the limitations set forth in GP7.10.2. To the extent the Contractor does not designate data as Limited Rights Data, or does not provide the restrictive markings on the data, then Miami-Dade County may treat the data as unrestricted data pursuant to GP7.10.1. Nothing herein, however, shall impair the right of Miami-Dade County to use data similar or identical to any Limited Rights Data, which data is acquired from other sources or which is generally available in the public domain.

GP7.10.4 The Contractor shall notify Miami-Dade County of all devices or processes covered by Technical Data or otherwise disclosed or used by or for Miami-Dade County pursuant to the Agreement which are the subject of patents owned by the Contractor, any Subcontractor or any Supplier and all appropriate patent markings shall be included on such devices or on relevant Technical Data.

GP7.10.5 The term "Technical Data" shall include all "Subject Data" as defined in GP7.10.8. Examples of Technical Data shall include, but not be limited to, the following:

(A) Any manuals or instructional materials prepared for installation, operation, maintenance, or training purposes related to the Work.

(B) Materials pertaining to end items, components, or processes which were prepared for the purpose of identifying sources, size, configuration, mating and attachment characteristics, functional characteristics, and performance requirements.

(C) Other materials which have been, or are, normally furnished without restriction by the Contractor, Subcontractor or Supplier.

(D) Other specifically described materials which the parties have agreed will be furnished without restriction.

GP7.10.6 The term "Limited Rights Data" shall mean data that embodies trade secrets or constitutes confidential or privileged commercial or financial information, to the extent that such data pertains to items, components, or processes developed at private expense.

GP7.10.7 The Contractor agrees to and does hereby grant to the County, and its directors, officers, agents, and employees acting within the scope of their official duties, a royalty–free, nonexclusive and irrevocable license throughout the world for the County to publish, translate, reproduce, deliver, perform, dispose of, and to authorize others to so do, all Technical Data now or hereafter covered by copyright as it relates to the operation, maintenance, upgrade and retrofit of equipment furnished in whole or in part through the Contract. Such copyrighted matter shall not be included in Technical Data furnished hereunder without the written permission of the copyright owner for the County to use such copyrighted matter in the manner herein described. The Contractor shall notify the County, in writing, of each notice or claim of copyright infringement or infringement of other intellectual property rights received by the Contractor with respect to any Technical Data delivered hereunder.

GP7.10.8 (A) The term "Subject Data" as used herein means recorded information, whether or not copyrighted, that is delivered or specified to be delivered pursuant to the Contract

Documents. The term includes graphic or pictorial delineations in media such as drawings or photographs; text in specifications or related performance or design-type documents; machine forms such as magnetic storage media, punched cards, magnetic tape or computer memory printouts; and information retained in computer memory. Examples include, but are not limited to: computer software, engineering drawings and associated lists, specifications, standards, process sheets, manuals, technical reports catalog item identifications and related information. The term does not include financial reports, costs analyses and similar information incidental to contract administration.

(B) The following restrictions apply to all Subject Data first produced in the performance of the Agreement:

(1) Except for its own internal use, the Contractor may not publish or reproduce such data, in whole or in part, or in any manner or form, nor may the Contractor authorize others to do so, without the written consent of Miami-Dade County, until such time as Miami-Dade County may have either released or approved the release of such data to the public; this restriction on publication, however, does not apply to agreements with academic institutions.

(2) As authorized by 49 C.F.R., Part 18.34, FTA reserves a royalty–free nonexclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, for Government purposes:

(a) Any work developed under a grant, cooperative agreement, sub–grant, sub–agreement or third party contract, irrespective of whether or not a copyright has been obtained; and

(b) Any rights of copyright to which Miami-Dade County, the Contractor, any Subcontractor or any Supplier purchases ownership with federal assistance.

(C) When FTA provides assistance for a contract involving planning, research, development or a demonstration, FTA's intent is to increase the body of mass

transportation knowledge, rather than to limit the benefits of the project to those parties that have participated therein. Therefore, the Contractor understands and agrees that, in addition to the rights set forth in GP7.10.8 (B)(2), FTA may make available to any FTA recipient, sub–grantee, sub–recipient, contractor, third party contractor or third party subcontractor, either FTA's license in the copyright to the Subject Data derived under the Agreement or a copy of the Subject Data first produced under the Agreement.

(D) GP7.10.8 (A) through (C) are not applicable to material furnished to the Contractor by Miami-Dade County or FTA and incorporated in the Work; provided that such incorporated material is identified by the Contractor at the time of the performance of the portion of the Work in question.

(E) In the event that the Work is not completed, all data developed under the Agreement shall become Subject Data and shall be delivered as Miami-Dade County may direct.

GP7.10.9 The Contractor shall indemnify and hold harmless, Miami-Dade County, FTA and their directors, officers, agents and employees against any liability, including costs, expenses and attorney's fees, resulting from any willful or intentional violation by the Contractor or its Subcontractors or Suppliers of proprietary rights, copyrights or right of privacy, arising out of the publication, translation, reproduction, delivery, use or disposition of any data or drawings furnished under the Agreement.

GP7.11 ENTIRE AGREEMENT

All the agreement between Miami-Dade County and the Contractor is included in the Contract Documents and no warranties, expressed or implied, representations, promises, or statements have been made by Miami-Dade County unless set forth therein in writing and no change or waiver of any provision in the Contract Documents shall be valid unless made in writing and executed by Miami-Dade County.

GP7.12 AGENT TO ACCEPT SERVICE

During the performance of this Agreement and for a period of four (4) years after the issuance of the Acceptance Certificate, the Contractor shall maintain, within Miami-Dade County, Florida, an agent to accept, on its behalf, notice or

service of any legal process and shall keep Miami-Dade County advised of such agent's name and address. The Contractor shall submit a letter to the County titled "Contractor Agent to Accept Service" and submit it to the Contracting Officer 10 days after NTP.

GP7.13 ACCESS TO AND RETENTION OF DOCUMENTS

GP7.13.1 The Contractor shall provide Miami-Dade County, FTA, the Comptroller General of the United States, the State of Florida, Miami-Dade County, and any of their authorized representatives access to any work, books, documents, papers and records of the Contractor which pertain or relate to this Agreement or the Work for the purposes of making audits, examinations, excerpts and/or transcriptions during the performance of the Work and for a period of four (4) years after the date of the issuance of the Acceptance Certificate, except in the event of litigation or settlement of claims regarding or arising from the performance of this Agreement or the Work, in which case the Contractor shall maintain all such documents until all such litigation or settlement of claims have been fully completed and all appeals or exceptions exhausted.

GP7.13.2 The Contractor shall permit any of the foregoing parties to reproduce by any means whatsoever or to copy any documents pertaining or relating to this Agreement or the Work.

GP7.13.3 Upon the completion of the periods set forth in GP7.13.1, the Contractor shall not destroy any such documents and data without first offering them, free of charge, to Miami-Dade County.

GP7.13.4 The Contractor shall include, or have included, the requirements of GP7.13 in all subcontracts of any tier.

GP7.14 UTILIZATION OF DISADVANTAGED BUSINESS ENTERPRISES

GP7.14.1 AFFIRMATIVE ACTION OBLIGATION

(A) Policy. It is the policy of the Department of Transportation and Miami-Dade County that DBE Contractors as defined in 49 CFR Part 26 and this Provision shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal Funds under this project. Consequently, the DBE requirements of 49 CFR Part 26 apply to this project.

(B) DBE Obligation. The Contractor agrees to ensure that DBE Contractors as defined in 49 CFR Part 26 and this Provision have the maximum opportunity to participate in the performance of contracts and subcontracts financed in whole or in part with Federal Funds provided under this project. In this regard the Contractor shall take all necessary and reasonable steps in accordance with 49 CFR Part 26 and this Provision to ensure that DBE Contractors have the maximum opportunity to compete for and perform contracts. The Contractor shall not discriminate on the basis of race, color, national origin, sexual orientation, or sex in the award and performance of DOT-assisted contracts.

All determinations of compliance or non-compliance of the Contractor with the requirements of this Provision, and of the appropriate consequences of non-compliance, shall be final and binding, except for administrative reconsideration from an adverse decision by MDC as provided in Section 26.53. All determinations shall be final and the result is not administratively appealable to the U.S. Department of Transportation. Nothing in this Provision shall be construed to diminish the legal responsibility or authority of MDC.

GP7.14.2 STATED GOAL

A "Stated Goal" is to have portions of the Work under the contract performed by qualified DBE firms owned and controlled by individuals who are socially or economically disadvantaged for prices totaling not less than the percentage of the contract price set out in the Bid/Price Proposal Form. For the purposes of DBE participation for this contract, the Stated Goal is established by the Transit Vehicle Manufacturer in its DBE submittal made directly to the FTA.

GP7.15 AMERICANS WITH DISABILITIES ACT

The Contractor shall comply with, and assure, that the Work complies with all applicable requirements of the Americans with Disabilities Act of 1990, 42 U.S.C. §§ 12101 et seq.; 49 U.S.C. § 5301(d); Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794; and all corresponding or similar state, county, or local laws, codes, rules, and regulations.

GP7.16 PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS OR RELATED ACTS

GP7.16.1 The applicable provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31, shall apply to this Agreement. Upon execution of the Agreement, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to this Agreement or the FTA assisted project for which this Agreement is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Government reserves the right to impose the penalties of the Program Fraud Civil Remedies on the Contractor to the extent the Government deems appropriate.

GP7.16.2 The Contractor shall include, or have included, the requirements of GP7.16 in all subcontracts of any tier.

GP7.17 USE OF MIAMI-DADE NAME IN CONTRACTOR ADVERTISING OR PUBLIC RELATIONS

GP7.17.1 The Contractor shall not publish, or allowed to be published, in any advertisements, public relations programs or other documents, any information or data related to this Agreement or the Work, until after the Contractor has submitted such proposed document to, and received prior written approval from Miami-Dade County.

GP7.17.2 The Contractor shall include, or have included, the requirements of GP7.17 in all subcontracts of any tier.

GP7.18 CARGO PREFERENCE

GP7.18.1 The Contractor shall use privately owned United States–flag commercial vessels to ship at least fifty (50) percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this Agreement to the extent such vessels are available at fair and reasonable rates for United States–flag commercial vessels.

GP7.18.2 The Contractor shall furnish within twenty (20) working days following the date of loading for shipments originating within the

United States or within thirty (30) working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "on–board" commercial bill–of–lading in English for each shipment of cargo described in the preceding subparagraph to the Division of National Cargo, Office of Markets Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the Contractor in the case of a subcontractor's bill–of–lading).

GP7.18.3 The Contractor shall include, or have included, the requirements of GP7.18 in all subcontracts of any tier when the subcontract may involve the transport of equipment, material or commodities by ocean vessel.

GP7.19 FLY AMERICA

GP7.19.1 International air transportation of any persons involved in or property acquired for this Agreement shall be provided by U.S.–flag air carriers to the extent service by these carriers is available, as required by the International Air Transportation Fair Competitive Practices Act of 1974, as amended, 49 U.S.C. § 40118, and in accordance with U.S. General Services Administration regulations pertaining to the use of United States flag air carriers, 41 C.F.R. § 301–3.60(b).

GP7.19.2 The Contractor shall include, or have included, the requirements of GP7.19 in all subcontracts of any tier.

GP7.20 PRIVACY ACT

The Contractor shall comply with the Privacy Act of 1974, 5 U.S.C. § 552a, and the regulations thereunder.

GP7.21 GOVERNING LAW

Unless otherwise specifically stated in the Contract Documents, the Agreement shall be governed by the laws of the State of Florida as they may from time to time be in effect, without giving effect to its conflicts of law provisions.

GP7.22 INSPECTOR GENERAL REVIEW

GP7.22.1 MIAMI-DADE COUNTY INSPECTOR GENERAL REVIEW

A. INDEPENDENT PRIVATE SECTOR INSPECTOR GENERAL REVIEW

Pursuant to Miami-Dade County Administrative Order 3-20 and in connection with any award issued as a result of this Solicitation, the County has the right to retain the services of an Independent Private Sector Inspector General ("IPSIG"), whenever the County deems it appropriate to do so. Upon written notice from the County, the selected Proposer shall make available, to the IPSIG retained by the County, all requested records and documentation pertaining to this Solicitation or any subsequent award, for inspection and copying. The County will be responsible for the payment of these IPSIG services, and under no circumstance shall the Proposer's cost/price for this Solicitation be inclusive of any charges relating to these IPSIG services. The terms of this provision herein, apply to the Proposer, its officers, agents, employees and assignees. Nothing contained in this provision shall impair any independent right of the County to conduct, audit or investigate the operations, activities and performance of the selected Proposer in connection with this Solicitation or any contract issued as a result of this Solicitation. The terms of this provision are neither intended nor shall they be construed to impose any liability on the County by the selected Proposer or third party.

B. MIAMI-DADE COUNTY INSPECTOR GENERAL REVIEW
According to Section 2-1076 of the Code of Miami-Dade County, as amended by Ordinance No. 99-63, Miami-Dade County has established the Office of the Inspector General which may, on a random basis, perform audits on all County contracts, throughout the duration of said contracts, except as otherwise provided below.

GP7.23 BUSINESS APPLICATION

The Contractor shall be a registered vendor with the County – Department of Procurement Management, for the duration of this Agreement. It is the responsibility of the Contractor to file the appropriate Vendor Application and to update the Application file for any changes for the duration of this Agreement, including any option years.

Section 2–11.1(d) of Miami-Dade County Code as amended by Ordinance 00–1, requires any County employee or any member of the employee's immediate family who has a controlling financial interest, direct or indirect, with Miami-Dade County or any person or agency acting for Miami-Dade County from competing or applying for any such contract as it pertains to this solicitation, must first request a conflict of interest opinion from the County's Ethic Commission prior to their or their immediate family member's entering into any

contract or transacting any business through a firm, corporation, partnership or business entity in which the employee or any member of the employee's immediate family has a controlling financial interest, direct or indirect, with Miami-Dade County or any person or agency acting for Miami-Dade County and that any such contract, agreement or business engagement entered in violation of this subsection, as amended, shall render this Agreement voidable. For additional information, please contact the Ethics Commission hotline at (305) 579–2593.

GP7.24 LOCAL, STATE, AND FEDERAL COMPLIANCE REQUIREMENTS

Contractor agrees to comply, subject to applicable professional standards, with the provisions of any and all applicable Federal, State and the County orders, statutes, ordinances, rules and regulations which may pertain to the Services required under this Agreement, including but not limited to:

(A) Equal Employment Opportunity (EEO), in compliance with Executive Order 11246 as amended and applicable to this Contract.

(B) Environmental Protection Agency (EPA), as applicable to this Contract.

(C) Miami-Dade County Code, Chapter 11A, Article 3. All contractors and subcontractors performing work in connection with this Contract shall provide equal opportunity for employment because of race, religion, color, age, sex, national origin, sexual preference, disability or marital status. The aforesaid provision shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in a conspicuous place available for employees and applicants for employment, such notices as may be required by the Dade County Fair Housing and Employment Commission, or other authority having jurisdiction over the work setting forth the provisions of the nondiscrimination law.

(D) "Conflicts of Interest" Section 2–11 of the County Code, and Ordinance 01–199.

(E) Miami-Dade County Code Section 10–38 "Debarment".

(F) Miami-Dade County Ordinance 99–5, codified at 11A–60 et. seq. of Miami-Dade Code pertaining to complying with the County's Domestic Leave Ordinance.

(G) Miami-Dade County Ordinance 99–152, prohibiting the presentation, maintenance, or prosecution of false or fraudulent claims against Miami-Dade County.

(H) Miami-Dade County Code of Business Ethics; Section 2-8.1(i) Code of Miami-Dade County.

Notwithstanding any other provision of this Agreement, Contractor shall not be required pursuant to this Agreement to take any action or abstain from taking any action if such action or abstention would, in the good faith determination of the Contractor, constitute a violation of any law or regulation to which Contractor is subject, including but not limited to laws and regulations requiring that Contractor conduct its operations in a safe and sound manner.

GP7.25 CONFLICT OF INTEREST

The Contractor represents that:

(A) No officer, director, employee, agent, or other consultant of the County or a member of the immediate family or household of the aforesaid has directly or indirectly received or been promised any form of benefit, payment or compensation, whether tangible or intangible, in connection with the grant of this Agreement.

(B) There are no undisclosed persons or entities interested with the Contractor in this Agreement. This Agreement is entered into by the Contractor without any connection with any other entity or person making a proposal for the same purpose, and without collusion, fraud or conflict of interest. No elected or appointed officer or official, director, employee, agent or other consultant of the County, or of the State of Florida (including elected and appointed members of the legislative and executive branches of government), or a member of the immediate family or household of any of the aforesaid:

i. Is interested on behalf of or through the Contractor directly or indirectly in any manner whatsoever in the execution or the performance of this Agreement, or in the services, supplies or work, to which this Agreement relates or in any portion of the revenues; or

ii. Is an employee, agent, advisor, or consultant to the Contractor or to the best of the Contractor's knowledge any subcontractor or supplier to the Contractor.

(C) Neither the Contractor nor any officer, director, employee, agency, parent, subsidiary, or affiliate of the Contractor shall have an interest which is in conflict with the Contractor's faithful performance of its obligation under this Agreement; provided that the County, in its sole discretion, may consent in writing to such a relationship, provided the Contractor provides the County with a written notice, in advance, which identifies all the individuals and entities involved and sets forth in detail the nature of the relationship and why it is in the County's best interest to consent to such relationship.

(D) The provisions of this Article are supplemental to, not in lieu of, all applicable laws with respect to conflict of interest. In the event there is a difference between the standards applicable under this Agreement and those provided by statute, the stricter standard shall apply.

(E) In the event Contractor has no prior knowledge of a conflict of interest as set forth above and acquires information which may indicate that there may be an actual or apparent violation of any of the above, Contractor shall promptly bring such information to the attention of the County's Project Manager. Contractor shall thereafter cooperate with the County's review and investigation of such information, and comply with the instructions Contractor receives from the Project Manager in regard to remedying the situation.

GP7.26 PREVENTION OF DRUG AND ALCOHOL MISUSE

The Contractor shall comply with the Department of Transportation's regulations on the Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations (49 CFR Part 655). As a recipient of Federal financial assistance, the Miami-Dade Transit (MDT) is required to insure complicity from all contractors performing safety-sensitive functions.

Safety-sensitive functions are defined as any of the following duties:

- Operating a revenue service vehicle, including when not in revenue service.
- Operating a non-revenue service vehicle when a commercial drivers license is required.
- Controlling dispatch or movement of a revenue service vehicle.
- Maintaining a revenue service vehicle or equipment used in revenue service, unless the recipient receives section 18 funding and contracts out such services.
- First line supervisors of anyone operating, controlling, and maintaining the movement of revenue and non-revenue vehicles.
- Firearm bearing police and security personnel.

Accordingly, the Contractor agrees to establish and implement a drug and alcohol-testing program that complies with 49 CFR Parts 655 and 40. The Contractor shall permit any authorized representative of the United States DOT or its operating administrations, the State Oversight Agency of Florida, or the Miami-Dade Transit, to inspect the facilities and records associated with the implementation of the drug and alcohol testing program as required under 49

CFR Part 655 and review the testing process.

The Contractor agrees further to certify its compliance with 49 CFR Parts 655 and 40 on a quarterly and annual basis and submit the Management Information System (MIS) report before February 15th of each year. The report shall be submitted to the following address with a copy of the transmittal to the Engineer.

Miami-Dade Transit Office of Civil Rights
Attn: Drug and Alcohol Compliance Officer
701 NW 1st Court, 17th Floor
Miami, FL 33136

To certify compliance, the Contractor shall use the "Substance Abuse Certifications" in the "Annual List of Certifications and Assurances for Federal Transit Administration Grants and Cooperative Agreements," which is published annually in the Federal Register.

The Contractor agrees to submit within 30 days following the Notice to Proceed (NTP) a copy of its manual delineating its 49 CFR 655 compliant drug and alcohol policy and implementation of its testing program.

The Contractor understands agrees that failure to submit the required policy documents within the allotted time frame may result in the suspension of business activity. Following the suspension of business activity, the Contractor shall be given a reasonable amount of time to submit the necessary reports. If the Contractor does not submit the required information within the allotted time frame this Contract may be declared null and void.

GP7.26.1 PRIVACY

Should the Contractor, its subcontractors or its employees administer any system of records on behalf of the County or Federal Government, the following terms and conditions are applicable:

(A) The Contractor agrees:

(1) To comply with the Privacy Act of 1974, 5 U.S.C. & 552a (the Act) and regulations thereunder, when performance under the contract involves the design, development, or operation of any system of records on individuals to be operated by the Contractor, its subcontractors or employees to accomplish a Government function;

(2) To notify the Government when the Contractor anticipates operating a system of records on behalf of the

Government in order to accomplish the requirements of this Contract, if such system contains information about individuals, which information will be retrieved by the individual's name or other identifier assigned to the individual. A system of records subject to the Act may not be employed in the performance of this Contract until the necessary approval and publication requirements applicable to the system have been carried out. The Contractor agrees to correct, maintain, disseminate, and use such records in accordance with the requirements of the Act, and to comply with all applicable requirements of the Act;

(3) To include the Privacy Act Notification contained in this Contract in every subcontract solicitation and in every subcontract when the performance of work under that proposed subcontract may involve the design, development, or operation of a system of records on individuals to be operated under the Contract to accomplish a Government function; and

(4) To include this clause, including this paragraph, in all subcontracts under which work for this Contract is performed or which is awarded pursuant to this Contract or which may involve the design, development, or operation of such a system of records on behalf of the Government.

(B) For purposes of the Privacy Act, when the contract involves the operation of a system of records on individuals to accomplish a Government function, the Contractor, subcontractor and any of their employees are considered to be an employee of the Government with respect to the Government function. The requirements of the Act, including the civil and criminal penalties shall not apply with regard to contracts effective prior to September 27, 1975. In addition, failure to comply with the provisions of the Act or of this clause will make this Contract subject to termination.

(C) The terms used in the foregoing sections have the following meanings:

(1) "Operation of a system of records" means performance of any of the activities associated with maintaining the system of records on behalf of the

Government including the collection, use and dissemination of records.

(2) "Record" means any item, collection, or grouping of information about an individual that is maintained by the Contractor on behalf of the Government, including, but not limited to, his education, financial transactions, medical history, and criminal or employment history and that contains his name, or the identifying number, symbol, or other identifying particular assigned to the individual, such as a finger or voice print or a photograph.

(3) "System of records" on individuals means a group of any records under the control of the Contractor on behalf of the Government from which information is retrieved by the name of the individual or by some identifying number, symbol or other identifying particular assigned to the individual.

GP7.27 INCORPORATION OF FEDERAL TRANSIT ADMINISTRATION (FTA) TERMS:

(A) The preceding provisions include, in part, certain Standard Terms and Conditions required by the U.S. Department of Transportation (DOT), whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1F or any revisions thereto, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all DOT or FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any Authority requests which would cause the Authority to be in violation of the FTA terms and conditions.

(B) The Contractor agrees to include this clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to the provisions.

GP7.28 WALSH – HEALEY PUBLIC CONTRACTS ACT (DEC 1996)

If this Contract is for the manufacture or furnishing of materials, supplies, articles, or equipment in an amount which exceeds or may exceed $10,000 and is subject to the Walsh-Healey Public Contracts Act, as amended (41 U.S.C. 35-45), the following terms and conditions apply:

(A) All stipulations required by the Act and regulations issued by the Secretary of Labor (41 CFR Chapter 50) are incorporated by reference.

These stipulations are subject to all applicable rulings and interpretations of the Secretary of Labor that are now, or may be hereafter, be in effect.

(B) All employees whose work relates to this contract shall be paid not less than the minimum wage prescribed by regulations issued by the Secretary of Labor (41 CFR 50-202.2). Learners, student learners, apprentices, and handicapped worker may be employed at less that the prescribed minimum wage (see 41 CFR 50-202.3) to the same extent that such employment is permitted under Section 14 of the Fir Labor Standards Act (41 U.S.C. 40).

GP7.29 DAVIS – BACON ACT, AS AMENDED

40 U.S.C. §§ 3141 *et seq.*, pursuant to FTA enabling legislation requiring compliance with the Davis – Bacon Act at 49 U.S.C. § 5333(a), and implementing U.S. DOL regulations, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction (also Labor Standards Provisions Applicable to Nonconstruction Contracts Subject to the Contract Work Hours and Safety Standards Act)," 29 C.F.R. Part 5.

END OF SECTION

SECTION GP8 – PROSECUTION AND PROGRESS

GP8.1 WORK TO BE PERFORMED BY CONTRACTOR

The Contractor shall be responsible for all of the Work to be performed on the Contract by its own personnel and all subcontractors and suppliers.

GP8.2 ASSIGNMENT

The Agreement or the performance thereof may not be assigned, sold, transferred or disposed of in any manner by the Contractor, except upon the written consent of Miami-Dade County.

GP8.3 SUBCONTRACTS

GP8.3.1 The Contractor may not contract or subcontract any of the Work, which agreement, subcontract or purchase order has a value in excess of $2,000,000 without the prior written approval by Miami-Dade County of the proposed agreement, subcontract or purchase order, which approval shall be provided at Miami-Dade County's sole discretion.

GP8.3.2 Additionally, the Contractor may not contract or subcontract any of the Work, which agreement, subcontract or purchase order has a value in excess of $2,000,000 to any proposed Subcontractor or Supplier other than the entity or person identified as the proposed prime Subcontractor or Supplier for said portion of the Work in the Contractor's Proposal upon which the Agreement is awarded, or in the Contractor's approved Management Plan (TPN16), without the prior written approval by Miami-Dade County.

GP8.3.3 Prior to Miami-Dade County's review of a proposed agreement, subcontract or purchase order, or proposed Subcontractor or Supplier, the Contractor shall provide Miami-Dade County with the name of the proposed Subcontractor or Supplier, the task to be performed by the proposed Subcontractor or Supplier, and the qualifications of the proposed Subcontractor or Supplier to perform said portion of the Work.

GP8.3.4 The Contractor shall provide to Miami-Dade County an executed Certification of Proposed Subcontractor from each proposed subcontractor for the Work. The eligibility of a proposed subcontractor to participate in the Work will be

determined, in part, in accordance with the applicable FTA regulations.

GP8.3.5 The Contractor shall require and ensure that the Certifications Regarding Lobbying is executed by each Subcontractor for all Subcontracts exceeding $100,000 at any tier and, if applicable, the Disclosure of Lobbying Activities form. All such forms shall be forwarded to Miami-Dade County, whereupon, Miami-Dade County will forward same to the FTA in accordance with 49 CFR, Part 20.

GP8.3.6 The Contractor shall not knowingly enter into any lower tier transactions with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in the Agreement, unless authorized in writing by Miami-Dade County. Furthermore, the Contractor shall include the provisions of this paragraph, without modification, in all lower tier contracts and in all solicitations for lower tier contracts.

GP8.3.7 The Contractor shall at a minimum include, or have included, in all subcontracts or purchase order in excess of $2,000,000 the following provisions of the General Provisions: 4.8.1, 4.8.9, 7.1, 7.3, 7.4, 7.5, 7.6, 7.7, 7.9, 7.10, 7.13, 7.14, 7.15, 7.16, 7.17, 7.18, 7.19, 7.20, 7.21, 7.24, 7.25, 7.26, 8.3.5, 8.3.6, 8.11, 8.12, and 8.13; or any other provisions that directly or indirectly impact the subcontractor's or other entity's ability to perform under this Contract; and advise subcontractors and other entities of GP 3.3.1 language that allows the subcontractor or other entity to receive payment from the Payment Bond Surety in the event of Contractor's failure to pay.

The Contractor shall provide to Miami-Dade County sufficient evidence of the inclusion of such provisions in its subcontracts.

GP8.3.8 Nothing contained in the Agreement shall create, or be construed as creating, any contractual relationship between any Subcontractor or any Supplier and Miami-Dade County.

GP8.3.9 The Contractor shall be responsible to Miami-Dade County for acts and omissions of actions in relation to its own employees, and for the acts and omissions of any Subcontractor or any Supplier in relation to its employees. The Contractor shall also be responsible for the coordination of the work of all Subcontractors and Suppliers. When a portion of the Work which has been subcontracted by the Contractor is not prosecuted in accordance with the Contract Documents, the

Subcontractor or Supplier shall be immediately replaced upon request of Miami-Dade County and shall not again be employed on the Work.

GP8.3.10 Miami-Dade County or the Engineer shall not be responsible for settling any differences between the Contractor and its Subcontractors or Suppliers.

GP8.4 NOTICE TO PROCEED

A written Notice to Proceed will be delivered to the Contractor as soon as practicable after execution of the Agreement and approval of any bonds or Letters of Credit and insurance certificates or policies by Miami-Dade County. The Contractor shall commence work within fourteen (14) days after receiving the Notice to Proceed and shall thereafter diligently prosecute the Work to completion.

GP8.5 PRE–COMMENCEMENT CONFERENCE

A Pre–Commencement Conference will be held within thirty (30) days after Notice to Proceed for the purpose of discussing with the Contractor all essential matters pertaining to the successful prosecution and completion of the Work as described in TPN16.

GP8.6 TIME OF COMPLETION

GP8.6.1 The Contractor shall complete all and any designated portion of the Work, which shall include, but is not limited to, the completion of all required tests, all reliability periods, the five (5) year warranty period for each of the New Metrorail Vehicles and spare parts, as set forth in GP5.2.4(A)(3), and all necessary repairs and modifications resulting from the tests, the reliability periods and warranties, within the schedule requirements of the issuance of the Notice to Proceed, unless revised by Change Order, and shall complete certain specified portions of the Work pursuant to the interim milestones set forth in GP8.6.8 and in the Engineer approved Project Schedule. Time shall be computed starting with the first day after receipt of the Notice to Proceed and ending with the last day of the Work.

GP8.6.2 Subject to the additional requirements of GP4.6 and GP8.6.3, adjustments in Time of Completion shall only be allowed if the work being delayed, or additional work included in a Change Order, falls on the critical path of the Project Schedule or alters such critical path so as to extend the time required for completion of the Work. The critical path shall be determined

from the latest approved version of the Contractor's Project Schedule required by GP8.8.

GP8.6.3 Subject to the additional requirements of GP4.6 and GP8.6.2, the Contractor may only be granted or entitled to an adjustment in Time of Completion and not assessed liquidated damages for a delay in the completion of the Work:

(A) Due to a Change Order issued pursuant to GP4.6; or

(B) Due to unforeseen causes beyond the control and without the fault or negligence of the Contractor (force majeure) such as those caused by act of God or of a public enemy, acts of terrorism, fire, floods, unusually severe weather, epidemics, quarantine restrictions, strikes and other work stoppage caused by a labor dispute, shortage of materials and freight embargoes, provided that the Contractor has taken reasonable precautions to prevent delays due to such causes.

Unusually severe weather is defined as adverse occurrences beyond the weather norms substantiated by the U.S. Department of Commerce in their Local Climate Data as published by the National Oceanic and Atmospheric Administration–Environmental Data Service, in its periodic reports and annual summary. Occurrence of unusually severe weather shall be recorded on the Project Schedule only after a finding of merit by Miami-Dade County.

The Contractor shall not be entitled, nor shall an adjustment in Time of Completion be granted, for a delay caused by a shortage of materials, except Miami-Dade County–furnished materials, unless the Contractor furnishes to the Engineer documentary proof that the Contractor has diligently made every effort to obtain such materials from all known and reasonable sources. The Contractor shall also submit proof, in the form of critical path analysis data required by GP8.8, showing that the inability to obtain such materials when originally planned did in fact cause a delay in the Time of Completion which delay could not be eliminated or reduced by revising the sequence of the Contractor's operations. Only the physical shortage of material shall be considered under this provision as a cause for an adjustment in Time of Completion. No consideration

shall be given to any claim that material could not be obtained at a reasonable, practical or economic cost.

(C) Delays caused by other contractors not under contract with the Contractor for this Work.

(D) Delays caused by Miami-Dade County through no fault of the Contractor.

GP8.6.4 As an express condition precedent for the Contractor to seek to receive a change in Time of Completion, the Contractor shall notify the Engineer in writing of the alleged causes for delay within fifteen (15) days from the beginning of any such delay. Failure by the Contractor to provide such notice shall be sufficient and valid cause for Miami-Dade County to deny the Contractor's request for an adjustment in Time of Completion.

GP8.6.5 Within thirty (30) days after the end of a delay described in GP8.6.3, the Contractor shall furnish the Engineer with detailed information concerning the circumstances of the delay, the number of days actually delayed, the appropriate Contract Document references and the measures taken to prevent or minimize the delay. Failure by the Contractor to submit such information shall be sufficient and valid cause for Miami-Dade County to deny the Contractor's request for an adjustment in the Time of Completion. After receipt of such information from the Contractor, Miami-Dade County will decide the length of the adjustment in Time of Completion, if any, to be granted to the Contractor, which decision shall be final and binding upon the Contractor.

GP8.6.6 If the prosecution of a portion of the Work is delayed, other portions of the Work unaffected by the delay shall be diligently prosecuted either to completion or until the prosecution of the delayed portion of the Work can be resumed.

GP8.6.7 Time is of the essence in the performance of the Work.

GP8.6.8 The following are the interim milestones which shall be met by the Contractor for the New Metrorail Vehicles and the related portions of the Work and in order to avoid the assessment of liquidated damages:

Description of Milestone	Months after NTP
1. Management Plan, Quality Assurance Plan	2
2. Release of Subcontracts for all major subsystems	3
3. Completion and Acceptance of all PDRs	6
4. Completion and Acceptance of all IDRs	12
5. Completion and Acceptance of all FDRs	16
6. Release of Vehicle Designs	18
7. Completion and Acceptance of FAIs	26
8. Delivery of First 3 Married Pairs (Pilot Cars)	34
9. Delivery of Initial Spare Parts and Special Tools	30
10. Delivery and Approval of Draft Manuals	32
11. Delivery and Approval of Instructor & Student Training Guides	32
12. Completion of All Testing of First 3 Married Pairs, excluding Consist Level Testing.	38
13. Commencement of Training	34
14. Delivery of Married Pairs 4-6	41-42
15. Delivery of Married Pairs 7-18	43-46
16. Delivery of Married Pairs 19-36	47-52
17. Delivery of Married Pairs 37-54	53-58
18. Delivery of Married Pairs 55-66	59-63
19. Delivery of Final Spares and Special Tools	68
20. Completion of all Work	123

GP8.7 LIQUIDATED DAMAGES

GP8.7.1 In the event a Vehicle or related equipment is not completed and/or delivered to Miami-Dade County, or the Work or a portion thereof is not completed, with the exception of Reliability Testing, within the number of days or weeks set forth in GP8.6 or the Engineer approved Project Schedule, damage will be sustained by Miami-Dade County. In such event, the Contractor shall pay to Miami-Dade County, as liquidated damages and not as a penalty, the sums set forth below for every day or fraction thereof of delay in completing the referenced portion of the Work and failing to meet the corresponding interim milestone or the Time of Completion. The Contractor shall pay the referenced sums as fixed, and agreed to, liquidated damages, and not by way of a penalty, to Miami-Dade County and Miami-Dade County may deduct the sum of liquidated damages from

any monies due or that become due the Contractor under the Agreement or under any other contract with Miami-Dade County, or if such monies are insufficient, the Contractor or its Surety or Sureties shall pay to Miami-Dade County any deficiencies in such monies within thirty (30) days of written notice by Miami-Dade County. The remedies provided in GP8.7 shall be Miami-Dade County's sole and exclusive monetary remedy for delay.

Milestone	Amount Per Day/Fraction Thereof
Delivery of each of the three (3) Pilot Married Pairs to the County	$1,653 per Married Pair
Delivery of each of the remaining Married Pairs to the County including Option Vehicles	$1,653 per Married Pair

GP8.7.2 In no event will the total liquidated damages paid by the Contractor to Miami-Dade County pursuant to GP8.7 exceed five percent (5%) of the Contract Sum, as it may have been changed from time to time in accordance with the Contract Documents.

GP8.7.3 Liquidated Damages shall be collectable in accordance with the Board of County Commissioner's Resolution R-173-08, 02/19/2008: Mandatory Collection of Contract Penalties.

GP8.8 PROJECT SCHEDULE

GP8.8.1 Within thirty (30) days after receipt of the Notice to Proceed, the Contractor shall finalize and submit for written approval by the Engineer, and in accordance with Technical Provisions, a Project Schedule which shall: specifically and expressly incorporate each and all of the applicable interim milestones set forth in, and the requirements of, GP8.6; show key design, manufacture, delivery, installation, test, and training milestones; and highlight significant events for the Project.

GP8.8.2 (A) Five (5) reproducible copies of the Project Schedule and each update thereto shall be submitted to the Engineer.

(B) Project Schedule sheets shall not be larger than twenty–two inches (22") by thirty–four inches (34").

(C) Approval of the Project Schedule, or any updates thereto, by the Engineer, shall, in no way, waive any requirements of the Contract Documents nor excuse the Contractor from any obligations under the Contract Documents. Upon approval by the Engineer in writing, the approved Project Schedule shall then be the schedule to be used by the Contractor for planning, organizing, and directing the Work and reporting progress.

(D) The Contractor shall submit for the Engineer's approval an updated Project Schedule by the tenth (10th) day of each month the Work is being performed. The Project Schedule will be submitted as part of the monthly progress report. The updated Project Schedule shall show progress during the preceding month, including actual start and finish dates for each activity.

(E) Failure of the Contractor to submit the Project Schedule, or updates thereto, within the time limits specified, shall be sufficient cause for Miami-Dade County to withhold the Contractor's progress payments, or any portion thereof, until such delinquent submittal is made.

(F) The Contractor shall execute the Work in accordance with the latest approved Project Schedule. Deviations therefrom shall be submitted to the Engineer for review and written approval. In the event that the progress of items along the critical path is delayed, the Contractor shall revise it's planning as necessary to meet the Time of Completion.

GP8.8.3 (A) For changes to the Contract Documents which could influence the order of all of or portions of the Work, restraints between various activities, or duration time estimated for activities on the Project Schedule, a determination of the impact of such changes on any interim milestone dates or the Time of Completion shall be made in accordance with the Contract Documents.

(B) If a Change Order is issued, the Project Schedule shall be changed, if necessary, to reflect the requirements of the Change Order. Changes to the Project Schedule shall be made no later than the next updating after the issuance of the Change Order.

(C) If the Contractor fails or refuses to submit or include the foregoing revisions within thirty (30) days after the date of change, the Engineer will furnish to the Contractor, at the Contractor's expense, the logic, duration time changes, or both, to be entered into the Project Schedule and used in subsequent updating of reports until such time that the change has been settled or until actual dates supersede the estimated dates. Inclusion of a revision in the Project Schedule and use of revised logic or duration time, or both, whether furnished by the Contractor or by the Engineer, will not be construed as an extension of time to the Time of Completion or as a deviation from any other requirements of the Contract Documents.

GP8.8.4 (A) The Contractor shall submit for approval by the Engineer, within thirty (30) days after receipt of the Notice to Proceed, five (5) reproducible copies of a critical path network analysis utilizing Primavera software. The critical path network analysis shall include a network diagram, and a brief written explanation of the proposed schedule and shall, furthermore, include the following:

(1) A logic diagram in precedence format that clearly depicts the order and interdependencies of planned activities as well as activities by others which affect the Contractor's planning. Activity descriptions shall be included for the starting and completing of each activity and the duration of each. The network diagram shall show such items as submittal and approval of drawings and samples specified, delivery of materials and equipment, and other significant items related to the progress of the Work. The network diagram shall be printed.

(2) Activities shall have a maximum duration of thirty (30) days. Those activities requiring greater than thirty (30) days for completion, shall be discussed and agreed upon between Contractor and the Engineer.

(3) The Contractor shall review information contained in schedules to check logic, perform time calculations and generate reports. For each activity the reports shall show the description, the estimated duration,

earliest starting and finishing dates, latest starting and finishing dates, and float or slack time. Activities, which constitute the critical sequence, shall be identified.

(4) The written explanation shall contain sufficient information to describe the manufacturing and installation process to be used and to enable the County to evaluate the schedule and supporting analysis for validity and practicability.

(5) If the listed starting dates or the listed duration of the performance of an activity delay the completion of the Work or any portion thereof, the delay shall be clearly identified. Reasons for delay shall be given with an explanation of the Contractor's corrective action.

(B) If the critical path network analysis or written explanation is not accepted by the Engineer, the Contractor shall resubmit the rejected items within twenty (20) days after rejection.

(C) Upon receipt of the Contractor's critical path network analysis, the Engineer may request the Contractor's participation in a review conference to appraise and evaluate the proposed schedule. Revisions necessary as a result of the review conference shall be made and the network analysis shall be resubmitted for approval to the Engineer within fifteen (15) days after the conference.

(D) A revised critical path network analysis shall be submitted for approval when one or more of the following conditions occur:

(1) When a Change Order affects the Time of Completion or the sequence of activities; or

(2) When the Contractor desires to change the sequence and interdependencies or duration of planned activities. The revised analysis shall be made in the same form and detail as the original submittal.

GP8.9 PROGRESS REPORTS

GP8.9.1 Progress Report shall be submitted in accordance with the requirements of TPN16.

GP8.9.2 The Contractor shall submit Progress Reports every calendar month during the performance of the Work in accordance with a format approved by the Engineer which shall provide detailed information for the preceding calendar month on the following items, as applicable:

(A) The activities started during the report period and to be started in the next report period;

(B) The activities completed during the report period and those to be completed in the next report period;

(C) Project Schedule deviations and slippage with explanations, a description of their effects on the Work, and plans for correction;

(D) Major problems;

(E) Pending action items requested by the Contractor or the Engineer;

(F) Subcontractor and Supplier status reports;

(G) Log of correspondence for the report period.

(H) Engineering Design Drawings, Manufacturing Drawings and Data submittals;

(I) As–built drawings for completed portions of the Work.

GP8.9.3 Progress photographs or digital images required by GP8.10 shall be included in the monthly Progress Reports, as appropriate, to illustrate typical equipment assemblies, assembly operations, in–plant test setups, installation techniques, and typical in–place installations of all types of equipment furnished.

GP8.9.4 Progress Reports shall be submitted by the tenth (10th) day of the month following the reporting period. Three (3) copies of the

report shall be bound in suitable covers and transmitted to the Engineer. An electronic version should also be provided.

GP8.10 PHOTOGRAPHS OR DIGITAL IMAGES

GP8.10.1 Photographs or digital images (5 megapixel, minimum) shall be submitted as part of the monthly progress reports.

GP8.10.2 The Contractor shall determine the views and the area of the Vehicles to be photographed. A maximum of 20 photographs and minimum of 10 photographs will be provided on a monthly basis with the monthly progress report. Additional photographs will be provided upon request, if required.

GP8.10.3 Each photograph or digital image shall show as much detail of the progress of the Work as possible in the interests of keeping the total number of photographs to a minimum.

GP8.10.4 Each photograph, if conventional, shall be 8" x 10" in size. Three sets of mounted color prints together with one set of negatives of each view shall be submitted to the Engineer within ten (10) days from the taking of the photograph.

GP8.10.5 Photographs or digital images shall be labeled with descriptive information: first line to show the Project Name and Number, then "Miami-Dade County"; second line shall show Agreement Name and Number; third line shall be a descriptive title of the view; and fourth line shall show the date of photograph and Contractor's name.

GP8.11 SUSPENSION OF WORK

GP8.11.1 Miami-Dade County may, without cause, order the Contractor in writing to suspend or interrupt all or any part of the Work. In no single instance will any period of suspension exceed 30 days. Total time for all periods of suspension will not exceed 60 days over the life of the Contract. Suspension of Work applies only to written suspension or interruption orders from the County and does not apply to any other delays or interruptions under the Contract Documents, including GP8.13 or otherwise.

GP8.11.2 If the performance of all or any part of the Work is suspended or interrupted per the written request of the County for less than twenty-two (22) days, the Contractor's sole and exclusive remedies in such an event shall be an extension of time as

determined in accordance with the provisions of the Contract Documents.

If the performance of all or any part of the Work is suspended or interrupted per the written request of the County for more than twenty-one (21) days, the Contractor's sole and exclusive remedies in such an event shall be an extension of time and an adjustment to the Contract Sum as determined in accordance with the provisions of the Contract Documents.

No adjustment in the Time of Completion or the Contract Sum, however, shall be allowed for any such suspension or interruption if:

(A) The performance is suspended or interrupted for a reasonable period of time;

(B) The performance would have been so suspended or interrupted by any other cause, including the fault or negligence of the Contractor; or

(C) An adjustment in the Time of Completion or the Contract Sum is provided for or excluded under any other provision of the Contract Documents.

GP8.11.3 No request for an adjustment in the Time of Completion or the Contract Sum shall be allowed under this provision unless the request is asserted in writing to the Engineer within twenty (20) days after the termination of such suspension or interruption, but not later than the date of the issuance of the Acceptance Certificate.

GP8.12 TERMINATION FOR DEFAULT

GP8.12.1 Wherever in this provision the word "Contractor" appears, it shall also be construed to mean the Surety in case of default and completion of the Agreement by the Surety.

GP8.12.2 If the Contractor fails to begin Work within the time specified in the Notice to Proceed; fails, solely in the reasonable opinion of the County, to perform the Work with sufficient laborers, equipment or materials to ensure the completion of said Work in accordance with the Contract Documents; performs the Work unsatisfactorily in the reasonable opinion of the County; neglects or refuses to remove materials or perform anew any work rejected as defective or unsatisfactory; discontinues the

prosecution of the Work without approval of the County; fails to resume work which has been discontinued or suspended within ten (10) days after notice to do so; becomes insolvent, the Contractor has become insolvent (other than as interdicted by the bankruptcy laws), or has assigned the proceeds received for the benefit of the Contractor's creditors, or the Contractor has taken advantage of any insolvency statute or debtor/creditor law or if the Contractor's affairs have been put in the hands of a receiver; the Contractor has failed to obtain the approval of the County where required by this Agreement; the Contractor has failed in the representation of any warranties stated herein; allows any final judgment to stand against it unsatisfied, after all appellate periods have expired, for a period of five (5) working days; makes an assignment for the benefit of creditors; fails or refuses, within ten (10) days after written notice by the County, to make payment or show cause why payment should not be made of any amounts due the County under the Contract Documents or for materials furnished, labor supplied or performed, equipment rentals, and utility services rendered as covered by the Bonds or Letters of Credit; fails to protect, repair or make good any damage or injury to property; for any cause whatsoever, does not, solely in the reasonable opinion of the County, carry on the Work in an acceptable manner; has failed to make prompt payment to subcontractors or suppliers for any Work, unless the Contractor has a good faith basis to assert that the wok performed or materials provided by the subcontractor or supplier was inadequate or unsatisfactory, or fails to perform or adhere to any provision of the Contract Documents, the County, after having given seven (7) days written notice to the Contractor and its Surety of any of the above identified delays, neglects, or defaults on the part of the Contractor, shall be entitled, without invalidating the Agreement, to declare the Contractor in default, take the prosecution of the Work out of the hands of the Contractor, appropriate or use materials and equipment and enter into a new contract or new contracts for the completion of the Work, or any portion of the Work; or may use such other methods as in the County's reasonable opinion will be expedient for the completion of the Work.

GP8.12.3 If the County, pursuant to GP8.12.2, elects to take the prosecution of the Work, or any portion of the Work, out of the hands of the Contractor, the County may, at its option, notify and require the Surety to complete the Work in accordance with the Contract Documents.

GP8.12.4 If the completion of the Work by any of the methods specified above results in financial loss to the County, it may:

(A) Dispose of, in the manner it determines to be in its best interest, any of the equipment or materials it acquired under this provision, without further legal process. Equipment or materials not required for completion of the Work or for the recoupment of loss or legal charges or any balance remaining from the disposition of any materials or equipment after the deduction of losses, costs and any legal charges, including attorneys' fees, by the County shall be turned over to the party legally or equitably entitled thereto;

(B) Deduct from monies due or to become due to the Contractor under the Agreement or any other contract with the County all costs and legal charges, including attorneys' fees, incurred by the County, and the County will credit the Contractor with the balance remaining from any disposal of the equipment or materials; and/or

(C) In the event the costs and legal charges, including attorneys' fees, incurred by the County, less the credits provided for, exceeds the sum which would have been payable under the Agreement for the completed Work, the County may hold the Contractor or its Surety liable to the County for the amount of said excess.

GP8.12.5 In the event the County exercises its right of termination under this provision, the Contractor shall be liable to the County for any re-procurement charges, outstanding warranty claims, its excess costs, including reasonable attorneys' fees, as set forth in GP8.12.4, and, in addition, for liquidated damages, pursuant to GP8.7, for each day until the completion of the Work.

GP8.12.6 If, after the Contractor is terminated under this provision, a determination is made that the Contractor was not in default, the rights and obligations of the parties shall be the same as if the termination had been issued pursuant to GP8.13.

GP8.12.7 The rights and remedies of the County provided in this provision are in addition to any other rights and remedies provided by law or under the Contract Documents.

GP8.12.8 If an Event of Default occurs, in the determination of the County, the County may so notify the Contractor ("Default Notice"),

specifying the basis for such default, and advising the Contractor that such default must be cured immediately or this Agreement with the County may be terminated. The County shall allow the Contractor to rectify the default to the County's reasonable satisfaction within a thirty (30) day period. The County may grant an additional period of such duration as the County shall deem appropriate without waiver of any of the County's rights hereunder, so long as the Contractor has commenced curing such default and is effectuating a cure with diligence and continuity during such thirty (30) day period or any other period which the County prescribes. The default notice shall specify the date the Contractor shall discontinue the Services upon the Termination Date.

GP8.12.9 If it is determined by the County that the provisions of the Contract have not or were not violated by the Contractor, or if it is subsequently found that any termination for default was legally improper, then the termination for default will be treated as if it had been a termination for convenience, and such termination will be compensated in accordance with the provisions of Section GP8.13.

GP8.13 TERMINATION FOR CONVENIENCE OF MIAMI-DADE

GP8.13.1 The Agreement may be terminated by the County in accordance with this provision in whole, or in part, whenever the County determines that such termination is in its best interests. Any such determination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which the Agreement is terminated and the date upon which such termination becomes effective.

GP8.13.2 After receipt of a Notice of Termination and except as otherwise directed by the County, the Contractor shall:

(A) Stop work under the Agreement on the date and to the extent specified in the Notice of Termination;

(B) Place no further orders or subcontracts for materials, services or equipment, except as may be necessary for completion of such portion of the Work not terminated;

(C) Terminate all orders and subcontracts to the extent that they relate to the terminated portion of the Agreement;

(D) Assign to the County, in the manner, at the time, and to the extent directed by the County, all of the rights, ownership and interest of the Contractor under the orders and subcontracts so terminated, in which case the County shall have the right, in its sole discretion, to settle or pay any claims arising out of the termination of such orders and subcontracts;

(E) Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval of the County, which approval shall be final for all the purposes of this provision;

(F) Transfer ownership and deliver to the County in the manner, at the times, and to the extent directed by the County:

(1) The fabricated or unfabricated parts, work in process, completed work, supplies and other material or equipment procured as a part of, or acquired in connection with the performance of, the portion of the Agreement terminated; and

(2) The completed or partially completed plans, drawings, data, information, and other property which, if the Agreement had been completed, would have been required to be furnished to the County;

(G) Complete performance of such portion of the Agreement as was not terminated by the Notice of Termination; and

(H) Take such action as may be necessary, or as the County may direct, for the protection and preservation of the property related to this Agreement, which is in the possession of the Contractor and in which the County has or may acquire an interest, until the effective date of termination.

GP8.13.3 After receipt of a Notice of Termination, the Contractor shall submit to the County its termination claim, if any, in the form and with the certification prescribed by the County. Such claim shall be submitted promptly but in no event later than one year from the date of termination. The failure of the Contractor to submit its termination claim within the time specified shall preclude the recovery of any costs or damages incurred by the Contractor as

a result of the total or partial termination of the Agreement pursuant to GP8.13.

GP8.13.4 Subject to the provisions of GP8.13, the Contractor and the County may agree upon the whole or any part of the amount or amounts to be paid to the Contractor by reason of the total or partial termination of the Agreement pursuant to GP8.13, which amount or amounts may include a reasonable allowance for profit on the portion of the Agreement performed; provided, that such agreed upon amount or amounts, shall not exceed the total Contract Sum as reduced by the amount of payment otherwise made and as further reduced by the portion of the Agreement not performed. No claims for lost or anticipated profit shall be allowed for the terminated portion of the Agreement.

GP8.13.5 If an agreement is reached by the Contractor and the County upon the amount to be paid the Contractor by reason of the termination of the Agreement pursuant to GP8.13, the Agreement shall be amended accordingly, and the Contractor shall be paid the agreed amount. Nothing in GP8.13.6, prescribing the amount to be paid to the Contractor in the event of failure of the Contractor and the County to agree upon the whole amount to be paid to the Contractor by reason of the termination of the Agreement pursuant to GP8.13, shall be deemed to limit, restrict, or otherwise determine or affect the amount or amounts which may be agreed upon to be paid to the Contractor pursuant to GP8.13.

GP8.13.6 In the event of submission of a timely termination claim by the Contractor and the failure of the Contractor and the County to agree upon the amount to be paid to the Contractor by reason of a termination pursuant to GP8.13, the County will determine, based on the information available to the County, the amount, if any, due to the Contractor by reason of the termination and will pay to the Contractor the amounts determined as follows:

(A) With respect to all work performed on the terminated portion of the Agreement, prior to the effective date of the Notice of Termination, the total (without duplication of any items) of:

(1) The cost of acceptable work performed, except defective work, and materials delivered;

(2) The cost of settling and paying claims arising out of the termination of work under subcontracts or orders as provided in GP8.13.2; and

(3) Reasonable profit for the portion of the Agreement performed but no lost or anticipated profit on the portion of the Agreement not performed.

(B) The reasonable cost of the preservation and protection of property incurred pursuant to GP8.13.2(I).

GP8.13.7 The total sum to be paid to the Contractor under GP8.13 shall not exceed the Contract Sum as reduced by the amount of payments otherwise made and as further reduced by the value of that portion of the Agreement not performed. Except for normal spoilage, and except to the extent that the County shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor under GP8.13 the fair value, as determined by the County, of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to the County, or to a buyer pursuant to GP8.13.2(G).

GP8.13.8 In arriving at the amount due the Contractor under this provision, there shall be deducted:

(A) All payments made to the Contractor by the County applicable to the terminated portion of the Agreement;

(B) Any claim which the County may have against the Contractor in connection with the Agreement; and

(C) The agreed price for, or the proceeds of sale of, any materials, supplies, or other things acquired by the Contractor or sold, pursuant to GP8.13 and not otherwise recovered by or credited to the County.

GP8.14 ACCEPTANCE, OWNERSHIP, AND RISK OF LOSS

GP8.14.1 When, in the judgment of the Engineer, a portion of the Work has been completed in compliance with the Contract Documents and all applicable tests, inspections, and rework have been completed therefore, the Engineer will recommend to the County that said portion of the Work be accepted. The recommendation of the Engineer will be subject to the approval and acceptance by the County.

GP8.14.2 Notwithstanding any provision of the Uniform Commercial Code, or other applicable law, risk of loss and ownership of a Vehicle, system, subsystem, component, part, equipment, or other material or other portion of the Work shall vest in the County when the Vehicle is satisfactorily placed on the rails on the County's property at the Miami-Dade Transit William Lehman Center or other location identified by Miami-Dade Transit, or the system, subsystem, component, part, equipment, or other material is satisfactorily unloaded onto the County's property at the Miami-Dade Transit William Lehman Center or other location identified by Miami-Dade Transit. The Certificate of Acceptance of Final Inspection for a Vehicle or other item of Work will be issued only after each Vehicle and its systems, subsystems, components, parts and equipment or other item of Work has been received by the County and fully and satisfactorily tested, inspected and accepted. The Certificate of Acceptance of Final Inspection for a Vehicle or other item of Work will be issued if the Vehicle or other item of Work is subject to the satisfactory completion of any outstanding Work items or the Vehicle or other item of Work is placed in revenue service.

GP8.14.3 Risk of loss for each New Metrorail Vehicle and the systems, subsystems, components, parts, and equipment therefore, while in transit (including loading and unloading while on County property) or otherwise not located on the County's property, shall be borne by the Contractor.

GP8.14.4 Ownership transferred to the County for any Vehicle, system, subsystem, component, part, equipment, or other material or other portion of the Work shall be absolute, good, marketable, and free and clear of any and all security interests, liens, or encumbrances of any kind or nature. The Contractor shall not pledge, hypothecate, or otherwise encumber the Vehicles, any system, subsystem, component, part or equipment thereof, the New Metrorail Vehicles or other portion of the Work in any manner that would result in any lien, security interest, charge, or claim upon or against any such item under the Uniform Commercial Code or any other law that may be applicable.

GP8.14.5 Adequate documentation, satisfactory to the County, for securing and transferring ownership to a Vehicle, system, subsystem, component, part, equipment, other material or other portion of the Work shall be provided to the County by the Contractor a minimum of fourteen (14) days before Delivery for

Acceptance Testing of the Vehicle or delivery of other portions of the Work to the County. Such documents shall meet all the requirements of the Florida Bureau of Motor Vehicles as applicable.

GP8.14.6 The issuance of a Certificate of Acceptance of Final Inspection, the Acceptance Certificate, the transfer of ownership for a Vehicle or other portion of the Work or the approval or acceptance by the County of a Vehicle or other portion of the Work shall not relieve or release the Contractor from liability for faulty workmanship or materials or the failure to strictly adhere to the requirements of the Contract Documents, including, but not limited to, the Contractor's warranty, reliability, and guaranty obligations, even after final payment of the Contract Sum has been made under the Agreement.

GP8.15 TESTING

GP8.15.1 Testing shall be performed in accordance with the requirements of TPN17.

GP8.15.2 Any defective or inferior materials, equipment or workmanship, which is discovered during the testing or inspection, shall be promptly corrected to the satisfaction of the Engineer.

GP8.16 PRE-PRODUCTION (PILOT) VEHICLES

GP8.16.1 The Contractor shall build three (3) Pre-Production Married Pairs required to be provided by the Agreement, i.e., New HRVs, after the Notice to Proceed. The Pre-Production Married Pairs must be delivered for Acceptance Testing within the time limits set forth in GP8.6.8. The Pre-Production Vehicles shall be provided to the Engineer for evaluation in accordance with the Contract Documents, and as such, the Pre-Production Vehicles must meet all requirements of the Contract Documents. The final determination as to whether the Pre-Production Vehicles and all systems, subsystems, components, equipment, parts and materials therefore meet the requirements of the Contract Documents shall be made by the County and such decision shall be final and binding upon the Contractor.

GP8.16.2 If the Contractor commences production of the remaining Married Pairs before the County has notified the Contractor that the testing for the corresponding Pre-Production Married Pairs has been approved, the Contractor does so solely at its own risk and subject to the requirements of the Contract Documents. Before production begins for the remaining Vehicles, sufficient

time should be allowed to make engineering design changes and order necessary components and parts. The Contractor shall notify the Engineer, in writing, when it plans to begin production on the remaining Vehicles.

GP8.17 SHIPMENTS/DELIVERIES

GP8.17.1 Shipments and deliveries shall be made by the Contractor in accordance with the Contract Documents or any written instructions received by the Contractor from the Engineer. All Vehicles, systems, subsystems, components, parts, equipment and other portions of the Work to be delivered to the County pursuant to the Contract Documents shall be FOB delivered to the County to the point set forth below in GP8.17.3 and all deliveries shall be coordinated with the County. Unless otherwise provided in the Contract Documents, delivery to the County must be made on, or before, the date specified in the Contract Documents.

GP8.17.2 All shipments or deliveries of Vehicles to the County shall only be made in the manner and on the date specified in the Contract Documents or as otherwise directed, in writing, by the Engineer. Adjustments in the scheduled delivery date for the Vehicles to the County's property shall be allowed only upon receipt of written approval by the Engineer.

GP8.17.3 All shipments and deliveries, other than the Vehicles, to the County required by the Contract Documents shall be made between the hours of 7:00 a.m. and 3:00 p.m., Monday through Friday, excluding all Miami-Dade Transit holidays. Shipments and deliveries to the County shall be made to the following address unless the Contractor is otherwise directed in writing by the Engineer:

Miami-Dade Transit
William Lehman Center
6601 NW 72 Avenue
Miami, Florida 33166

GP8.17.4 Vehicles may be shipped resting on their own wheels with the suspension system blocked. All systems, subsystems, components, parts and equipment shall be protected from damage during shipment. If shipped by sea, all Vehicles or components thereof shall be stored below deck and protected to minimize the effect from exposure to the marine environment.

Also, if a Vehicle or component part is shipped by sea, the Engineer shall be advised, by the Contractor, in writing, at least three (3) days prior to the shipment, of the arrival date and port of entry of the shipment.

GP8.17.5 All rotating equipment shall be shipped, in accordance with the manufacturer's suggested procedures. All parts that must be removed to permit shipment shall be securely boxed and shipped with, and identified to, the Vehicle to which they belong.

GP8.17.6 The Vehicles shall be secured against unlawful entry during transit by sealing closed all doors and exterior compartments. Any special, temporary fittings such as straps, grab handles and locking devices required for shipment of the Vehicles shall be provided and removed by the Contractor at its expense.

GP8.17.7 The Contractor shall identify existing equipment and facilities at the delivery site for unloading and receiving the Vehicles and shall assess their suitability. The Contractor shall also supply all special tools and additional equipment necessary for delivering, unloading and storing the Vehicles.

GP8.17.8 In the event any item shipped by the Contractor is not received by the County, or its agent, the Contractor shall immediately replace said item in like quantity.

GP8.17.9 If the Contractor delivers an item which fails to meet the requirements of the Contract Document, and does not promptly replace said item as required by the Contract Documents, or if the Contractor fails to deliver an item within the time specified in the Contract Documents after notification by the County, the County reserves the right to purchase said item in the open market and deduct the expense, including any excess in price over the cost of said item pursuant to the Agreement, from the Contract Sum. If the amount due the Contractor under the Agreement is not sufficient to meet such expenses, the County may proceed against the Contractor and/or its Sureties.

GP8.18 MEETINGS AND REPORTS

GP8.18.1 The Contractor shall record and maintain the minutes for all meetings held with the Engineer and Miami-Dade Transit as well as any Subcontractors or Suppliers. All meeting minutes shall be provided to the Engineer for approval prior to issuance. Disagreement shall be resolved to the satisfaction of the Engineer.

GP8.18.2 Meetings shall be scheduled at the convenience of the Engineer and at a location selected by the Engineer.

GP8.18.3 Meetings requiring the attendance of the Contractor shall include the Pre–Commencement Conference, all design reviews, Monthly Progress Meetings and others as notified by the County or the Engineer.

GP8.19 TRAINING

GP8.19.1 Training shall be performed by the Contractor in accordance with the requirements of TPN15.

GP8.19.2 Instructors supplied by the Contractor for any training required by the Contract Documents shall be totally fluent in English, both in technical terminology and commonly used expressions.

GP8.20 CANCELLATION

If a previously scheduled or agreed to test, inspection or meeting is cancelled by the Contractor less than seven (7) days prior to the test, inspection or meeting date, without the prior written approval of the Engineer, the Contractor agrees to, and shall, promptly reimburse the County for all travel costs and expenses incurred by the County and/or the Engineer for, or in preparing for, the cancelled test, inspection or meeting. Should the Contractor fail to be properly prepared to conduct such test, inspection or meeting, and such test, inspection or meeting is cancelled, the Contractor shall bear all expenses of Miami-Dade County. Should the Contractor fail to promptly reimburse the County, said cost and expenses may be deducted from monies due, or which become due, to the Contractor.

If a previously scheduled or agreed to test, inspection or meeting is cancelled by Miami-Dade County less than two (2) days prior to the test, inspection or meeting date, Miami-Dade County agrees to reimburse the Contractor for direct travel costs incurred by the Contractor.

SECTION GP9 – PAYMENT

GP9.1 SCOPE OF PAYMENT

GP9.1.1 The Contractor will be paid, in the manner set forth in GP9.2 and GP9.4, the Contract Sum provided for in the Agreement which sum shall be full compensation for all costs incurred for furnishing all Work, including management, materials, engineering, manufacturing, labor, incidentals, tools and equipment, for performing the Work in a complete and acceptable manner, and for all risk, loss, damage and expense arising out of the nature and performance of the Work.

GP9.1.2 Full compensation for conforming to all the requirements of the Contract Documents shall be considered to be included in the Contract Sum and no additional compensation shall be owed or allowed to the Contractor.

GP9.2 PROGRESS PAYMENTS

GP9.2.1 The Contractor understands that funds to pay for the Work have been or will be made available from the United States Department of Transportation through FTA, the State of Florida and/or Miami-Dade County. All such funds must be approved and/or administered by FTA, the State of Florida and Miami-Dade County.

GP9.2.2 The Agreement is subject to the availability of the above–referenced funds and the County's obligation under the Agreement is contingent upon the availability of such funds from which payment for the Agreement can be made. No obligation on the part of the County for any payment shall arise until such funds are made available to the County for the Agreement and until the Contractor receives written notice of such availability from the County.

GP9.2.3 The County will make progress payments to the Contractor during the course of the Contractor's satisfactory performance of the Work, based on an approved detailed Schedule of Values developed in accordance with the percentages set forth below and submitted by the Contractor on approved invoices. Before issuance of the Notice To Proceed (NTP), the County and the Contractor will review the Progress Payment Milestones' Schedule of Values (SOV), and the Contractor's spend plan to

identify contract expenditures. The County must approve the SOV prior to NTP. Progress payments will be made by the County to the Contractor, pursuant to approval by the County of the SOV, in accordance with the provisions of GP9.2.7, and after the County has ensured receipt of goods and services, and that the value of such goods and services are in accordance with the SOV. Mutually agreeable adjustments to the payment schedule will be made as required. Progress payment invoices shall not be submitted by the Contractor until after satisfactory completion of each of the milestones set forth in the detailed Schedule of Values and shall not exceed the following stated corresponding percentages of the Contract Sum:

Progress Payment Milestones	
Description of Task	**Percentage of Contract Sum for New HRVs**
1. Notice to Proceed/Program Kickoff a. Approval of Detailed Schedule of Values (GP9.2.3) b. Approval of Project Schedule CDRL (CDRL N1603) c. Completion of Post Award Kick-Off Meeting (TPN16.2.3) d. Provide Certificate of Insurance e. Provide Performance and Payment Bonds f. Mobilization	4%

Progress Payment Milestones	
Description of Task	**Percentage of Contract Sum for New HRVs**
2. Conceptual Design a. Proof of release (signed agreement) of Subcontracts for the following Primary Systems, as applicable: • Carbody • Couplers and Draft Gear • Operator's Cab • Door Control • HVAC • Lighting System • Auxiliary Electric • Propulsion • Truck Assemblies • Friction Braking • Communications • Automatic Train Control • Vehicle Monitoring System b. Approval of Management Plan (CDRL N1601) c. Approval of System Safety Program Plan (CDRL N1805) d. Approval of Quality Assurance Plan (CDRL N1802) e. Approval of Software Quality Assurance Plan (CDRL N2202) f. Approval of Software Project Management Plan (CDRL N2203 g. Approval of Reliability and Maintainability Program Plans (CDRL N1809, N1812)	2%
3. Completion and Acceptance of Preliminary Design a. Approval of Drawing List (CDRL N1541) b. Approval of the Reliability Analyses (CDRL N1809) c. Approval of Preliminary Hazard Analysis (CDRL N1806) d. Approval of Maintenance Concept (CDRL N1814) e. Completion of Preliminary Design Review Meeting(s) Including Approval of PDR Packages (CDRL N1608)	2%

Progress Payment Milestones	
Description of Task	**Percentage of Contract Sum for New HRVs**
4. Completion and Acceptance of Intermediate Design a. Approval of the Initial Weight Statement (CDRL N203) b. Approval of Human Engineering Analysis (CDRL N501) c. Approval of Operating Characteristics and Load Analyses (CDRLs N901, N902, N903) d. Completion of Intermediate Design Review Meeting(s)Including Approval of IDR Packages (CDRL N1614)	2%
5. Completion and Acceptance of Final Design a. Completion of Operator's Cab Mock-up Review and Report (CDRL N1615) b. Approval of Front End and Underfloor Equipment Mock-Up Review and Report (CDRLs N301, N1616) c. Approval of Recommended Spare Parts List (CDRL N1535) d. Approval of All System Safety Analyses (CDRL N1806) e. Completion of Final Design Review Meeting(s) Including Approval of FDR Packages (CDRL N1614)	2%
6. Release of Vehicle Designs a. Release of System and Subsystem Designs for Manufacture of First Article Units.	3%
7. Completion and Acceptance of First Article Inspections a. Approval of Flammability, Smoke Emission and Toxicity Matrix and Test Results (CDRLs N1930, N1931) b. Approval of all Design Baseline Submittals (CDRL N1617, N1712) c. Approval of Subsystem and System First Article Inspections (CDRL N1713) d. Approved Vehicle Carbody First Article Inspection (CDRL N1713) e. Approval of Subsystem and System Design Qualification Tests (CDRL N1707)	3.5%

Progress Payment Milestones	
Description of Task	**Percentage of Contract Sum for New HRVs**
8. Manufacture and Delivery of First Three Married Pairs (Pre-Production Vehicles) a. Completion of three Pre-Production Married Pairs b. Acceptance of First Article Inspection of the Pre-Production Cars (CDRL N1713) c. Approval of Pre-Production Married Pairs Qualification Test Results (CDRL N1707) d. Approval of all Required Factory Testing (CDRL N1705, N1707) and Pre-shipment Inspections (CDRL N1710) e. Delivery and Unloading of Pre-Production Cars at MDT	6%
9. Delivery of Initial Spare Parts and Special Tools a. Delivery and Demonstration of Portable Test Equipment b. Delivery and Demonstration of Diagnostic Test Equipment c. Delivery of Initial Spare Parts d. Delivery of Initial Special Tools	3%
10. Delivery and Approval of Draft Manuals a. Approval of the Manuals Program Plan (CDRL N1503), Manuals Style Guide (CDRL N1504) and Manual Samples (CDRL N1505) b. Submittal of Draft Manuals and Parts Catalogs and Signed Review Sheets (CDRL N1506) c. Approval of Delivered Manuals (CDRL N1507) d. Delivery of Electronic Documentation Support System (CDRL N1502) and Electronic Drafting Support System (CDRL N1537)	0.5%
11. Delivery and Approval of Instructor & Student Training Guides a. Approval of Training Program Plan (CDRL N1513) b. Approval of the Training Material (CDRL N1516)	0.5%

Progress Payment Milestones	
Description of Task	**Percentage of Contract Sum for New HRVs**
12. Completion of All Testing of Pre-Production Married Pairs, excluding Consist Level Testing a. Approval of On-site Qualification Test Results (CDRL N1707) b. Approval of the Safety Certification Plan (CDRL N1805) c. Safety Certification of the Pre-Production Married Pairs (CDRL N1805) d. Issuance of the Certificate of Acceptance of Final Inspection for the three Pre-Production Married Pairs including delivery and completion of Car History Books (GP8.14.2, CDRL N1623)	6%
13. Commencement and Completion of Training a. Commencement of Training b. Completion of Training	2%
14. Delivery of Married Pairs 4-5 a. Completion, including testing and inspection, and Approval for Shipment of Married Pairs 4-5 b. Delivery and unloading of Married Pairs 4-5 c. Issuance of the Certificate of Acceptance of Final Inspection of Married Pairs 3-5 including delivery and completion of Car History Books (GP8.14.2, CDRL N1623)	1.8%
15. Delivery of Married Pairs 6-17 a. Completion, including testing and inspection, and Approval for Shipment of Married Pairs 6-17 b. Delivery and unloading of Married Pairs 6-17 c. Issuance of the Certificate of Acceptance of Final Inspection of Married Pairs 6-17 including delivery and completion of Car History Books (GP8.14.2, CDRL N1623)	10.8%
16. Delivery of Married Pairs 18-35 a. Completion, including testing and inspection, and Approval for Shipment of Married Pairs 18-35 b. Delivery and unloading of Married Pairs 18-35 c. Issuance of the Certificate of Acceptance of Final Inspection of Married Pairs 18-35 including delivery and completion of Car History Books (GP8.14.2, CDRL N1623)	16.2%

Progress Payment Milestones	
Description of Task	**Percentage of Contract Sum for New HRVs**
17. Delivery of Married Pairs 36-53 a. Completion, including testing and inspection, and Approval for Shipment of Married Pairs 36-53 b. Delivery and unloading of Married Pairs 36-53 c. Issuance of the Certificate of Acceptance of Final Inspection of Married Pairs 36-53 including delivery and completion of Car History Books (GP8.14.2, CDRL N1623)	16.2%
18. Delivery of Married Pairs 54-68 a. Completion, including testing and inspection, and Approval for Shipment of Married Pairs 54-68 b. Delivery and unloading of Married Pairs 54-68 c. Issuance of the Certificate of Acceptance of Final Inspection of Married Pairs 54-68 including delivery and completion of Car History Books (GP8.14.2, CDRL N1623)	13.5%
19. Delivery of Final Spares and Special Tools a. Delivery and Demonstration of Shop Test Equipment b. Delivery of Remaining Spares c. Delivery of all Remaining Special Tools	2%
20. Completion of all Work a. Delivery and approval of As Built Drawings (CDRL N1542) b. Delivery and Approval of all Operation and Maintenance Manuals and Spare Parts Catalogs c. Final Acceptance of As Built Drawings d. Reliability test successfully completed e. Completion of five year warranty period items	3%
Total	**100.0%**

The final detailed Schedule of Values shall include, but not be limited to:

- Approval of CDRLs, drawings, plans, procedures, analyses, manuals, training materials, car history books, and design review packages.
- Satisfactory completion of design reviews, various manufacturing phases, tests, training, and warranty.

- Delivery of vehicles, spares, test equipment and special tools.
- Specific values assigned to each payment milestone such that the total milestone payments for each line item above does not exceed the percentage allocated. MDT reserves the right to approve all values assigned to the payment milestones in the Schedule of Values.

GP9.2.4 Invoices for progress payments shall be submitted no more than once per month by the Contractor in a format mutually agreed upon at the Project Kickoff Meeting. A draft of each Contractor's invoice shall be submitted to the Engineer for review and approval, after which the "Final" edition may be submitted for payment. At a minimum, each invoice shall include:

(A) The Agreement/Contract number and date of invoice;

(B) A unique invoice number;

(C) Completed milestone number(s) and description(s);

(D) The total invoice amount;

(E) The total amount previously invoiced;

(F) The total remaining Contract balance:

(G) Final invoices shall be labeled "Final" and shall be signed by a designated Contractor representative.

The preliminary payment milestones listed for each line item in GP9.2.3 do not represent every milestone required to complete the specific line item. Applicable payment milestones shall be those set forth in the final approved Schedule of Values. Payments will be made upon satisfactory completion and acceptance of each milestone in the Schedule of Values.. Attached to each invoice shall be objective evidence that the activities associated with the Milestone Payments have been completed. The Contractor shall assign all deliverables to a specific milestone in the Master Program Schedule. Partial payments will not be made for any given payment milestone

The Contractor shall certify, in each invoice, that the Work invoiced has been completed and approved by the Engineer and performed in accordance with the requirements of the Contract Documents.

GP9.2.5 No markup is permitted on expenses for Subcontractors, Suppliers, printing, communications, travel, subsistence or other such expenses.

GP9.2.6 In the event expenditures reimbursed to the Contractor under the Contract Documents are subsequently disallowed by the County, due to accounting errors or changes not in conformity with the Contract Documents, the Contractor shall immediately refund such amounts to the County.

GP9.2.7 After receipt, the Engineer will review and evaluate each invoice for progress payments and the supporting data, and forward same to the County for approval with Engineer's recommendation on payment. No progress payment will be approved by the Engineer until an invoice therefore is received from the Contractor and accepted, and the Engineer has verified that all Work covered thereby has been performed in accordance with the requirements of the Contract Documents.

GP9.2.8 The County will notify the Contractor within ten (10) days of receipt of an invoice if there are any issues regarding the invoice. Each Engineer approved invoice will be paid by the County within forty-five (45) days of the County's receipt of a proper invoice in accordance with Florida Statute 218.74 and Section 2-8.1.4 of the Miami-Dade County Code. Progress payments shall not be construed as relieving the Contractor from sole responsibility for all engineering, material, equipment and work upon which payments have been made and the restoration of all defective work, or as waiving the right of the County to require the fulfillment of all of the requirements of the Contract Documents.

GP9.2.9 Payments made under the Contract Documents by the County shall not be construed as an acceptance of defective work or acceptance of improper material, nor as condoning any omission of required work. No payment or certificate, final or otherwise, shall be construed as relieving the Contractor from its contractual obligations to make acceptable any defects and consequences thereof, discovered in the Work, even when discovered after completion or acceptance of same. No payment or certificate, final or otherwise, shall be construed as a waiver of any of the Contractor's obligations set forth in the Contract Documents.

GP9.2.10 No progress payments will be owed or made for any portion of the Work not in accordance with the requirements of the Contract Documents.

GP9.2.11 Miami-Dade County may withhold payment of any progress payment due the Contractor until the County has confirmed that the Contractor has performed all applicable administrative tasks pertaining to the specific progress payment as required by the Contract Documents. Also, if documents, data, samples, drawings, and submittals or any part thereof required to be supplied by the Contractor pursuant to the Contract Documents are not delivered within the time specified by the Contract Documents, or are deficient upon delivery, the County may, until such documents, data, samples, drawings or submittals are delivered or the deficiencies are corrected, withhold any monies due or that may become due to the Contractor. The withholding of any payments to the Contractor shall not be construed as a waiver of any rights accruing to the County under the Contract Documents or according to law.

GP9.2.12 In the event that a dispute arises between the County and any other contractor, person or entity, which dispute is based upon increased costs claimed by such contractor as a result of delays or other actions of the Contractor, monies in the sum of one and one–half times the amount of any possible liability may be withheld by the County from the Contractor as retainage until such time as a final resolution is agreed to by all parties directly or indirectly involved, unless the Contractor furnishes a bond satisfactory to the County to indemnify and hold harmless the County against the claim.

GP9.2.13 In the event that the Engineer determines the Contractor has failed to complete an item or items of the Work in accordance with the requirements of the Contract Documents, the Engineer shall identify, in detail, each uncompleted item of the Work and determine a reasonable cost of completion. The County may withhold the sum of one and one–half times the cost of completing said items of the Work until such time as said item is completed in accordance with the Contract Documents.

GP9.3 AGREEMENT ADMINISTRATIVE CLOSE–OUT

The following list of items collectively constitutes the administrative close–out work for the Agreement:

(A) The Contractor supplying a general release to Miami-Dade County in a form to be supplied by Miami-Dade County;

(B) Surety concurrence in final payment (both labor and material);

(C) For non–Florida corporations, the necessary certificates from the Florida Department of Revenue and Department of Labor and Industry, Bureau of Unemployment Compensation;

(D) Release of all claims and liens against the County and the Engineer arising by virtue of the Agreement;

(E) Final and satisfactory As–Built Drawings (TPN15) and the satisfactory delivery of all other remaining documents required by the Contract Documents to be supplied to Miami-Dade County by the Contractor;

(F) Finalized Operation and Maintenance Manuals (TPN15);

(G) Finalized spare parts, catalogs and/or lists (TPN15); and

(H) Delivery of the five (5) year warranty and the completion of all reliability testing.

All of the above listed items shall be completed and submitted to Miami-Dade County, at the latest, within thirty (30) days after the completion by the Contractor and the acceptance by Miami-Dade County of all other portions of the Work. Agreement Administrative Close-Out shall not be considered complete until all items which comprise the Agreement Administrative Close-Out are completed in a manner acceptable to Miami-Dade County.

GP9.4 FINAL PAYMENT

GP9.4.1 Within thirty (30) days after the completion by the Contractor and acceptance by Miami-Dade County of all portions of the Work, the Contractor shall prepare and submit a proposed invoice for the final pay estimate. Prior pay estimates and payments shall be subject to correction on the proposed final pay estimate.

GP9.4.2 The Work shall not be complete until, as noted above, the Contractor has completed, and Miami-Dade County has accepted, all portions of the Work including, but not limited to the completion and, as applicable, acceptance of: all required tests; all technical support; all reliability periods; at least, the five (5) year warranty period for each of the New Vehicles as set forth in GP5.2.4; and all necessary repairs and modifications

resulting from said tests, reliability periods and warranties, as required by the Contract Documents.

GP9.4.3 The Engineer will review the Contractor's proposed invoice for the final pay estimate. Any changes or corrections found necessary by the Engineer will be submitted to the Contractor for revision. Within ten (10) days thereafter, the Contractor shall submit to Miami-Dade County an invoice for the final pay estimate incorporating any changes or corrections made by the Engineer. Said invoice will then be reviewed by Miami-Dade County and if approved by Miami-Dade County, this estimate will become the approved final pay estimate. If, however, a proposed invoice for the final pay estimate is not submitted by the Contractor within sixty (60) days after the completion by the Contractor and acceptance by Miami-Dade County of all portions of the Work, Miami-Dade County may elect to make payment of such sums which are not in dispute, without prejudice to the rights of either Miami-Dade County or the Contractor in connection with such sums which are in dispute.

GP9.4.4 Upon approval of the invoice for the final pay estimate by Miami-Dade County, and after completion, to the satisfaction of Miami-Dade County, of the Agreement Administrative Close-Out items as provided in GP9.3, Miami-Dade County will issue an Acceptance Certificate. The Acceptance Certificate shall certify that all the Work has been completed and accepted as of the date of the Acceptance Certificate subject to any guarantee or warranty, expressed or implied, provided by the Contractor or pursuant to the Contract Documents. The issuance by Miami-Dade County of the Acceptance Certificate shall not be construed to be acceptance by Miami-Dade County of any defective or inferior work, improper materials, or work not adhering to the requirements of the Contract Documents. Miami-Dade County will transmit copies of the Acceptance Certificate to the Contractor, Surety and other appropriate interested agencies.

GP9.4.5 Miami-Dade County will make final payment to the Contractor within thirty (30) days after issuance of the Acceptance Certificate. Such final payment shall constitute full and complete payment to the Contractor for the Work.

END OF SECTION

EXHIBIT 1

SAMPLE SURETY PERFORMANCE BOND

By this Bond, _____, as Principal, whose principal business address is _____, as contractor under the contract dated _____, 20___, between Principal and Miami-Dade County for Metrorail Heavy Rail Vehicle Procurement - Contract No. XXX (hereinafter referred to as "Contract" and made a part of this Bond by reference) and _____, a corporation, whose principal business address is _____as Surety, are bound to Miami-Dade County (hereinafter referred to as "County") in the sum of $_____, for payment of which we bind ourselves, our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is that if Principal:

1. Performs all the work in the Contract Documents, in the times and manner prescribed in the Contract Documents; and

2. Pays the County all losses, damages, including damages for delay, expenses, costs, and attorney's fees, including costs and fees for appellate proceedings, that the County sustains because of a default by Principal under the Contract Documents, for its work or materials within the time period provided in the Contract Documents; and

3. Performs the guarantee of all work and materials furnished under the Contract Documents for the time(s) specified in the Contract Documents, as presently written and as may be hereafter amended; then this bond is void; otherwise it remains in full force.

Surety specifically assumes liability for any and all delay damages arising from Principal's default of the Contract Documents.

Any changes in or under the contract documents and compliance or noncompliance with any formalities connected with the contract or the changes will not affect Surety's obligation under this bond.

The Surety hereby explicitly waives any and all common law suretyship defenses, whether expressed or implied.

This Bond shall remain in full force from NTP and decreasing at a rate of 1/68 for each Married Pair accepted by MDT after the manufacture and for such period or periods of time after the date of acceptance by the County of the Contract work as are provided for in the Contract by which Principal guarantees to repair or replace any or all work performed or materials and equipment furnished, which were not performed or furnished according to the terms of the Contract Documents.

DATED ON _____, 20___.

_____
(Name of Principal)

By: _____
(As Attorney in Fact)

_____
(Name of Surety)

_____
(Address)

_____
(Telephone)

(COMPLETE SIGNATURE BLOCKS AND
FLORIDA REGISTERED AGENT, ETC.)

EXHIBIT 2

SAMPLE SURETY PAYMENT BOND

By this Bond,_____, as Contractor, whose principal business address is _____ , as contractor under the contract dated _____ , 20___, between Contractor and Miami-Dade County for the Metrorail Heavy Rail Vehicle Procurement - Contract No. XXX (hereinafter referred to as "Contract" and made a part of this Bond by reference) and _____, a corporation, whose principal business address is _____ as Surety, are bound to Miami-Dade County (hereinafter referred to as "County") in the sum of $_____for payment of which we bind ourselves, our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is:

The Contractor shall promptly make payments to all subcontractors, or any other entity, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the Contract Documents, and in the times and manner prescribed in the Contract Documents; and

If the Contractor fails to make payments to any subcontractor, or any other entity, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the Contract Documents, and in the times and manner prescribed in the Contract Documents, then subcontractor, or any other entity shall have a right of action against the Contractor and the Surety for the amount it is due. Such action shall not involve the County in any expense. The Contractor shall pay the County for all losses, damages, costs, and attorney's fees, including appellate proceedings, that the County sustains because of a failure by Contractor to make any such payments.

A subcontractor, or any other entity as identified above, except a laborer, who is not in privity with the Contractor and who has not received timely payment for its labor, materials, or supplies may, within 60 days after performance of the labor or after complete delivery of the materials or supplies, and issuance of a properly submitted invoice, deliver to the Contractor and to the Surety written claim advising of the performance of the labor or delivery of the materials or supplies and of the nonpayment. No action for labor, materials or supplies may be instituted against the Contractor or the Surety unless notice has been given. No action shall be instituted against the Contractor or the Surety on the bond after 120 days from the performance of the labor or completion of delivery of the materials or supplies. A claimant may not waive in advance its right to bring an action under the bond against the Surety.

Any changes in or under the Contract Documents and compliance or noncompliance with any formalities connected with the contract or the changes does not affect Surety's obligation under this bond.

DATED ON _____, 20__.

_____
(Name of Contractor)

By: _____
(As Attorney in Fact)

_____
(Name of Surety)

_____
(Address)

_____
(Telephone Number)

(COMPLETE SIGNATURE BLOCKS AND
FLORIDA REGISTERED AGENT, ETC.)

EXHIBIT 3

SAMPLE LETTER OF CREDIT

We hereby establish this Irrevocable Letter of Credit No_____ in favor of the aforesaid beneficiary _____ (Beneficiary) for drawings up to $_____ effective immediately. This Letter of Credit is available for payment at sight at our correspondent banking office, _____ (our Office) and expires with the close of banking business at our office on _____.

The term Beneficiary includes any successor by operation of law of the named beneficiary including, without limitation, any liquidator, manufacturer, receiver, or conservator.

We hereby undertake to honor your sight draft(s) drawn on our office, within three banking days upon presentation of documents in _____, indicating our credit no. _____for all or any part of this credit if presented at our office, in person or by mail, specified in the first paragraph on or before the expiration date. Partial drawings under this Letter of Credit are permitted.

The sight draft(s) shall be accompanied by at least one of the following statements purportedly signed by the Director of the Miami-Dade Transit, or his designee, reading as follows:

1. The undersigned, Director _____, or designee, certifies that the amount demanded as per the attached draft is due to the _____and that _____<Contractor><Contractor>has not fulfilled its performance obligations in the time and manner prescribed in the contract signed and dated on or about _____ entered into by the _____, Beneficiary, and _____<Contractor>for the Contract or:
2. The undersigned, Director _____ or designee, certifies that the amount demanded as per the attached draft is claimed to be owed to a person or persons defined in section 255.05(1) or 713.01, Florida Statutes, who furnished labor, services, or materials used directly or indirectly by _____<Contractor><Contractor>in the prosecution of the work provided for in the contract signed and dated on or about _____ entered into by the _____, Beneficiary, and _____<Contractor>for the Contract and that such claimant(s) allege(s) that _____<Contractor>has not fulfilled its performance obligations under the Contract, by not making payments to such claimant.

Except as expressly stated herein, this undertaking is not subject to any agreement, condition or qualification. Our obligation under this Letter of Credit is our individual obligation and is in no way contingent upon reimbursement with respect thereto.

Any changes in or under the Contract documents and compliance or noncompliance with any formalities connected with the contract of the changes does not affect our duty to honor drafts under this Letter of Credit.

This Letter of Credit is subject to and governed by the 1993 Revision of the Uniform Customs and Practice for Documentary Credits of the International Chamber of Commerce (Publication 500) and, to extent not inconsistent therewith the laws of the State of Florida, including the Uniform Commercial Code as in effect in the State of Florida. In the event of any conflict, the laws of the State of Florida will control.

If the credit expires during an interruption of business as described in Article 17 of said Publication 500, the Bank hereby specifically agrees to effect payment if this Credit is drawn against within sixty (60) days after the resumption of business.

Communications with respect to the Letter of Credit shall be addressed to us at our office, _____, specifically referring to the number of this Letter of Credit.

Signed by and on behalf of _____:

By: _____
(Signature)

_____
(Name and Title)

By: _____
(Signature)

_____
(Name and Title)

Corporate Seal

INDEX

ACCEPT, 10, 34, 85
ACCEPTANCE, 8, 28, 32, 34, 35, 45, 48, 50, 69, 116, 118, 130, 132, 133, 134
ACCESS, 40, 64, 68, 86
ACCESSIBLE, 20
ADVERTISING, 88
AGENCY, 8, 30, 39, 73, 77, 79, 90, 92
AGREEMENT, 8, 19, 23, 85, 131
AIR, 89
AMENDMENTS, 15
ANALYSIS, 101, 106, 107
ANSI, 7, 69, 143
APTA, 7
ASSEMBLY, 11, 12, 67, 108
ATO, 7, 46
ATP, 7, 46
AUTHORITY, 21, 64, 73, 87, 91
BEARING, 93
BOARD, 78, 89
BONDING, 19, 23
BOOK, 55, 67
CABLES, 71
CARBODY, 50
CARRIERS, 88, 89
CDRL, 7, 10
CEILING, 67
CERTIFICATE, 9, 18, 20, 24, 29, 38, 41, 46, 48, 49, 50, 63, 64, 69, 70, 75, 85, 86, 110, 117, 118, 133
CERTIFICATES, 24
CERTIFIED, 21, 39, 60
CFR, 7, 18, 86, 87, 88, 93, 94, 143, 144
CLASSIFICATIONS, 75
CLASSIFIED, 60
COMMUNICATION, 41
COMMUNICATIONS, 139
COMPLIANCE, 17, 21, 46, 47, 52, 57, 62, 64, 75, 76, 87, 91, 94, 116, 134, 137, 139, 143
COMPLYING, 33, 56, 91, 144
COMPONENTS, 44, 45, 46, 48, 50, 51, 53, 54, 55, 58, 59, 63, 66, 67, 69, 83, 117, 118, 119
CONFIDENTIAL, 83
CONFIGURATION, 12, 40, 65, 83
CPU, 48
DEFECTIVE, 45, 49, 51, 52, 53, 54, 56, 58, 110, 115, 118, 130, 133
DEFECTS, 14, 15, 55, 58, 130
DESIGN, 11, 13, 14, 19, 65, 108
DESTINATION, 45
DOCUMENTATION, 29, 47, 90, 117
DOORS, 67, 120
DOT, 7, 17, 74, 75, 87, 88, 93, 144
DRAWING, 11, 65, 66
DRAWINGS, 10, 11, 12, 28, 29, 65, 66, 67, 84, 85, 106, 108, 114, 131, 138
END, 83, 102
ENERGY, 76
ENVIRONMENT, 119
ENVIRONMENTAL, 7, 75, 91, 101, 143
EXCEPT, 22, 28, 35, 39, 44, 55, 57, 82, 86, 87, 90, 98, 101, 113, 115, 116, 136
EXCEPTIONS, 86
EXISTING, 12, 120
FABRICATED, 114
FABRICATION, 11, 69
FAILURE, 23, 102, 105
FDOT, 8, 17
FIRMWARE, 46
FLEET, 12, 17
FLOOR, 50, 67
FTA, 8, 17, 18, 38, 68, 75, 80, 81, 84, 85, 86, 87, 88, 89, 99, 122, 144
FUNCTION, 12, 48, 94, 95
HAZARDOUS, 75, 76
HRV, 12, 17
IDENTIFICATION, 70
INFLICTS, 11
INFORMATION, 8, 94
INJURY, 24, 39, 71, 82, 111
INSPECT, 58, 61, 68, 93
INSPECTED, 51, 69, 117
INSPECTION, 9, 20, 29, 41, 45, 49, 69, 70, 117, 118
INTEGRATED, 29, 32
ITEM, 14
KEY, 68, 104

LABOR, 9, 13, 14, 15, 22, 23, 27, 31, 40, 52, 53, 54, 56, 101, 111, 122, 132, 136, 138
LIMITS, 105, 118
LINERS, 88
MAINTENANCE, 11, 20, 33, 34, 41, 44, 49, 59, 63, 83, 91, 144
MANUALS, 53, 83, 84
MANUFACTURER, 9, 11, 49, 63, 120, 138
MATERIAL, 9, 12, 13, 14, 44, 45, 46, 49, 50, 51, 52, 54, 59, 60, 69, 85, 88, 89, 101, 114, 117, 130, 132
MATERIALS, 10, 15, 22, 23, 27, 28, 35, 38, 40, 44, 45, 46, 48, 50, 51, 52, 56, 57, 58, 59, 61, 62, 63, 69, 70, 71, 73, 80, 81, 83, 101, 106, 110, 112, 113, 115, 116, 118, 122, 133, 134, 136, 138
MDT, 8, 14, 41, 49, 63, 68, 93, 134
MEMBER, 77, 78, 79, 90, 92
MEMBERS, 24, 79, 92
METHOD, 14
MODIFIED, 13, 19, 31, 64
MOTOR, 118, 143
MSDS, 8
NEMA, 8, 60
NTP, 8, 12, 19, 20, 23, 86, 94, 103, 134
OSHA, 8, 76
OUTSIDE, 82, 89
PARKING, 40
PATH, 11
PERFORMANCE, 9, 10, 11, 12, 14, 15, 18, 19, 20, 21, 22, 23, 25, 29, 31, 34, 37, 41, 46, 54, 55, 56, 57, 68, 70, 71, 73, 77, 79, 83, 84, 85, 86, 87, 90, 92, 94, 95, 98, 102, 107, 108, 109, 110, 114, 122, 136, 138
PRIMAVERA, 106
PROCUREMENT, 76, 145
PROPOSAL, 10, 13, 14, 17, 18, 19, 27, 35, 46, 68, 87, 98
PURCHASE, 40, 98, 99, 120
QUALIFIED, 49, 68, 87
QUALITY, 14, 28, 40, 46, 59, 63, 70
REGULATION, 75, 82, 92
RELIABILITY, 9, 15, 27, 33, 55, 65, 69, 100, 118, 132
RELIEVE, 17, 25, 28, 45, 54, 60, 62, 63, 65, 69, 118
RESULT, 25, 30, 31, 32, 33, 34, 38, 57, 64, 71, 82, 87, 90, 94, 107, 115, 117, 131
RETROFIT, 55, 56, 65, 67, 83
REVISION, 139
RFP, 10, 12, 13, 17, 18, 27
ROOF, 67
SAFETY, 8, 74, 75, 93, 144
SAMPLING, 63, 69
SCOPE, 12, 19, 52, 81, 83
SECURED, 120
SERVICE, 14, 49, 50, 86, 101
SIGN, 70
SIGNAL, 71
SOFTWARE, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 84, 106
SOUND, 92
SPARE, 14, 50, 58, 100, 132
SPEED, 40
STOP, 64, 113
STRUCTURAL, 50
STRUCTURE, 50
SUBCONTRACTOR, 14
SUBSYSTEM, 14, 49, 51, 52, 53, 54, 55, 56, 57, 58, 60, 67, 117
TEST, 11, 63, 66, 67, 69, 70, 104, 108, 121
TESTING, 11, 55, 67, 103, 104, 118
TRAIN, 7
TRANSFER, 91, 118
TRANSFERRED, 98, 117
TRANSPORTATION, 7, 8, 18, 86, 87, 89, 93, 122, 143, 144
TRUCK, 50
UMTA, 8
UNDERFLOOR, 67
VEHICLE, 9, 11, 12, 14, 15, 41, 43, 48, 49, 50, 51, 52, 53, 54, 55, 57, 61, 65, 67, 70, 87, 103, 117, 118, 120, 134, 136
WARRANTY, 9, 15, 20, 48, 49, 50, 51, 52, 53, 54, 55, 65, 69, 100, 112, 118, 132, 133

WATER, 41
WEATHER, 101
WHEELS, 119
WINDOWS, 67
WIRING, 11
WORDS, 15
WORK, 9, 12, 13, 15, 19, 21, 22, 23, 27, 29, 31, 33, 52, 53, 54, 55, 56, 60, 64, 67, 70, 74, 75, 78, 79, 82, 84, 86, 87, 91, 92, 95, 99, 100, 101, 110, 113, 114, 115, 116, 130, 131, 132, 133, 134, 136, 138
WORKMANSHIP, 14, 28, 46, 51, 118
WRITTEN, 8, 9, 12, 13, 20, 22, 24, 28, 30, 32, 35, 38, 40, 46, 47, 50, 51, 52, 55, 56, 57, 60, 62, 63, 66, 67, 68, 74, 76, 77, 79, 81, 82, 83, 84, 88, 90, 92, 98, 100, 104, 105, 106, 107, 109, 110, 111, 119, 121, 122, 134, 136

CITED REFERENCES:

- 29 C.F.R., Section 5.5
- 40 U.S.C., §§ 3141 et seq
- 49 C.F.R., Part 18.34
- 49 C.F.R., Part 26
- 49 C.F.R., Parts 655 and 40
- 49 C.F.R., Part 661.13
- Americans with Disabilities Act of 1990 (and related Acts)
- Americans with Disabilities Act of 1990, 42 U.S.C. §§ 12101 et seq., 49 U.S.C. § 5301(d)
- ANSI/ASQC Z1.4
- ANSI/ASQC Z1.9
- Best's Insurance Guide, published by A. M. Best Company, Oldwick, New Jersey
- Board of County Commissioner's Resolution R-173-08, 02/19/2008: Mandatory Collection of Contract Penalties
- Buy America; 49 U.S.C. § 5323(m)
- Circular 570 of the U.S. Department of the Treasury entitled "Surety Companies Acceptable on Federal Bonds"
- Clean Air Act, as amended, 42 U.S.C. §§ 7401, et seq.
- Comprehensive Environmental Response, Compensation and Liability Act, as amended, ("CERCLA"), 42 U.S.C. §§ 9601
- "Conflicts of Interest" Section 2–11 of the County Code, and Ordinance 01–199
- County Ordinance 94.40 (Prompt Payment)
- Davis – Bacon Act at 49 U.S.C. § 5333(a), and implementing U.S. DOL regulations, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction (also Labor Standards Provisions Applicable to Nonconstruction Contracts Subject to the Contract Work Hours and Safety Standards Act)," 29 C.F.R. Part 5
- Department of Transportation's regulations on the Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations (49 CFR Part 655)
- DOL regulations, "Safety and Health Regulations for Construction " 29 C.F.R. Part 1926
- Energy Policy and Conservation Act, 42 U.S.C. §§ 6321
- Equal Employment Opportunity (EEO), in compliance with Executive Order 11246
- Federal Acquisition Regulations (FAR) subpart 1-1.11 "Qualified Products"
- Federal Insurance Contributions Act and Federal Unemployment Tax Act.
- Florida Bureau of Motor Vehicles
- Florida Sales and Use Tax, in accordance with Section 212.08, Florida Statutes, as amended
- Florida Statute 218.74 and Section 2-8.1.4 of the Miami-Dade County Code
- Florida Statute 440
- Florida's Public Records Law

- FTA in accordance with 49 CFR, Part 20
- FTA Circular 4220.1F or any revisions thereto
- FTA regulations, "Pre-Award and Post-Delivery Audits of Rolling Stock Purchases" 49 CFR Part 663
- International Air Transportation Fair Competitive Practices Act of 1974, as amended, 49 U.S.C. § 40118, and in accordance with U.S. General Services Administration regulations pertaining to the use of United States flag air carriers, 41 C.F.R. § 301–3.60(b)
- "List of All Insurance Companies Authorized or Approved to Do Business in Florida", issued by the State of Florida Department of Insurance
- Miami-Dade County Administrative Order 3-20
- Miami-Dade County Code, Chapter 11A, Article 3
- Miami-Dade County Code of Business Ethics; Section 2-8.1(i) Code of Miami-Dade County
- Miami-Dade County Code Section 10–38 "Debarment".
- Miami-Dade County Ordinance 99–152, prohibiting the presentation, maintenance, or prosecution of false or fraudulent claims against Miami-Dade County.
- Miami-Dade County Ordinance 99–5, codified at 11A–60 et. seq. of Miami-Dade Code pertaining to complying with the County's Domestic Leave Ordinance.
- Miami-Dade County Resolution No. R-385-95
- Privacy Act of 1974, 5 U.S.C. § 552a, and the regulations thereunder
- Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31
- Regulatory Provisions of 40 C.F.R. Part 247, and Executive Order 12873,
- Resource Conservation and Recovery Act, as amended, 42 U.S.C. §§ 6901
- Secretary of Labor (41 CFR Chapter 50)
- Secretary of Labor (41 CFR 50-202.2) and (41 CFR 50-202.3)
- Section 2-1076 of the Code of Miami-Dade County, as amended by Ordinance No. 99-63
- Section 2-11.1(d) of Miami-Dade County Code as amended by Ordinance 00–1
- Section 2-11.1 of the Code of Miami-Dade County, Florida, known as the "Miami-Dade County Conflict of Interest and Code of Ethics Ordinance"
- Section 14 of the Fir Labor Standards Act (41 U.S.C. 40)
- Section 102 of the Contract Work Hours and Safety Standards Act, as amended, 40 U.S.C. §§ 327–332
- Section 107 of the Contract Work Hours and Safety Standards Act, 40 U.S.C. section 333
- Section 165 of the Surface Transportation Assistance Act of 1982, and 49 CFR Part 661
- Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794;
- Section 6002 of the Resource Conservation and Recovery Act, (as amended), 42 U.S.C. § 6962
- Section 287.0935, Florida Statutes (1991)
- Subpart B of 40 C.F.R. Part 247
- Surface Transportation and Uniform Relocation Assistance Act of 1987

- Uniform Commercial Code
- United States Department of the Treasury under ss. 31 U.S.C. 9304-9308
- U.S. DOL regulations Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction (also Labor Standards Provisions Applicable to Nonconstruction Contracts Subject to the Contract Work Hours Safety Standard Act)," 29 C.F.R., Part 5
- Walsh-Healey Public Contracts Act, as amended (41 U.S.C. 35-45)
- Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251

CERTIFICATE OF LIABILITY INSURANCE

DATE(MM/DD/YYYY) 07/06/2011

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

Holder Identifier :

PRODUCER
Aon Risk Services Northeast, Inc.
New York NY Office
199 Water Street
New York NY 10038-3551 USA

CONTACT NAME:
PHONE (A/C. No. Ext): (866) 283-7122
FAX (A/C. No.): (847) 953-5390
E-MAIL ADDRESS:

INSURER(S) AFFORDING COVERAGE		NAIC #
INSURER A:	National Union Fire Ins Co of Pittsburgh	19445
INSURER B:		
INSURER C:		
INSURER D:		
INSURER E:		
INSURER F:		

INSURED
Ansaldobreda, Inc.
1461 Loveridge Road
Pittsburg CA 94565 USA

COVERAGES **CERTIFICATE NUMBER:** 570043185442 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS. Limits shown are as requested

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	
	COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	
	CLAIMS-MADE / OCCUR						MED EXP (Any one person)	
							PERSONAL & ADV INJURY	
							GENERAL AGGREGATE	
	GEN'L AGGREGATE LIMIT APPLIES PER: POLICY / PRO-JECT / LOC						PRODUCTS - COMP/OP AGG	
A	AUTOMOBILE LIABILITY			CA 3374139	12/09/2010	12/09/2011	COMBINED SINGLE LIMIT (Ea accident)	$5,000,000
	X ANY AUTO						BODILY INJURY (Per person)	
	ALL OWNED AUTOS / SCHEDULED AUTOS						BODILY INJURY (Per accident)	
	X HIRED AUTOS / X NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	
							COMP/COLL DEDUCTIBLE	$1,000
	UMBRELLA LIAB / OCCUR						EACH OCCURRENCE	
	EXCESS LIAB / CLAIMS-MADE						AGGREGATE	
	DED / RETENTION							
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR / PARTNER / EXECUTIVE OFFICER/MEMBER EXCLUDED? Y/N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N/A					WC STATU-TORY LIMITS / OTH-ER	
							E.L. EACH ACCIDENT	
							E.L. DISEASE-EA EMPLOYEE	
							E.L. DISEASE-POLICY LIMIT	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
RFP 654

Certificate No : 570043185442

CERTIFICATE HOLDER

Miami-Dade County
111 NW 1 Street, Suite 1300
Miami FL 33128-1974 USA

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Aon Risk Services Northeast, Inc.

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ACORD 25 (2010/05)

OP ID: CM

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 07/07/11

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Thompson Risk Management Corp.
1 Dupont Street, Suite 210
Plainview, NY 11803
516-349-5910
516-349-5916

CONTACT NAME:
PHONE (A/C, No, Ext):
FAX (A/C, No):
E-MAIL ADDRESS:
PRODUCER CUSTOMER ID #: BREDA-1

INSURED
Ansaldobreda, Inc.
101 The Embarcadero, Suite 210
San Francisco, CA 94105

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : The Insurance Company	
INSURER B : of the State of Pennsylvania	
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	CLAIMS-MADE OCCUR						MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
	GEN'L AGGREGATE LIMIT APPLIES PER: POLICY PRO-JECT LOC						PRODUCTS - COMP/OP AGG	$
								$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	ANY AUTO						BODILY INJURY (Per person)	$
	ALL OWNED AUTOS						BODILY INJURY (Per accident)	$
	SCHEDULED AUTOS						PROPERTY DAMAGE (Per accident)	$
	HIRED AUTOS							$
	NON-OWNED AUTOS							$
	UMBRELLA LIAB OCCUR						EACH OCCURRENCE	$
	EXCESS LIAB CLAIMS-MADE						AGGREGATE	$
	DEDUCTIBLE							$
	RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						WC STATU-TORY LIMITS X OTH-ER	
A	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? Y / N	N / A	X	WC024549754 CA ONLY	10/01/10	10/01/11	E.L. EACH ACCIDENT	$ 1,000,000
A	(Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below			WC024549753 (NY, FL & HI)	10/01/10	10/01/11	E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
Re: For the Procurement of New Metrorail Vehicles RFP 654

CERTIFICATE HOLDER

MIAMI--

Miami-Dade County
111 N.W. 1st Street, Suite1300
Miami, FL 33128-1974

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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ACORD 25 (2009/09)

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THE AMERICAN INSTITUTE OF ARCHITECTS

BID BOND
The American Institute of Architects
AIA Document No A310 (February, 1970 Edition)

Bond No. BID 2009-5

KNOW ALL MEN BY THESE PRESENTS, that we Ansaldobreda, S.p.A.
via Argine 425
80147 NAPOLI (Italy)

as Principal, hereinafter called the Principal, and Fidelity and Deposit Company of Maryland, and
Liberty Mutual Insurance Co.
As Co-Surety

a corporations duly organized under the laws of the state of Maryland and Massachusetts respectively

as Surety, hereinafter called the Surety, are held and firmly bound unto Miami-Dade Transit
Miami-Dade County
111 NW 1st St.
Miami, Fl 33128-1983

as Obligee hereinafter called the Obligee, in the sum, not to exceed three million four hundred eighty thousand and xx/100----------Dollars ($3,480,000.00)

for the Payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents

WHEREAS, the Principal has submitted a bid for RFP # 654, a project for the Purchase of New Heavy Rail Vehicles

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this 11th day of September 2009.

(Witness)

(Witness)

(Witness)

Ansaldobreda, S.p.A.
(Principal) (Seal)

(Signature)

Liberty Mutual Insurance Co.
(Surety) (Seal)

Christopher A. Thompson, Attorney-in-Fact

Fidelity and Deposit Company of Maryland
(Surety) (Seal)

Christopher A. Thompson, Attorney-in-Fact

Revised to February, 1970
SB5714b Printed in U.S.A.

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON RED BACKGROUND.

1178546

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

LIBERTY MUTUAL INSURANCE COMPANY
BOSTON, MASSACHUSETTS
POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS: That Liberty Mutual Insurance Company (the "Company"), a Massachusetts stock insurance company, pursuant to and by authority of the By-law and Authorization hereinafter set forth, does hereby name, constitute and appoint

ALAN J. THOMPSON, CHRISTOPHER A. THOMPSON, LYNN ANN ORME, ALL OF THE CITY OF PLAINVIEW, STATE OF NEW YORK

, each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations in the penal sum not exceeding **FIFTY MILLION AND 00/100**********DOLLARS ($ **50,000,000.00*****) each, and the execution of such undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents, shall be as binding upon the Company as if they had been duly signed by the president and attested by the secretary of the Company in their own proper persons.

That this power is made and executed pursuant to and by authority of the following By-law and Authorization:

ARTICLE XIII - Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

By the following instrument the chairman or the president has authorized the officer or other official named therein to appoint attorneys-in-fact:

Pursuant to Article XIII, Section 5 of the By-Laws, Garnet W. Elliott, Assistant Secretary of Liberty Mutual Insurance Company, is hereby authorized to appoint such attorneys-in-fact as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

That the By-law and the Authorization set forth above are true copies thereof and are now in full force and effect.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Company and the corporate seal of Liberty Mutual Insurance Company has been affixed thereto in Plymouth Meeting, Pennsylvania this 5th day of March, 2003.

LIBERTY MUTUAL INSURANCE COMPANY

By Garnet W. Elliott
Garnet W. Elliott, Assistant Secretary

COMMONWEALTH OF PENNSYLVANIA ss
COUNTY OF MONTGOMERY

On this 5th day of March, 2003, before me, a Notary Public, personally came Garnet W. Elliott, to me known, and acknowledged that he is an Assistant Secretary of Liberty Mutual Insurance Company; that he knows the seal of said corporation; and that he executed the above Power of Attorney and affixed the corporate seal of Liberty Mutual Insurance Company thereto with the authority and at the direction of said corporation.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

TERESA PASTELLA COMMONWEALTH OF PENNSYLVANIA NOTARY PUBLIC

Notarial Seal
Teresa Pastella, Notary Public
Plymouth Twp., Montgomery County
My Commission Expires Mar. 28, 2005
Member, Pennsylvania Association of Notaries

By Teresa Pastella
Teresa Pastella, Notary Public

CERTIFICATE

I, the undersigned, Assistant Secretary of Liberty Mutual Insurance Company, do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy, is in full force and effect on the date of this certificate; and I do further certify that the officer or official who executed the said power of attorney is an Assistant Secretary specially authorized by the chairman or the president to appoint attorneys-in-fact as provided in Article XIII, Section 5 of the By-laws of Liberty Mutual Insurance Company.

This certificate and the above power of attorney may be signed by facsimile or mechanically reproduced signatures under and by authority of the following vote of the board of directors of Liberty Mutual Insurance Company at a meeting duly called and held on the 12th day of March, 1980.

VOTED that the facsimile or mechanically reproduced signature of any assistant secretary of the company, wherever appearing upon a certified copy of any power of attorney issued by the company in connection with surety bonds, shall be valid and binding upon the company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seal of the said company, this 11th day of September, 2009.

By David M. Carey
David M. Carey, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, bank deposit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00 am and 4:30 pm EST on any business day.

ASSETS

	Current Year 1 Assets	2 Nonadmitted Assets	3 Net Admitted Assets (Cols. 1 - 2)	Prior Year 4 Net Admitted Assets
1. Bonds (Schedule D)	15,335,083,671		15,335,083,671	14,335,788,460
2. Stocks (Schedule D):				
2.1 Preferred stocks	322,986,839		322,986,839	234,308,916
2.2 Common stocks	7,648,869,047	271,819,000	7,377,050,047	5,069,085,324
3. Mortgage loans on real estate (Schedule B):				
3.1 First liens	429,255,101		429,255,101	249,680,880
3.2 Other than first liens				
4. Real estate (Schedule A):				
4.1 Properties occupied by the company (less $ 0 encumbrances)	418,561,083		418,561,083	326,183,102
4.2 Properties held for the production of income (less $ 0 encumbrances)	1,069,882		1,069,882	1,111,445
4.3 Properties held for sale (less $ 0 encumbrances)				
5. Cash ($ 212,635,233 , Schedule E-Part 1), cash equivalents ($ 92,190,216 Schedule E-Part 2) and short-term investments ($ 523,294,378 , Schedule DA)	828,119,827		828,119,827	1,207,665,883
6. Contract loans (including $ 0 premium notes)				
7. Other invested assets (Schedule BA)	4,644,249,806	1,597,635	4,642,652,171	3,447,295,251
8. Receivables for securities	13,535,760		13,535,760	41,352,591
9. Aggregate write-ins for invested assets				
10. Subtotals, cash and invested assets (Lines 1 to 9)	29,641,731,016	273,416,635	29,368,315,381	24,912,331,852
11. Title plants less $ 0 charged off (for Title insurers only)				
12. Investment income due and accrued	175,281,336		175,281,336	168,971,988
13. Premiums and considerations:				
13.1 Uncollected premiums and agents' balances in the course of collection	963,823,216	35,685,825	928,137,391	703,139,102
13.2 Deferred premiums, agents' balances and installments booked but deferred and not yet due (including $ 34,554 earned but unbilled premiums)	1,638,538,797	3,827	1,638,534,970	1,462,229,358
13.3 Accrued retrospective premiums	438,736,647	51,047,015	387,689,632	452,717,401
14. Reinsurance:				
14.1 Amounts recoverable from reinsurers	685,885,885		685,885,885	740,190,011
14.2 Funds held by or deposited with reinsured companies	28,022,671		28,022,671	78,859,530
14.3 Other amounts receivable under reinsurance contracts				
15. Amounts receivable relating to uninsured plans	2,597,574	2,437,580	159,994	
16.1 Current federal and foreign income tax recoverable and interest thereon	118,948,060		118,948,060	13,749,788
16.2 Net deferred tax asset	900,020,000	269,859,863	630,160,137	555,066,006
17. Guaranty funds receivable or on deposit	29,552,458		29,552,458	32,691,612
18. Electronic data processing equipment and software	263,119,215	213,712,586	49,406,629	42,760,804
19. Furniture and equipment, including health care delivery assets ($ 0)	98,104,698	98,104,698		
20. Net adjustment in assets and liabilities due to foreign exchange rates				
21. Receivables from parent, subsidiaries and affiliates	238,266,862		238,266,862	235,522,672
22. Health care ($ 0) and other amounts receivable				
23. Aggregate write-ins for other than invested assets	633,225,209	82,381,943	550,843,266	511,661,867
24. Total assets excluding Separate Accounts, Segregated Accounts and Protected Cell Accounts (Lines 10 to 23)	35,855,854,744	1,026,650,172	34,829,204,572	29,920,012,089
25. From Separate Accounts, Segregated Accounts and Protected Cell Accounts				
26. Total (Lines 24 and 25)	35,855,854,744	1,026,650,172	34,829,204,572	29,920,012,089

DETAILS OF WRITE-INS				
0901.				
0902.				
0903.				
0998. Summary of remaining write-ins for Line 09 from overflow page				
0999. Totals (Lines 0901 through 0903 plus 0998) (Line 09 above)				
2301. Other assets	212,369,467	72,186,660	140,182,807	164,433,785
2302. Cash surrender value life insurance	204,675,583		204,675,583	162,038,957
2303. Equities and deposits in pools and associations	32,235,326		32,235,326	20,497,883
2398. Summary of remaining write-ins for Line 23 from overflow page	183,944,833	10,195,283	173,749,550	164,691,242
2399. Totals (Lines 2301 through 2303 plus 2398) (Line 23 above)	633,225,209	82,381,943	550,843,266	511,661,867

LIABILITIES, SURPLUS AND OTHER FUNDS	1 Current Year	2 Prior Year
1. Losses (Part 2A, Line 34, Column 8)	12,594,762,751	10,169,462,164
2. Reinsurance payable on paid losses and loss adjustment expenses (Schedule F, Part 1, Column 6)	106,915,231	108,972,670
3. Loss adjustment expenses (Part 2A, Line 34, Column 9)	2,572,655,246	2,084,690,735
4. Commissions payable, contingent commissions and other similar charges	134,968,818	130,987,309
5. Other expenses (excluding taxes, licenses and fees)	414,446,861	355,278,576
6. Taxes, licenses and fees (excluding federal and foreign income taxes)	250,690,678	208,364,692
7.1 Current federal and foreign income taxes (including $ 0 on realized capital gains (losses))		
7.2 Net deferred tax liability		
8. Borrowed money $ 949,875 and interest thereon $ 565,850	1,515,726	1,396,151
9. Unearned premiums (Part 1A, Line 37, Column 5) (after deducting unearned premiums for ceded reinsurance of $ 1,937,007,225 and including warranty reserves of $ 0)	3,678,689,493	3,114,705,894
10. Advance premium	39,998,380	22,746,128
11. Dividends declared and unpaid:		
11.1 Stockholders		
11.2 Policyholders	12,802,684	3,999,990
12. Ceded reinsurance premiums payable (net of ceding commissions)	851,675,481	819,145,981
13. Funds held by company under reinsurance treaties (Schedule F, Part 3, Column 18)	1,878,182,260	1,866,405,417
14. Amounts withheld or retained by company for account of others	632,437,218	619,581,207
15. Remittances and items not allocated		
16. Provision for reinsurance (Schedule F, Part 7)	116,580,664	120,072,684
17. Net adjustments in assets and liabilities due to foreign exchange rates		
18. Drafts outstanding	286,356,848	274,794,753
19. Payable to parent, subsidiaries and affiliates	81,311,436	159,008,230
20. Payable for securities	31,683,685	278,480,820
21. Liability for amounts held under uninsured plans		
22. Capital notes $ 0 and interest thereon $ 0		
23. Aggregate write-ins for liabilities	(679,769,042)	(369,600,531)
24. Total liabilities excluding protected cell liabilities (Lines 1 through 23)	23,005,904,618	19,967,883,060
25. Protected cell liabilities		
26. Total liabilities (Lines 24 and 25)	23,005,904,618	19,967,883,060
27. Aggregate write-ins for special surplus funds	948,875,402	811,135,623
28. Common capital stock	10,000,000	10,000,000
29. Preferred capital stock		
30. Aggregate write-ins for other than special surplus funds	1,250,000	1,250,000
31. Surplus notes	891,966,161	1,013,209,431
32. Gross paid in and contributed surplus	4,343,951,176	3,146,160,105
33. Unassigned funds (surplus)	5,622,257,215	4,968,373,870
34. Less treasury stock, at cost:		
34.1 0 shares common (value included in Line 28 $ 0)		
34.2 0 shares preferred (value included in Line 29 $ 0)		
35. Surplus as regards policyholders (Lines 27 to 33, less 34) (Page 4, Line 39)	11,823,299,954	9,952,129,029
36. TOTALS (Page 2, Line 26, Col. 3)	34,829,204,572	29,920,012,089

DETAILS OF WRITE-INS		
2301. Other liabilities	228,177,979	180,862,761
2302. Retroactive reinsurance reserve - ceded	(1,731,268,038)	(1,528,795,171)
2303. Amounts held under uninsured plans	568,100,759	485,811,161
2398. Summary of remaining write-ins for Line 23 from overflow page	257,220,358	490,520,728
2399. Totals (Lines 2301 through 2303 plus 2398) (Line 23 above)	(679,769,042)	(369,600,531)
2701. Special surplus from retroactive reinsurance	948,875,402	811,135,623
2702.		
2703.		
2798. Summary of remaining write-ins for Line 27 from overflow page		
2799. Totals (Lines 2701 through 2703 plus 2798) (Line 27 above)	948,875,402	811,135,623
3001. Guaranty funds	1,250,000	1,250,000
3002.		
3003.		
3098. Summary of remaining write-ins for Line 30 from overflow page		
3099. Totals (Lines 3001 through 3003 plus 3098) (Line 30 above)	1,250,000	1,250,000

State of Massachusetts
County of Suffolk ss

The officers of this reporting entity being duly sworn, each depose and say that they are the described officers of said reporting entity, and that on the reporting period stated above, all of the herein described assets were the absolute property of the said reporting entity, free and clear from any liens or claims thereon, except as herein stated, and that this statement, together with related exhibits, schedules and explanations therein contained, annexed or referred to, is a full and true statement of all the assets and liabilities and of the condition and affairs of the said reporting entity as of the reporting period stated above, and of its income and deductions therefrom for the period ended, and have been completed in accordance with the NAIC Annual Statement Instructions and Accounting Practices and Procedures manual except to the extent that: (1) state law may differ; or, (2) that state rules or regulations require differences in reporting not related to accounting practices and procedures, according to the best of their information, knowledge and belief, respectively. Furthermore, the scope of this attestation by the described officers also includes the related corresponding electronic filing with the NAIC, when required, that is an exact copy (except for formatting differences due to electronic filing) of the enclosed statement. The electronic filing may be requested by various regulators in lieu of or in addition to the enclosed statement.

(Signature)	(Signature)	(Signature)
Edward Francis Kelly	Dexter Robert Legg	Lawrence Henry Sayer Yelvin
(Printed Name) 1.	(Printed Name) 2.	(Printed Name) 3.
Chairman of the Board President & CEO	Vice President & Secretary	Senior Vice President & Treasurer
(Title)	(Title)	(Title)

Subscribed and sworn to before me this
22nd day of January, 2008

a. Is this an original filing? YES [X] NO [ ]
b. If no 1. State the amendment number
2. Date filed
3. Number of pages attached

Individual Acknowledgment

State of _____

County of _____ }ss.:

On this _____ day of _____, _____, before me personally came

_____ to me known,

and known to me to be the individual described in and who executed the foregoing instrument, and acknowledged to me that he executed the same.

My commission expires _____ _____

Notary Public

Firm Acknowledgment

State of _____

County of _____ }ss.:

On this _____ day of _____, _____, before me personally came

_____ to me known,

and known to me to be a member of the firm of _____

described in and who executed the foregoing instrument, and thereupon acknowledged to me that he executed the same as and for the act and deed of said firm.

My commission expires _____ _____

Notary Public

Corporation Acknowledgment

State of ITALY

County of PISTOIA }ss.:

On this 07th day of September, 2009, before me personally came

MR. SALVATORE BIANCONI to me known,

who being by me duly sworn, did depose and say that he is the chief Executive officer General Manager

of ANSALDOBREDA SPA

the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that is was so affixed by the order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

My commission expires 2016 _____

Notary Public

Surety Acknowledgment

State of New York

County of Nassau }ss.:

On this 11th day of September, 2009, before me personally came

Christopher A. Thompson to me known, who, being by me duly sworn, did depose and say that he is an

Attorney-in-fact of **Liberty Mutual Insurance Company**

the corporation described in and which executed the within instrument; that she knows the corporate seal of said corporation; that the seal Affixed to the within instrument is such corporate seal, and that she signed the said instrument and affixed the said seal as Attorney-in-Fact by authority of the Board of Directors of said corporation and by authority of this office under the Standing Resolutions thereof.

Irene Kaufman
Notary Public, State of New York
No. 01KA6076834
Qualified in Nassau County
Commission Expires July 1, 2010

My commission expires: _____

Notary Public

Individual Acknowledgment

State of _____

County of _____ }ss.:

On this _____ day of _____, _____, before me personally came

_____ to me known,

and known to me to be the individual described in and who executed the foregoing instrument, and acknowledged to me that he executed the same.

My commission expires _____ _____

Notary Public

Firm Acknowledgment

State of _____

County of _____ }ss.:

On this _____ day of _____, _____, before me personally came

_____ to me known,

and known to me to be a member of the firm of _____

described in and who executed the foregoing instrument, and thereupon acknowledged to me that he executed the same as and for the act and deed of said firm.

My commission expires _____ _____

Notary Public

Corporation Acknowledgment

State of ITACY

County of PISTOIA }ss.:

On this 07th day of September, 2009, before me personally came

MR. SALVATORE BIANCONI to me known,

who being by me duly sworn, did depose and say that he is the Chief Executive Officer General Manager

of ANSALDOBASIA SPA

the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that is was so affixed by the order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

My commission expires 2016 _____

Notary Public

Surety Acknowledgment

State of New York

County of Nassau }ss.:

On this 11th day of September, 2009, before me personally came

Christopher A. Thompson to me known, who, being by me duly sworn, did depose and say that he is an Attorney-in-fact of Fidelity And Deposit Company of Maryland

the corporation described in and which executed the within instrument; that she knows the corporate seal of said corporation; that the seal Affixed to the within instrument is such corporate seal, and that she signed the said instrument and affixed the said seal as Attorney-in-Fact by authority of the Board of Directors of said corporation and by authority of this office under the Standing Resolutions thereof.

Irene Kaufman
Notary Public, State of New York
No. 01KA6076834
Qualified in Nassau County
Commission Expires July 1, 2010

My commission expires: _____

Notary Public

Power of Attorney

FIDELITY AND DEPOSIT COMPANY OF MARYLAND

HOME OFFICE: 3910 KESWICK ROAD, BALTIMORE, MD 21211

KNOW ALL MEN BY THESE PRESENTS: That the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, a corporation of the State of Maryland, by M. P. HAMMOND, Vice President, and L. L. GOUCHER, Assistant Secretary, in pursuance of authority granted by Article VI, Section 2, of the By-Laws of said Company, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, does hereby nominate, constitute and appoint **Alan J. THOMPSON, Christopher A. THOMPSON and Lynn Ann INFANTI, all of Plainview, New York, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Company, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the Company at its office in Baltimore, Md., in their own proper persons.

The said Assistant Secretary does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article VI, Section 2, of the By-Laws of said Company, and is now in force.

IN WITNESS WHEREOF, the said Vice-President and Assistant Secretary have hereunto subscribed their names and affixed the Corporate Seal of the said FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 9th day of January, A.D. 2001.

FOR YOUR PROTECTION
LOOK FOR THE FSC WATERMARK

ATTEST:

FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By:

L. L. Goucher *Assistant Secretary* *M. P. Hammond* *Vice President*

State of Maryland
County of Baltimore } ss:

On this 9th day of January, A.D. 2001, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, came M. P. HAMMOND, Vice President, and L. L. GOUCHER, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and they each acknowledged the execution of the same, and being by me duly sworn, severally and each for himself deposeth and saith, that they are the said officers of the Company aforesaid, and that the seal affixed to the preceding instrument is the Corporate Seal of said Company, and that the said Corporate Seal and their signatures as such officers were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Carol J. Fader *Notary Public*
My Commission Expires: August 1, 2004

POA-F 093-7389

EXTRACT FROM BY-LAWS OF FIDELITY AND DEPOSIT COMPANY OF MARYLAND

"Article VI, Section 2. The Chairman of the Board, or the President, or any Executive Vice-President, or any of the Senior Vice-Presidents or Vice-Presidents specially authorized so to do by the Board of Directors or by the Executive Committee, shall have power, by and with the concurrence of the Secretary or any one of the Assistant Secretaries, to appoint Resident Vice-Presidents, Assistant Vice-Presidents and Attorneys-in-Fact as the business of the Company may require, or to authorize any person or persons to execute on behalf of the Company any bonds, undertaking, recognizances, stipulations, policies, contracts, agreements, deeds, and releases and assignments of judgements, decrees, mortgages and instruments in the nature of mortgages,...and to affix the seal of the Company thereto."

CERTIFICATE

I, the undersigned, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the original Power of Attorney of which the foregoing is a full, true and correct copy, is in full force and effect on the date of this certificate; and I do further certify that the Vice-President who executed the said Power of Attorney was one of the additional Vice-Presidents specially authorized by the Board of Directors to appoint any Attorney-in-Fact as provided in Article VI, Section 2, of the By-Laws of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed."

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seal of the said Company,

this 11th day of September, 2009.

R. E. Smith

Assistant Secretary

FIDELITY AND DEPOSIT COMPANY

OF MARYLAND

3910 KESWICK ROAD, BALTIMORE, MD 21211-2226

The F&D Companies

Statement of Financial Condition

As Of December 31, 2007

ASSETS

Bonds	$ 152,119,394
Stocks	43,598,075
Cash and Short Term Investments	58,417,758
Reinsurance Recoverable	20,969,268
Other Accounts Receivable	40,255,904
TOTAL ADMITTED ASSETS	$ 315,360,399

LIABILITIES, SURPLUS AND OTHER FUNDS

Reserve for Taxes and Expenses		$ 875,904
Ceded Reinsurance Premiums Payable		70,455,734
Securities Lending Collateral Liability		43,430,120
TOTAL LIABILITIES		$ 114,761,758
Capital Stock, Paid Up	$ 5,000,000	
Surplus	195,598,641	
Surplus as regards Policyholders		200,598,641
TOTAL		$ 315,360,399

Securities carried at $34,597,845 in the above statement are deposited as required by law.

Securities carried on the basis prescribed by the National Association of Insurance Commissioners. On the basis of December 31, 2007 market quotations for all bonds and stocks owned, the Company's total admitted assets would be $315,825,091 and surplus as regards policyholders $201,063,333.

I, DAVID A. BOWERS, Corporate Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing statement is a correct exhibit of the assets and liabilities of the said Company on the 31st day of December, 2007.

Corporate Secretary

State of Illinois
City of Schaumburg } SS:

Subscribed and sworn to, before me, a Notary Public of the State of Illinois, in the City of Schaumburg, this 14th day of March, 2008.

NOTARY PUBLIC OFFICIAL SEAL STATE OF ILLINOIS
MARLO G. SARABYN
MY COMMISSION EXPIRES
NOVEMBER 25, 2011

Notary Public

TECHNICAL PROVISIONS FOR MIAMI-DADE COUNTY

MIAMI-DADE COUNTY

Delivering Excellence Every Day

For The Procurement of New Metrorail Vehicles RFP 654

Submitted by: Miami-Dade County Department of Procurement Management

CONFORMED NOVEMBER 2010

Table of Contents

1	SYSTEM DESCRIPTION	1-1
2	SYSTEM REQUIREMENTS	2-1
3	CARBODY	3-1
4	COUPLERS AND DRAFT GEAR	4-1
5	OPERATOR'S CAB	5-1
6	DOOR CONTROL	6-1
7	HEATING VENTILATION AND AIR CONDITIONING	7-1
8	LIGHTING	8-1
9	AUXILIARY ELECTRIC	9-1
10	PROPULSION	10-1
11	TRUCK ASSEMBLIES	11-1
12	FRICTION BRAKING	12-1
13	COMMUNICATIONS	13-1
14	AUTOMATIC TRAIN CONTROL	14-1
15	SYSTEM SUPPORT	15-1
16	MANAGEMENT SUPPORT	16-1
17	INSPECTION AND TESTING	17-1
18	SYSTEM ASSURANCE	18-1
19	MATERIALS AND WORKMANSHIP	19-1
20	VEHICLE MONITORING SYSTEM	20-1
21	FLEET COMPATIBILITY	21-1
22	SOFTWARE SYSTEMS	22-1
23	CONTRACT DOCUMENTS REQUIREMENTS LIST	23-1

TABLE OF CONTENTS

N1. SYSTEM DESCRIPTION 1-1
N1.1. GENERAL 1-1
N1.1.1. CITED REFERENCES 1-1
N1.1.2. SUBMITTALS – CDRLS 1-1
N1.2. SCOPE OF WORK 1-2
N1.3. ABBREVIATIONS, DEFINITIONS, AND TERMS 1-2
N1.3.1. ABBREVIATIONS 1-2
N1.3.2. TERMS 1-12
N1.3.3. ADDITIONAL DEFINITIONS 1-21
N1.4. REFERENCE STANDARDS 1-21
N1.5. MDT OPERATIONS 1-21
N1.6. VEHICLE DELIVERY, TESTING AND ACCEPTANCE 1-23

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N1. SYSTEM DESCRIPTION

N1.1. GENERAL

Miami-Dade Transit operates several modes of transportation, including bus, rail, and people mover vehicles. This specification focuses on the scope of work associated with the procurement of new vehicles for the Miami Metrorail system.

The Miami Metrorail system is a 22.4 mile dual track primarily elevated transit system with 22 stations. The system has the capability of full automation, with the central control facility located downtown, and the maintenance facility located at Lehman Center. Terminal stations are the Dadeland South station and the Palmetto station.

The Miami Metrorail vehicles are electrically powered, steel wheeled, air conditioned, married pairs, designated as A-cars and B-cars. Each car has designated "F-"(front) and "R-"(rear) ends, with primarily identical equipment, however, some equipment is shared (ATC, Air Compressor, and Battery Box.) Train consists of two, four, and six car trains are feasible, however, the Miami Metrorail operates with four and six car trains exclusively.

There are plans for expansion of the system to address significant growth throughout Miami-Dade County.

N1.1.1. CITED REFERENCES

Source/Section	Title
None	

N1.1.2. SUBMITTALS – CDRLS

CDRL No.	Title	TP Reference
None		

N1.2. SCOPE OF WORK

The Contractor shall be responsible for performing all project management, design, systems engineering, procurement, manufacture, test, and deployment of all married pairs of rail transit vehicles for MDT's Metrorail System in accordance with the Contract Documents. The work shall also include the production of all drawings, documentation, manuals, and training in accordance with the Contract Documents. Quality assurance shall be provided to ensure that all work submitted meets the pre-established criteria.

It is the Contractor's responsibility to be aware of all vehicle interfaces, including standard operational requirements and maintenance practices associated with Miami-Dade Transit.

If at any time the Contractor finds that any requirement of this Specification appears to be in error or in conflict with the general intent of the Contract Documents, the Contractor shall immediately bring the apparent issue to the attention of the Engineer, in writing, for disposition.

The Contractor shall be solely responsible for the detailed design of the vehicles to comply with the MDT operating profile and environment, and shall provide vehicles that are in all respects compliant with the Contract Documents.

N1.3. ABBREVIATIONS, DEFINITIONS, AND TERMS

Whenever abbreviations or terms are used or referenced in these Technical Provisions, they shall have the meaning set forth as follows, otherwise, they shall have the meaning set forth in the General Provisions (GP).

N1.3.1. ABBREVIATIONS AND ACRONYMS

AA	Aluminum Association
AAR	Association of American Railroads
AATCC	American Association of Textile Chemists and Colorists
AC	Alternating Current
ADA	Americans with Disabilities Act
ADU	Aspect Display Unit
AF	Audio Frequency
AFBMA	Anti-Friction Bearings Manufacturers Association
AGMA	American Gear Manufacturers Association
AISI	American Iron and Steel Institute

ANSI	American National Standards Institute
APS	Auxiliary Power Supply
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance of Way Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association of America
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATOM	Automatic Train Operation Mode
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
AVAS	Automatic Voice Announcement System
AVL	Automatic Vehicle Locator
AW0	Empty transit vehicle weight
AW1	Empty transit vehicle weight plus passenger seated load
AW2	Empty transit vehicle weight plus passenger seated and normal standing load
AW3	Empty transit vehicle weight plus passenger seated and full rated standing load
AWG	American Wire Gauge
AWS	American Welding Society
BECU	Brake Electronic Control Unit
BOM	Bill of Materials
BTE	Bench Test Equipment
BTU	Bench Test Unit
C	Celsius
CAD	Computer Aided Design
CBTC	Communication Based Train Control
CC	Coast Contractor

CCH	Communications Control Head
CCTV	Closed Circuit Television
CCU	Communications Control Unit
CD	Contract Documents
CDR	Concept Design Review
CDRL	Contract Data Requirements List
CFM	Cubic Feet per Minute
CFR	United States Code of Federal Regulations
CHB	Car History Book
CIN	Customer Information Network
CIS	Customer Information System
CMMI SE/SW	Capability Maturity Model Integrated Systems Engineering and Software
CPM	Critical Path Method
CPU	Central Processing Unit
CR	Concept Report
CTS	Communication Transmission System
CU	Central Unit
CU1	Central Unit 1
CU2	Central Unit 2
CWR	Continuously Welded Rail
dBA	Decibels – 'A' scale
DC	Direct Current
DCU	Door Control Unit
DOT	Department of Transportation
DR	Data Recorder
D_s	Optical Density (of Smoke)
DST	Daylight Saving Time
DTE	Diagnostic and Test Equipment
DVA	Digital Voice Announcement
DVD	Digital Versatile (Video) Disc
DVR	Digital Video Recorder
EAM	Enterprise Asset Management

EAMS	Enterprise Asset Management System
EB	Emergency Brake
ECN	Engineering Change Notice
EIA	Electronic Industries Association
EIS	Electronic Information Screens
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read Only Memory
EPTFE	Expanded Polytetrafluoroethylene
ESD	Electrostatic Discharge
EST	Eastern Standard Time
F	Fahrenheit
FAA	Federal Aviation Administration
FAI	First Article Inspection
Fc	Foot Candle
FCC	Federal Communications Commission
FDOT	Florida Department of Transportation
F-end	Front End
FEA	Finite Element Analysis
FIFO	First In First Out
FMECA	Failure Mode Effect and Criticality Analysis
FMVSS	Federal Motor Vehicle Safety Standards
FPS	Frames per Second
FRA	Federal Railroad Administration
FRP	Fiber Reinforced Plastic
FS	Federal Specifications & Standards
FSK	Frequency Shift Keyed
ft.	Foot (Feet)
FTA	Federal Transit Administration, an agency within the United States Department of Transportation, formerly known as UMTA
g	Gravitational acceleration
GIS	Geographic Information System

g/sec	Gravitational acceleration/second
GHz	Giga Hertz
GP	General Provision
GPS	Global Positioning System
Hrs.	Hours
HRV	Heavy Rail Vehicle
HSCB	High-Speed Circuit Breaker
HVAC	Heating, Ventilation, and Air Conditioning
HVDC	High Voltage Direct Current
Hz	Hertz
I/O	Input/Output
IC	Intercom
ICEA	Insulated Cable Engineers Association
ID	Identification
IDR	Intermediate Design Review
IEC	International Electro-Technical Commission
IESNA	Illuminating Engineering Society of North America
IEEE	Institute of Electrical and Electronics Engineers
IGBT	Insulated Gate Bipolar Transistor
In.	Inch (es)
IPCEA	Insulated Power Cable Engineers Association
Is	Radiant Panel Index
ISO	International Standards Organization
IT	Information Technology
IVLSN	Integrated Vehicle Level Schematics and Narrative
IVR	Innovative Voice Response
J	Joule
kHz	Kilo Hertz
KS	Key Switch (Master Controller)
kVA	Kilo Volt Ampere
LAHT	Low Alloy – High Tensile
LAN	Local Area Network

LCD	Liquid Crystal Display
LED	Light Emitting Diode
LLRU	Lowest Line Replaceable Unit
LRU	Line Replaceable Unit
LS	LUMP SUM
LVDC	Low Voltage Direct Current
LVPS	Low Voltage Power Supply
Mbps	Mega Bits per Second
MCL	Master Control Logic
MCS	Main Control System
MCU	Motor Control Unit
MDBSF	Mean Distance Between Service Failures
MDT	Miami-Dade Transit
MEA	Maintenance Engineering Analysis
MHz	Mega Hertz
MI&D	Mobility Impaired and Disabled
MIL	Military Specification (U.S.)
mm	Millimeter
MMI	Man Machine Interface
MMIS	Maintenance Management Information System
MOV	Metal Oxide Varistors
MPH	Miles per Hour
MPHPS	Miles per hour per second
MPHPSPS	Miles per hour per second per second
MRB	Material Review Board
ms	Millisecond
MS	Microsoft
MSS	Mode Select Switch
mT	MilliTesla
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
mV	MilliVolt

MVB	Main Vehicle Bus
N/A	Not Applicable
NDT	Non Destructive Testing
NEC	National Electrical Code (NFPA part 70, latest edition)
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards & Technology
NTP	Notice to Proceed
NTSC	National Television System Committee
O&M	Operations and Maintenance
OCC	Operations Control Center
OCU	Operation Console Unit
ODBC	Open Database Connectivity
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor
OSHAT	Occupational Safety and Health Act
P&ID	Piping and Instrumentation Diagram
P/BRK	Propulsion/Brake
Pa	Pascal
PA	Public Address
PA/PIS	Public Address/Passenger Information System
PATH	Program Advanced Transit and Highway
PBS	Propulsion and Braking System
PC	Personal Computer
PCB	Printed Circuit Board
PDA	Personal Digital Assistant
PDR	Preliminary Design Review
PDS	Power Distribution System
PECU	Propulsion Equipment Control Unit
PEIC	Passenger Emergency Intercom System
PF	Power Frequency

pH	Potential of Hydrogen - negative 10-base log (power) of the positive hydrogen ion concentration; measure of acidity
PIS	Passenger Information Screen
PLD	Programmable Logic Devices
PM	Preventive Maintenance
PTU	Portable Test Unit
PVID	Permanent Vehicle Identification
PVC	Polyvinyl Chloride
PWM	Pulse Width Modulation
QAM	Quality Assurance Manual
R-end	Rear End
RF	Radio Frequency
RFP	Request for Proposal
RMO	Remote Mode of Operation
RMS	Root Mean Square
RMSH	Reliability Maintainability Safety and Human Factors
ROM	Read Only Memory
rpm	Revolutions per Minute
SAE	Society of Automotive Engineers
SCADA	Supervisory Control and Data Acquisition
SCCP	Software Configuration Control Plan
SCE	Software Capability Evaluation
SCI	Software Configuration Items
SCMP	Software Configuration Management Plan
SDD	Software Design Descriptions
SEC	Second
SEI	Software Engineering Institute
SFD	Software Functional Description
SMC	Station Media Controller
SOAP	Simple Object Access Protocol
SONET	Synchronous Optical Network
SPL	Sound Pressure Level
SPMP	Software Program Management Plan

SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SRTM	Software Requirements Traceability Matrix
SST	Stainless Steel
SSPC	Structural Steel Paint Council
STD	State Transition Diagram
STE	Special Test Equipment
SVD	Software Version Description
SVVP	Software Verification and Validation Plan
T	Tesla
T/L	Train Line
TBD	To Be Determined
TC	Train Control
TCH	Transit Control Head
TCN	Train Control Network
TCP/IP	Transfer Control Protocol/Internet Protocol
TFE	Tetrafluoroethylene
TIG	Tungsten Inert Gas
TMP	Traffic Management Procedure
TMS	Train Management System
TOD	Train Operator Display
TP	Technical Provisions
TPN	Technical Provisions referring to New build car
TTW	Train to Wayside
TVS	Train Vision System
TWC	Train to Wayside Communication
UDP	Users Datagram Protocol
UL	Underwriters' Laboratories, Inc.
US	United States
US&S	Union Switch and Signal
USB	Universal Serial Bus
UV	Ultra Violet

VAC	Volts Alternating Current
VDC	Volts Direct Current
VLU	Vehicle Logic Unit
VMC	Vehicle Media Controller
VMS	Vehicle Monitoring System
VOD	Vehicle Operator Display
Vs.	Versus
VSWR	Voltage Standing Wave Ratio
VVVF	Variable Voltage, Variable Frequency
VZ	Zero Velocity
XML	Extensible Markup Language

N1.3.2. TERMS

49 CFR: 49 CFR, Part 38, Americans with Disabilities Act (ADA) Accessibility Specifications for Transportation Vehicles.

A-Car: See Married Pair.

AGREEMENT (CONTRACT): The negotiated, written agreement executed by County and the Contractor, in conformance with the Contract Documents, for the performance of the Work, which incorporates and includes the remaining Contract Documents.

APPROVED: The endorsement or authorization by MDT or the Engineer of a proposal, plan, procedure, action, document, report, specification, design, or any parts thereof, undertaken, promulgated, or developed by the Contractor in accordance with the requirements of the Contract Documents.

APPROVED EQUAL OR EQUIVALENT: An item, material, or method proposed as a substitute for that specified in the Contract Documents that does not alter form, fit, or function, for which allowance in writing has been obtained from the Engineer. Approval as an equal does not relieve the Contractor from the responsibility of meeting the specification. The final burden of specification compliance is the sole responsibility of the Contractor.

AUXILIARY EQUIPMENT: Any mechanism or structure, other than the vehicle body, traction motor, or propulsion equipment gearing, that performs a function at any time during the operation of the Vehicle, such as, the heating and cooling subsystem, pumps, auxiliary inverter, vehicle door mechanism, air compressor, or rail vehicle lighting.

AVERAGE BRAKE RATE ($(V_u-V_l)/T$): The speed (V_u) at which brake force, as measured by motor current or brake cylinder pressure, has ramped up to its full service level, minus the lower speed (V_l), divided by the elapsed time (T) required to go from the speed (V_u) to the lower speed.

AVERAGE DECELERATION RATE: The ratio of the rail vehicle speed at which braking effort achieves the commanded value and the elapsed time from that occurrence to zero vehicle speed. The elapsed time does not include braking effort build up time during jerk limiting and does not include Operator reaction time or allowable dead time.

B-Car: See Married Pair.

BLENDING: A simultaneous application of dynamic and friction brakes, in which the effort of the friction brake supplements the electrical braking effort as needed, in order to achieve the total required braking effort.

COUPLER: A device for mechanically coupling rail vehicles together. This term is also applied to connectors, as in "electric coupler" and "pneumatic coupler".

CRITICAL PATH: In a schedule, a sequence of stages toward the achievement of a final task that accounts for all other tasks that must be completed in order to accomplish the final task.

DAYS: Shall mean calendar day(s), unless otherwise designated.

DEADMAN FEATURE: A device designed to detect a lack of attention or disability of an Operator and to automatically apply full-service braking when it detects such lack of attention or disability.

DEFECT(S)/DEFECTIVE: The condition of any part of the Work that does not meet the Contract Document requirements; causes a Vehicle or a portion of the Work to cease operating or operate in a degraded mode; or inflicts damage or harm on any other portion of a Vehicle or the Work.

DELIVERY FOR ACCEPTANCE TESTING: The delivery of a New Vehicle (Metrorail), by the Contractor to the County's property, for the performance of Acceptance Testing by the Contractor pursuant to TPN17, with all previously scheduled portions of the Work having been fully and properly completed by the Contractor for the Vehicle.

DRAFT GEAR: The resilient portion of the coupler device and the energy-absorbing mechanism that attaches the coupler to the anchorage.

DRAWING: Any drawing or similar data which is required to be submitted or prepared pursuant to the Contract Documents; prepared by the Contractor or others to supplement, detail, or describe the Work; and/or is a Contract Drawing, Engineering Design Drawing, and/or Manufacturing Drawing. These may also include, but are not limited to, electrical schematics and wiring diagrams, fabrication, erection, layout, assembly, installation, test, maintenance, and repair drawings, as well as instructions and Manufacturer's catalog information.

DYNAMIC BRAKING: Braking in which the power generated by the traction motors, when driven as generators, is either regenerative or is dissipated in resistor banks.

DWELL: The period of time from the instant a train stops at a station until the instant the train resumes moving.

ELECTRIC BRAKING: Braking in which the power generated by the traction motors, when driven as generators, is either regenerative or is dissipated in resistor banks.

EMERGENCY STOP: The stopping of a rail vehicle or train by an emergency brake application. Once initiated, the emergency brake application cannot be released until the rail vehicle or train has stopped.

BRAKING EFFORT: Retarding force developed by the propulsion subsystem, braking subsystem, or a combination of both subsystems.

CAR: See Vehicle.

COAST: The mode of operation of a rail vehicle or consist in which propulsion (positive traction) and braking are inactive except for normal drive train losses.

COEFFICIENT OF ADHESION: The ratio between the maximum longitudinal tangential force before a spin or slide occurs and the normal force at the wheel-rail interface during rolling contact.

COMMUNICATIONS SYSTEM INTEGRATOR: The individual, firm, partnership, corporation, joint venture, or any combination thereof, who coordinates the integration of the communications subsystems that interface with the local area network.

COMPATIBILITY (COMPATIBLE): The condition where vehicle performance and control are operationally identical between two or more vehicles. Compatibility will allow multiple vehicles to couple together, with control of systems on all vehicles being effected by any lead vehicle of the consist.

CONSIST: The number and types of rail vehicle married pairs that make up a train.

CONSOLE: The control panel located in the F-end or cab of a rail vehicle directly in front of the Operator's seat.

CONTRACT SPECIFICATIONS (SPECIFICATIONS): The directions, provisions, and requirements contained, or referenced, in the General Provisions and Technical Provisions prescribing the manner of performing the Work, or to the quantities and qualities of materials to be furnished or incorporated into the Work.

CONTRACT DATA REQUIREMENTS LIST (CDRL): A matrix listing data, such as drawings, catalogs, reports, notices, and samples, required to be submitted by the Contractor, pursuant to the Contract Documents. The matrix also establishes when and how often such submittals and revised submittals are required to be provided by the Contractor. In these Contract Documents, CDRLs are identified and tabulated at the beginning of each section and are called out within the specific text as (CDRL) in parentheses. A summary listing of all CDRLs is located in TPN23.

CONTRACTOR: The individual, firm, partnership, corporation, joint venture, or any combination thereof, who, as an independent Contractor, has entered into the Agreement with the County.

COUNTY: Miami-Dade County.

ENGINEER: The County or its authorized representative acting within the scope of the duties assigned to it.

EXISTING HRV: A Heavy Rail Vehicle in the County's existing Metrorail Fleet.

EXISTING FLEET: MDT's Existing Fleet of 136 vehicles.

F-End: The controlling end of the car fitted with an Operator's cab, coupler.

FAIL-SAFE: A design principle of a system or hardware configuration that ensures that a failure shall not result in an unsafe condition.

FAILURE: Any detected inability of material or equipment, or any portion thereof, to function or perform in accordance with the Contract Documents.

FORM, FIT, AND FUNCTION: The physical attributes of a device that allow the device to be used in place of another device due to similarities of general shape (outline, clearances), mounting arrangement (footprint), and operation (inputs/outputs) of the device.

FULL MAINTENANCE: All servicing and repairs as required by the manufacturer's maintenance manuals, including cleaning and repairs due to accidents.

FULL-SERVICE BRAKING: The maximum normal braking effort employed to stop a rail vehicle in the absence of an emergency stop signal.

GANGWAY: A flexible section between passenger compartments allowing passenger movement between the A car and the B car.

GAUGE, WHEEL: The distance between the gage points on adjacent wheels. Nominally, 55-$^{11}/_{16}$ inches for MDT's Metrorail System.

HEADWAY: The time separation between two trains, both traveling in the same direction on the same track, which is measured from the time the front end of the leading train passes a given reference point to the time the front end of the train immediately following passes the same reference point.

HIGH VOLTAGE: See Primary Power.

HORIZONTAL ALIGNMENT: The horizontal location of a track as described by curves, tangents, and spirals.

HRV (Heavy Rail Vehicle): A Metrorail transit vehicle.

INDICATED: As described in the Contract Documents.

INSPECTOR: The Engineer's or the County's authorized representative assigned to make inspections of the Work.

INTERFACE: The point at which one system component or subsystem comes into physical or functional contact with another for the purpose of transferring energy or information.

INTERLOCK: A condition whereby one function is dependent on the operation of another function.

IRRETRIEVABLE: Describes an application of the brakes that cannot be released until the train is at zero speed.

JERK: The time rate of change of acceleration or deceleration, equal to the second derivative of velocity with respect to time, normally measured in miles per hour per second per second, $mphps^2$.

LEAD CAB: The controlling end of a married pair or consist.

LEAD CAR: In the direction of travel, the forward-most rail vehicle of the consist.

LEFT HAND: Left side of the rail vehicle when one is facing the windshield of the F-end of the vehicle from inside the vehicle.

LOAD WEIGHING: A function that measures rail vehicle weight to permit control of tractive/braking effort, in order to achieve a constant effort-to-weight ratio for any given controller setting.

LOWEST LINE REPLACEABLE UNIT (LLRU): The lowest level component or part that can be replaced.

LINE REPLACEABLE UNIT (LRU): A component or part that can be replaced during running maintenance.

MAINTAINABILITY: Ability of any system or equipment to be easily, effectively, and properly serviced.

MAINTENANCE MANUALS: Manuals provided by the Contractor that provide detailed information on maintenance and repair of the Vehicle and its systems.

MARRIED PAIR: A married pair consists of A-cars and B-cars semi-permanently joined by a drawbar.

MDT: Miami-Dade Transit, located at 701 NW 1st Court, Miami, Florida, 33136, acting by and through its authorized representatives.

MEAN DISTANCE BETWEEN SERVICE FAILURES (MDBSF): Is the total operating distance accumulated by the vehicles divided by the total number of service failures occurring during accumulation of that distance, either predicted or in accordance with Engineer approved standards.

MEAN TIME BETWEEN FAILURE (MTBF): The failure rate of a device expressed in hours, either predicted or in accordance with Engineer approved standards.

METRORAIL SYSTEM (SYSTEM): Miami-Dade County's rail transit system and services as currently existing, subsequently modified, or proposed to be modified.

MIAMI-DADE: Miami-Dade County acting by and through its authorized representatives.

MIAMI-DADE'S HRV (Metrorail) FLEET: Miami-Dade's Existing Fleet of Metrorail Vehicles.

MIAMI-DADE-SUPPLIED EQUIPMENT: Equipment furnished by MDT to the Contractor for installation in or on a Vehicle (Metrorail).

NO MOTION: No vehicle movement, either forward or reverse.

NORMAL SERVICE CONDITIONS: Environmental conditions and operating parameters that the rail vehicles will be exposed to and must operate in daily, as outlined in the Contract Documents.

OPERATOR: The individual onboard who is responsible for the rail Vehicle and train operation.

PERFORMANCE: The measure of output or results obtained by a component, system, person, team, etc., as specified in the Contract Documents.

PRE-PRODUCTION VEHICLES: The first two new married pairs.

PRIMARY POWER: High-Voltage DC (HVDC) power supplied to the rail vehicle via the interface between the current collector and the third rail.

PROCUREMENT: The furnishing of all the items, materials, equipment, data, design, services, management, labor, and incidentals, specified or otherwise, necessary for timely and properly designing, manufacturing, delivering, and testing the Vehicles, or otherwise completing the Work.

PROOF: (used as a suffix) An apparatus is designated as splash-proof, dust-proof, etc., when constructed, protected, or treated so that its successful operation is not impeded when subjected to the specified material or condition.

PROPOSAL: The written submission, in response to the RFP, by a Proposer for the Work, properly signed, dated and completed and as may be amended or modified through a Best and Final Offer.

R-End: The end of the car with a drawbar, and a stainless steel end wall, or gangway, if applicable.

RECOVERY TIME: The time required for a system or condition to return to its original state (or some stated percentage of its original value) after being disrupted or destabilized.

REDUNDANCY: The existence in a system of more than one means of accomplishing a given function.

REGENERATIVE BRAKING: Electric braking where the power generated by the traction motors, when driven as a generator, is conditioned and returned to the third rail.

RELIABILITY: The probability that a system, subsystem, component, part, or other equipment will perform its intended functions without failure, within design parameters under specified operating conditions for which it is designed, and for a specific distance or time.

RELIABILITY OR RELEVANT FAILURE: A reliability or relevant failure is any failure that requires repair or replacement of any vehicle system, subsystem, or component that is not an approved consumable item or that is an approved consumable, but has not achieved its design service life.

REVENUE SERVICE: The utilization of a Vehicle, replacement part, spare part, or other portion of the Work by MDT in the collection of fares from Miami-Dade's customers.

RHEOSTATIC BRAKING: Electrical braking in which the power generated by the traction motors, when driven as generators, is dissipated by resistor banks on the rail vehicle providing a velocity retardation effort.

RIGHT HAND: Right side of the rail vehicle when one is facing the windshield of the F-end of the vehicle from inside the vehicle.

ROLLBACK: Unintended train movement in the direction opposite of the selected Master Controller direction.

ROLL/BODY: The number of degrees in an arc having its base at top-of-rail height and at the centerline of the track, swept by a point in the center of the roof as the vehicle sways from side to side during normal running at any speed on level, tangent track.

SAFETY-CRITICAL: Describes any condition, process, or equipment whose failure or malfunction may result in personal injury, occupational illness, or damage.

SAMPLES: Physical examples that illustrate material, equipment, or workmanship and establish standards by which the Work will be judged.

SERVICE (as in Service Use and Service Braking): The operation of the rail vehicles under normal conditions with passengers.

SERVICE FAILURE: A service failure is any relevant failure that results in a train delay in excess of 3 minutes or causes a train to be removed from revenue service or any relevant failure that prevents a Married Pair or Train from being placed into service. Failures occurring during the burn-in period are excluded.

SERVICE LIFE: Useful life of the new Vehicles which is specified as 30 years from the date of Vehicle acceptance by MDT.

SERVICE-PROVEN DESIGN: Refers to the design of any component, system, or subsystem that has a proven history of successful operation in revenue service similar to that of the Heavy Rail Transit System. Proof of successful operation shall be substantiated by submission of reliability/failure data, service time and location, modification information, and maintenance records, as required by the Contract Documents.

SPECIFICATIONS: See Contract Specifications.

STANDARD TRAIN: A train may consist of 4 or 6 cars (2 or 3 married pairs). For design qualification and acceptance testing, the standard train shall be four cars.

START-UP SPARES: Spares provided by Contractor to support the Vehicles first delivered to MDT.

STEP SIGNAL: A signal having a constant value prior to a certain instant and a different constant value immediately thereafter.

SUBCONTRACTOR: Any individual, partnership, firm, corporation, joint venture, or any combination thereof, who performs or installs, totally or partially, a Contract Item, or who performs other services for the Contractor, as required to fulfill the Work, by virtue of an agreement with the Contractor.

SUPERELEVATION: On a curve, the vertical distance, measured in millimeters (inches), that the outer rail is above the inner rail.

SUPPLIER: Any individual, partnership, firm, corporation, joint venture, or any combination thereof, who provides material or equipment, but not labor or services, to the Contractor, and who is responsible to the Contractor by virtue of an Agreement with the Contractor.

TECHNICAL PROVISIONS (Technical Specifications): Specific requirements setting forth the descriptions of elements of the Work to be performed or supplied, the quality of required labor, material, and equipment, and the method of measurement and payment for the identified elements of the Work.

TECHNICAL SPECIFICATIONS: See Technical Provisions.

TIGHT (used as a suffix): Apparatus is designated as watertight, dust-tight, etc., when so constructed that the enclosing case will exclude the specified material.

TRACTION SYSTEM: The system of wheels, motors, driving mechanisms, brakes, direct controls, and other equipment that propels or retards a rail vehicle in response to input control signals.

TRACTIVE EFFORT: The horizontal force that is measured at the wheel-rail interface.

TRAIN: A series of Vehicles coupled together.

TRAINLINE: The means of sending a signal to all rail vehicles in a consist via a continuous electrical or pneumatic circuit connected through appropriate coupling devices.

TRAM: A condition of ideal truck geometry in which the axles are perfectly parallel and the wheels longitudinally in perfect alignment. The centers of the journal bearings represent the corners of a perfect rectangle. Tram is checked by measuring the diagonal and longitudinal distances between reference points on the axle bearing housings.

TWC: Train to Wayside Communications.

VEHICLE(S): A Metrorail Heavy Rail Vehicle(s), unless expressly stated otherwise.

VITAL (as in vital circuit, vital relay): A term applied to any device or circuit that is designed using fail-safe principles.

V/T: Velocity/Time, see Average Brake Rate.

WARM-UP TIME: The elapsed time from application of power to an operable device until it is capable of performing its intended function.

WAYSIDE: Trackwork and system related equipment associated with the support, guidance, operation, and control of the Metrorail vehicles and vehicle subsystems.

WHEEL SLIDE: The condition where the decelerating or braking torque applied to an axle is in excess of that which would maintain adhesion, resulting in a non-zero relative point velocity of the wheel tangent at rail.

WHEEL SPIN: The condition where the torque applied to an axle is in excess of that which would maintain adhesion, resulting in a non-zero relative point velocity of the wheel tangent at rail.

WORK (PROJECT): All designs, engineering, manufacturing, operations, materials, equipment, parts, and labor required to, properly, timely, and to the satisfaction of MDT, provide the completed new Vehicles; provide all other items of work indicated or referenced in the Contract Documents, including all alterations, amendments, or extensions thereto made by Change Order; successfully complete all required tests and all reliability periods; remedy all defects which occur during, at least, the three (3) year warranty period for each of the new Vehicles as set forth in GP5; and complete all necessary repairs and modifications resulting from the tests, the reliability periods, and warranties, as required by the Contract Documents. Nothing herein shall effect the period or duration of the Warranty Bond or the warranties set forth in or required by the Contract Documents.

ZERO SPEED: Vehicle velocity of less than 2 mph for one second.

N1.3.3. ADDITIONAL DEFINITIONS

Wherever in the Contract Documents the words "directed," "required," "ordered," "designated," "prescribed," or similar words are used, it shall be understood that the "direction," "requirement," "order," "designation," or "prescription" of MDT or the Engineer is intended, unless otherwise expressly stated. Similarly, the words "approved," "satisfactory," or similar words shall mean "approved by," or "satisfactory to" MDT or the Engineer, unless otherwise expressly stated.

N1.4. REFERENCE STANDARDS

Whenever the Contract Documents reference a standard, said standard shall be, unless otherwise indicated, the latest version or edition on the date for which the Notice to Proceed is issued.

In the case of a conflict between referenced standards and the Contract Documents, the Contract Documents shall govern.

In the event that it is advantageous to MDT for the Contractor to utilize a reference standard other than that specified in these Contract Documents, the Contractor may propose this standard to MDT and submit the standard for approval to the Engineer. The Contractor shall indicate in a separate document what the advantages are and where the proposed reference standard is equal to or superior to the specified standard.

N1.5. MDT OPERATIONS

Miami-Dade's Metrorail System operates within Miami-Dade County in the State of Florida. MDT's System serves the Miami metropolitan area and the suburbs to the north and north-east. The System operates seven days a week, from approximately 6 a.m. to 12:30 a.m., and serves on average over 54,200 riders on weekdays and 42,900 riders on weekends. MDT's rider base is currently served by a fleet of 68 married pairs. Trains normally operate in two or three married pair consists. Under normal conditions, consists are made up at MDT's Lehman Center rail yard. The trains have the capability of operating with a minimum headway of 90 seconds during peak hours, with the headway increasing as passenger usage drops off during non-peak hours. The new Metrorail vehicles must be able to perform to parameters contained in these Technical Provisions for interface with the existing trackwork, ATC, and power distribution systems.

Procedures, policies, and practices for operations and maintenance of new equipment shall be based on and be compatible with those currently

in use by Miami-Dade Transit. The physical design of vehicles, systems, and components shall have the following features:

a. Components and equipment cabinets shall be located so that the most frequently inspected and maintained items are most accessible. Additionally, this determination shall be based upon failure rates, frequency of calibration, and need for periodic preventive maintenance.

b. The number of special tools shall be minimized. However, if they are required, they shall be defined and furnished as part of the Work of this Contract, even if MDT already possesses the special tools.

   (1) Where required for running maintenance, twenty (20) each shall be provided.

   (2) Where required for heavy maintenance, eight (8) each shall be provided.

   (3) Where required for both running and heavy maintenance, twenty-eight (28) each shall be provided.

c. Lifting slings and cables shall not be considered as special tools.

d. Components shall be accessible for required level of maintenance. No active electrical or mechanical components that may require maintenance shall be structurally embedded without convenient access for repair or replacement.

e. Panels and openings shall be of sufficient quantity, size, and placement to permit ready access from normal work areas. Adjustment controls, fittings, safety valves, test points, and similar items shall be directly accessible through panels and openings. Access panels in public areas shall use tamper resistant fasteners. Non removable covers shall be provided with a mechanical hold-open device.

f. Latches used for cover plates shall not require special tools, be minimum in number, and be self-locking when set. Torqueing of latches shall not be required.

g. Cable connectors shall be spaced far enough apart so that they can be grasped firmly for connecting and disconnecting, properly labeled and keyed so that they cannot be interchanged nor improperly installed, and so designed that signal and power pins shall not be adjacent.

h. Handles, lifting lugs, or equal shall be provided on components of forty pounds or more.

i. Visual inspection of equipment or indicators shall be unobstructed.

j. Major components having test panels, test points, or status indicators shall be located for easy accessibility and shall permit

external monitoring of critical functions. Additionally, test points shall be protected against environmental damage and human error.

k. Items that are heavy or difficult to remove shall be located where pit-based undercar maintenance can position a lift underneath them. Five sets of special handling fixtures shall be supplied where required.

l. All test points, fault indicators, modules, wire junctions, pipes, tubing, etc., must be identified by nameplates, color coding, number coding, or other means to assist maintenance.

m. Line Replaceable Units (LRU) that are functionally interchangeable shall be physically interchangeable. LRU's that are not functionally interchangeable shall not be physically interchangeable.

n. Major subassemblies shall not require different orientation from that as mounted on vehicle to perform heavy maintenance and shall be capable of repair and test by heavy maintenance on a flat work surface.

Delivery requirements as well as testing and acceptance requirements are set forth in GP8.

Vehicle-level acceptance testing shall be conducted, as detailed in TPN17, prior to vehicle acceptance for revenue service. Reliability testing, as defined in TPN18, shall be conducted prior to final vehicle acceptance.

N1.6. VEHICLE DELIVERY, TESTING AND ACCEPTANCE

Vehicle delivery, testing and acceptance requirements are set forth in GP8.

Vehicle acceptance testing specified in TPN17 shall be performed prior to issuance of a Certificate of Acceptance of Final Inspection for revenue service. Reliability testing specified in TPN18 shall be completed prior to issuance of the Acceptance Certificate for completion of all Work.

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TABLE OF CONTENTS

N2. SYSTEM REQUIREMENTS 2-1
N2.1. GENERAL 2-1
N2.1.1. CITED REFERENCES 2-1
N2.1.2. SUBMITTALS – CDRLS 2-2
N2.1.3. SCOPE OF WORK 2-3
N2.1.4. VEHICLE CHARACTERISTICS 2-3
N2.1.5. WAYSIDE CHARACTERISTICS AND CLEARANCES 2-4
N2.1.6. STATION CHARACTERISTICS 2-8
N2.1.7. DYNAMIC ENVELOPE 2-8
N2.1.8. WEIGHT 2-9
N2.1.9. STANDARD CONDITIONS FOR SPECIFIED PERFORMANCE 2-9
N2.1.10. STANDARD TRAIN PERFORMANCE 2-10
N2.1.11. STANDARD FOR POWER DISTRIBUTION NETWORK 2-11
N2.2. DUTY CYCLE REQUIREMENTS 2-11
N2.2.1. ACCELERATION REQUIREMENTS 2-12
N2.2.2. CONTINUOUS SPEED REQUIREMENTS 2-13
N2.2.3. DECELERATION REQUIREMENTS 2-13
N2.2.4. WHEEL SPIN/SLIDE REQUIREMENTS 2-14
N2.2.5. JERK LIMITING REQUIREMENTS 2-14
N2.2.6. CONTROL RESPONSE (DEAD) TIME 2-14
N2.2.7. LOAD WEIGH SYSTEM 2-15
N2.2.8. BRAKE AND PROPULSION CONTROL SIGNALS 2-15
N2.2.9. TRAIN RESISTANCE 2-15
N2.3. ENVIRONMENTAL CONDITIONS 2-16
N2.3.1. AMBIENT TEMPERATURE AND HUMIDITY 2-16
N2.4. NOISE 2-16
N2.4.2. ELECTRICAL INTERFERENCE CONTROL CRITERIA 2-19
N2.5. SHOCK AND VIBRATION 2-25
N2.5.1. GUIDEWAY RESPONSE 2-26
N2.6. VIBRATION GENERATION 2-26
N2.6.1. TRACTION MOTORS 2-26
N2.6.2. AUXILIARY UNITS 2-26
N2.7. RIDE QUALITY 2-26

N2.8. MOCK UPS 2-27
N2.9. VEHICLE AND COMPONENT IDENTIFICATION 2-28
N2.10. VEHICLE PHOTOGRAPHS 2-28

N2. SYSTEM REQUIREMENTS

N2.1. GENERAL

This section establishes the functions, subsystem performance, and general design criteria for the Miami-Dade Transit heavy rail rapid transit vehicle fleet. Included are requirements for configuration, capacity, dimensions, performance, environmental, noise, vibration, ride quality, weight, and other elements that impact system design. These requirements apply to all aspects of the vehicle and vehicle equipment design.

All systems, components and equipment used in the Metrorail Vehicles shall be of a Service Proven design in an application and environment similar to that of the Miami-Dade Metrorail system.

The Service Life of the vehicle shall be 30 years minimum.

The vehicle shall be compliant with 49CFR Part 38.

N2.1.1. CITED REFERENCES

Source/Section	Title
49CFR Part 38	Americans With Disabilities Act (ADA)
ANSI S1.2	Physical Measurement of Sound
ANSI S1.4	Specifications for Sound Level Meters
ANSI S1.11	Specification for Octave, Half Octave, and Third Octave Band Filter Sets
ANSI S1.13	Method for the Measurement of Sound Pressure Levels
ANSI S12.30	Guidelines for the Use of Sound Power Standards and the Preparation of Noise Test Codes
ANSI S12.31	Method for Physical Measurements of Sound
ANSI S12.32	Method for Physical Measurements of Sound
APTA SS-E-010-98	Standard for the Development of an Electromagnetic Compatibility Plan

Source/Section	Title
AREMA Plan 6-71	American Railway Engineering and Maintenance of Way Association
ASCE	American Society of Civil Engineers
FCC	Federal Communications Commission
FRA Class 6, Article 2.31C	Track Standards
FTA-MA-06-0153-85-6	Conductive Interference in Rapid Transit Signaling Systems, Volume II, Suggested Test Procedures
FTA-MA-06-0153-85-8	Inductive Interference in Rapid Transit Signaling Systems, Volume II, Suggested Test Procedures
FTA-MA-06-0153-85-11	Radiated Interference in Rapid Transit Systems, Volume II, Suggested Test Procedures
IEC-1000-4-2 1995	Electrostatic Discharge Requirements
IEC-1000-4-3 1995	Radiated Electromagnetic Field Requirements
IEC-1000-4-4 1995	Electrical Fast Transient (Burst) Requirements
IEC-1000-4-5 1995	Surge Voltage Immunity Requirements
ISO 2631-1	Guide to the Evaluation of Human Exposure to Whole Body Vibration

N2.1.2. SUBMITTALS – CDRLS

CDRL No.	Title	TP Reference
N201	Vehicle Dynamic Clearance Envelope Outline Drawings	TPN2.1.7.
N202	Analysis Results	TPN2.1.7.
N203	Vehicle Center of Gravity	TPN2.1.8.1.
N204	Power Consumption Report	TPN2.1.11.
N205	Acceleration Requirements List	TPN2.2.1.3.
N206	Acoustic Noise Plan	TPN2.4.
N207	Interference in Rapid Transit Signaling Systems, Suggested Test Procedures Noise Analysis	TPN2.4.2.

CDRL No.	Title	TP Reference
N208	Electromagnetic Compatibility (EMC) Control and Test Plan	TPN2.4.2. TPN2.4.2.9.
N209	Electromagnetic Compatibility Detailed Test Procedure	TPN2.4.2.
N210	Electromagnetic Compatibility Detailed Test Report	TPN2.4.2.
N211	Shock and Vibration Test Plan	TPN2.5.
N212	Ride Quality Test Procedure	TPN2.7.
N213	Final Photographs on DVD	TPN2.10.

N2.1.3. SCOPE OF WORK

The work associated with this project shall include all elements of engineering, systems integration, design, production, documentation, test, and deployment associated with the production of new Metrorail Vehicles for Miami-Dade Transit as required by the Contract Documents.

N2.1.4. VEHICLE CHARACTERISTICS

The Miami Metrorail vehicle produced under this Contract shall be designed to be operationally and of a configuration similar to the existing Metrorail vehicle. The new vehicles shall be designed in accordance with the following base physical parameters, but shall only meet the physical parameters specified in lines D, E, G2, G3, G5, G6, I, L, O1 and O2. The dimensions in the table below reflect the existing vehicle. The new Metrorail Vehicle shall be capable of operating within the existing fixed facilities in accordance with the specified parameters defined in this section. Tolerances for compliance with these dimensions shall be approved by the Engineer.

Physical Parameters		
A.	Length over couplers	75 ft.
B.	Length over anti-climbers	74 ft, 8 in.
C.	Distance, center to center of trucks	52 ft.
D.	Width of car, greatest outside dimension	10 ft, 6 in.
E.	Width over threshold (Ref. ADA 49 CFR Part 37)	10 ft, 2 ½ in.
F.	Carshell Width	10 ft, 1 in.
G.	Height (new wheels, empty car, except as indicated in 5 and 6)	

Physical Parameters		
	1. Top of rail to top of roof (max. including antenna)	12 ft.
	2. Top of rail to car floor, with new wheels	43 1/8 in.
	3. Top of rail to top of anti-climber	43 1/8 in.
	4. Top of rail to coupler centerline	25 3/8 in.
	5. Top of rail to bottom of underfloor equipment under worst condition worn wheels, deflated air springs and AW3 load	6 in.
	6. Top of rail to bottom of truck mounted equipment (except wheels, power collector shoes, and axle-mounted equipment) under worst condition with worn wheels, deflated air springs and AW3 load	3 in.
	7. Height, minimum, floor to headlining at center line of car, minimum	6 ft, 8 in.
H.	Width of side door openings	48 in. Minimum
I.	Width of end door openings	32 in. Minimum
J.	Height of side door openings	6 ft, 4 in. Minimum
K.	Height of end door openings	6 ft, 4 in. Minimum
L.	Truck Wheelbase	6 ft, 10 in.– 8ft, 6 in.
M.	Wheel diameter, new	28 in.
N.	Wheel diameter, worn condemning limit	25 ½ in.
O.	Wheel gauge	
	1. Between gauge points	4 ft, 7-11/16 in.
	2. Between backs of flanges	4 ft, 5-3/8 in.
P.	Seating capacity	not less than 68
Q.	Door openings per side	3

N2.1.5. WAYSIDE CHARACTERISTICS AND CLEARANCES

The following data is provided to assist the Contractor with the design of the vehicle subsystems.

N2.1.5.1. PRIMARY ELECTRICAL POWER

The Metrorail Power Distribution Network consists of individual 5 MW substations located at stations along the Metrorail route. Utilizing a baseline performance of six car trains loaded to AW2 on three minute

headways, the Contractor shall ensure that power consumption of the new fleet vehicles is no greater than the existing fleet. The Contractor shall measure or simulate the power consumption of the existing 6-car trains and compare the results with the new trains. Any power consumption measurements required by the Contractor to confirm adherence to this requirement shall be performed by the Contractor prior to NTP.

Primary voltages:

- Nominal: 750 VDC.
- Minimum: 450 VDC.
- Maximum: 900 VDC.
- Transient 3rd rail voltages: Plus or minus half cycle of sine-wave voltage, 3,000 volts peak, 8ms duration and plus or minus 6,000 volts, 1.2 x 50 µs (1.2 µs rise time, 50 µs fall time to 3000 volts). Transient voltage is measured while operating at primary voltage of 750 VDC.

Contact rail:

- Direct current resistance: Varies with location, however, 2 micro-ohm maximum per foot.

Running rail:

- Direct current resistance: 9.04 micro-ohm per linear foot of single rail.
- Loop inductance, contact and running rail: 0.38 mH maximum per 1000 feet.

N2.1.5.2. TRACK CHARACTERISTICS

Rail Type: 115 RE section, continuous welded steel, having a 1:40 cant, 9.04 micro-ohm per linear foot.

The low/inner rail in curves was installed in a vertical orientation. The high rail is in a rotated orientation. For the link to Miami Airport, both rails include a cant.

The lower rail on all the curves on the mainline does not have any cant. This however will not be the case for the Airport Link.

The Contractor is advised that the as built condition of the spirals for the Stage 1 Metrorail are shorter in length than the length specified by the original design criteria. In addition, the actual superelevation of the track is not uniformly distributed over the length of these spirals.

N2.1.5.3. **MINIMUM LATERAL RADIUS AT CENTERLINE OF TRACKS OUTSIDE OF SPECIAL WORK**

a. Yard: 250 feet.

b. Mainline: 900 feet.

Maximum Superelevation: 4 inches.

N2.1.5.4. **MOST SEVERE REVERSE CURVE CONDITIONS**

a. Mainline outside of special work: The minimum tangent length is 75 feet.

b. Yards outside of special work: Reverse curves with 250 foot radii and zero intervening tangent.

c. Yard special work: Two No. 6 turnouts with their points of switch 14 feet apart and facing each other.

d. Smallest Turnout: No. 6.

N2.1.5.5. **VERTICAL GRADES**

a. Mainline: ± 4.0% maximum.

b. Yard: ±1.0% maximum.

N2.1.5.6. **VERTICAL CURVES: RATE OF CHANGE OF VERTICAL CURVES**

Mainline: ±1.0% maximum per 100 feet (parabolic).

Yard and Storage Tracks: ±5% maximum per 100 feet (parabolic).

Special Trackwork		
Turnout No.	**Straight Side**	**Turnout Side**
6	4ft, 8-½ in. (1)	4ft, 9 in. (1) (2) (3)
8	4ft, 8-½ in. (1)	4ft, 8-½ in. (1) (2) (3)

a. Gauge will be 4 ft, 9-¼ inch between point of switch and heel of switch - See AREMA Plan 6-71.

b. If guard rails are used, Guard Rail Gauge will be 4 feet, 6-5/8 inches regardless of track gauge.

c. Self-guarded frogs will be used on yard track.

Double crossover gauge will be 4 feet, 8-½ inches between the frogs.

N2.1.5.7. **NOMINAL TRACK GAUGE**

Standard Trackwork Horizontal Track Alignment	
Tangent track	4 ft, 8-¼ in.
Curve radius greater than 1000 ft.	4 ft, 8-¼ in.
Curve radius between 1000 ft. and 510 ft.	4 ft, 8-½ in.
Curve radius less than 510 ft.	4 ft, 9 in.

Track Quality: Minimum track quality will be FRA Class 6 (Article 2.31C). For ride quality purposes (requirements of TPN2.6) track quality will be as follows:

Track Quality	
Gauge variation, per 31 feet of track	± ¼ in.
Cross level variation, per 31 feet of track	± ¼ in.
Super-elevation, per 31 feet of track	± ¼ in.

N2.1.5.8. **TRACK SPACING**

14 feet minimum, center-to-center, tangent track.

N2.1.5.9. **RUNNING RAIL WEAR**

0.50 inch (maximum), vertical and horizontal.

N2.1.5.10. **CONTACT RAIL**

The composite contact rail is an 85 lbs ASCE Section steel rail with aluminum conductors attached next to the rail web on both sides. The aluminum conductors are specially designed shapes extruded from 6061-T6 aluminum, and are attached to the steel rail by 5/8 inch steel lock bolts at 18 inches intervals. The composite contact rail is a low resistance conductor with a resistance ≤ 2.0 μΩ/ft. The nominal height of the top of the contact rail above the top of the running rail is 4-½ inches.

N2.1.5.11. **NOMINAL CONTACT RAIL RAMP**

a. High speed: 1.6 degrees nominal.

b. Slow speed: 3 degrees nominal.

c. Distance between centerline of contact rail and gauge point of near running rail: 2ft, 2 inches.

d. Minimum height of lower side of cover-board above contact rail: 4 inches.

N2.1.6. STATION CHARACTERISTICS

Station design characteristics for the Metrorail stations include the following:

Station Characteristics	
Platform Length	460 ft. minimum
Platform Height – nominal above top of rail	43 in.
Track grade at stations* **All stations, except Tri-Rail Station*	1% maximum* Tri-Rail = 2% maximum
Maximum gap between platform edge and car threshold	Shall Conform to ADA Gap Requirement

N2.1.7. DYNAMIC ENVELOPE

The dynamic clearance envelope for the new vehicle, at all speeds up to and including 70 mph, shall conform to the existing Miami-Dade Metrorail system under all normal operating conditions. The Contractor shall provide vehicle dynamic clearance envelope outline drawings for the vehicle to the Engineer for review and approval (CDRL N201). All lateral, vertical, longitudinal, and roll motions of the vehicle, with and without failure conditions, shall be included in the vehicle dynamic clearance envelope outline drawings. All operating conditions with proper allowance for vertical and lateral movement of springs, wheel wear, coupler height, flange wear, lateral body lean, failed springs, and all other elements affecting the vehicle shall be considered.

The Contractor shall demonstrate, using the vehicle dynamic clearance envelope and the system clearance envelope, that the new vehicle will be able to operate throughout MDT's system with a 2 inches margin between the vehicle dynamic clearance envelope and the system clearance envelope, under all conditions and failure modes, and at the speeds listed in the system speed profile (for a vehicle dynamic outline refer to Figure 2.4). If a 2 inches margin is not achieved, the assumed vehicle operating conditions, system location, and calculated margin shall be identified for each case. The results of this analysis shall be submitted to the Engineer for review and approval as the system clearance margin report (CDRL N202).

N2.1.8. WEIGHT

Currently, the weight for both A-cars and B-cars is nominally 75,500 lbs. All new vehicles shall weigh no more than 80,000 lbs (AW0). In addition the following weight requirements shall be met.

a. The maximum permitted weight difference between an A-car and a B-car shall be not greater than 1,500 lbs with all equipment installed and the draw bar and jumper cables connected.

b. Weight variation and balance of the cars shall meet the following limits:

(1) Maximum weight measured under each truck: 54% of car weight.

(2) Minimum weight measured under each wheel of any truck: 23% of total weight measured under truck.

N2.1.8.1. WEIGHT STATEMENT

The Contractor shall provide a weight statement for the vehicles. The weight statement shall include all major component and assembly weights, and rotating inertia, and shall be organized by the systems defined in TPN3 through TPN22 of this specification. The weight statement shall be updated monthly to include actual weights and/or updated estimated weights. A final weight statement shall be submitted that provides the actual weights for the as-built car.

The Contractor shall implement a weight control program per TPN16 beginning with the Preliminary Design Review, and progressing through the weighing of the last vehicle. The weight control program shall regularly assess the vehicle design weight, and as-built weights of the first married pair. Any deviations from the design weight of the vehicle shall be promptly addressed with a corrective action plan to assure that married pairs are delivered at a weight that is at or below the design target.

The weight control program shall also include design processes and manufacturing methods to assure that the vehicle is balanced. Weight balance shall be measured on each married pair prior to delivery to MDT. The underfloor equipment installation drawing shall include the position of the vehicle center of gravity (CDRL N203) for approval by the Engineer.

N2.1.9. STANDARD CONDITIONS FOR SPECIFIED PERFORMANCE

a. Primary Electrical Power: Nominal system voltage will be 750 VDC. All vehicle system performance requirements shall be met with any voltage between 650 VDC and 900 VDC. All equipment must be able to function properly, but not necessarily to specified performance, with voltages between 450 VDC and 650 VDC.

b. Definition of Standard Train: A standard train may consist of 2, 4, or 6 cars (1, 2, or 3 married pairs). For design qualification and acceptance testing, the standard train shall be four cars.

For performance purposes, passenger weight shall be defined as 150 lb. per passenger, and the weight of each car shall be defined by the following table:

Symbol		Condition	Weight
1.	AW0	Actual Weight (empty)	80,000 (maximum allowed)
2.	AW1	Seated Load	AW0 + Weight of seated passengers
3.	AW2	Seated plus Standing Load	AW1 + Weight of standing passengers at 2.5 sq.ft. per standing passenger
4.	AW3	Full Rated Load May not exceed 120,000 lbs	AW1 + Weight of standing passengers at 2.0 sq.ft. per standing passenger

c. Condition of Standard Car: The specified acceleration, deceleration and speed shall be met with new and fully worn wheels.

d. Condition of Roadbed: The requirements for acceleration, speed, and deceleration shall be met on clean, dry, level, tangent track.

e. Abnormal Operation: The design standard train loaded to AW2 shall be capable of pushing or pulling a stalled design equivalent length standard train loaded to AW2, with no tractive effort or braking capability, at 15 mph for one round trip on the MDT routes with station stops without going beyond the design limits of any hardware.

N2.1.10. STANDARD TRAIN PERFORMANCE

The following data summarizes the standard train performance on level tangent track in either direction of travel. Succeeding paragraphs detail the performance requirements.

Performance Requirements	
Maximum Speed	70 mph
Maximum Initial Acceleration (nominal)	3.0 mphps

Performance Requirements	
Maximum Service Braking (nominal) 1. Service Braking (70 to 50 mph) 2. Service Braking (50 to 0 mph)	3.0 mphps 2.25 to 3.0 mphps 3.0 mphps
Emergency Braking	3.2 mphps
Jerk Limit	2.0 mphpsps
Spin/Slide Efficiency (braking)	90%

N2.1.11. STANDARD FOR POWER DISTRIBUTION NETWORK

The Metrorail Power Distribution Network consists of 5 MW substations located at stations along the Metrorail route. Utilizing a baseline performance of six car trains loaded to AW2 on three minute headways, the Contractor shall ensure that power consumption of the new fleet vehicles is no greater than the existing fleet. Any power consumption measurements required by the Contractor to confirm adherence to this requirement shall be performed by the Contractor. A power consumption measurements report shall be submitted to the Engineer for approval (CDRL N204).

N2.2. DUTY CYCLE REQUIREMENTS

The thermal capacity of the propulsion and friction brake systems shall be based on the most severe duty cycle for a standard train operating between terminal points of the Miami-Dade Metrorail route. Descriptions of these routes, to be used for duty cycle and run time design purposes, are included in TPN10. These route descriptions are similar to but may not be the same as the actual route.

a. Dwell Times: For duty cycle and run time design purposes, the station dwell times shall be 15 seconds per station and turn back times at the terminals shall be 180 seconds.

b. Run Time: The round trip run time shall be specified in the Contractor's proposal, including dwell times of 15 seconds per station, and turnback times of 180 seconds at each turnback.

c. Car Weight: Car weight shall be taken as AW2 for the duty cycle design.

d. Propulsion System: The propulsion system shall be based upon eight hours of continuous operation on the above duty cycle.

e. Friction Brake System: The friction brake system thermal design shall be based on one round trip, assuming the duty cycle

constraints specified above, and assuming that 25% of the electric braking is not functioning.

f. Performance Level: Maximum acceleration and deceleration rates shall be used. The run times described herein shall be achieved.

N2.2.1. ACCELERATION REQUIREMENTS

The acceleration performance of the standard train shall be based on a car weight of AW2.

N2.2.1.1. ACCELERATION

Maximum initial acceleration shall be 3.0 mphps. Deviation from the maximum initial acceleration, between zero mph and base speed, shall not exceed plus zero or minus 0.2 mphps of the maximum initial acceleration. This shall be under control of the load weighing system and does not apply to periods where limited by jerk control. (See Figure 2-3 for acceleration diagram). The acceleration vs. speed requirement on level tangent track for all speeds is shown in Figure 2-3 for third rail voltages of 650 V and 900 V. For voltages between 450V and 650V the acceleration rates may be reduced as approved by the Engineer. The required acceleration rates shown in Figure 2-3 are for all vehicle weights between AW0 and AW2. For vehicle load weights greater than AW2, the tractive effort vs. speed shall be the same as that required for AW2.

N2.2.1.2. DECELERATION

For all line voltages between 450V and 900V, all train lengths between 2 and 6 cars, and all car weights between AW0 and AW3 the train shall decelerate at the rates shown in Figure 2-3 with a maximum deviation of ±10% and a maximum average deviation of ± 7% with electric brake fully operational and for all line voltage. For car weights up to AW2 dynamic braking shall be capable of supplying the brake rate for speeds between 3 and 50 mph. Friction and dynamic braking may be blended between 50 and 70 mph. For vehicle weights greater than AW2, friction and dynamic braking shall be blended to produce the required brake rates.

N2.2.1.3. TIME, SPEED, DISTANCE

Based upon the duty cycle and run time design requirements herein, the Contractor shall calculate the resulting time, speed, and distance performance on level, tangent, dry track of a consist of two married pairs for car weights of AW0, AW1, AW2 and AW3. These specific acceleration points, after approval and acceptance by the Engineer, shall become qualification and acceptance test requirements for the cars. The Contractor shall determine the speed obtained and distance traveled by a

consist of two married pairs (weights AW0, AW1, AW2, AW3) after the listed times from initiation of the control signal by the Operator.

- 20 seconds.
- 30 seconds.
- 40 seconds.
- 50 seconds.
- 60 seconds.

The above listed speed and distance data is required by the Train Control Contractor (CDRL N205).

N2.2.2. CONTINUOUS SPEED REQUIREMENTS

The standard train at AW2 weight shall be capable of maintaining continuous speed of 70 mph on a 1.0% adverse grade.

When operating in the "CAR WASH" and "REVERSE" submodes, the train speed shall be limited to 2 mph or less by the propulsion control equipment.

Train speed in the "AUTOMATIC" mode shall be regulated as specified in TPN14.

N2.2.3. DECELERATION REQUIREMENTS

Service braking shall be provided primarily through retardation effort through the propulsion system to a nominal velocity of 3 mph, at which time blending of electrical brakes and friction brakes will transition to a complete stop. The following braking performance shall be achieved for AW0, AW1, and AW2 weight conditions by dynamic braking for all speeds between 3 and 70 mph.

Service Brake Rates: The following blended service brake rates shall be available for a standard train with passenger loads up to AW3:

Speed	Braking Rate
70 mph	2.25 mphps
70 - 50 mph	Linear increase from 2.25 to 3.0 mphps
50 - 0 mph	3.0 mphps

The above rates and any lower blended rates requested by the tractive effort control shall be maintained within plus or minus 7% in any 5 second interval above 5 mph. Peak blended rates shall not deviate beyond plus

or minus 10% of the requested rate for all speeds above 5 mph. (See Figure 2-3 for service braking diagram).

Friction Only Service Brake: With electrical brakes cut out, the service friction brakes alone shall be capable of providing braking rates as defined above to car weights AW3. Friction only average rates ($\Delta v/\Delta t$) shall be measured by using a time period beginning at the completion of jerk limiting and ending at zero mph. The average rate achieved shall not deviate more than plus or minus 20% of the requested rate. Peak rates shall not deviate beyond plus or minus 30% of requested.

Emergency Brakes: Emergency braking shall be friction braking only. The average emergency brake rate (v/t) shall not be less than 3.2 mphps, exclusive of the dead time and brake build up time. The total dead time and brake build up time (to 90% of final brake cylinder pressure) shall not exceed one and one-half seconds. The instantaneous maximum brake rate shall not exceed 4.5 mphps. Jerk limiting shall not be active upon loss of brake pipe air pressure, or when emergency braking is activated by the emergency-stop push button.

N2.2.4. WHEEL SPIN/SLIDE REQUIREMENTS

The wheel spin/slide protection system shall detect spins and slips whether random or synchronous and shall operate in both normal braking and propulsion modes at all speeds. Wheel slide protection shall be deactivated when an emergency brake application is initiated through use of the emergency-stop push button mounted in the cab. In the braking mode, fail safety shall be inherent in the design so that a failure of the spin/slide system will result in no less than the commanded brake cylinder pressure. The efficiency of the spin/slide system above 8% adhesion and above 5 mph shall be at least 90% in the braking mode and at least 65% in propulsion as defined in Figure 2-1. (Note: A1 and A2 refer to areas).

N2.2.5. JERK LIMITING REQUIREMENTS

The maximum rate of change of acceleration or deceleration shall be 2.0 mphpsps for all car weights up to AW3. Jerk limiting shall not apply to emergency braking or release or reapplication of braking effort during slide correction. Jerk limiting shall apply during reapplication of tractive effort following spin correction. Jerk shall remain within the above limit during the time period beginning at the initial change in tractive effort until 90% of commanded acceleration/deceleration has been achieved.

N2.2.6. CONTROL RESPONSE (DEAD) TIME

Dead time from a step change of command signal until the beginning of traction motor torque reaction shall be:

a. Mode Change (Drive to Brake or Brake to Drive) 250 milliseconds. This includes propulsion-to-coast, coast-to-brake, brake-to-coast, and coast-to-propulsion transitions.

b. Modulation within the Drive or Brake Modes 0.1 sec.

c. Friction brake control response shall be as specified in TPN12.

Dead times shall be measured from the time a trainline command occurs until the vehicle acceleration changes by 10% of the commanded change in rate (i.e., 10% of the difference between the initial and requested rates).

Multiple mode change dead times, propulsion-to-coast-to-brake and brake-to-coast-to-propulsion, shall be measured consecutively, adding the two dead times allowed for each mode change.

For emergency braking, the maximum dead time is 500 ms.

N2.2.7. LOAD WEIGH SYSTEM

The load weighing compensation signals to the propulsion and braking system shall be a continuous function available for all transit car weights up to and including AW3. The load weighing system shall be designed to ensure that, if load sensing is lost, the braking system will respond as if the car weight were AW0. The load weighing system shall be damped to prevent responding to dynamic suspension motions. Emergency braking shall be load weighed.

N2.2.8. BRAKE AND PROPULSION CONTROL SIGNALS

Tractive effort shall be controlled by an analog signal that represents the percent of maximum tractive effort to be developed by propulsion and/or brake systems. Braking and propulsion shall use separate ranges of the analog signal. A separate two level signal (high/low) shall control mode changes between braking and propulsion. Another two level (high/low) signal shall control emergency braking. See Figure 2-2 for tractive effort versus control signal diagram. Propulsion and friction brake systems shall respond to changes greater than 4% in the analog signal.

N2.2.9. TRAIN RESISTANCE

For design purposes on level tangent track and in still air, the traction resistance of the vehicle(s) shall be calculated based on the following modified Davis equation:

$$TR = (1.3W + 29n + 0.045WV) + [0.0024 + (0.00034)(N-1)]\,AV^2$$

where:

TR = Resistance, total, lbs.

W = Weight per train, tons.

n = Number of axles per train.

V = Train speed, mph.

N = Number of cars in train.

A = Frontal Area of lead car, ft^2.

N2.3. ENVIRONMENTAL CONDITIONS

The vehicle and vehicle systems shall be designed for operation, storage, and maintenance at specified performance levels within the following environmental conditions of Miami-Dade County, Florida.

The Contractor shall provide state of the art lightning strike protection for all vehicle wiring and equipment.

N2.3.1. AMBIENT TEMPERATURE AND HUMIDITY

Temperature Range: From 30°F to 105°F.

Relative Humidity: Between 45% and 100%.

Wind:

- Continuous - 45 mph.
- Gusting - 70 mph.

Precipitation - Maximum Rainfall Rate: 4.0 in/hr.

Track Contamination: The vehicle shall operate in the presence of dust, trash, and leaf/frond accumulation.

Air Pollutants: The vehicle shall operate in the presence of airborne pollutants, such as, but not limited to, dust, airborne salt, acids, and oxides, that are characteristic of the Miami, Florida area.

Fordability: With maximum allowable wheel and rail wear and a maximum rainfall rate, the vehicles shall be operational in water 4" above the minimum rail height while standing indefinitely or creeping at up to 5 mph for a distance of 500 ft. with no entry of moisture into any compartment, component, or device, causing the vehicle's equipment to malfunction, to be damaged, or to wear or fail prematurely.

Chemicals: The vehicle will be exposed to chemicals, such as, but not limited to, cleaning agents, lubricants, and graffiti removal chemicals.

N2.4. NOISE

This section contains the requirements for maximum allowable sound levels in passenger spaces, operator locations, and at the wayside.

Enclosures, baffles, seals, acoustical absorption body panels with adequate sound transmission loss, vibration isolators, or other appropriate methods shall be incorporated into the vehicle design to attenuate noise and vibration generated by wheels, rails, motors, and equipment, and to ensure that the limitations on the interior and wayside noise are not exceeded.

Equipment shall be designed to eliminate rattling and resonance at all speeds up to 10% above maximum normal operating speed by the use of damping, gaskets, resilient mounts, or similar methods.

In general, the noise control features of the equipment shall last for the design life of the vehicle.

The Contractor shall utilize ANSI S12.31, S12.32, and S12.30 as guidelines and methods for determining sound level.

The Contractor shall submit a plan and an analysis to the Engineer for review and approval indicating how the requirements of this section will be met (CDRL N206).

N2.4.1.1. DEFINITIONS

The following definitions shall apply to the acoustic noise requirements:

Sound Pressure Level (SPL): SPL is defined per ANSI S1.4. All noise levels are expressed in decibels (dB), referenced to 20μPa.

Measurements: All overall noise levels shall be measured in terms of A-weighted levels in decibels, abbreviated dBA, in accordance with requirements of ANSI S1.2 and ANSI S1.13, with a measuring system complying with the Type 2 requirements of ANSI S1.4. Unless otherwise indicated, "slow" meter response time shall be used. Where octave or 1/3 octave band measurements are specified, an analyzer with filters meeting the requirements of ANSI S1.11 shall be used. Narrow band noise or pure tones shall be identified using filters with a band width not exceeding 1/3 octave.

Environment: Noise criteria specified herein for a stationary vehicle are based on measurements taken in an essentially free-field environment, such as outdoors away from any reflective surfaces, other than ballast and tie trackbed upon which the vehicle is parked. Noise criteria specified herein for a moving vehicle are based on measurements taken on ballast and tie track aligned to MDT track criteria and standards.

Auxiliary Equipment: Defined per TPN1.

Pure Tone or Narrow Band: If the sound pressure level of any 1/3 octave band from the 250 Hz band to the 4,000 Hz band exceeds the average of levels in two adjacent 1/3 octave bands (containing no pure tones or tonal noise) by 5 dBA or more, that band shall be considered to contain pure

tone or narrow-band components. If the interior noise contains pure tones, then, the noise levels specified herein shall be reduced by 3 dBA.

N2.4.1.2. INTERIOR NOISE CONTROL/CRITERIA

The arithmetic average of noise levels, measured at a minimum of six positions along the vehicle's longitudinal centerline, 53 in. above the floor, and 24 in. or more from the end wall, shall not exceed the following limits set forth. The maximum noise level at any position along the centerline shall not exceed the limits by more than 3 dBA. Measurements of interior noise levels shall be taken in a fully equipped vehicle with only the measurement team onboard.

Condition	Average Noise Level
In the open, on dry, level, tangent, ballast, and tie track, at any speed up to 70 mph, in any normal mode of acceleration, coasting, or braking, with all auxiliaries operating under normal conditions	72 dBA
Vehicle stationary in the open, on ballast and tie track with all auxiliaries except doors operating simultaneously at maximum capacity, including any propulsion subsystem components	68 dBA

N2.4.1.3. WAYSIDE NOISE CONTROL CRITERIA

Sound pressure levels at the wayside shall not exceed the following values for the specified test condition for a two-car consist on dry, level, tangent ballast and tie track. Measurements shall be made at the specified distance from the track centerline 60 inches above the top of the rail.

Condition	Average Noise Level
All auxiliaries operating simultaneously, vehicle stationary	68 dBA at 50 ft.
Two-car train at any speed between 0 to 20 mph, maximum acceleration or maximum full-service electrical or friction brake (whichever is worse), all auxiliary systems, including HVAC, operating under normal conditions	73 dBA at 50 ft.
Two-car train at any speed between 0 to 70 mph, maximum acceleration or maximum full-service electrical or friction brake (whichever is worse), all auxiliary systems, including HVAC, operating under	84 dBA at 50 ft.

Condition	Average Noise Level
normal conditions	
Each auxiliary alone, except air compressor, vehicle stationary	68 dBA at 15 ft.
Air Compressor, vehicle stationary	75 dBA at 15 ft.

N2.4.1.4. DOOR OPERATION, PA SYSTEM, AND LIGHTING NOISE CONTROL CRITERIA

The noise produced by the individual operation of equipment shall not exceed the following values for the specified condition and at the specified distance.

Condition	Average Noise Level
Operation of all doors on one side, excluding audible warning tone from door, at 12 in. from door, 54 in. above floor	76 dBA (fast meter)
PA equipment in the standby condition with electrical equipment energized at its nominal level at 12 in. from loudspeakers	45 dBA
Fluorescent lamps, fixtures, and ballasts energized at the rated voltage and frequency at 12 in. from lighting fixture	48 dBA

N2.4.2. ELECTRICAL INTERFERENCE CONTROL CRITERIA

Design techniques, construction methods, and equipment shall be employed to prevent internal or external electrical interference from affecting the proper operation of any vehicle subsystem or component. In addition to coordinating frequencies, necessary balancing, filtering, shielding, modulation techniques, and isolation shall be provided to maintain signal-noise ratios within clearly workable limits.

The Contractor shall submit a plan and analysis to the Engineer for review and approval, indicating how the requirements herein will be met (CDRL N207). The Contractor shall submit an Electromagnetic Compatibility Control Plan in accordance with APTA SS-E-010-98, and Test Plan to the Engineer for review and approval indicating how the requirements herein will be met (CDRL N208). The Contractor shall also submit to the Engineer for review and approval an Electromagnetic Compatibility Detailed Test Procedure (CDRL N209) to be used to measure the radiated, conductive, and inductive emissions of the vehicle.

The testing will include both lab and field testing of conductive and inductive emissions. The Contractor shall next submit to the Engineer for review and approval an Electromagnetic Compatibility Detailed Test Report (CDRL N210) to prove that the measured vehicle emissions are within the limits listed in TPN2.

Electrostatic and magnetic electrical shielding methods shall be employed to minimize the effect of stray signals and transient voltages on low-level interconnecting cables. Interconnecting power and signal cables shall be physically separated where practicable and shall be magnetically shielded when necessary. Suppression devices shall be employed on relay circuits, if necessary, to protect low-level circuits from relay transients.

Components and functional circuits shall be grouped according to their similar sensitivities to electrical interference and power supply needs and grouped to reduce the effects of voltage drops in ground circuits. Power and return leads shall be routed in the same raceway or harness. Suppression devices shall be used on power-supply leads, when necessary, to suppress interference at the input to sensitive circuits.

Any harmonic currents produced by the vehicle in the running rail shall not interfere with the normal operation of the existing signaling equipment. Acceptable levels of radiated and conductive interference for the cab signaling equipment shall be determined by the Contractor from field measurements of actual conditions and submitted to the Engineer as a part of the report.

The vehicle shall not have any high-voltage input filters with a resonant frequency above 50 Hz.

N2.4.2.1. RADIO FREQUENCY INTERFERENCE/CONTROL CRITERIA

When measured at a distance of 50 ft. and tested in accordance with FTA-MA-06-0153-85-11, equipment supplied under these Technical Provisions shall not exceed the following interference limits:

109 dB over 1 µvolt/m/MHz at 150 kHz to 84 dB over 1 µvolt/m/MHz of bandwidth at 30 MHz (straight line semilog).

58 dB over 1 µvolt/m/MHz of bandwidth at 30 MHz through 90 MHz.

68 dB over 1 µvolt/m/MHz of bandwidth at 400 MHz through 3 GHz.

The defined limits shall be met under all normal, abnormal, and failure conditions. The full range of modes, speeds, operating voltages, train lengths, and loadings shall be considered by the Contractor.

N2.4.2.2. CONDUCTIVE EMISSION LIMITS

Conductive per train emissions, per FTA-MA-06-0153-85-6, shall have current limits defined as follows:

Conductive Emission Limits	
From 20 Hz, up to 55 Hz	10A maximum.
From 55 Hz, up to 80 Hz	4A maximum.
From 80 Hz, up to 720 Hz	10A maximum.

Above 720 Hz, the emissions limit shall follow a smooth curve through 10 A at 720 Hz, 0.06 A at 4 kHz, 0.027 A at 5.1 kHz, and 0.0066 A at 8 kHz.

The defined limits shall be met under all normal, abnormal, and failure conditions. The full range of modes, speeds, operating voltages, train lengths, and loadings shall be considered by the Contractor.

N2.4.2.3. CONDUCTED DISTURBANCES

The Contractor shall formulate a set of criteria governing both generation and tolerance of electrical disturbances on conductors between assemblies. The criteria shall:

- Distinguish the basic types of circuits present on the vehicle and define a suitable comprehensive classification of disturbances that could be present in each type of circuit.
- Ensure that each connected assembly tolerates the disturbances introduced simultaneously by all of the other assemblies to which it could be connected.
- Include any required modification of the limits previously described regarding conducted interference into the third rail system and running rails with levels selected to prevent interference with signal and communication systems that use those circuits for their means of operation and communication.

These criteria shall be a part of the EMC control plan described herein.

N2.4.2.4. INDUCTIVE EMISSION LIMITS

In accordance with FTA-MA-06-0153-85-8, the inductive emissions, measured rail-to-rail at rail frequencies, shall be limited to a maximum of:

- 100 mV, RMS, between 40 Hz and 200 Hz.
- 20 mV, RMS, between 200 Hz and 0.9 kHz.
- 10 mV, RMS, between 0.9 kHz and 20.5 kHz.

These conditions shall be met individually by each power equipment apparatus, as well as during simultaneous operation of all equipment.

Magnetic field strength in the vehicle interior and cabs shall not exceed 0.2 mT.

The defined limits shall be met under all normal, abnormal, and failure conditions. The full range of modes, speeds, operating voltages, train lengths, and loadings shall be considered by the Contractor.

N2.4.2.5. INDUCTIVE DISTURBANCES

The Contractor shall formulate a set of criteria governing generation and tolerance of magnetically coupled disturbances on or between assemblies. The criteria shall:

- Identify the basic types of circuits present on the vehicle and define a suitable comprehensive classification of disturbances that could be present in each type of circuit.
- Ensure that each connected assembly tolerates the disturbances introduced simultaneously by all other assemblies to which it is magnetically coupled.
- Include any required modifications to the limits previously described regarding the inductive interference into the running rails with levels selected to prevent interference with signal and communication systems which use those circuits for their means of operation and communication.

These criteria shall be a part of the EMC control plan described herein.

N2.4.2.6. AUDIO FREQUENCY INTERFERENCE

MDT's future vehicle signaling system will likely operate through track and onboard audio frequency circuits based on a carrier frequency ranging from 1 kHz to 20.5 kHz for cab signal and train detection frequencies. The transmission point for audio frequencies is the rail itself. Signal acquisition occurs at the antennae mounted at the lead end of each motored truck.

Power frequency (60 Hz) track circuits are presently used throughout MDT's vehicle system for train detection.

The vehicle emissions shall not, under any circumstances, interfere with the proper operation of the 60 Hz power-frequency track circuits, the automatic trip stop system, the Train-to-Wayside Communication system, or the cab signal system.

Therefore, design techniques and construction methods shall be employed to ensure suppression of any emissions. In addition, since equipment boxes and cabling will be removed, inspected, and/or replaced on a routine basis, the equipment shall be designed to ensure proper sealing of boxes, cables, etc., during routine maintenance procedures.

N2.4.2.7. ELECTROMAGNETIC FREQUENCY DATA

Operating Frequencies: Track circuits shall operate at the Power Frequency (PF) of 60 Hz.

Radio Frequencies: MDT currently uses a trunked 800 MHz system shared with the County.

N2.4.2.8. TRAIN-TO-WAYSIDE COMMUNICATIONS SYSTEM

Refer to TPN14 for requirements for the Train-To-Wayside Communications (TWC) system frequencies.

N2.4.2.9. ELECTROMAGNETIC COMPATIBILITY CONTROL AND TEST PLANS

The Contractor shall submit to the Engineer for review and approval an Electromagnetic Compatibility (EMC) control and test plan, addressing complete vehicle and vehicle system requirements, prior to purchasing any carborne apparatus (CDRL N208).

The plans shall ensure that proper emphasis is placed on interference control, interface design, and FCC requirements from the earliest stages of vehicle design. The EMC control and test plans shall describe the Contractor's approach to ensure that the specified EMC requirements are met.

At a minimum, the Contractor's EMC control plan shall include the following:

- General design and mitigation techniques to be applied to the complete vehicle and all vehicle systems.
- Analysis of the susceptibilities of vehicle systems and the standards/criteria to be applied to system designs.
- Analysis of wayside and non-railroad susceptibilities applicable to vehicle design, plus overall EMC emission requirements as defined herein.
- Requirements for emission limits for the complete vehicle and vehicle systems.

The following design requirements shall be included in the EMC control plan:

- To contain EMC emissions whenever possible, the suppression of transients shall be at the source of the transient.
- All magnet valves, relay and contactor coils, and other inductive devices shall have transient suppression. The absence of suppression for performance reasons will require approval.
- The number of suppression devices shall be kept to a minimum.

- Equipment design, wiring techniques, and enclosures shall shield equipment from any effects resulting from the operation of MDT's hand-held transceiver.
- Equipment design, wiring techniques, and enclosures shall shield equipment from any effects resulting from the operation of cellular telephones, including when cellular telephones are operated within the vehicle or on the passenger platforms.
- Equipment design, wiring techniques, and enclosures shall shield systems to prevent the vehicle and its systems from causing undesired effects to external equipment and systems with particular emphasis being placed on safe operation with the wayside signal and communications systems. Operational sensitivities of the wayside signal and communications systems shall be confirmed by the Contractor. Interference-free operation, based on design requirements and test confirmation, shall be a requirement of this program.
- The EMC test plan shall address how the susceptibility and emission limits will be verified.
- The Contractor shall perform testing which shall include both lab qualification testing for the propulsion and auxiliary power equipment for conductive and inductive emissions, as well as vehicle level testing for conductive, inductive, and radiated emissions.
- The Engineer's approval of the EMC control and test plans does not relieve the Contractor from the requirement to provide equipment that functions safely and properly in the transit environment and to the requirements of the Contract Documents.

N2.4.2.10. EMI COMPATIBILTY ASSURANCE

The Contractor shall perform an FMECA (Failure Mode Effect and Criticality Analysis) to identify all subsystem failures that can create EMI (Electromagnetic Interference) capable of causing false track signaling or cab signaling indications. There shall be no undetectable failures that result in elevated magnetic fields or any other potentially hazardous condition. Detected failures shall result in subsystem shutdown or reduced performance eliminating the excessive EMI.

All car carried equipment shall have been certified to be immune to electromagnetic interference by being tested or having been tested to the following procedures:

- IEC-1000-4-2 1995 Electromagnetic Compatibility, Part 4 Testing and Measurement Techniques, Section 2 Electrostatic Discharge Immunity Test.

- IEC-1000-4-3 1995 and Amendment 1998-1 Electromagnetic Compatibility, Part 4 Testing and Measurement Techniques, Section 3 Radiated Radio Frequency Electromagnetic Field Immunity Test.
- IEC-1000-4-4 1995 Electromagnetic Compatibility, Part 4 Testing and Measurement Techniques, Section 4 Immunity to Electrical Fast Transient Burst.
- IEC-1000-4-5 1995 Electromagnetic Compatibility, Part 4 Testing and Measurement Techniques, Section 5 Surge Immunity Test.

N2.5. SHOCK AND VIBRATION

All vehicle borne equipment shall be designed and tested to operate without damage or degradation of performance when subjected to vibration and shocks encountered during normal service.

A Shock and Vibration Test Plan shall be submitted to the Engineer for approval (CDRL N211).

Equipment design and mounting arrangements shall be based on the specific location of the vehicle's equipment and shall consider the influence of adjacent components as well as the dynamic effects of normal vehicle operation. In addition to any shock or vibration encountered in normal operation, vehicle equipment shall withstand the following vibration levels.

Carbody-mounted components shall be designed and installed to successfully sustain continuous sinusoidal vibrations, consisting of 0.2g Root Mean Squared (RMS) at any frequency from 5 to 100 Hz along 3 mutually perpendicular axes.

The carbody-mounted components shall also successfully sustain randomly oriented shock impulses of 3g peaks with duration of 4 to 10 milliseconds.

Components mounted on the truck frame shall be designed and mounted to withstand, without fatigue or deterioration for the life of the vehicle, the normally occurring random shock and vibration magnitudes present at the support points on the truck frame. The design and mountings shall be exposed to random vibrations of 1g RMS in all directions with a crest factor (ratio of peak to RMS acceleration level) of 5 within the frequency range of 1 Hz to 100 Hz. The design and mountings shall also be exposed to shocks occurring up to 100 times per operating day of 20g peaks in the vertical axis and 6g peaks in the lateral axis with pulse duration ranging from 4 to 10 milliseconds.

Axle-mounted components shall be designed to withstand continuous vibrations of 10g RMS within the frequency range of 1 Hz to 100 Hz in all directions and shock pulses of 100g in each major axis with duration

ranging from 0.5 millisecond to 2.0 milliseconds, occurring approximately 100 times per operating day.

N2.5.1. GUIDEWAY RESPONSE

The natural frequency of the standard aerial structure of the Miami Metrorail includes the following criteria: Minimum natural frequency of repetitive spans 2.5 Hertz Minimum natural frequency of non-repetitive spans 2.25 Hertz.

N2.6. VIBRATION GENERATION

Components and mounting systems shall be designed to limit vibrations levels as specified herein.

N2.6.1. TRACTION MOTORS

Vibration of traction motors, when detached and supported on resilient mountings that provide at least 0.25 inch static deflection, shall not exceed 0.0015 inch peak-to-peak displacement at the motor bearing housings and mounting bosses while the motor is rotating at any speed between 50% and 100% of its maximum normal operating speed.

N2.6.2. AUXILIARY UNITS

With the vehicle stationary and with all auxiliary units operating simultaneously at rated capacity, the vertical or horizontal vibrations of floors, walls, seat frames, or any surface to which a passenger or Operator is exposed shall not exceed any of the following values:

Vertical and Horizontal Vibrations		
Displacement, peak-to-peak	0.10 in.	(0 to 1.4 Hz)
Acceleration, peak value	0.01g	(below 20 Hz)
Velocity, peak value	0.05 in./sec	(above 20 Hz)

N2.7. RIDE QUALITY

The vehicle shall provide a smooth, comfortable ride without objectionable vibration and shock, defined as follows, throughout the operational environment, as defined in this section, in acceleration, coast, and braking modes. Vehicle elements mounted in the passenger areas shall be resonance-free and shall be properly isolated to avoid audible and visible distractions. No element or assembly mounted on the carbody shall have a natural resonant frequency, as it is supported, of less than 4

Hz. The frequencies of the sources of excitation, such as wheels, motors, gears, and brakes, shall be within the parameters established in this section at speeds from 0 to 70 mph. Ride quality tests shall be performed on the current alignment in accordance with the provisions of TPN17.

Ride quality shall be evaluated as per the methods of ISO 2631-1. The limits of exposure shall be according to the reduced comfort boundaries defined in ISO 2631-1. The processed RMS acceleration values (RMS averaged over the test section of the current alignment while traveling at normal operating speeds) shall not exceed the 4-hour vertical (az) and 4-hour transverse (ax and ay) boundaries defined in figures 2a (longitudinal) and 3a (transverse) of ISO 2631-1. The range of frequencies for which the ride quality is evaluated shall be 1 to 80 Hz for all load and operational conditions. If any suspension frequency is above or below this range, Vehicle Dynamic Modeling, as defined in TPN11, shall define and quantify this mode and shall be subject to ISO 2631-1. The Contractor shall provide to the Engineer for review and approval a ride quality test procedure to verify compliance with these requirements (CDRL N212).

N2.8. MOCK UPS

The Contractor shall provide a full scale undercar mock-up showing undercar equipment locations and maintenance accessibility. The Mock-up may be accomplished on a car or appropriately designed framework.

The mock up will be used to verify the equipment mounting configuration, piping routing, cable routing, maintenance clearance, and other interfaces, and shall be approved by the Engineer.

The Contractor shall provide full scale interior mock-ups as follows:

a. Interior mock up, representing the portion of the vehicle beginning with the F-end, to no less than the center of the first set of passenger doors of the vehicle, showing new interior liners, access panels, flooring, stanchions, grab handles, and other interior hardware to confirm clearances, installation methods, and other hardware. Also, a mock up of the R-end of the vehicle shall be provided. The interior mock up shall be presented for approval by the Engineer.

b. One 2-passenger transverse seat with proposed color scheme for upholstered cushions. The seat mock-up shall be presented for approval by the Engineer.

N2.9. VEHICLE AND COMPONENT IDENTIFICATION

The vehicle carbody and equipment shall be referred to in accordance with the following conventions.

Vehicle number and location information will be furnished by MDT.

Cars shall be referred to by their car number, with designation of "A" or "B" as appropriate. Vehicle numbering shall begin with "301". All "A" cars shall be odd numbered cars; "B" cars shall be even numbered cars.

Trucks, axles, wheels, and doors shall be referred to as follows: Facing forward in the F-end of the car from the interior, items located within that section on the right shall be designated "Right", and items on the left shall be designated "Left". Vehicles shall, in addition to existing car number identification locations, have the car number painted on the roof of the F-end of each car in 24 inch tall digits. The font shall be "Helvetica". The car number shall also be applied at eye level at each door opening.

N2.10. VEHICLE PHOTOGRAPHS

The Contractor shall provide photographs to the Engineer to use as a visual production record as described in GP8.

In addition to the photographic prints, the Contractor shall provide all final photographs in an electronic format, as approved by the Engineer, on DVD to enhance distribution of the visual information (CDRL N213).

Figure 2-1: Spin / Slide Efficiency Calculation

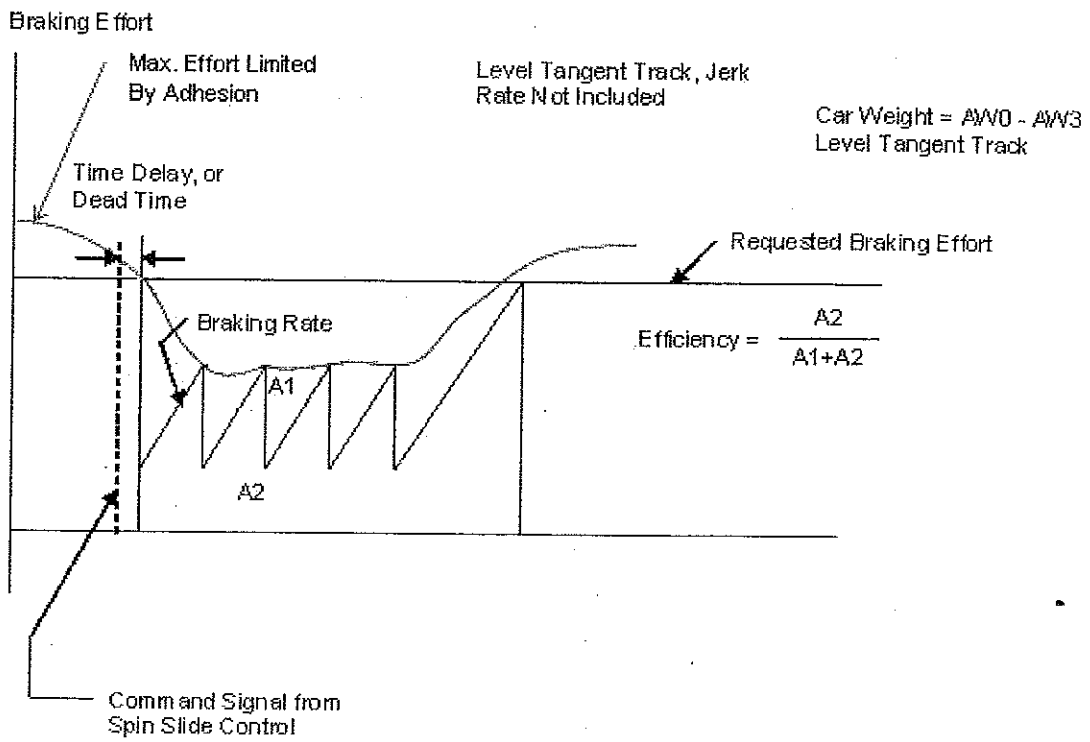
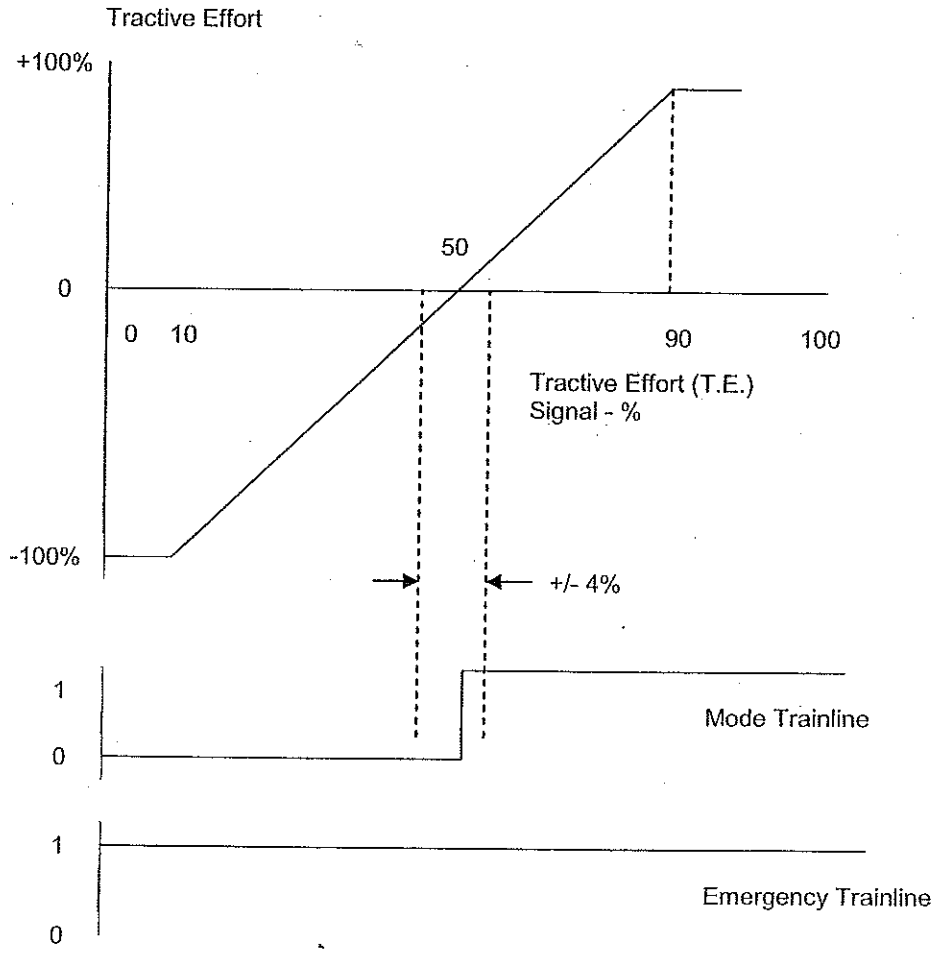


Figure 2-2: Tractive Effort



T.E. Signal	Mode T/L	Emergency T/L	Control Response
>50%	1	1	Power
<50%	0	1	Service Brake
>50%	0	1	Full Service Brake
<50%	1	1	Full Service Brake
-	-	0	Emergency Brake

Figure 2-3: Acceleration vs. Speed AW0 to AW2
Deceleration vs. Speed AW0 to AW3

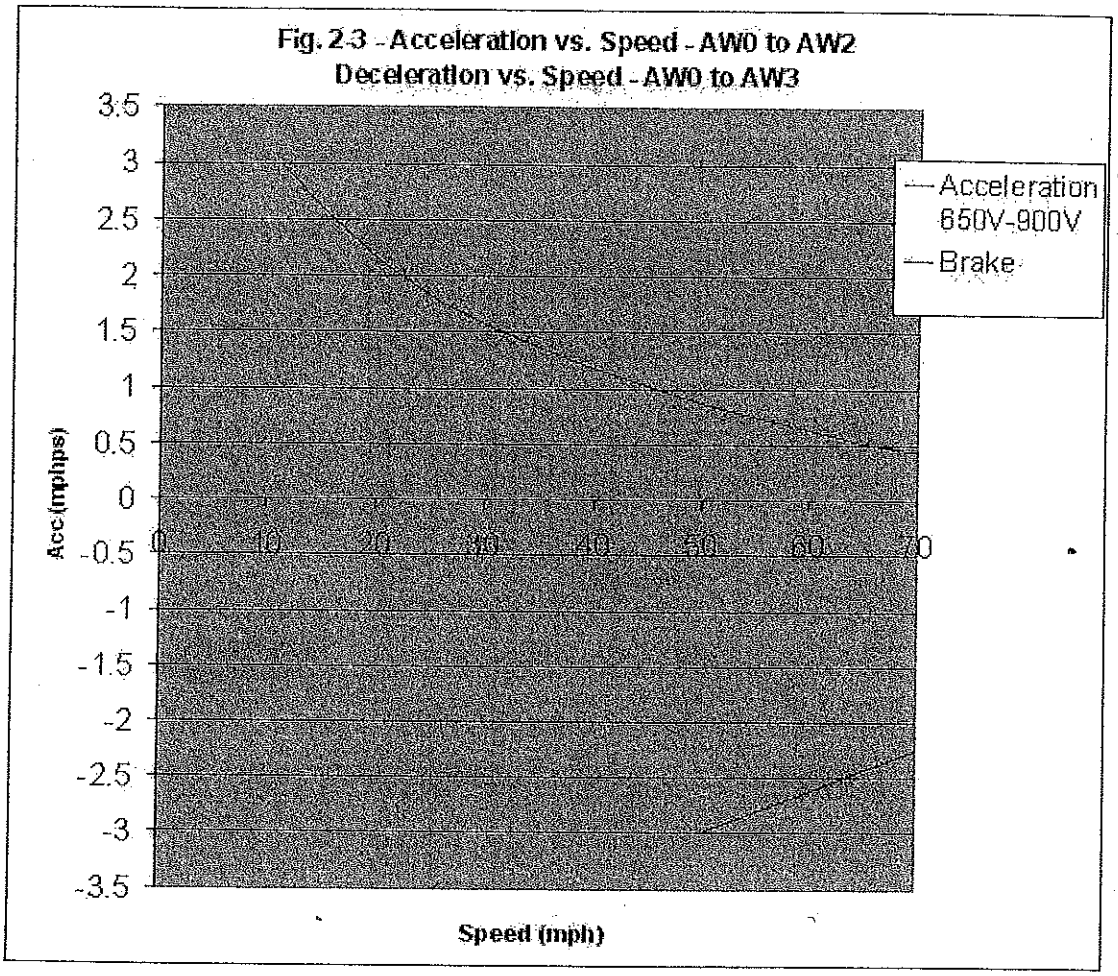
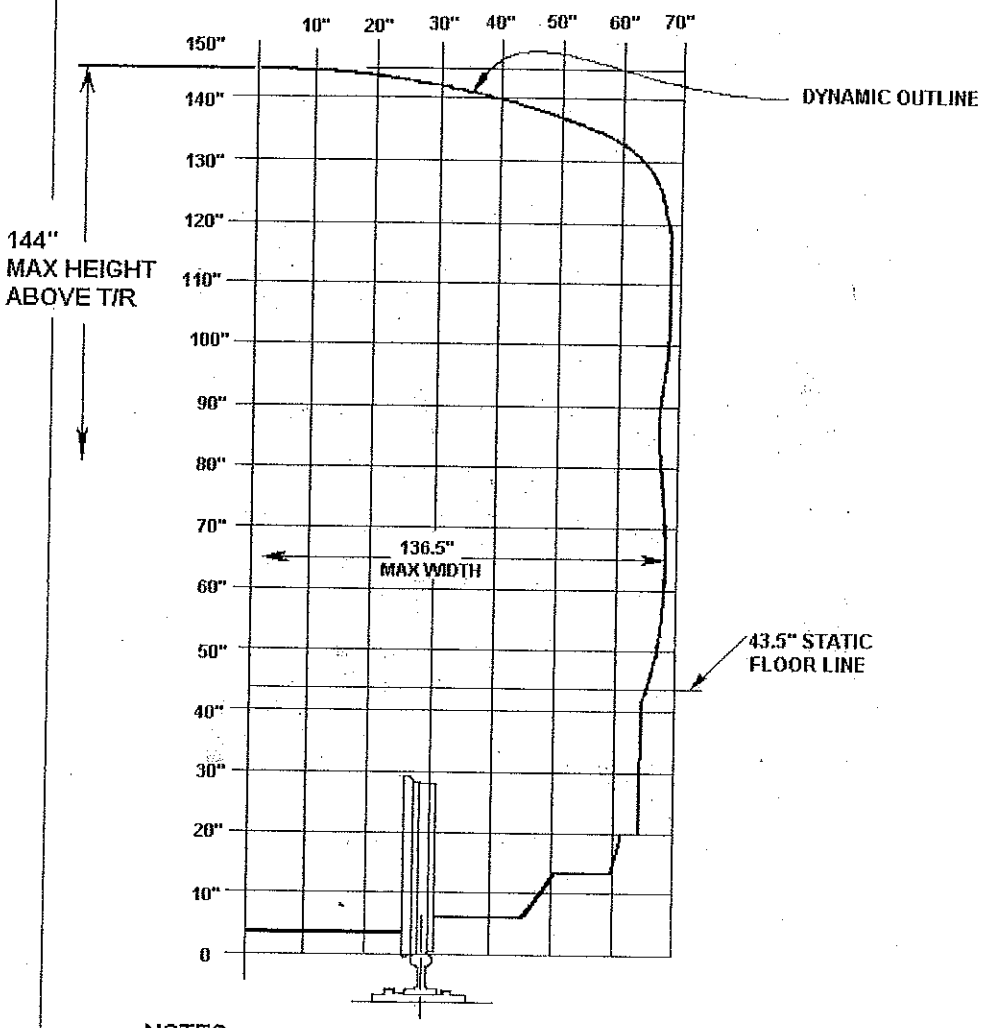


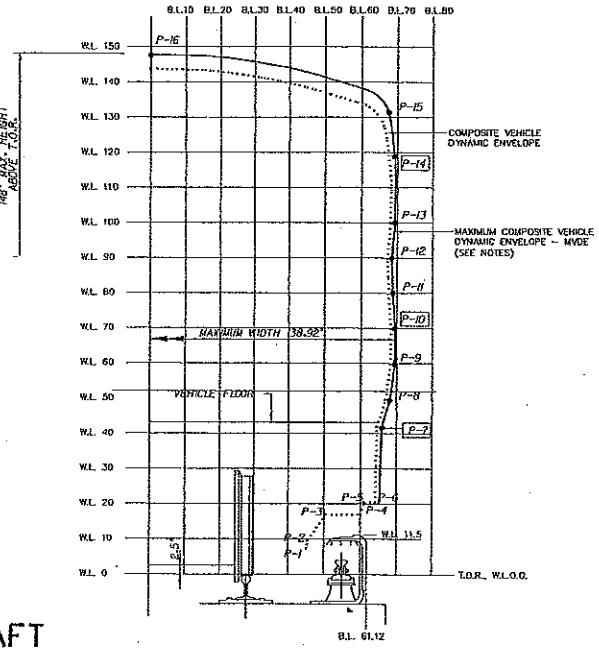
Figure 2-4: Vehicle Dynamic Outline



NOTES

1. THE DYNAMIC OUTLINE REPRESENTS THE MAXIMUM ALLOWED EXCURSION OF THE VEHICLE WITH NEW WHEELS AND ON NDW "IDEAL" TANGENT TRACK.
2. THE DYNAMIC OUTLINE DRAWING INCLUDES THE SUM OF ALL MAXIMUM VERTICAL (UP AND DOWN), LATERAL, YAW, AND ROLL MOTIONS OF THE VEHICLE.

METROPOLITAIN DADE COUNTY	
KAISER TRANSIT GROUP SECTION DESIGNER	FIGURE 02850-2 Y591 VEHICLE DYNAMIC OUTLINE
SCALE: NA DATE: 3/17/81	



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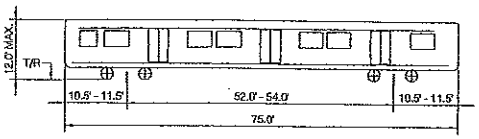

GENERAL VEHICLE DIMENSIONS

NOTES:

1. COMPOSITE VEHICLE DYNAMIC ENVELOPE DEVELOPED FROM INFORMATION SHOWN ON MDT VEHICLE PROCUREMENT DRAWING NO. VP-10, MDT PASSENGER VEHICLE DWG. NO. GID-09-E AND THE BUDD COMPANY, INC VEHICLE CROSS SECTION DWG. NO. T42-0672. (SEE TABLE NO. 1)

2. THE MAXIMUM COMPOSITE VEHICLE CLEARANCE ENVELOPE IS OBTAINED BY SHIFTING THE COMPOSITE VEHICLE DYNAMIC ENVELOPE AS FOLLOWS:

LATERAL:
FLANGE WEAR 0.375"
CONSTRUCTION TRACK RAIL & WEAR (+-.500) 0.500"
TOTAL LATERAL SHIFT: 0.875"

YAW:
A 0.875" LATERAL DISPLACEMENT IN OPPOSITE DIRECTIONS AT EACH TRUCK LOCATION RESULTS IN A YAW DISPLACEMENT AT THE CAR ENDS OF 1.210" MAXIMUM COMPOSITE VEHICLE DYNAMIC OUTLINE IS OBTAINED BY ADDING 1.23" TO THE COMPOSITE VEHICLE DYNAMIC ENVELOPE (SEE TABLE NO. 2)

VERTICAL:
TRACK PROFILE (± 0.500") AND WEAR (– 0.500") VARIATIONS = + .500"
TOTAL NET VARIATION –1.000"

3. FOR POINTS P-1 THROUGH P-13 ON THE MVDE THE VERTICAL ELEVATION IS DETERMINED ON STATIC NEW CAR CONDITION. WHERE WARRANTED THOSE POINTS MAY BE + 0.50" OR –1.00" FROM THE SHOWN ELEVATION.

4. FOR POINTS P-14 THROUGH P-16 ELEVATIONS ARE BASED ON MDT'S GID-09-E PLUS 4.0" OVER THE STATIC ENVELOPE WHICH INCLUDES ALL DYNAMIC FACTORS.

TABLE #1	COMPOSITE VEHICLE DYNAMIC ENVELOPE	
POINT No.	BL	WL
1	3'-9 3/8"	7.75
2	3'-9 3/8"	9.75
3	4'-2 1/8"	17.25
4	5'-0"	17.25
5	5'-1 1/2"	20.70
6	5'-4 1/2"	20.70
7	5'-4 1/2"	41.00
8	5'-7"	50.00
9	5'-8 3/4"	60.00
10	5'-8 3/4"	70.00
11	5'-8 3/4"	78.00
12	5'-7 3/8"	90.00
13	5'-7 1/8"	100.00
14	5'-8 1/2"	118.00
15	5'-6 1/4"	132.00
16	0	148.00

TABLE #2	MAXIMUM COMPOSITE VEHICLE DYNAMIC ENVELOPE (MVDE)			
	FEET-INCHES		INCHES	
POINT No.	BL	WL	BL	WL
1	N/A		N/A	
2	N/A		N/A	
3	N/A		N/A	
4	N/A		N/A	
5	N/A		N/A	
6	5'-5 3/8"	1'-8 3/4"	65.4	20.70
7	5'-5 1/4"	3'- 5"	65.7	41.00
8	5'-8 1/2"	4'- 2"	68.2	50.00
9	5'-9 1/2"	5'- 0"	69.5	60.00
10	5'-9 1/2"	5'- 10"	69.5	70.00
11	5'-9 1/2"	6'- 6"	69.8	78.00
12	5'-8 1/2"	7'- 6"	68.5	90.00
13	5'-8 3/8"	8' - 4"	69.4	100.00
14 *	5'-9 1/2"	9'- 10"	69.5	118.00
15 *	5'-7 1/2"	11'- 0"	67.5	132.00
16 *	0	12'- 4"	0.0	148.00

* SEE NOTE No.4

30% SUBMITTAL AUGUST 15, 2005 (PRELIMINARY PLANS – NOT FOR CONSTRUCTION)

Designed by
Drawn by
Checked by

No.	Date	Chk	App.	Revision

DIRECTIVE DRAWINGS

MIAMI-DADE COUNTY TRANSIT

PMG Program Management Consultant

APPROVED DATE 06-14-06 NAME P.E. NO.

MINIMUM CLEARANCE CRITERIA
MAXIMUM COMPOSITE VEHICLE DYNAMIC ENVELOPE

DRAWING NO. VPD-001 SHEET NO. 65 of 584

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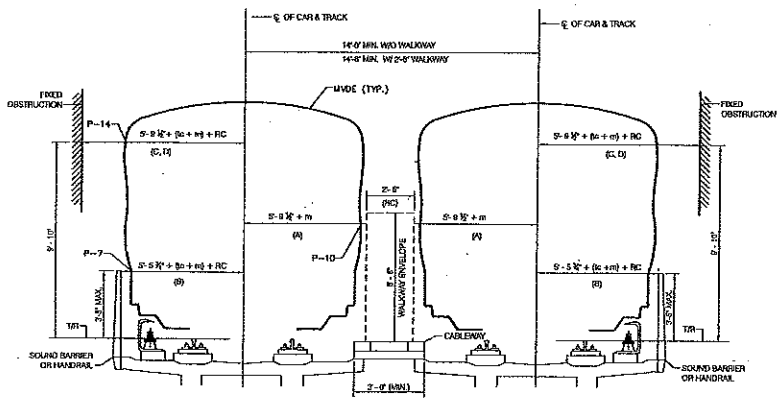
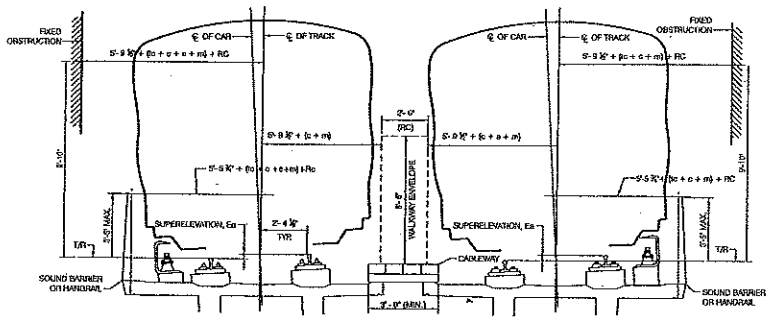


TANGENT



CURVE

NOTE: ALL FORMULAS TO BE USED TO DETERMINE DESIGN OFFSETS AND TRACK CENTER DISTANCE

MINIMUM CLEARANCE FOR TANGENT TRACK (c = 0 AND e = 0)

	OBJECT	MVDE	tc	m	RUNNING CLEARANCE	DO (*)	F.M.
A	TRACK-CENTER DISTANCE (WITH CENTER WALKWAY)	5'-9 1/2" (x 2)	0	1.68" (x 2)	2'-- 6"	14'-8" (**)	14' -- 6"
B	SOUND BARRIER OR HANDRAIL	5'-- 5 3/4"	1"	1.35"	6"	6' -- 2 1/8"	6'-- 1 1/8"
C	MAJOR STRUCTURE (MIN.)	5'-- 9 1/2"	2 1/2"	2.02"	2' -- 0"	8' -- 2 1/2"	8' -- 0"
D	MAJOR STRUCTURE (DESIRABLE)	5'-- 9 1/2"	2 1/2"	2.02"	2' -- 6"	8' -- 8 1/2"	8' -- 6"

* ROUNDED UP TO THE NEAREST 1/8"
** ROUNDED UP TO THE NEAREST 3" INCREMENT OF ONE FOOT

DO = DESIGN OFFSET
FM = FIELD MEASUREMENT (AS BUILT)

MINIMUM CLEARANCE COMPENSATION FACTORS

DO = MVDE + OWF + RC

MVDE = POINT ON VEHICLE

PT	DISTANCE	HEIGHT
P7	5'-5 3/4"	3' -- 5"
P10	5'-9 1/2"	6' -- 6"
P14	5'-9 1/2"	9'-- 10"

FOR OTHER POINTS ON THE MAXIMUM COMPOSITE VEHICLE DYNAMIC ENVELOPE SEE DWG. NO. VPD001

OWF = OTHER WAYSIDE FACTORS
OWF = tc + c + e + m

tc = CONSTRUCTION TOLERANCE (WAYSIDE)

MINOR STRUCTURE 1.0"
MAJOR STRUCTURE 2.5"

SEE DESIGN CRITERIA FOR ADDITIONAL DIRECTION ON CONSTRUCTION TOLERANCES

c = COMPENSATION FOR CURVATURE FACTOR
c = c1 + c2
c1 = 0.25" x DEGREE OF CURVE
c2 = COMPENSATION FOR TRACK GAGE WIDENING

TRACK GAGE	c2 INSIDE	c2 OUTSIDE
4' -- 8 1/2"	0.38"	0.11"
4' -- 8 3/4"	0.66"	0.16"
4' -- 9"	0.97"	0.22"

STANDARD GAGE 4' -- 8 1/4"
TRACK ℄ 2' -- 4 1/8" (HIGH RAIL)

e = COMPENSATION FOR SUPERELEVATION FACTOR (INSIDE OF CURVE ONLY)

PT	H	e
P7	3'-- 5"	11/16 x Ea
P10	6'-- 6"	1.25 x Ea
P14	9'-- 10"	2 x Ea

FOR OTHER HEIGHTS USE: (H/59) x Ea
Ea = ACTUAL SUPERELEVATION

FOR OUTSIDE OF CURVE CLEARANCE USE e = 0"

m = TRACK MAINTENANCE FACTOR = (m1 + m2)

DIRECT FIXATION TRACK

PT	H	m1	m2	m
P7	3'-- 5"	1"	0.35"	1.35"
P10	6'-- 6"	1"	0.66"	1.66"
P14	9'-- 10"	1"	1.02"	2.02"

OTHER PT USE: m1 = 1" AND m2 = 0.5 x (H/59)

BALLASTED TRACK

PT	H	m1	m2	m
P7	3'-- 5"	2"	0.69"	2.69"
P10	6'-- 6"	2"	1.32"	3.32"
P14	9'-- 10"	2"	2.03"	4.03"

OTHER PT USE m1 = 2" AND m2 = 1.0 x (H/59)

RC = RUNNING CLEARANCE (MIN.)

MINOR STRUCTURES: 6"
MAJOR STRUCTURES: 2' -- 6" DESIRABLE
MAJOR STRUCTURES: 2' -- 0" MINIMUM
CENTER WALKWAY: 2' -- 6"

SEE DESIGN CRITERIA FOR FURTHER INFORMATION ON RUNNING CLEARANCES

NOTES:

1. THE COMPENSATION FOR CURVATURE FACTOR (c) TAKES INTO CONSIDERATION BOTH THE END OVERHANG OFFSET AND MIDDLE ORDINATE OFFSET, AND IS APPLICABLE TO BOTH 52FT. AND 54FT. TRUCK SPACING.
2. ALL T.O.'S ARE TO BE CONSIDERED AS CURVES AND CLEARANCES COMPENSATED ACCORDINGLY. USE C=6" FOR A NO. 18 T.O.
3. CONSTRUCTION TOLERANCES ARE TOLERANCES RELATED TO WAYSIDE CONSTRUCTION. THE MAXIMUM COMPOSITE DYNAMIC VEHICLE ENVELOPE (MVDE) INCLUDES TRACK CONSTRUCTION TOLERANCES AS WELL AS THE EFFECTS DUE TO RAIL AND WHEEL WEAR.
4. FOR VERTICAL CLEARANCES SEE DESIGN CRITERIA

DRAFT

30% SUBMITTAL AUGUST 15, 2005 (PRELIMINARY PLANS - NOT FOR CONSTRUCTION)

Designed by
Drawn by
Checked by
No. | Date | CHK | APP. | Revisions

DIRECTIVE DRAWINGS

MIAMI-DADE COUNTY TRANSIT

PMC Program Management Consultant

APPROVED | DATE 06-11-06 | NAME | P.E. NO.

MINIMUM CLEARANCE CRITERIA
HORIZONTAL
TANGENT AND CURVED TRACK
DOUBLE TRACK

DRAWING NO. VPD-003 | SHEET NO. 66 of 58

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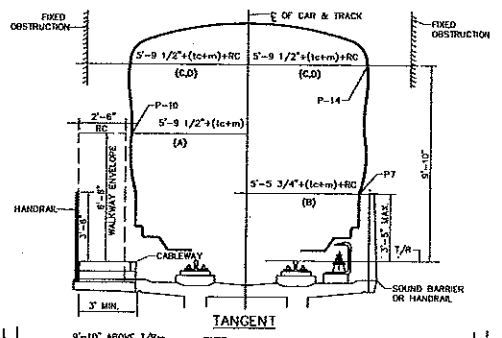

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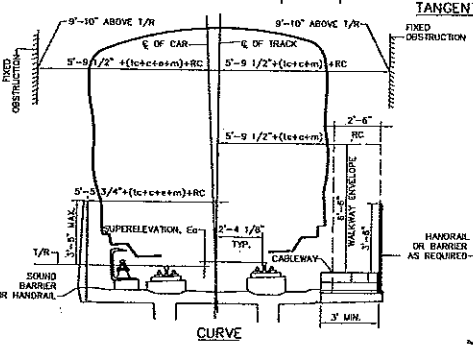

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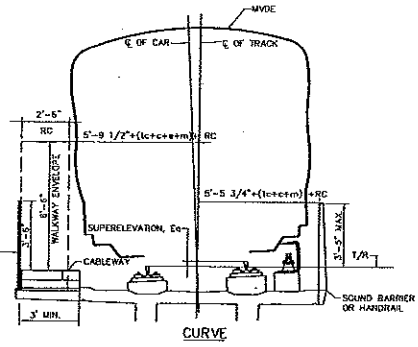

CURVE

DRAFT

MINIMUM CLEARANCE FOR TANGENT TRACK (c = 0 AND e = 0)

	OBJECT	MVDE	tc	m	RUNNING CLEARANCE	DO (*)	F.M.
A	SOUND BARRIER OR HANDRAIL WITH WALKWAY	5'-9 1/2"	1"	1.65"	2'- 6"	8'-5 1/4"	8' - 5 1/4"
B	SOUND BARRIER OR HANDRAIL	5'- 5 3/4"	1"	1.35"	8"	6' - 2 1/8"	6'- 1 1/8"
C	MAJOR STRUCTURE (MIN.)	5'- 9 1/2"	2 1/2"	2.02"	2' - 0"	8' - 2 1/2"	8' - 0"
D	MAJOR STRUCTURE (DESIRABLE)	5'- 9 1/2"	2 1/2"	2.02"	2' - 6"	8' - 8 1/2"	8' - 6"

* ROUNDED UP TO THE NEAREST 1/8"

DO = DESIGN OFFSET
FM = FIELD MEASUREMENT (AS BUILT)

MINIMUM CLEARANCE COMPENSATION FACTORS

DO = MVDE + OWF + RC

MVDE = POINT ON VEHICLE

PT	DISTANCE	HEIGHT
P7	5'-5 3/4"	3' - 5"
P10	5'-9 1/2"	6' - 6"
P14	5'-9 1/2"	9'- 10"

FOR OTHER POINTS ON THE MAXIMUM COMPOSITE VEHICLE DYNAMIC ENVELOPE, (MVDE) SEE DWG. NO. VPD001

OWF = OTHER WAYSIDE FACTORS
OWF = tc + c + e + m
tc = CONSTRUCTION TOLERANCE (SEE NOTE 3)

MINOR STRUCTURE 1.0"
MAJOR STRUCTURE 2.5"

SEE DESIGN CRITERIA FOR ADDITIONAL DIRECTION ON CONSTRUCTION TOLERANCES

c = COMPENSATION FOR CURVATURE FACTOR
c = c1 + c2
c1 = 0.75" x DEGREE OF CURVE
c2 = COMPENSATION FOR TRACK GAGE WIDENING

TRACK GAGE	c2 INSIDE	c2 OUTSIDE
4' - 8 1/2"	0.35"	0.11"
4' - 8 3/4"	0.66"	0.16"
4' - 9"	0.97"	0.22"

STANDARD GAGE 4' - 8 1/4"
TRACK @ 2' - 4 1/8" (HIGH RAIL)

e = COMPENSATION FOR SUPERELEVATION FACTOR (INSIDE OF CURVE ONLY)

PT	H	e
P7	3'- 5"	11/16 x Ea
P10	6'- 6"	1.25 x Ea
P14	9'- 10"	2 x Ea

FOR OTHER HEIGHTS USE: (H/59) x Ea
Ea = ACTUAL SUPERELEVATION

FOR OUTSIDE OF CURVE CLEARANCE USE e = 0"

m = TRACK MAINTENANCE FACTOR = (m1 + m2)

DIRECT FIXATION TRACK

PT	H	m1	m2	m
P7	3'- 5"	1"	0.35"	1.35"
P10	6'- 6"	1"	0.65"	1.66"
P14	9'- 10"	1"	1.02"	2.02"

OTHER PT USE: m1 = 1" AND m2 = 0.5 x (H/59)

BALLASTED TRACK

PT	H	m1	m2	m
P7	3'- 5"	2"	0.69"	2.69"
P10	6'- 6"	2"	1.32"	3.32"
P14	9'- 10"	2"	2.03"	4.03"

OTHER PT USE m1 = 2" AND m2 = 1.0 x (H/59)

RC = RUNNING CLEARANCE (MIN.)

MINOR STRUCTURES: 6"
MAJOR STRUCTURES: 2' - 6" DESIRABLE
MAJOR STRUCTURES: 2' - 8" MINIMUM
WALKWAY: 2' - 6"

SEE DESIGN CRITERIA FOR FURTHER INFORMATION ON RUNNING CLEARANCES

NOTES:

1. THE COMPENSATION FOR CURVATURE FACTOR (c) TAKES INTO CONSIDERATION BOTH THE END OVERHANG OFFSET AND MIDDLE ORDINATE OFFSET, AND IS APPLICABLE TO BOTH 52FT. AND 54FT. TRUCK SPACING.
2. ALL T.O.'S ARE TO BE CONSIDERED AS CURVES AND CLEARANCES COMPENSATED ACCORDINGLY. USE C=6" FOR A NO. 10 T.O.
3. CONSTRUCTION TOLERANCES ARE TOLERANCES RELATED TO WAYSIDE CONSTRUCTION. THE MAXIMUM COMPOSITE DYNAMIC VEHICLE ENVELOPE (MVDE) INCLUDES TRACK CONSTRUCTION TOLERANCES AS WELL AS THE EFFECTS DUE TO RAIL AND WHEEL WEAR.
4. FOR VERTICAL CLEARANCES SEE DESIGN CRITERIA

30% SUBMITTAL AUGUST 15, 2005 (PRELIMINARY PLANS - NOT FOR CONSTRUCTION)

Designed by
Drawn by
Checked by

No.	Date	CHK	APP.	Revisions

DIRECTIVE DRAWINGS

MIAMI-DADE COUNTY TRANSIT

PMC Program Management Consultant

APPROVED DATE 06-14-06 NAME P.E. NO.

MINIMUM CLEARANCE CRITERIA
HORIZONTAL
TANGENT AND CURVE TRACK
SINGLE TRACK

DRAWING NO. VPD-002 67 of 58-PHASE NO.

DATES SPECS

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TABLE OF CONTENTS

N3. CARBODY 3-1
N3.1. GENERAL 3-1
N3.1.1. CITED REFERENCES 3-2
N3.1.2. SUBMITTALS – CDRLS 3-2
N3.2. INTERFACE REQUIREMENTS 3-3
N3.3. CONSTRUCTION 3-3
N3.3.1. CAR FRAME 3-4
N3.3.2. VERTICAL LOADING 3-4
N3.3.3. CAMBER 3-4
N3.3.4. COMPRESSION LOADING 3-4
N3.3.5. CRASHWORTHINESS CRITERIA 3-5
N3.3.6. JACKING 3-6
N3.3.7. UNDERFRAME 3-6
N3.3.8. END UNDERFRAME 3-6
N3.3.9. UNDERCAR EQUIPMENT BRACKETS 3-8
N3.3.10. BODY SHELL 3-9
N3.3.11. INSULATION 3-11
N3.3.12. FLOORS 3-11
N3.3.13. END WALLS 3-11
N3.3.14. WATER TIGHTNESS 3-12
N3.4. BETWEEN CAR BARRIERS 3-12
N3.5. DOORS 3-12
N3.5.1. SIDE DOORS 3-12
N3.5.2. END DOORS 3-13
N3.5.3. CAB DOORS 3-13
N3.5.4. DOOR ATTACHMENT AND RESTRAINING HARDWARE 3-14
N3.6. WINDOWS 3-14
N3.6.1. CAR SIDE AND SIDE DOOR WINDOWS 3-14
N3.6.2. CAB SIDE WINDOWS 3-14
N3.6.3. END DOOR WINDOWS 3-14
N3.6.4. VANDAL RESISTANT FILM 3-14
N3.6.5. CAB DOOR AND PARTITION WINDOWS 3-15
N3.6.6. WINDSHIELDS 3-15

N3.6.7. PRESSURE LOADING 3-15
N3.7. INTERIORS 3-15
N3.7.1. INTERIOR LINERS 3-15
N3.7.2. INTERIOR FASTENERS 3-16
N3.7.3. DEFLECTION AND IMPACT LOADS 3-16
N3.7.4. DOOR POCKETS 3-16
N3.7.5. WINDSCREENS 3-17
N3.7.6. PARTITIONS 3-17
N3.7.7. COVING AND TRIM 3-17
N3.7.8. ADVERTISING AND NOTICE FRAMES 3-17
N3.7.9. GRAPHICS 3-17
N3.7.10. LOCKS AND KEYS 3-18
N3.8. THRESHOLDS AND DOOR GUIDES 3-18
N3.9. EQUIPMENT LOCKERS 3-18
N3.10. PASSENGER SEATING 3-19
N3.10.1. SEATING STRUCTURE 3-19
N3.10.2. SEATING CUSHIONS 3-19
N3.10.3. SEAT LOADING 3-20
N3.11. STANCHIONS AND GRAB RAILS 3-20
N3.12. STANCHIONS 3-20
N3.12.1. GRAB RAILS 3-21
N3.12.2. CREW GRAB HANDLES AND STEPS 3-21
N3.13. SAMPLES 3-21
N3.14. CAR NUMBERING 3-22
N3.15. INTER-CAR GANGWAY 3-22

N3. CARBODY

N3.1. GENERAL

The Miami-Dade Metrorail vehicles operate as married pairs, with vehicles designated as A-cars and B-cars. Carbodies for both A-cars and B-cars shall be substantially identical, and consist of a basic structural shell including floor framing, roof and wall framing, supports for trucks, supports for equipment, exterior sheathing for the roof and walls, cabs, and the floor deck. The carbody shall also include insulation, interior lining, windows, seats, stanchions, handrails, grab-handles, crew steps, door panels, and car end sections.

The carbody of both A- and B-cars, shall be a stainless steel structure with carbon steel underframe members in areas of high stress. Welding of the stainless steel frame members and skin shall be the predominant attachment system. Service proven mechanical attachment methods may be proposed provided that such fasteners do not degrade the aesthetics of the exterior. The door openings shall be reinforced with stainless steel sections to insure continuity of side wall strength. The ends of the car shall be designated as F-end (Front) and R-end (Rear). The F-end shall have a fiberglass molded section with a center door. The R-end shall be closed out by stainless steel sheet, and contain a center door. Ends shall be framed to provide torsional stiffness to the car body. Roof and lower side wall skins shall be of an approved design. Normal bending (vertical) loads shall be carried by the sidewalls to the side sills, and then be transmitted by steel bolsters thru the air suspension system to the trucks.

Operator's cabs shall be located at the F-end of each A-car, and contain equipment frames and structures for control equipment, the Operator's seat, and the Operator's console.

The F-end of the vehicle shall be of an aesthetically pleasing design, subject to the approval of the Engineer.

The exterior surface of the car shall be brushed stainless steel. Non-visible surfaces and undercar exposed areas are coated with corrosion protective coating. All external riveted joints shall be sealed to ensure weather tightness, prior to application of any coating or paint.

N3.1.1. CITED REFERENCES

Source/Section	Title
49 CFR Part 37	Americans with Disabilities Act (ADA) Part 1192 Accessibility Guidelines for Transportation Vehicles
49 CFR 571.222 § S5.3.1.	Federal Motor Safety Standard, Standard No. 222 "School Bus Passenger Seating and Crash Protection, Head Protection Zone
AISI	American Iron and Steel Institute
APTA C&S-016-99	Standard for Row-to-Row Seating in Commuter Rail Cars
APTA SS-C&S-004-01	Standard for Austenitic Stainless Steel
APTA SS-C&S-034-99 (Rev 1, Section 7.4)	Standard for the Design and Construction of Passenger Railroad Rolling Stock
ASCE 21	Automated People Mover Standards
ASTM A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
FRA, Type 1	Safety Glazing Standards for Locomotives, Passenger Cars and Cabooses
NEMA 250, Type 2	Enclosure for Electrical Equipment (1000 Volts Maximum)

N3.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is listed for reference purposes.

CDRL No.	Title	TP Reference
N300	Structural Analysis	TPN3.3.
N301	End Accessibility Scheme	TPN3.3.13.
N302	Water Test Procedure	TPN3.3.14.
N303	Advertising and Notice Frame Design	TPN3.7.8.
N304	Graphics and Decals Design	TPN3.7.9.

CDRL No.	Title	TP Reference
N305	Lock Key Configuration	TPN3.7.10.

N3.2. INTERFACE REQUIREMENTS

Carshells provided for the Miami-Dade Metrorail Fleet shall comply with the following requirements:

a. Car bodies shall present a sleek appearance, with attention to frontal appearance and profile appearance.

b. Passenger side doors shall be configured in a manner that is compatible with the existing MDT right of way.

N3.3. CONSTRUCTION

The carbody shall be a stainless steel superstructure with a LAHT substructure. The shell of the car body shall be made of austenitic stainless steel. The selection and application of stainless steels shall be in conformance with APTA SS-C&S-004-01. Stainless steels applied as exterior surfaces shall be an alloy with corrosion resistance greater than or equal to AISI 301 LN (low carbon, with nitrogen) with a brush finish. Corrosion resistance of the car body shell shall not rely upon application of protective coatings. Underframes may be made of low alloy high strength steels, protected by an Engineer approved corrosion-resistant coating system. The carbody shall be designed to carry the specified loads, and all loads of installed equipment under all operating conditions and maintenance loads. For load cases specified below, when the analysis incorporates local stress concentrations, it is permissible for the theoretical stress to locally exceed the material yield limit, however the areas of local plastic deformation associated with the stress concentrations shall be sufficiently small as to not cause significant permanent deformation when the load is removed. In the sections following N3.3, such a condition is applicable when permanent deformation is prohibited. The structure shall be designed for a minimum fatigue life of 30 years.

The Contractor shall submit a Structural Analysis, including Stress Analysis for vertical and compression loading of the carbody, to the Engineer for approval (CDRL N300). Structural analysis shall be presented utilizing modeling software approved by the Engineer. The analysis shall be based upon all loading criteria herein, all equipment loads, static and dynamic loading, and combinations of loading compliant with the operating environment for the Miami-Dade Metrorail system.

The carbody shall be functionally compatible with the overall dimensional criteria in TPN2.

Structural joints shall be welded unless otherwise approved by the Engineer. The car body structure shall be assembled by either welding (arc, laser or resistance) or mechanical fasteners. Sheathing shall be attached to the framing by resistance or laser welding. Stiffeners shall be attached to the sheathing by resistance or laser welding. Where car body structure is assembled with mechanical fasteners, the fasteners shall be high-strength lock bolts.

For service load cases, structural connections shall be designed to prevent slippage with a factor of safety of 2.0. For all exceptional load cases, the design shall withstand the worst-case loading condition.

Mechanically fastened connections shall be designed and analyzed using standard industry practice, taking into account the relative stiffness of the fastener and clamped members. Fasteners shall be torqued to a minimum of 75% of their proof load.

Shear loading of mechanical fasteners shall be avoided whenever possible. Clamping force friction can be relied upon for service load cases of structural connections of carbody components.

The carshell shall be designed and fabricated to be watertight, including installed windows and doors.

N3.3.1. CAR FRAME

The framing of the carshell shall be designed to carry normal loads efficiently and to provide cars which shall, under the conditions indicated, dissipate energy of impact without the vehicle leaving the trackway or overriding an adjacent coupled car. This shall be accomplished with the least possible shock and with the maximum plastic deformation at the carshell ends. End underframe elements shall be fabricated of low-alloy high-tensile steel and contain adequate drain holes in cavities.

N3.3.2. VERTICAL LOADING

A vertical load of 2 times AW3, with the live load uniformly applied to seat frames and the standing area of the floor deck, shall not result in any permanent deformation of any structural member of the vehicle.

N3.3.3. CAMBER

Carbodies shall be built with positive camber. Under any design approach, car structures and car mounted equipment shall not violate the car clearance envelope.

N3.3.4. COMPRESSION LOADING

The Carshell shall be designed to comply with the following compression loading criteria:

a. A minimum static compressive end load equal to 220,000 lb. acting along vehicle body longitudinal centerline and distributed about center one-third of end sill shall not cause any permanent deformation of any part of car body structure when combined with a vertical load of AW3 minus AW0.

b. Cantilevered seat loads shall be applied to side walls and any other mounting arrangement which is supported by the roof structure, with the remainder of the vertical load applied uniformly over the standee area of the car floor. Floor support of seating is not permitted.

c. Combined stresses due to loading conditions specified in the "Underframe" requirements for "Truck Connection to Car Body" shall not exceed 90% of the yield value of structural materials.

d. The vehicle body shall be tested for these combined load conditions or analytically verified for same.

N3.3.5. CRASHWORTHINESS CRITERIA

The carbody structure and supplemental energy absorption devices shall be designed to absorb maximum energy in a collision and prevent telescoping, overturning, and departure from the guideway.

The following crashworthiness criteria shall apply for a moving four car consist on level tangent track with brakes applied contacting a stationary four car consist with brakes applied. Analyses shall be performed for cases with couplers engaged and couplers not engaged for the cases described below:

Case 1 - Coupling impact: For impact velocity of 5 mph or less, there shall be no damage to any vehicle.

Case 2 - Low speed impact: For impact velocity of 20 mph, vehicle damage shall be confined to the ends of the vehicle(s) outboard of the bolsters. The structure of the cars inboard of the bolsters shall remain intact, with no permanent deformation of any member except that localized yielding may be allowed, provided the ability of the structure to sustain the crash load is not compromised; no passenger compartment shall rupture or collapse or suffer telescoping; high voltage devices and associated connecting cables shall remain contained and shall not create electrical shock hazards to personnel; and there shall be no fire hazards.

The Contractor shall provide crashworthiness analysis per APTA Standard SS-C&S-034-99 (Rev 1, Section 7.4), test data, and validated mathematical model simulation to demonstrate that the vehicle will satisfy these requirements.

N3.3.6. JACKING

The car shell shall be designed for maintenance operations as currently in use by MDT. Car maintenance involves a variety of processes, most of which are done with either wheel lifts or jacking at the jack pads.

a. Four jacking pads shall be provided, one adjacent to each bolster outboard of the truck attachment points on both sides of cars as shown in the Contract Drawings. Jacking pads on the new vehicle body (at the carbody bolster structure) on the side sill must be designed to match the dimensions for the existing body support stands in the MDT maintenance shop.

b. Each jacking pad shall be capable of supporting ½ of the weight of a complete car and capable of a restraining force in the horizontal plane equivalent to 1/8 of the weight of a complete car without permanently deforming or damaging the car body.

c. Pads shall have an alignment hole in center of the pad and have a three sided guard to provide an anti-slip feature.

d. The vehicle body shall be capable of resisting torsional and bending loads caused by any jacking condition, including diagonal jacking at two of most adversely opposing jacking pads, without suffering any permanent deformation or damage.

The Carbuilder must also provide two jacking pads at each end of each vehicle to provide lifting points for rerailing derailed vehicles using beam type rerailing systems (such as HOESCH). These pads may be also used for car body support using portable side jacks for extended period of time. These jack pads must be located on the side sills such that rerailing jacking systems will not be encumbered by any part of the trucks.

N3.3.7. UNDERFRAME

The underframe shall consist of a structural assembly over which the floor is mounted, and to which the ends, trucks, and couplers are attached. The underframe shall be designed to function integrally with other car body elements in supporting design loads.

The underframe structure shall be painted an approved gray Munsell Neutral Value Scale N6.0/30%R in accordance with the requirements of TPN19, herein with a durable high gloss paint system, as approved by the Engineer.

N3.3.8. END UNDERFRAME

The end underframe shall consist of end sill, draft sill, and body bolster. The end underframe assembly shall act as an integral unit to transfer loads generated at anticlimber, coupler, and truck interfaces, and shall include joints designed to provide a continuous load path.

N3.3.8.1. END SILL

The end sill structure shall be the mating structure between the anticlimber and the draft sill for the transfer of collision loads. Together with the end frame structure, the end sill structure shall be capable of carrying, without permanent deformation, a minimum of a 40,000 lbs vertical load acting upward or downward, as well as the specified buff loads.

N3.3.8.2. DRAFT SILL

The draft sill structure shall be designed to react to buff and draft loads induced by the coupler-draft gear or drawbar draft gear unit, in addition to any vertical loads induced by the anticlimber or coupler/drawbar.

N3.3.8.3. BODY BOLSTER

The body bolster shall be a structure capable of transferring loads passing between the trucks and the car body, and shall function integrally with other body elements in resisting the specified design loads.

N3.3.8.4. ANTICLIMBER

The anticlimber shall be mechanically fastened to end sills at F- and R-ends of the vehicles.

Under collision conditions, each anticlimber shall mate with the opposing anticlimber to prevent one car from climbing over the other car. Additionally, no structural deformation or slippage shall occur under vertical load of 40,000 lbs minimum acting upward or downward, combined with longitudinal compression load three times AW0. The structure design shall allow end sill yield prior to failure of the anticlimber or attachment.

Anticlimbers shall be constructed of same material as the end underframe.

Vehicle configurations utilizing a gangway design shall have an anti-climber mechanically fastened at the F-end of the vehicles. The R-end of the vehicles shall have the anti-climber function performed at the drawbar location through the use of vertical stops.

N3.3.8.5. TRUCK/CARBODY CONNECTION

The connection between the carbody and the trucks shall be such that trucks shall be raised with the carbody, unless intentionally detached. The connection shall provide adequate strength to resist shock loads as specified for car mounted equipment, as specified in herein.

The truck to carbody connection shall meet the strength requirements specified in TPN11.

The truck to carbody connection shall provide electrical insulation in compliance with the requirements of TPN9 and TPN19. Positive stops shall be provided to limit vertical and transverse movement of trucks.

N3.3.8.6. UNDERFLOOR

The underfloor shall consist of cross members and floor deck cross bearers (lateral beams) or longitudinal sections, which tie securely to the side sills to form a basic framing for support of the floor deck and underfloor equipment units.

Supplementary beams and intercostals shall be used as required for equipment supports and floor deflection requirements.

The primary loads on the underfloor shall be the vertical loads created by passenger, floor, and interior item weights, together with specific underfloor equipment loads.

The underfloor at the ends of the car shall be designed to comply with the crashworthiness requirements specified herein.

N3.3.9. UNDERCAR EQUIPMENT BRACKETS

The underframe equipment bracket system shall be designed such that equipment can be readily removed and installed using lift tables. The bracket system shall withstand loads associated with the equipment weight and orientation, and the shock and vibration parameters from TPN2, and shall be fatigue-resistant throughout the design life of the vehicle. All underfloor equipment mounting for equipment weighing greater than 150 lbs. shall utilize a safety hanger configuration. Undercar equipment hanging shall comply with the following loads:

- Vertical loading of 3g.
- Longitudinal loading of 5g plus a vertical load of 1g.
- Transverse load of 3g plus vertical load of 1g.

Equipment weighing over 150 lbs shall be attached using hardware that accepts cotter pins, or other service proven method as approved by the Engineer. Equipment shall remain within the specified clearance envelope after the loss or failure of any one attachment point.

Undercar equipment shall be arranged as approved on an underfloor CAD model, followed by a full scale underfloor mock up. These tools shall be utilized to confirm adherence to the maintainability requirements of TPN15.

Undercar equipment and the full undercar structure, excluding stainless steel members, shall be painted with an approved paint system, color to be Munsell Neutral Value Scale N6.0/30%R, in accordance with the requirements of TPN19.

N3.3.9.1. MOUNTING REQUIREMENTS

Equipment supported on resilient mounts shall be designed to achieve positive retention above the clearance line in the event of a failure of resilient elements. Equipment shall be mounted in a configuration compatible with the existing maintenance schemes in use by MDT. Mounting threaded fasteners shall have self-locking nuts and be drilled and equipped with cotter pins, or other service proven method. Fasteners shall meet the requirements of TPN19.

Failure of any single mount shall not allow equipment to drop below the clearance envelope.

The design for undercar equipment shall include the following loads:

- Vertical loading of 3g.
- Longitudinal loading of 5g, plus a vertical load of 1g.
- Transverse load of 3g, plus vertical load of 1g.

N3.3.9.2. UNDERCAR ENCLOSURES

Undercar enclosures shall be designed such that the assembly interior is waterproof. Boxes shall be designed to protect equipment from undercar environmental conditions. The interior of each enclosure, with the exception of the battery box, shall be painted white in accordance with the requirements of TPN19.

Hardware used to secure doors and access covers on underfloor boxes and enclosures shall comply with the requirements of TPN19, and shall include secondary retention (e.g., safety catch) or failsafe design. Access covers secured by multiple bolts do not require secondary retention.

All cover securement hardware, except the battery box, shall be identical and interchangeable.

Covers of underfloor equipment boxes shall be interchangeable between like boxes on different cars, and, to the extent possible, between boxes on the same car. All box covers shall have two inch wide white reflective tape on both sides of the cover, visible in headlights.

N3.3.10. BODY SHELL

The carbody shell shall include sides, roof, and end assemblies mounted to the vehicle frame and underfloor.

Side and roof surfaces shall not be damaged when passing through high-velocity jet-type or rotary-brush-type automatic car wash equipment.

All exterior surfaces of the car body shall be unpainted, brushed finish, stainless steel with an 80 grit finish, unless otherwise specified. In addition, the surface roughness shall be between 30 and 60 μ-in. The

brush finish shall be approved by the Engineer. All exterior non-corrugated surfaces shall be free of ripples, buckling and coloration from the manufacturing process.

N3.3.10.1. SIDES

The carbody shall consist of external sheathing, vertical framing members, and longitudinal members.

Side construction shall utilize a combination of sheet stainless steel and fluted stainless steel for a sleek modern appearance. Alternatively, it may consist of flat plate, internally reinforced in order to guarantee rigidity and flatness requirements.

Sidewalls shall provide adequate space for wire harnessing as determined by the Contractor.

Loads: The side structure shall be designed to withstand loadings induced by vertical bending effects, vehicle body compression, vehicle jacking, and cantilever-seat effects.

Reinforcement: Deflections shall be limited to prevent door movement from being restricted and window glazing from coming loose, being damaged, or leaking under environmental and loading conditions as specified herein.

Flatness: Side materials and manufacturing methods shall ensure uniform flatness along the length of the vehicle. Car side longitudinal waviness shall not exceed plus or minus 1/300 of the span between adjacent vertical members. More than one node between adjacent vertical members shall not be allowed. If sidewalls are welded, surface welds shall be hidden by sidewall features. Sidewall to vertical post welds shall be designed far enough away from surface to prevent dimpling. Side wall waviness caused by welding shall be precluded by design or completely eliminated after fabrication.

N3.3.10.2. ROOF

Car roof framing shall consist of carlines with appropriate longitudinal members, all suitably fastened to obtain an integrated structure of adequate strength and rigidity. The roof skin shall consist of fluted or corrugated stainless steel. Alternatively, it may consist of flat plate internally reinforced in order to guarantee rigidity and flatness requirements.

Roof framing members shall be designed and positioned to permit fastening of ceiling wiring, lighting fixtures, handholds, stanchions, and any other ceiling mounted equipment.

The roof structure shall be capable of withstanding without damage a load generated by a 300 lbs person walking on any 6 x 6 feet area of the roof.

Rain gutters shall be installed on the roof in such manner as to preclude water draining over passenger side doors, cab windows, or end doors. Additionally, aforementioned requirement shall also apply when the train is accelerating or decelerating. Rain gutters shall drain completely when the car is standing on level track. Rain gutters at the F-end shall stop at the cab. A rain stop/gutter shall be provided to prevent water accumulated on the roof from pouring down over the end doors.

N3.3.11. INSULATION

Thermal insulation shall be provided, integrated with the car structure, and supporting the overall thermal requirements as specified in TPN7, Heating, Ventilating, and Air Conditioning.

Acoustical insulation shall be applied where necessary to comply with noise and vibration requirements of TPN2, with materials in compliance with TPN19.

Rigid and non-rigid preformed insulation shall be secured with mechanical fasteners or fire-resistive adhesives, or both.

N3.3.12. FLOORS

Floors shall include a composite deck onto which the floor covering will be installed. Wood based plymetal shall not be utilized. Floors shall be secured to the underframe structure utilizing an approved method and fasteners. Attachment methods shall prevent squeaking, chafing, and horizontal and vertical movement. Floors shall be designed such that no permanent deformation occurs during the life of the car. Assembled floor decks shall be level and flat except for designed camber, with the upper surface free from indentations. Exposed edges of the floor, including openings for conduits, tubing, and joints between floors, shall be sealed with a fire retardant sealant.

Openings in the floor shall be minimized. Any holes shall be fitted with protective flanges or covers, or other approved fire barrier system capable of providing resistance to penetration of fire at least equal to the base floor.

N3.3.13. END WALLS

The R-end wall shall be a brushed stainless steel surface with an end door located in the center.

The F-end wall shall also have a central doorway, which shall be surrounded by a molded fiberglass end piece, or approved aesthetic equivalent. The fiberglass end piece shall be designed as approved by the Engineer. The design will include the following features:

- Resistance to ultraviolet light.

- Aesthetic appearance.
- Prevention of water intrusion.

F-end access is to be designed by ergonomic review of the crew step and grab handles, and development of a scheme for placement of steps and grabs. The Contractor shall develop this scheme for design review and mock-up as approved by the Engineer (CDRL N301).

N3.3.14. WATER TIGHTNESS

Following installation of doors and windows, but prior to installation of the undercar equipment and the interior lining, the Contractor shall perform a water-tightness test to confirm the water tightness of the car shell. Repairs and retesting shall be performed until no leaks are found.

The Contractor shall consider the heavy rains and wind that are part of the South Florida climate, and vehicle speed in their development of the water-tightness test procedure for the approval of the Engineer (CDRL N302).

N3.4. BETWEEN CAR BARRIERS

Vehicles shall include between car barriers in compliance with ADA requirements. Between car barrier schemes shall be submitted to the Engineer for approval. Chain systems are acceptable for between cars of a married pair, but shall not be used for F-end applications. F-end applications shall be a semi-rigid non-coupling type of design. Fasteners and metallic components for between car barriers shall be stainless steel.

N3.5. DOORS

The vehicle shall have three types of doors:

- Side bi-parting passenger doors.
- End doors.
- Cab doors.

N3.5.1. SIDE DOORS

Each side doorway shall contain sliding doors of the bi-parting type, opening from the center, and retracting into pockets in the car side wall. There shall be a window placed in the top half of each door leaf, with height equal to the height of the side windows of the vehicle.

N3.5.1.1. SIDE DOOR CONSTRUCTION

Doors shall be adequately reinforced internally to provide strength and rigidity. In addition, appropriate drain holes shall be provided at the bottom of the door track to prevent water entrapment and allow for

drainage of rain and moisture. The Contractor is advised of the heavy precipitation conditions in Miami, and shall design the drainage scheme accordingly. Water shall not be drained onto underfloor apparatus.

Door panels shall be stainless steel, with the exterior finish matching that of the car shell.

Joints and edges of the door panels shall be sealed. Door edges shall be tongue and groove configuration and be black resilient material conforming to TPN19 and TPN6.

Side doors and associated mounting hardware shall be constructed to provide the strength and rigidity to withstand a maximum load of 200 lb. applied from the inside over an area 24 x 12 inches, 2 inches from the door edge, and centered within the height of the door, with a deflection not to exceed ½ inch.

Doors shall be weather-stripped for sealing as required to comply with the climatic and noise environmental requirements presented in TPN2.

N3.5.1.2. SIDE DOOR INSTALLATION AND OPERATION

Each door leaf shall be hung at top from a guide rail arrangement, with guide at bottom to restrict lateral movement. Door leafs shall allow ready access to door adjustments. It shall be possible to remove and replace door leafs without removal of windscreens. Doors shall not rattle, vibrate, or whistle when in the closed position with the vehicle either stationary or in motion.

Emergency door release requirements are specified in TPN6.

N3.5.2. END DOORS

End doors shall be designed to operate manually, but shall have a mechanism that shall cause the doors to close when released. In addition, this mechanism shall include an adjustable deceleration feature to ensure safe and smooth closing operation. Each end door shall have a window located in the top half of the door for maximum visibility.

Both F-end and R-end doors shall be of swing type, pivoting about stainless steel hinge hardware. Doors shall swing inward, to allow ready access by crew members when traversing vehicles.

N3.5.3. CAB DOORS

Cab doors shall be designed to hinge at the rear end of the cab, and swing outwardly. The cab door, when open and latched, shall close off the whole cab end to passengers. The cab door shall have a window in the top half of the door, and have hardware to latch and lock in both closed positions. The cab door shall utilize an approved key for access from outside the cab.

N3.5.4. DOOR ATTACHMENT AND RESTRAINING HARDWARE

Door hangers for sliding doors shall be supported at a minimum of two positions on the overhead support rail.

N3.6. WINDOWS

Windows shall not leak water, and shall be single glazed. Windows shall conform to the requirements of TPN19, and be installed with the tempered side toward the inside of the car.

N3.6.1. CAR SIDE AND SIDE DOOR WINDOWS

Vehicle side windows shall be integral units, with both fixed and vent type. There shall be two fixed type per side, located toward the F-end of the vehicle. The vent type windows shall be located toward the R-end of the vehicle. Windows shall be installed with elastomeric glazing beads, with lites for both car side and side door windows.

Windows with the venting provision shall be a tilt-in, horizontally split design, with the upper portion serving as the vent window. Vent windows shall be designed to provide exterior air circulation in the event of an HVAC failure. Vent windows shall be manually opened/closed, shall not extend beyond the envelope of the car shell, and shall be designed to prevent passengers from protruding limbs through the window.

N3.6.2. CAB SIDE WINDOWS

Cab side windows shall be designed to function smoothly, allowing smooth opening and closing, and be of a size to allow operators to view forward and rear clearance of passengers boarding and alighting.

The window opposite the Operator's console shall have a standard key lock for locking in the closed position from inside the cab.

Windows shall be reinforced and weather-stripped, and shall not leak.

Cab windows shall be provided with an annunciation when left open in "Car Wash" mode.

N3.6.3. END DOOR WINDOWS

Each end door shall have a window installed as approved by the Engineer.

N3.6.4. VANDAL RESISTANT FILM

All glass that is within the passenger compartment and accessible to passengers shall have a protective film applied to prevent graffiti. This vandal resistant film, and its installation and replacement process, shall be submitted to the Engineer for approval.

N3.6.5. CAB DOOR AND PARTITION WINDOWS

Windows in the cab door and the right side cab partition shall be located in the upper half of each structure. The glass in the right side cab partition and cab door shall be supported directly in elastomeric glazing strips.

N3.6.6. WINDSHIELDS

Windshields shall be designed in conjunction with the overall vehicle end appearance, with glazing designed to maximize operator visibility and end appearance aesthetics.

Windshields shall be installed such that the lite cannot be forced into the car, and shall be retained in elastomeric glazing replaceable from outside the car without the need for sealing compounds.

Windshields shall meet FRA Type I Impact and Ballistic tests.

The interior surface of the interior windshield shall be a polycarbonate film a minimum of 2 mils thick, which shall not extend under the elastomeric glazing section.

N3.6.7. PRESSURE LOADING

Windows as installed shall be designed for air pressures acting perpendicularly to the window surface in both positive and negative direction, a pressure of 40 lb/ft^2, with a minimum safety factor of 2.5 against failure.

N3.7. INTERIORS

Vehicle interiors shall be designed as an integrated area, maximizing interior aesthetics, brightness, and comfort. Renderings of the proposed vehicle interior shall be developed for the Contractor's proposal, and developed for approval during the vehicle design reviews. The aesthetic integration of liners, seats, windscreens, flooring, and stanchions will be thoroughly evaluated during the proposal evaluation process.

N3.7.1. INTERIOR LINERS

Interior liners material shall comply with materials and fire-resistance requirements of TPN19.

Interior liners shall be designed to eliminate unnecessary joints and to accommodate dimensional changes due to fluctuations in environmental conditions. Interior liners must be removable from a completed car.

Attachments to the vehicle structure and sub-structure shall be made by concealed fasteners in a manner that discourages vandalism and/or tampering, but allows easy removal of linings when done in accordance

with maintenance procedures. Trim strips, if used, shall be securely fastened.

Installed interior liners shall be designed to withstand the deflections and impact loads specified in below.

"Anti-squeak" tape or similar material shall be used between linings and any structure to which they are attached or with which they come in contact.

The finish and surface of the interior liners shall be durable, graffiti resistant, and facilitate the removal of graffiti. The appearance of the interior liners shall be of a uniform quality and color throughout.

Lining materials shall be supported sufficiently to prevent sagging and drumming.

N3.7.2. INTERIOR FASTENERS

Fasteners utilized for the vehicle interior shall comply with TPN19, and shall be of an approved tamperproof design.

N3.7.3. DEFLECTION AND IMPACT LOADS

Interior linings, windscreens, and partitions shall be designed to accommodate the following deflection and impact load conditions and be integrated with supporting structure such that integrity of the supporting structure is retained under these loads when tested in both directions:

a. Static Loading: A centrally applied static load of 30 pounds applied on maximum area of four square inches shall not deflect panels more than 1/360 of the short span between carbody structural supports.

b. Uniform Pressure: A uniform pressure of 15 lb/ft2 shall not deflect panels more than 1/360 of the short span between carbody structural supports.

c. Impact Loads: Panels shall be designed to resist centrally applied impact load of five foot-pounds applied on maximum contact area of four square inches, incurring deflection no greater than 1/180 of short span between carbody structural supports, without permanent deformation or cracking.

N3.7.4. DOOR POCKETS

Door pockets adjacent to each side door location shall match the interior side lining in appearance. Access doors at these locations shall be provided in the door pocket areas and shall have hinges and locks that operate using the standard car key. The number of locks per door shall be minimized.

N3.7.5. WINDSCREENS

Windscreens shall be located between the side door openings and the adjacent seat or other designated area. Windscreens shall be designed for durability and vandal resistance.

N3.7.6. PARTITIONS

Partitions between the Operator's Cab area and the passenger compartment shall have the same appearance as the wall and ceiling liners.

N3.7.7. COVING AND TRIM

Coving shall be provided as an aesthetic and protective interface at the transition from the floor to the side wall liners. Coving shall be brushed stainless steel, and shall include all transitions at doorways, corners, and other areas for a continuous attractive appearance, without sharp edges or gaps.

Trim pieces shall be minimized. Where required, trim shall be of equivalent color and finish as the surrounding elements.

N3.7.8. ADVERTISING AND NOTICE FRAMES

The Contractor shall provide advertising and notice frames within the interior of the Vehicles. The Contractor shall submit proposed ad frame drawings, including frame dimensions, mounting details, and materials, to the Engineer for review and approval prior to installing the frames (CDRL N303).

N3.7.9. GRAPHICS

Vehicle graphics shall include, at a minimum, the following:

- Car numbers.
- MDT logos.
- MDC logos.
- Indicator and switch labeling.
- Graphics for safety and public information.
- Exterior stripes and decals.
- Destination sign list.

The Contractor shall review the graphics configuration of the existing MDT Metrorail vehicles, and submit for the approval of the Engineer a Graphics Installation Drawing, detailing the style, color, and installation of all vehicle graphics (CDRL N304).

Exterior graphics and decals shall be resistant to ultraviolet light, graffiti removal chemicals, and the car wash formulation detailed herein.

N3.7.10. LOCKS AND KEYS

Three different keys shall be supplied to provide access to all locks on the vehicle.

a. One barrel key shall operate the Operator's Control Console.

b. A second key to access equipment panels (ATC equipment, Communications Locker, Propulsion Logic locker, Brake Control Logic locker).

c. A skeleton train key shall allow access to all doors, cab windows, and access panels, including door operator access panel (if applicable).

Three of each type of key shall be provided with each vehicle. The Contractor shall submit three samples of each key and its lock to the Engineer for review and approval (CDRL N305). Keys and locks shall be U.S. made and comply with the configuration requirements described herein. Keys and locks shall be available directly from the key/lock manufacturer.

N3.8. THRESHOLDS AND DOOR GUIDES

Thresholds shall be cast stainless steel, with a roughened surface for slip resistance. Thresholds shall be designed to promote trouble free and maintenance free operation over the life of the vehicle. Thresholds shall be designed to minimize water intrusion into the car, while providing maximum drainage for the significant rain fall rates exhibited in the Miami area.

Thresholds shall include a replaceable stainless steel insert which shall function as the threshold interface with the door guide.

Door guides shall include components made of stainless steel and low friction polymer components.

Door guides shall engage the threshold by at least ¼ inch over its entire length and shall have at least 1/8 inch clearance between the underside of the guide and the threshold.

Door guides shall be adjustable vertically and laterally (perpendicular to the door plane).

N3.9. EQUIPMENT LOCKERS

Electrical and electronic control equipment lockers shall be located in the cab area(s) or behind secured panels equipped with locks that operate with the standard car key. No equipment shall be located under seats.

Equipment lockers shall be equipped with air vents as required for the applicable equipment. Lockers shall provide protection in accordance with the NEMA 250, Type 2 enclosure specification.

Access doors shall be the flush type, and be designed for vandal resistance.

N3.10. PASSENGER SEATING

Seating shall be designed as an aesthetically pleasing and comfortable element of the vehicle interior. Passenger seating shall be designed to maximize the number of seated passengers, facilitate the ready flow of passengers through the vehicle, and provide maximum leg spacing and comfort, while providing seat spaces for passengers as listed in TPN2. The seating layout shall provide for two ADA compliant wheelchair areas per car. The seating layout shall include no less than 68 individual seating positions.

The seating arrangement shall include an area in the R-end of the vehicle with center facing flip-up seating to allow for passengers with either baggage or bicycles. Bicycle racks shall be installed with provisions to support a minimum of two (2) bicycles per car to secure bicycles.

N3.10.1. SEATING STRUCTURE

The seat structure shall be carbon steel, finished with an approved paint system, attached to the interior side wall and shall not create dirt-holding pockets. The seat supporting structure shall not be visible to passengers.

Each transverse seat shall include a grab handle and bump pad. The grab handle and bump pad shall be energy absorbing to protect passengers. Bump pads shall be provided for the upper rear side of the seat back. Bump pad material shall comply with requirements of TPN19. Longitudinal seats do not require a grab handle or bump pad.

N3.10.2. SEATING CUSHIONS

Seat cushions shall be designed to fit on the seat frame in a clean, well designed appearance, and shall include cushion foam and upholstery in conformance with the requirements of TPN19.

Seat cushions shall be completely interchangeable between seats to facilitate replacement and cleaning. Seat cushions shall be provided with a service proven suspension system, with the back cushions supported by a rigid interior liner panel.

Seat upholstery shall be a material resistant to graffiti, vandalism, and liquid penetration, as approved by the Engineer.

N3.10.3. SEAT LOADING

The passenger seat structure, including carbody support structure and attachments to vehicle structure, shall be designed to resist the loads listed below without permanent deformation.

Seats or seat components shall not separate from the car wall section at any attachment point conforming with the loading criteria in part 5.1 of APTA C&S-016-99.

N3.11. STANCHIONS AND GRAB RAILS

Stanchions and grab rails shall be provided to facilitate passenger movement and safety throughout the passenger compartment.

N3.12. STANCHIONS

Vertical stanchions shall be located strategically for passenger support at all locations within the vehicle, in compliance with ASCE 21-98, Part 2.

Handrails and/or stanchions shall be provided to assist safe boarding, on-board circulation, seating and standing assistance, and alighting by persons with disabilities.

Handrails, stanchions, and seats shall allow a route at least 32 inches wide so that at least two wheelchair or mobility-aid users can enter the vehicle and position the wheelchairs or mobility aids in areas. Each handrail, stanchion, and seat shall have a minimum clear space of 30 x 48 inches that do not unduly restrict movement of other passengers. Particular attention shall be given to ensuring maximum maneuverability immediately inside doors. Ample vertical stanchions from ceiling to seat back rails shall be provided. Vertical stanchions from ceiling to floor shall not interfere with wheelchair or mobility-aid user circulation and shall be kept to a minimum in the vicinity of doors. Stanchions and handrails immediately in the entrances and exits of the vehicle should be a visibly contrasting color to aid the visually impaired.

The diameter or width of the gripping surface of handrails and stanchions shall be 1-¼ inches to 1-½ inches and provide a minimum of 1-½ inches knuckle clearance from the nearest adjacent surface.

Each vertical stanchion shall be stainless steel and shall withstand, without permanent deformation, a concentrated load of 350 lb. applied at its mid point acting in any direction.

Fittings shall be of aluminum of similar construction, shall provide tight and rattle proof fastenings, and shall be free of burrs and sharp edges.

The design of vertical stanchions shall exclude additional loads being applied to the seat through the stanchions due to carbody deflections.

N3.12.1. GRAB RAILS

Handrails shall be as indicated and allow overhead clearance of no less than 76 inches.

Handrail fittings shall be aluminum, of similar construction to those for stanchions, shall provide tight and rattle proof fastening, and shall be free of burrs and sharp edges.

Each handrail shall be stainless steel tubing and shall withstand, without permanent deformation, a distributed load of 10 lb/in. applied at any angle within 45° from vertical downward.

N3.12.2. CREW GRAB HANDLES AND STEPS

Crew grab handles and steps shall be provided at each side of car to facilitate entry and exit by technicians, recovery personnel, and emergency personnel.

Grab handles shall be stainless steel and shall withstand, without permanent deformation, a concentrated load of 350 lbs applied at its midpoint acting in any direction.

Steps shall be designed with a safety factor of 1.5 against yield, to withstand loads imposed by 300 lbs person and shall be placed in an approved location.

To facilitate access to the vehicle by police and other emergency responders, a step shall be provided below the threshold of each center side loading door. The step shall extend the full width of the side loading door threshold, have an anti-skid surface, and be constructed so that it can bear the weight of two fully equipped emergency responders or 650 lbs.

N3.13. SAMPLES

Three samples of all exterior finishes shall be submitted for approval. Samples shall have a minimum surface area of 6 by 12 inches. The following samples shall be included as a minimum:

- 2B (bright cold rolled) and scratch finishes.
- Other mill finishes per ASTM A480.
- Each proposed method of fastening on exposed surfaces, *i.e.*, non-welded connections.
- Interior surface materials.
- Stanchion Materials.
- Paints.
- Interior brush finishes.

- Floor materials.

N3.14. CAR NUMBERING

Vehicles shall be assigned and provided with car numbers. Exterior car number plaques shall be provided and installed on the exterior sidewalls at a location similar to that of the existing Metrorail vehicles. Car numbers shall be of a size to accommodate a four digit car number. Car numbering shall begin with the number 300.

Vehicle interiors shall also be provided with a stainless steel 3 x 5 inches Builder's plate, to be located in an Engineer approved location, with text and coloring as approved by the Engineer. The builder plate shall contain the carbuilders' name, car number, year delivered, and additional text to be provided by the Engineer.

The car number shall also be applied to the roof of the vehicle utilizing an approved black paint system designed for adhesion to the stainless steel roof. Roof numerals shall be an "Arial" font, no less than three feet in height.

N3.15. INTER-CAR GANGWAY

Inter-car gangways for the MDT vehicle married pair are permitted, but not required. If a gangway configuration is utilized, it shall conform to the requirements herein, and comply with the remainder of the performance specifications within these technical provisions. Gangways shall provide a safe means of passage between cars for standing passengers and staff under all operating conditions.

a. Minimum dimensions of the internal passageway shall be 60 in. wide and 70 in. high.

b. The gangway interior shall be free of any protrusions and devoid of any gaps that may be exposed during gangway movements and which would be a danger to passengers.

c. The gangway shall withstand the loads and aerodynamic effects encountered in service up to the maximum operating speed without permanent deformation or premature fatigue failure and without any deflection of the gangway internal lining surfaces.

d. The gangway shall be sufficiently thermally and acoustically insulated to ensure that the overall air conditioning performance and noise limits of the vehicle are achieved.

e. The gangway shall be symmetrical about the centerline between cars.

f. The gangway shall not interfere with the vehicle end structure under normal operations.

g. If clamping devices are fitted to the gangway at the bar coupler end, they shall be inaccessible to passengers and shall be easy and quickly operable by authorized personnel, without the aid of tools, from track level.

Floor surfaces of the gangway shall match with that of the passenger compartment. When the vehicle married pair is in service, there shall not be any interruption of the floor level which would present a hazard to passengers. Readily replaceable wear pads shall be provided to facilitate any movement between floor sheets. The gangway floor shall be designed to support a load of 1.3 ft^2 per passenger.

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TABLE OF CONTENTS

N4. COUPLER AND DRAFT GEAR 4-1
N4.1. GENERAL 4-1
N4.1.1. CITED REFERENCES 4-2
N4.1.2. SUBMITTALS – CDRLS 4-2
N4.1.3. COUPLER SYSTEM DESIGN PROPERTIES 4-2
N4.2. COMPONENT DESCRIPTION AND REQUIREMENTS 4-3
N4.2.1. MECHANICAL COUPLER 4-3
N4.2.2. MECHANICAL COUPLER HEAD 4-3
N4.2.3. UNCOUPLING SYSTEM 4-3
N4.2.4. TRAINLINE ISOLATION 4-4
N4.2.5. ANCHOR ASSEMBLY 4-5
N4.2.6. COUPLER CENTERING SPRINGS 4-5
N4.2.7. ELECTRIC COUPLER 4-5
N4.2.8. INTER-CAR DRAWBAR 4-6
N4.3. TESTING 4-6

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N4. COUPLER AND DRAFT GEAR

N4.1. GENERAL

Vehicles shall be equipped with a fully automatic coupler on each F-end, and include provisions for emergency pipe and main reservoir pneumatic connections to form an integral part of each mechanical portion. Electrical connections shall be through an electrical head attached to the side or bottom of the mechanical portion.

The coupler system shall consist of the draft gear and anchor assembly, mechanical head, electric head, coupling controls, inter-car draw bar, and all associated piping and wiring. Each married pair shall be equipped with electrical and mechanical head couplers at either end of the married pair. The link between cars of a married pair shall be provided by a semi-permanent inter-car draw bar, which shall connect to draft gear assemblies on both vehicles. Electric cables and pneumatic hoses shall be provided to connect trainlined electric and pneumatic circuits between cars of a married pair.

The design of the coupler system, including drawbars, draft gear, and attachments to the carbody, shall respond to normal and overload conditions in a predictable manner. The coupler system shall be capable of absorbing the compression and tension forces encountered in normal vehicle operation in a train, including coupling and uncoupling, without damage.

The coupler system shall also contain a "shear-back" design consisting of a release mechanism to respond to compressive overload conditions. The coupler system may also include a recoverable or non-recoverable energy absorption unit(s). In a collision, the draft gear elements and/or energy absorption unit(s) shall compress, followed by activation of the release mechanism, which shall allow the coupler system to retract a sufficient distance to permit the carbody anticlimbers to engage. If the collision forces are sufficiently high such that compression continues following the full retraction of the coupler system, the coupler system shall not impede the energy absorption response of the carbody to overload conditions. The value of the release load shall satisfy the specific characteristics of the subject transit system intended operation. The coupler system at all times shall be supported in a safe manner.

The draft gear shock dampening action shall be accomplished by a service proven energy absorption system to isolate the anchor casting from the mechanical head. Trainlined pneumatics for connection to other married pairs in the consist shall be done through the mechanical head.

Trainlined electrical circuits for connection to other married pairs in the consist shall be done through contacts in the electric head.

N4.1.1. CITED REFERENCES

Source/Section	Title
APTA SS-E-001-98	Standard for Insulation Integrity
OSHA	Occupational Safety and Health Administration

N4.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference. All coupler overhaul procedures shall be submitted as a set for review and approval.

CDRL No	Title	TP Reference
N401	Mechanical Coupler Head Documentation	TPN4.2.2.
N402	Mechanical Coupler Head Qualification Test Procedure and Report	TPN4.2.2.
N403	Uncoupling System Documentation	TPN4.2.3.
N404	Uncoupling Qualification Test Procedure and Report	TPN4.2.3.
N405	Coupler Centering Spring Assembly Design Documentation	TPN4.2.6.
N406	Coupler Electric Head System Design Documentation	TPN4.2.7.
N407	Coupler Electric Head System Qualification Test Procedure and Report	TPN4.2.7.
N408	Inter-Car Draw Bar Clearance Diagram	TPN4.2.8.

N4.1.3. COUPLER SYSTEM DESIGN PROPERTIES

The coupler system shall be designed to:

- Have a minimum service life of 30 years.
- Incorporate advanced safety and operational features to perform coupling and uncoupling operations.

- Minimize the frequency of maintenance and periodic inspection performed on the coupler and draft gear system.
- Demonstrate state of the art mechanical, electrical, and pneumatic system reliability.
- Minimize the maintenance cost of the system.

N4.2. COMPONENT DESCRIPTION AND REQUIREMENTS

N4.2.1. MECHANICAL COUPLER

The mechanical coupler shall be a service proven design, selected for the loading, vehicle, and operating environment at MDT.

N4.2.2. MECHANICAL COUPLER HEAD

The mechanical head shall have the ability to couple on curved track where a 20° mismatch between adjacent coupler faces exists and when the mismatch between adjacent couplers is 3 inches vertically and 6 inches horizontally.

Draft gear shall be provided to absorb shock in both buff and draft conditions, and be self leveling from a 5 degree rotational displacement to either side of the vertical centerline around the longitudinal axis during coupling.

The Contractor shall provide to the Engineer for review and approval, technical specifications, drawings, schematics, maintenance instructions and any other information requested by the Engineer to determine the suitability of the mechanical head (CDRL N401). Also, as part of CDRL N401, an analysis of the draft gear structural design shall be provided, integrating the vehicle characteristics and the strength and energy absorption characteristics of the coupler.

The Contractor shall provide five (5) sets of all special tools and wear gages necessary for the normal maintenance and heavy repair of the mechanical head.

The Contractor shall submit to the Engineer for review and approval procedures detailing qualification testing to be conducted on the mechanical coupler head (CDRL N402). The testing shall demonstrate the adequacy of all operational aspects of the system.

N4.2.3. UNCOUPLING SYSTEM

Uncoupling shall be permitted only in "Yard" mode and only when the vehicle is fully stopped, at zero speed. All valves and hoses shall conform to the requirements as specified in TPN19. All hoses shall be dated and have been manufactured no more than nine (9) months prior to

installation on the vehicle. All hoses shall be fitted with swivel type fittings to prevent hose binding and kinking.

- The uncoupling system shall allow a single operator to automatically uncouple married pairs from the control cab of the vehicle.
- The uncoupling system shall also allow a single operator to remotely uncouple married pairs that are immediately behind the controlled pair.
- In the event of a loss of electrical systems the operator shall be able to manually uncouple.
- A single operator shall be able to initiate a manual uncouple from the controlled cab and a handle shall be provided adjacent to the mechanical coupler head to allow manual uncoupling from outside the vehicle.

The Contractor shall provide to the Engineer for review and approval, technical specifications, drawings, schematics, maintenance instructions and any other information requested by the Engineer to determine the suitability of the uncoupling system (CDRL N403).

The Contractor shall submit to the Engineer for review and approval Procedures detailing qualification testing to be conducted on the uncoupling system (CDRL N404). The testing shall demonstrate the adequacy of all operational aspects of the system.

N4.2.4. TRAINLINE ISOLATION

Provisions for electrical trainline isolation shall be used at the F-end to automatically perform the breaking and looping of circuits, and the closing and opening of pneumatic lines specified herein. Isolation provisions shall include sufficient spare contacts for the specified numbers of spare trainline circuits and spare loop circuits in addition to the circuits in use. Operation of the contacts shall be sufficiently rapid to preclude damage by arcing.

If a trainline switch is utilized, provision shall be made for manual operation of the switch. The switch shall be designed so as to prevent creeping from the "ON" or "OFF" position. Rotary valves and switches for manual coupler control shall be adjacent to each other at the right front corner of the car. Handle shall point down in uncoupled position. The manual handle shall be coated with OSHA Orange as specified in Section 12.28. The rotary switch enclosure shall also serve as the trainline junction box specified in TPN13.

N4.2.5. ANCHOR ASSEMBLY

The anchor assembly shall support the draft gear and coupler. The draft gear and coupler shall rotate around a clevis pin located in the draft gear anchor.

N4.2.6. COUPLER CENTERING SPRINGS

Coupler centering springs shall be provided on both sides of the couplers at either end of a married pair of vehicles, and serve to center the coupler and facilitate coupler mating.

The coupler centering spring assemblies shall:

a. Be of a corrosion-resistant design, consisting of either stainless steel, plastic-coated, or appropriately plated components.

b. Have a permanent attachment at the vehicle end and an easily removable attachment at the coupler end.

c. Be designed such that there is a pre-load on the springs of sufficient magnitude to eliminate the nuisance noise generated by the swinging of the assembly.

d. Be installed without interfering with any other components when in the stretched or relaxed state.

The Contractor shall submit design documentation to the Engineer for review and approval (CDRL N405).

N4.2.7. ELECTRIC COUPLER

An electric coupler head shall be side or bottom mounted to the mechanical coupling head. All trainlined circuits pass between the contacts of mating boxes throughout the consist.

The electric coupler head shall be of approved design. Contact pins shall be the spring-loaded, button-type with rounded contact face, pin-sleeve, or specials for Ethernet connections. Each electrical contact pin shall have sufficient capacity to carry 150% of the maximum current to which it will be subjected. Pin replacement shall be from the front of the electric portion for ready maintenance. The electric portion shall have a cover that protects electric contacts from the Miami weather conditions per TPN2 and mechanical damage. The system shall permit an operator to perform coupling and uncoupling from the control cab of the vehicle unassisted. The arrangement of cables and circuits shall minimize electromagnetic interference (EMI) in the system. The Contractor shall submit to the Engineer for review and approval documentation which includes technical specifications, functional test results, pin arrangements, schematics, assembly drawings, maintenance instructions and any other information requested by the Engineer to determine the suitability of the electrical head design (CDRL N406).

The Contractor's coupler design shall be such that after coupling any train consist, all trainlines shall become continuous to perform the intended functions as specified herein. A minimum of ten percent (10%) spare pins shall be provided in the new electric head. All pins shall be the self-wiping type.

The Contractor shall submit to the Engineer for review and approval Procedures detailing the parameters of qualification testing to be conducted on the electric coupler head assembly (CDRL N407).

N4.2.8. INTER-CAR DRAWBAR

The inter-car draw bar shall be a one piece assembly designed to function with the draft gear specified herein. The draw bar shall support all runs of trainlined wires and cables and permit the vehicle to meet the performance requirements of TPN2. The Contractor shall present to the Engineer for review and approval a structural analysis of the drawbar along with material composition reports and any other information requested by the Engineer to structurally evaluate the drawbar design.

The Contractor shall develop and present to the Engineer for review and approval a clearance diagram for the entire inter-car draft gear and draw bar system. The clearance diagram shall include all inter-car trainline wire and cable suspended from the drawbar (CDRL N408).

N4.3. TESTING

The Contractor shall perform acceptance testing in accordance with TPN17 to verify the functionality of the components and assemblies, including the draft gear.

The Contractor shall perform continuity, megger, and high potential tests, compliant with APTA SS-E-001-98, on all wire runs after each vehicle coupler system is assembled.

TABLE OF CONTENTS

N5. OPERATOR'S CAB 5-1
N5.1. GENERAL 5-1
N5.1.1. CITED REFERENCES 5-1
N5.1.2. SUBMITTALS – CDRLS 5-1
N5.2. CAB LAYOUT 5-2
N5.3. OPERATOR CONSOLE GROUP 5-3
N5.3.1. CONSOLE LAMPS 5-4
N5.3.2. CONSOLE SWITCHES 5-4
N5.3.3. FAULT ANNUNCIATION 5-4
N5.3.4. WARNING DEVICES 5-5
N5.3.5. MASTER CONTROLLER GROUP 5-5
N5.3.6. OPERATOR'S CONTROL PANEL 5-8
N5.3.7. OPERATOR'S INSTRUMENT PANEL 5-10
N5.3.8. INDICATOR LIGHTS AND SWITCH PANEL 5-13
N5.4. OTHER EQUIPMENT 5-15
N5.4.1. WINDSHIELD WIPER 5-15
N5.4.2. CONVENIENCE OUTLET 5-15
N5.4.3. EMERGENCY LANTERN 5-16
N5.4.4. VISOR/SHADE 5-16
N5.4.5. STORAGE 5-16
N5.4.6. SILENT ALARM SWITCH 5-16
N5.4.7. ANNUNCIATOR GROUP 5-17
N5.4.8. FIRE EXTINGUISHER 5-17
N5.4.9. CAB HEATER 5-17
N5.4.10. HVAC DIFFUSER 5-17
N5.4.11. OTHER PROVISIONS 5-17
N5.5. OPERATOR'S SEAT 5-17
N5.6. CAB MOCK-UP 5-18

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N5. OPERATOR'S CAB

N5.1. GENERAL

Each car shall be provided with an Operator's cab located at the F-end of the car. The Operator's cab shall be fitted with an Operator's console, controls, and other apparatus and equipment required to operate a vehicle. The Operator's cab shall be secure from passenger access.

N5.1.1. CITED REFERENCES

Source/Section	Title
AREMA	American Railway Engineering and Maintenance of Way Association
MIL-STD-1472	Human Engineering Design Criteria

N5.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is listed for reference.

CDRL No.	Title	TP Reference
N501	Human Engineering Analysis	TPN5.2.
N502	Final Equipment Location and Cab Configuration	TPN5.2.
N503	Operator Console Design	TPN5.3.
N504	Fault Annunciation System Details	TPN5.3.3.
N505	Warning Device Details	TPN5.3.4.
N506	Proposed Operator's Storage Area Configuration	TPN5.4.5.
N507	Silent Alarm Switch Location	TPN5.4.6.
N508	Fire Extinguisher	TPN5.4.8.
N509	Hostler Panel Design	TPN5.6.
N510	Operator's Cab & Hostler Panel Mock-Up	TPN5.7.

N5.2. CAB LAYOUT

The Operator's cab design shall provide ready access to controls, devices, and cabinets, with layout resulting in the Operator having full view of the track before the train. Frequently used controls shall be located within the Operator's easy reach. All indicator lamps in the cab area shall be LED type. The Operator shall be able to operate the train while seated or standing. The cab design shall provide an ergonomically comfortable environment for either female or male Operators. The Operator's space, seat, and control devices shall permit Operators to perform train operations safely and efficiently. Glare from either the windshield or side windows shall be minimized and shall not be affected by passenger compartment lighting. The Contractor shall provide to the Engineer for review and approval an analysis to demonstrate compliance with the principles of human factors engineering as recommended in MIL-STD-1472 (CDRL N501).

The Operator's cab shall include the following equipment, mounted in a manner that will allow for ready maintenance.

- Communications.
- Automatic Train Protection (ATP).
- Train-to-Wayside Communication (TWC).
- Door Control Switches.
- Low Voltage Circuit Breaker Panel.
- Auxiliary Relay Panel.
- VMS Train Operator Displays (TOD).
- Single Point PTU Interface.
- Parking Brake Release.

The location of all equipment and the configuration of the cab shall be submitted to the Engineer for review and approval (CDRL N502).

The cab shall be configured such that a lockable door secures the console area at the left of the cab. When operating as a lead cab, this lockable door shall secure the full cab end, allowing the Operator access to both side cab windows. Cab doors, whether open or closed, shall not impair the Operator's view of the front. The vehicle shall be operable with the cab door either open or closed.

The cab side window design shall be submitted for review and approval. The side windows of the cab shall be interlocked to prevent going into "Car Wash Mode" if any side window of any cab in a consist is open.

Provisions for a mechanical (non-electrical) release of the parking brake shall be provided above the floor within the cab area in the event of loss of air pressure. The parking brake release mechanism shall be by a single release mechanism removing the parking brake on the complete truck. The parking brake release mechanism shall be submitted for review and approval.

N5.3. OPERATOR CONSOLE GROUP

The primary control interface for the Operator with the vehicle shall be the Operator's Console. The console shall be located on the left side of the Operator's cab, facing forward, and allowing a clear, unobstructed view of the track ahead.

All switches, pushbuttons, controls, and indicators required for proper operation of the vehicle, unless otherwise specified, shall be located on the Operator's console and organized by function in the following groups:

- Master controller.
- Instrumentation.
- Control.
- Cutout and bypass.

Switches, buttons, controls, and indicators from one group shall not be intermixed with those from another.

Console material shall be corrosion-resistant with protective covers as needed. Switches shall be rear-mounted on hinged panels.

The Contractor shall submit all proposed designs to the Engineer for review and approval (CDRL N503).

Whenever there is an indicator light or gauge associated with the function of a control, the indicator and control shall be directly adjacent and not separated by any other control or indicator. Warning function indications shall be located in the primary field of vision of the Operator. Audio signals shall be sufficiently different from each other for the Operator to quickly recognize each of them.

Placement of all controls, including the "Master Controller" and the Operator's control and instrumentation panels, shall be demonstrated as a part of the cab mock-up.

Keying shall be as specified in TPN3.

To the greatest extent possible, status annunciations shall be made at the appropriate console switch location. The nomenclature of each indicator shall be readable when either energized or de-energized.

N5.3.1. CONSOLE LAMPS

The indicating lights of the control console shall be LED type and shall illuminate only in the lead (active) cab of the vehicle, unless indicated otherwise.

The console light control switch shall include a lamp test position in which all cab console indicators shall be illuminated.

N5.3.2. CONSOLE SWITCHES

Console switches shall be heavy-duty push-button, rocker, rotary (spring return to center), or toggle switches. Guards shall be provided on switches to prevent inadvertent activation of critical circuits.

The function and position of each console switch shall be clearly identified and visible at night and when the vehicle is operating in direct sunlight. Switches and controls shall not pose a hazard to the Operator. The door control switches shall be grouped in a manner similar to those of the existing console.

N5.3.3. FAULT ANNUNCIATION

The Contractor shall implement a comprehensive fault annunciation system that consists of local and trainlined subsystem and general fault indications. Each vehicle subsystem, including HVAC, auxiliary power supply, low-voltage power supply, doors, propulsion, friction brakes, cab window open during car wash, and truck bearing over temperature, or any other faults as required by the Engineer, shall provide a fault indication output. In the minimum implementation, the various subsystem fault indication outputs shall, upon de-energization, result in the illumination of a fault light, appropriately labeled with the subsystem's name, in both Operator's cabs of the vehicle married pair on which the fault occurs (local fault indication). Corresponding to the illumination of any of the local

vehicle fault lights in both Operator's control console in the leading cab of the consist. Subsystem fault indications shall be integrated with the VMS, and provide fault information on the TODs. The fault annunciation system shall be arranged to allow consistent, compatible fault annunciation, and shall be coordinated and integrated with the design parameters of TPN13, TPN14, and TPN20. The Contractor shall submit details of the fault annunciation system to the Engineer for review and approval (CDRL N504).

N5.3.4. WARNING DEVICES

An air horn and electric horn with controls shall be provided. These devices shall operate and sound at the controlling cab end only. The horn shall be controlled by a pushbutton located on the Operator's console. The beeper's operation shall be controlled by a separate pushbutton that is mounted on the Operator's console. The air horn shall emit a sound of a minimum of 100 dBA and the beeper shall emit a minimum of 70 dBA, when measured with a sound level meter on slow response setting, at a distance of 100 ft. in front of the vehicle. Details of these warning devices shall be submitted to the Engineer for review and approval (CDRL N505).

N5.3.5. MASTER CONTROLLER GROUP

The master controller group shall consist of a master controller, including a deadman feature, a mode selector switch, a key switch, and a key lock switch.

N5.3.5.1. MASTER CONTROLLER

A handle shall be provided to control the propulsion and friction braking subsystems via the propulsion, brake, and rate request trainlines. The following master controller handle positions shall be provided and clearly labeled:

- FULL POWER.
- COAST.
- FULL SERVICE BRAKE.
- EMERGENCY BRAKE.

The defined master controller handle positions shall have sufficient tactile feel and be spaced far enough apart to clearly indicate the position of the handle to the Operator.

N5.3.5.1.1. **Deadman Feature**

To activate propulsion, it shall be necessary to rotate the handle against a spring through approximately 90 degrees. If the handle is not in this position, the propulsion and brake trainline signals shall be zero. It shall not be possible to latch or fasten the handle in its operating position. It shall require continual Operator effort to hold the handle in its operating position. Release of the handle shall result in a full-service brake application as defined in TPN2.

N5.3.5.1.2. **Detents**

Master controller handle motion detents shall be provided to delineate the master controller handle positions. The following positions shall be located at the extremes of handle motion:

- FULL POWER (foremost handle travel position).
- EMERGENCY BRAKE (rearmost handle travel position).

The following master controller handle positions shall be indicated with a detent. The detent shall offer sufficient resistance to preclude the inadvertent movement of the handle to the next rearward or forward handle position:

- MINIMUM POWER.
- COAST.
- MINIMUM BRAKE.
- FULL SERVICE BRAKE.

Between "MINIMUM BRAKE" and "FULL SERVICE BRAKE" and between "MINIMUM POWER" and "FULL POWER", the master controller handle shall move in a smooth and linear manner free of detents.

The Contractor shall coordinate and integrate the acceleration and braking requirements as specified in TPN14.

N5.3.5.1.3. **Trainline Control**

The master controller shall provide signal input to the propulsion, braking, and rate request trainlines as indicated in TPN2.

Master controller handle movement between "MINIMUM POWER" and "FULL POWER" and between "MINIMUM BRAKE" and "FULL SERVICE BRAKE" shall translate into a rate request value that varies linearly between the values defined at the minimum and maximum endpoints.

The propulsion or brake rate request shall subsequently be propagated to the propulsion and braking subsystems via the rate request trainline.

The master controller handle in the "EMERGENCY BRAKE" position shall request maximum brake effect.

Placing the master controller handle in the "EMERGENCY BRAKE" position shall not cause any momentary reduction of maximum braking.

N5.3.5.2. KEY LOCK

When the key lock is in the "LOCK" position, the master controller shall be interlocked so that the master controller handle is locked in the "FULL SERVICE BRAKE" or "EMERGENCY BRAKE" position and the key switch is in "OFF" position and the mode selector switch is in the "OFF" position.

When the key lock is in the "UNLOCK" position, the key switch shall be released to allow it to be switched from "OFF" to "ON". When the key switch is moved to the "ON" position the mode selector switch can be moved from "OFF" to any of the positions described below.

N5.3.5.3. KEY SWITCH

A two-position "ON/OFF" switch shall be provided. The switch shall energize the cab, automatically locking out other cab. It shall only be possible to have one cab energized at any time.

N5.3.5.4. MODE SELECTOR SWITCH

A four-position rotary switch, mounted in the same panel as the master controller, shall provide the means of controlling the operating status of that cab. This switch shall be mechanically interlocked with the key switch and the key lock switch described as follows. The four positions of the mode selector switch shall be:

a. YARD: In this fully counterclockwise (11 o'clock) position, it shall not be possible to move the key switch from the "ON" position. The master controller handle is free to move through its entire range. This mode can only be entered with the key switch in the "ON" position.

b. OFF: In this (12 o'clock) position the key switch can be turned to "OFF", at which point the key lock can be switched to "LOCK". The master controller handle is locked in either the "FULL SERVICE BRAKE" or "EMERGENCY BRAKE" position.

c. MAN (Manual): In this position (1 o'clock) position, it shall not be possible to move the key switch from the "ON" position. The master controller handle is free to move through its entire range.

d. ATO (Automatic Train Operation): In this (2 o'clock) position, it is not possible to move the key switch from the "ON" position. The master controller handle motion is locked at "FULL SERVICE BRAKE" or "EMERGENCY BRAKE".

N5.3.6. OPERATOR'S CONTROL PANEL

The Operator's control panel shall be the main panel of the Operator's console, and contain the following:

- Master Controller Group described above.
- Emergency stop button.
- Public Address (PA) and Passenger Intercom controls.
- Door controls.
- System control switches.

A listing of the components and their functions for the existing Operator's Control panel are listed below.

N5.3.6.1. EMERGENCY-STOP PUSHBUTTON

The emergency-stop control shall be a large, red, mushroom-shaped, latching push-button switch mounted on the right side of the console. Upon activation, this switch shall initiate an irrevocable emergency brake application. When this switch is pulled (reset) and the zero speed signal is present, emergency-braking control shall be reset. The emergency-stop pushbutton shall be active in all cabs of a train.

N5.3.6.2. COMMUNICATION CONTROL UNIT (CCU)

The CCU (fully described in TPN13) is the unit used to control Public Address Announcements and Passenger Intercom and Operator Radio communications.

N5.3.6.3. DOOR CONTROLS

Door controls shall be integrated with the ATP system, such that door opening is commanded automatically, and door closing is commanded manually by the Operator. Manual door controls shall be provided to override the automatic door opening. The door control switches shall be grouped and located as per the existing fleet design with controls on the console side and on the right side of the cab.

N5.3.6.4. SYSTEM CONTROL SWITCHES

The following switches shall be provided as part of the Operator's Control Panel:

- CAR WASH: When this momentary action switch is depressed, while in YARD Mode, the consist shall operate in a forward direction at 2 mph when the master controller is in full service brake.

  This function shall be interlocked with cab windows throughout the consist. All equipment cooling fans shall be interlocked such that they are disabled when in this mode to prevent the inadvertent intake of water.
- REVERSE: When this spring return-to-off rotary switch is rotated and held in the fully clockwise position while in Yard Mode, the train shall travel in the reverse direction at 2 MPH. A backup alarm shall sound repeatedly at the rear end of each car in a multiple-car consist while the vehicle is in reverse.
- UNCOUPLE: When this momentary action pushbutton is pushed, and the Mode Selector Switch is in Yard Mode, it shall allow the Operator to uncouple from cars forward of the cab in which the uncouple switch was activated.
- TRAINLINE SWITCH: Disconnects trainlines to vehicles forward of the active cab.
- REMOTE UNCOUPLE: When this momentary action pushbutton is pushed, and the Mode Selector Switch is in Yard Mode, it shall allow uncoupling of the trailing cars from the controlling married pair.
- REMOTE TRAINLINE SWITCH: Disconnects trainlines to vehicles behind the married pair with the active cab.
- HIGH BEAM: A two-position selector switch for high and low beam headlights.
- LIGHT SWITCHES: Four alternate action (push-on, push-off) switches controlling different lights in the cab area;
  - Console Lights: Controls lights that illuminate the console and gauge and speedometer backlighting.
  - Reading Light: Controls the cab reading light.
  - Cab Light: Controls the cab dome light.

- Vestibule Light: Controls the LED vestibule light and the floodlight located over the end door.

- DEFOGGER: A four-position selector switch with OFF, FAN, LOW (heat), and HIGH (heat).
- ATO START: A momentary switch that the Operator pushes after a programmed stop to start the train in ATO.
- ATO STOP: A two-position switch (push on, pull off) that stops the ATO by interrupting power to the ATO unit and signal generators.
- BEEPER: A momentary switch when activated sounds the electronic beeper.
- HORN: A momentary switch that when pressed energizes the Air Horn Solenoid which causes the Air Horn to sound.

N5.3.7. OPERATOR'S INSTRUMENT PANEL

The Operator's Instrument Panel shall be a panel located immediately above the Operator's Control Panel. A listing of the components and their functions for the Operator's Instrument panel are listed below.

N5.3.7.1. INDICATOR LIGHTS

The following indicator lights shall be provided on the Operator's Instrument panel. Unless indicated otherwise, the faceplate of the indicator lights shall be translucent white in an unlit condition with black lettering. In the lit condition, the faceplates shall illuminate red.

- FRICTION BRAKE FAULT: Lights in the lead cab when any brake pressure switch in the consist does not close. Also lights in the car that has the fault.
- ELECTRIC BRAKE FAULT: Lights in the lead cab when an electric brake fault is detected within the consist. Also lights in the car that has the fault.
- PROPULSION SYSTEM FAULT: Lights in the lead cab when a propulsion fault is detected within the consist. Also lights in the car that has the fault.
- FRICTION BRAKE CUTOUT: Lights in the lead cab whenever a Friction Brake Cutout toggle switch in any car of the consist is placed in "CUTOUT".

- ELECTRIC BRAKE CUTOUT: Lights in the lead cab whenever an Electric Brake Cutout toggle switch in any car of the consist is placed in "CUTOUT".
- PROPUSION CUTOUT: Lights in the lead cab whenever a Propulsion Cutout toggle switch in any car of the consist is placed in "CUTOUT".
- DOORS BYPASSED: Lights in the lead cab whenever a Door Bypass toggle switch, in any car of the consist, is placed in "BYPASS".
- DOORS OPEN: Lights in the lead cab whenever any door in the consist is open.
- BRAKES ON: Lights in the lead cab when a brake pressure switch in any car opens or the Loop Controller is energized (red faceplate).
- ATP BYPASSED: Lights in the lead cab and on the exterior of the vehicle whenever the ATP Bypass toggle switch of the lead cab is placed in the BYPASS position.
- OVERSPEED: Lights in the lead cab whenever the ATP system detects an overspeed condition (internal filter cause a blue faceplate when lit).
- PERFORMANCE LIMIT: Lights in the lead cab whenever the Operator places the consist in performance modes 2 or 3 using the "PERF MOD" control.
- SPEED LIMIT: Speed indications shall be provided as part of an Aspect Display Unit as described in TPN14.
- CAR WASH/REVERSE POWER: Lights in the lead cab when either the car wash or reverse modes are selected.
- HEADLAMP OUT: Lights in the lead cab when either headlight has failed.
- CAB WINDOW INTERLOCK: Lights in the lead cab whenever the Operator activates "CAR WASH" and the cab windows are open.
- SPARE.

N5.3.7.2. SWITCHES

Six flush mounted pushbuttons, with covers to prevent being inadvertently pushed, shall be provided on the Operator's Instrument panel.

- PROGRAM STOP: A momentary switch used to cancel a Program Stop during ATO operation.
- MOTOR OVERLOAD: A momentary switch when activated energizes the Reset Trainline.
- LOW RATE STOP: This is an alternate action switch. When activated adjusts the ATO for lower brake rates at Program Stops.
- PARKING BRAKE ON: Applies the Parking Brake.
- PARKING BRAKE OFF: Releases the Parking Brake.
- SPARE.

Two extended head pushbuttons shall be provided on the Operator's Console back panel.

- RECHARGE: A momentary switch that permits the Operator to charge the air brakes of the consist.
- LAMP TEST: The momentary switch energizes all of the indicating lamps in that car's driving compartment.

Three multiple selection switches shall be included on the Operator's Console back panel with the following functions.

- PERF MOD: A three-position switch that dictates acceleration rates.
- PRGM STOP: A two-position switch that dictates program station stop deceleration rates.
- TRAIN LENGTH: A four-position switch that provides train length information to the ATO.
- SIDE SIGNS: A double decade switch with which the Operator selects the side destination sign coding.

Miscellaneous Switches.

- WASHER/WIPER: Controls the windshield wiper and washer unit.
- DIMMER: Used to dim the Driving Compartment indicating lights and console lights for Operator convenience.

N5.3.7.3. GAUGES

The Operator's Instrument panel shall include the following gauges:

- Digital speedometer.
- Brake Pipe pressure.
- Main Reservoir Air Pressure gauge.
- Brake Cylinder air pressure.

Brake cylinder pressure indication shall be available on the T.O.D., with capability for the Operator to select individual truck brake cylinder pressure throughout the consist.

N5.3.8. INDICATOR LIGHTS AND SWITCH PANEL

The cutout and bypass controls and indicating lights shall be located as a separate group on a cutout and bypass switch panel located in the cab area.

N5.3.8.1. SEALED CUTOUT SWITCHES

The following sealed cutout switches shall be provided and clearly marked:

- DOORS BYPASS: In the BYPASS position, the Door Bypass Relay of the same car is energized to overcome door closure problems.
- PROPULSION CUTOUT: This switch permits the Operator to deactivate the F-end, R-end, or both propulsion inverters of that vehicle.
- ATP BYPASS: This switch is effective only in the yard position of the Mode Selector Switch and allows the Operator to by-pass the ATP on the married pair of the controlling car.
- SERVICE FRICTION BRAKE CUTOUT: This switch is used to permit the Operator to deactivate the service friction brakes of a car if its brakes are defective.
- HEADLIGHT BYPASS: This switch is used during intermediate cab operations to light the headlights of the lead car of a consist and to enable the Parking Brake pushbutton in the lead car.
- DOOR INHIBIT: The purpose of this switch is to allow the Operator to open and close all doors in the consist aft of the controlling car, with the exception of doors 1 thru 4 immediately behind the control

cab of the lead car in a consist, without the ATP Berthing Permissive Signal.

- BRAKE ON BYPASS: This switch permits operation of the ATO, Propulsion and Brake Signal Generators, and Propulsion Logic when the car does not obtain a brake release as indicated by the Brakes On Indication on the Operator's back panel.
- ELECTRIC BRAKE CUTOUT: This switch removes electric braking (Dynamic and Regenerative) in all cars of the consist.
- SPARES: 2 each spare switches shall be supplied.

The function cutout/bypass indicator on the Operator's console shall illuminate when any sealed cutout/bypass switch is activated on any vehicle in the train.

N5.3.8.2. NON-SEALED CUTOUT SWITCH

The following non-sealed cutout switch shall be provided and clearly marked:

- COUPLER CONTROL.

N5.3.8.3. INDICATING LIGHTS

Indicating lights to be included on the Indicator Light and Switch panel are:

- AUX POWER FAILURE.
- PROPULSION SYSTEM FAULT.
- AIR COMPRESSOR FAILURE.
- PARKING BRAKE ON.
- FRICTION BRAKE CUTOUT.
- ELECTRIC BRAKE FAULT.

N5.3.8.4. PUSHBUTTON SWITCHES

The following pushbutton switches shall be provided on the console:

- AUX ON: This switch shall activate the Auxiliary Inverter to supply power to the HVAC system and pneumatic compressor and all low voltage equipment including lighting, assuming the married pair is connected to third rail power. If the key lock is placed in the "UNLOCK" position and the key switch moved to "ON" the power shall remain on indefinitely. If third rail power is not available the

battery shall power the low voltage equipment. All lighting shall remain on for 1 minute until a load shedding circuit can remove all but the emergency loads and lighting circuits.

- AUX OFF: De-energizes the AUX ON circuit.
- DOOR FAULT TEST: An internally lit, extended head pushbutton switch that when activated checks the Door Interlock trainline for stray B+ to ensure proper door closure.

N5.3.8.5. AUXILIARY RELAY PANEL

The auxiliary relay panel shall include relays, relay bases, surge suppressors, and associated panel wiring. The panel shall also include vital relays conforming to AREMA standards.

N5.4. OTHER EQUIPMENT

Other devices required in the Operator's Cab shall be provided as listed herein.

N5.4.1. WINDSHIELD WIPER

An electric windshield wiper that operates from the low-voltage power supply shall be provided at each vehicle cab and shall sweep at least 80% of the width and 60% of the height of the windshield over a complete cycle. The drive units shall provide at least two speeds of operation and an intermittent mode. The rest period shall be adjustable from 2 to10 seconds. The wiper blades shall return to the park position at the extreme ends of their sweep in the "OFF" position. The operating mechanism of the drive units shall be enclosed and mounted above the windshield.

A windshield washer nozzle shall be mounted on the wiper arms. A windshield washer fluid reservoir, with a minimum capacity of 1 gallon, shall be located such that it can be easily filled. A means of visually identifying the level of this reservoir from inside the vehicle shall be provided. The reservoir shall be located such that refilling can be accomplished easily from inside the cab area.

N5.4.2. CONVENIENCE OUTLET

A 120 VAC, duplex-grounded convenience outlet shall be installed in a selected cab equipment locker.

N5.4.3. EMERGENCY LANTERN

A rechargeable emergency lantern and charging system shall be located in the Operator's cab.

N5.4.4. VISOR/SHADE

The cab windshield shall be equipped with vertically adjustable visor with a positive holding device. The visors shall cover the entire width of the windshield. Exterior signals shall be clearly visible through the visor. Visor material shall be specified as follows:

Visor Material Specifications		
Film Type	Solar-reflective gold/gray	
Solar Energy	Percentage transmitted:	7%
	Percentage reflected:	51%
	Percentage absorbed:	42%
Visible Light	Percentage transmitted:	5%
UV Light	Percentage transmitted:	1%
Total Solar Energy	Percentage rejected:	71%
U-Factor	0.44	
Shading Coefficient	0.33	

N5.4.5. STORAGE

Storage shall be provided for the Operator's personal items. The storage area for personal items shall have a volume in excess of 1.0 ft^3. The storage area shall be identified as such on the outside of the access door. The configuration shall be submitted to the Engineer for review and approval (CDRL N506).

N5.4.6. SILENT ALARM SWITCH

A concealed silent alarm switch shall be mounted in each Operator's cab and integrated with the radio equipment to provide annunciation to Central Control upon activation of the silent alarm switch. The location of the switch shall be submitted for approval by the Engineer (CDRL N507), and shall be in a location not readily observable by passengers. The switch shall have both normally open and normally closed contacts.

N5.4.7. ANNUNCIATOR GROUP

In addition to visual indications, the following conditions shall be audibly annunciated in the cab area by sounds sufficiently different from each other so that the Operator can readily interpret each.

- Overspeed alarm.
- Passenger intercom request.

Audible annunciators shall be designed and mounted to be tamperproof.

N5.4.8. FIRE EXTINGUISHER

An Engineer approved fire extinguisher shall be mounted within easy reach of the Operator's position within the Operator's Cab (CDRL N508).

N5.4.9. CAB HEATER

A cab heater shall be provided with the capability of maintaining the cab interior temperature in the vicinity of the Operator at 70 °F while the vehicle ambient temperature is 50 °F. This heater shall be located below the console such that warm air will rise in the vicinity of the Operator. Two fan speeds shall be provided with directional vents. Heat shall be controllable by the Operator.

N5.4.10. HVAC DIFFUSER

Multiple air diffusers shall be provided in the cab ceiling and walls. Diffusers shall be adjustable for both airflow (off to Maximum On) and direction, and selected to be integrated with the cab interior.

N5.4.11. OTHER PROVISIONS

Provisions for the Operator's coat hook, a holder for a hand held radio, and ID card clip shall be included in the cab.

N5.5. OPERATOR'S SEAT

Operator's seats shall be provided in each Operator's cab. The Operator's Seat shall be a USSC Model 9100 ALX, or approved equal, designed with contours and adjustment features for maximum Operator comfort, and structurally designed for long rugged life in the transit environment and when being used by an Operator within the range of either a 5th percentile female to a 95th percentile male range.

The following design features shall be provided:

- Variable headrest height and tilt adjustment.
- Manual lumbar adjustment via pneumatic bulb activation.
- Manual thigh adjustment.
- Base mounted swivel pedal for ready Operator access, with straight ahead locking position.
- Backrest release, which allows the seat back to tilt forward.
- Variable bolster support.
- Manual recline capability.
- Gas cylinder height adjustment, with a minimum of 4" of height adjustment.
- Rake adjustment from -5° to +10° in no less than 6 increments.
- Hinged right hand arm rest.

The seat back shall be constructed of solid stamped steel conforming to the natural S curve of the anthropomorphic model. The seat back and base shall be of high density fire retardant foam, a minimum of 24" in height and 18.5" wide. The seat back shall be protected by a plastic back shell conforming to the seat.

Seat cushions shall have readily removable side bolsters, suitable for ready cleaning.

The seat covering shall be a durable fire retardant material. Seat color, design, and material shall be submitted to the Engineer for approval.

In order to have sufficient space to allow to the driver to operate standee, the seat support is mounted on apposite rails. The seat can be moved back until the cab partition to create the necessary space for a standee operator. In addition with a rotation of the seat this mentioned space can be increased.

N5.6. CAB MOCK-UP

A full size mock-up of the Operator's cab shall be provided to the Engineer for review and approval (CDRL N510). The mock-ups may be constructed from wood or other approved materials and shall represent size, location, placement of windows, doors, cabinets, light fixtures, HVAC functions, controls, Operator's seat, circuit breakers, switch panels, and similar items.

The cab mock-up shall extend back to the second passenger seat and demonstrate all cab appointment locations and ease of access for the Operator and Maintenance personnel.

The mock-ups shall become the property of MDT once it is no longer needed for design review purposes. Upon request, it shall be shipped to MDT, as directed by the Engineer, at the Contractor's expense following its use at design reviews.

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TABLE OF CONTENTS

N6. DOOR CONTROL 6-1
N6.1. GENERAL 6-1
N6.1.1. CITED REFERENCES 6-1
N6.1.2. SUBMITTALS – CDRLS 6-2
N6.1.3. SCOPE OF WORK 6-2
N6.2. INTERFACE REQUIREMENTS 6-3
N6.3. SIDE DOOR FUNCTION 6-3
N6.3.1. CLOSING FORCE 6-4
N6.4. DOOR CONTROLS 6-4
N6.4.1. TRAINLINED DOOR OPERATION 6-4
N6.4.2. LOCAL OPERATION 6-4
N6.4.3. DOOR CLOSING WARNING 6-5
N6.4.4. DOOR PULSATIONS 6-5
N6.4.5. POWER 6-5
N6.4.6. CREW SWITCHES 6-5
N6.4.7. OBSTRUCTION DETECTION 6-5
N6.5. DOOR OPERATORS 6-6
N6.5.1. POWER SUPPLY 6-6
N6.5.2. DOOR OPERATOR MOTORS 6-6
N6.5.3. RELEASE SWITCHES AND LOCKS 6-6
N6.5.4. DOOR OPERATOR LIMIT SWITCHES 6-7
N6.6. INTERLOCK REQUIREMENTS 6-7
N6.7. DOOR DIAGNOSTICS 6-8
N6.8. SPECIAL TEST EQUIPMENT 6-8

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N6. DOOR CONTROL

N6.1. GENERAL

The door control system shall be a combination of electrical, electronic, and mechanical devices acting as a system to open and close the passenger doors at the command of an Operator or the Train Control System.

Door operators and controls shall consist of the mechanism that opens and closes (operates) the side doors, the electronic controls for that mechanism, and the wiring harnesses associated with the entire system. The door operator ends at the connection to the door leaf.

The door operator shall be actuated by a small series-wound DC or AC motor in line with a gearbox integral to the frame of the operator. Other configurations, if proposed, shall be supported by detailed service proven history. Pneumatic or hydraulic actuation is not permitted.

The door control system shall be microprocessor-based for control of the vehicle door operators and shall log status of the door positions, with the additional requirement that it interface with the vehicle fault monitoring system.

Door control equipment shall be designed to be fully interchangeable between doors and vehicles. The side doors system shall be designed and constructed to have operational interfaces with applicable subsystems such as traction trainline controls, emergency handle, public address announcements and monitoring to ensure train coordinated functioning. There shall be sufficient isolation provided to ensure that none of these interfaces can deliver an unwanted signal into the door control or indication systems, and the system must abide by all regulatory requirements.

N6.1.1. CITED REFERENCES

Source/Section	Title
49 CFR, Subtitle A, Section 37.83	Americans with Disability Act (ADA) Accessibility Specification for Transportation Vehicles

N6.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is provided for reference.

CDRL No.	Title	TP Reference
N601	Qualification Testing and Factory Acceptance Testing Procedure	TPN6.1.3.
N602	Door System Test Plan	TPN6.1.3.
N603	Side Door Functional Operation Description	TPN6.3.
N604	Door Controls Description	TPN6.4.

N6.1.3. SCOPE OF WORK

The door control system for the Miami Metrorail Vehicles shall consist of the following elements:

- Door Control Logic/Relay Unit.
- Door Operators.
- Door Linkages.
- Door Operator Mounting Frame.
- External Door Emergency Release.
- Internal Door Emergency Release.
- Test Equipment.

In addition, the door control system Supplier shall perform all engineering and design associated with the door control system to provide:

- System Schematic.
- Subsystem Schematics.
- Installation Drawings.
- Assembly Drawings.
- Electrical Component Drawings.
- Mechanical Component Drawings.
- Test Procedures and Reports.
- Software Documentation.

The door control system contractor shall also provide interfaces as required for annunciation of door closing as required by the Americans with Disabilities Act.

Qualification testing and factory acceptance testing shall be conducted, using an Engineer-approved procedure, on all door system components (CDRL N601).

The Contractor shall submit a door system test plan that details all required testing as specified herein (CDRL N602).

The door control system shall interface with the Vehicle Monitoring System (VMS), specified in TPN20 of the Technical Provisions.

N6.2. INTERFACE REQUIREMENTS

Electrical interfaces shall be developed by the Contractor for door prime power, control, fault annunciation, and trouble shooting circuitry as designed by the Contractor.

The door close summary circuit control relays shall be interlocked with the door close summary trainline, and the door open indication relay.

N6.3. SIDE DOOR FUNCTION

Each of the six passenger doorways shall contain sliding doors of the bi-parting leaf type with two leaves per door, opening from their center, and retracting completely into pockets in the car side wall. Side door functional operation shall be as described herein (CDRL N603). The door operator shall be capable of maintaining a minimum door opening of 48 inches when both leaves of a door are open.

Door control signals shall be trainlined so that all doors on each side of the train may be opened automatically or manually by the operator. Door closing shall be done manually by the train Operator at the activated console, as specified in TPN1.

The door operator shall:

- Take a maximum of 1-½ seconds to move from the closed position to within 3 inches of the fully open position.
- Take no less than 2 seconds, or more than 2-½ seconds, to move from the fully open position to the fully closed and locked position.

Operating speeds shall be adjustable for door synchronization.

The door operator shall decelerate the door leaf at each extremity to preclude slamming or rebound, and bring the leaf to rest gently at its extremity of travel.

Center door sets shall be designed such that actuating the emergency door release handle will open both leaves of the center side loading doors.

N6.3.1. CLOSING FORCE

Each door leaf shall:

- Exert a closing force of not less than 15 pounds and not more than 30 pounds as a static measurement at mid-stroke at 48 inches above the threshold.
- Open or close with 60 pounds total force applied perpendicularly to the center of the interior door surface.

N6.4. DOOR CONTROLS

The door control system shall be:

- As specified in TPN2.
- Designed with safety features to preclude unintentional signals from operating the doors.
- Made to maintain door closed and locked mechanism.
- Made to maintain door leaf free wheeling (broken drive mechanism).
- Designed to preclude door opening without confirmation of no-motion.
- Microprocessor-based, capable of determining door position by suitable door position sensing devices, and have other sensors to determine positions including door closed and locked over center, and door open.

Door controls, including the function of the microprocessor controller, shall be described in detail for approval of the Engineer (CDRL N604).

N6.4.1. TRAINLINED DOOR OPERATION

Doors shall operate from trainlined control to provide separate control components for opening and closing doors on both sides of the vehicle, complying with the following: Doors of a train shall unlock, open, and remain open on a momentary signal from the door open or door close trainline, low-voltage signal unfiltered and unregulated. Additionally, reversal of the signal shall automatically close the doors.

The door inhibit function signal shall be transmitted via the VMS as a major alarm to Central Control.

N6.4.2. LOCAL OPERATION

One set of side door panels on the left and right side of the vehicle, located towards the center, shall be designed to open or close electrically from outside or inside crew switches by using the car keys.

All door sets shall be designed to open or close electrically, from controls inside the car by using a standard car key.

Positive action shall be required to open and close doors from either actuating location. Additionally, it shall be possible to remove the key following any actuation to facilitate routine entry and exit by maintenance personnel.

Doors opened by local control shall close after doors are opened and then closed by trainline control.

N6.4.3. DOOR CLOSING WARNING

A warning tone shall be initiated by the door controller and sound over the Public Address system to warn passengers that the doors are about to close.

Visual warning signals shall be provided on or adjacent to the windscreen at each door to alert passengers of closing doors in compliance with 49 CFR, Subtitle A, Section 37.83, regulations.

N6.4.4. DOOR PULSATIONS - DELETED

N6.4.5. POWER

Doors shall operate from the low-voltage electric power circuit with voltage characteristics as specified in TPN9.

When the vehicle is in lay-up status, the door control system shall draw no power when the doors are either closed or open, other than the power required for the microprocessor to "sleep".

N6.4.6. CREW SWITCHES

Exterior and interior crew switches shall utilize the standard car key (barrel key) specified in TPN3.

Interior crew switches shall be located in a position not directly adjacent to the doorway. The location of the interior crew switch shall be submitted by the Contractor for approval by the Engineer.

N6.4.7. OBSTRUCTION DETECTION

An approved method for detecting an obstruction and preventing the closure of a side door shall be included as part of the design of the door system. The doors shall not lock and permit a doors closed indication if an obstruction is detected. The sensitivity of the obstruction detection system shall be as follows:

- Capable of detecting a flat bar, ¼-inch wide and 3 inches high, held rigidly between and perpendicular to the door panel, as a hand might be held to stop the doors. This sensitivity shall be required everywhere along the length of the panel except the uppermost 3 inches and lowermost 1 inch of the nosing seal.
- Capable of detecting an object, 3/8-inch in diameter, held rigidly between and perpendicular to the door panels at all locations along the length of the door nosing seal, except the uppermost 3 inches and lowermost 3 inch of the seal.

Upon sensing of an obstruction on which recycling is to occur, the local door controls shall cause the door operator on the obstructed panel to immediately reverse and open partially. The panel shall attempt to close up to a total of three times. The number of recycles shall be selectable from 0 to 3.

For a setting of (0) recycles, no recycling occurs. The obstructed panel closes on the obstruction and stays in that position with obstruction detection protection active at all times.

For a setting of 1, 2, or 3 recycles, the door shall attempt to close, and upon detection of an obstruction, the door panel shall open approximately three inches from the detected obstruction, and attempt to re-close. If the obstruction is still detected after completing the set number of recycles, the door shall close on the obstruction.

N6.5. DOOR OPERATORS

Door operators shall be a service proven design as defined by the RFP.

N6.5.1. POWER SUPPLY

Door operators shall operate from the car's low-voltage circuit with voltage characteristics as specified in TPN9.

N6.5.2. DOOR OPERATOR MOTORS

Door operator motors, or drive mechanism, shall be protected against thermal overload by a cutout switch or other suitable device which shall automatically reset when cooled.

Door operator motors shall not be subject to damage by attempts to move doors in the stalled condition or with intermittent operation of the thermal overload cutout switch or device.

N6.5.3. RELEASE SWITCHES AND LOCKS

The door operator mechanism shall prevent manual opening of a closed door leaf under normal conditions.

For emergency operation, the door mechanism shall be capable of providing, without use of any key or electrical power, inside emergency release of all door leaves, and outside release for leaves of the center doors. One mechanism per doorway shall open both door leaves with an actuation force not to exceed 15 lbs.

Upon activation, the emergency release mechanism shall initiate an emergency stop, and interrupt the door indication trainline and not allow doors to open until zero-speed indication is received.

Key-controlled cut-out switches shall be provided at each side door operator, readily accessible for crew use. In event of a single door operator failure:

a. It shall be possible to make such operator both: "electrically inoperative" or "electrically inoperative with door leaf mechanically locked in closed position." Additionally, such locking procedure shall activate the cut-out switch signal circuit.

b. When in the "electrical inoperative" only position, the Door Cut-out Switch Panel access door shall be prevented from being closed and locked.

c. Access to the cut-out switch shall not expose the door operator drive mechanism.

N6.5.4. DOOR OPERATOR POSITION SENSING

Door operator position sensing devices shall be readily replaceable complying with the requirements of TPN19, and shall be designed and installed such that if they are replaced, no adjustments shall be necessary to obtain proper functioning. Devices shall be designed to provide a "door closed" indication (contact closure) which shall be given only after leaves are positively closed and locked. Additionally, this indication shall be activated by door leaves.

N6.6. INTERLOCK REQUIREMENTS

Interlock and detection circuits are safety critical circuits. The system shall provide the following control interlocking when operating as the lead car of a train:

Door Controls shall be interlocked in such a way that doors cannot be opened until train berthing signals and the train zero speed and local zero speed signal are generated by automatic train protection and propulsion or brake logic as specified in Sections TPN1 and TPN2.

Traction Control: Input signals to the traction system shall be interlocked with the door control system such that no train can be moved in any mode of operation until all doors are closed and locked on each car. Additionally, if any door is unlocked while train is in motion, an

irretrievable open-loop brake application shall be initiated. The Contractor shall provide a door interlock by-pass switch and circuitry as required to enable emergency train movement.

The door control system sensors with normally open contacts shall provide the necessary logic to the VMS, as specified in TPN20, to indicate that the side doors are not fully closed and locked.

Local Status Annunciator: The Contractor shall provide an Annunciator at each door leaf to indicate leaf status. The Annunciator shall be energized to indicate door is not closed and locked and has not been cut out.

N6.7. DOOR DIAGNOSTICS

The Contractor shall provide a diagnostic system that shall continuously monitor the operation of the side doors and side door controls, and record and save any operational faults in a non-volatile RAM memory sufficient to save 500 blocks of data. Fault memory shall be resettable by using a Portable Test Unit (PTU). Additionally, a data logger shall be provided and shall reside in non-volatile memory. This information shall be examined or retrieved by using a Portable Test Unit. All fault data shall be preserved in Battery-Backed RAM.

Each fault shall be time-dated and recorded in Eastern Standard Time (EST) with (automatic) adjustments being made for Daylight Saving Time (U.S.).

Fault data shall be displayed in English. The display shall indicate the fault type without the use of cross references.

In addition to operational faults, the diagnostic system shall record the door leaf(s) opened in yard and manual modes of operation.

Door operation data recorded shall include:

- Open and Close timing.
- Door Cycle Count.
- Door Interruption Count/ Obstruction Detection Count.

Fault information shall be transmitted to the lead vehicle's VMS (Vehicle Monitoring System) as in TPN20.

N6.8. SPECIAL TEST EQUIPMENT

The Contractor shall provide test equipment as required to support the maintenance of the components of this Section by MDT in accordance with TPN17.

TABLE OF CONTENTS

N7. HVAC 7-1
N7.1. SYSTEMS DESCRIPTION 7-1
N7.1.1. CITED REFERENCES 7-1
N7.1.2. SUBMITTALS – CDRLS 7-1
N7.2. INTERFACE REQUIREMENTS 7-2
N7.3. DESIGN REQUIREMENTS 7-3
N7.3.1. INTERIOR CONDITIONS 7-4
N7.4. HEATING 7-4
N7.4.1. VENTILATION 7-5
N7.4.2. COOLING 7-6
N7.4.3. PIPING 7-8
N7.4.4. TEMPERATURE CONTROL 7-8
N7.4.5. SPECIAL TEST EQUIPMENT 7-10

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N7. HVAC

N7.1. SYSTEMS DESCRIPTION

This section specifies requirements for the heating, ventilation, and air conditioning (HVAC) subsystem and equipment to be provided for each car.

The HVAC system shall be roof mounted, and provide cooling, ventilation, and heating to the vehicle interior. There shall be 2 HVAC systems per car, with each system including Compressor, Condenser, and Evaporator units. The refrigeration circuit shall be hermetic in design. Rooftop mounted HVAC units shall be flush with the roof line of the vehicle.

The use of refrigerants containing hydro-chlorofluorocarbons (HCFCs) is prohibited.

N7.1.1. CITED REFERENCES

Source/Section	Title
ANSI/ASHRAE 34-2004	Designation and Safety Classification of Refrigerants
APTA SS-E-001-98	Standards for Insulation Integrity
ASHRAE 52.1	Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASME Sect VIII Div-1	Standard for Unfired Pressure Vessels
ASTM B280	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
AWS B2.2	Standard for Brazing Procedure and for Performance Qualification
UL Standard 900 Class 2	Standard for Safety Air Filter Units

N7.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is listed for reference.

CDRL No	Title	TP Reference
N701	Passenger Heat Loads Air Conditioning Analysis	TPN7.3.
N702	Refrigeration Circuit Performance Analysis	TPN7.3.
N703	HVAC System Test Specification	TPN7.3.
N704	System Component Data	TPN7.3.
N705	Air Flow Design Calculations	TPN7.3.
N706	Stress Analysis	TPN7.3.
N707	Qualification Test Procedure	TPN7.3.
N708	Acceptance Test Procedure	TPN7.3.
N709	Refrigerant Selection	TPN7.4.2.
N710	Soldering Procedures for HVAC Piping	TPN7.4.3.

N7.2. INTERFACE REQUIREMENTS

The HVAC system shall interface electrically with the AC Auxiliary Inverter and Low Voltage Power Supply for drive power and control power. Compressors, evaporator blower, and condenser fan motors, and other electrical components shall operate within the characteristics of the auxiliary power supply. The heater elements shall operate using power from the Auxiliary Inverter. HVAC functions, apart from heating, shall be supported by one Auxiliary Inverter of a married pair in the event of a failure of the other Auxiliary Inverter of a married pair.

The HVAC system shall also interface with the car level Vehicle Monitoring System (VMS) specified in TPN20.

Mechanical interfaces associated with the unit shall be designed to minimize air flow loss and vehicle borne vibration.

Refrigeration controls and temperature controls shall be located in separate enclosures. Refrigeration controls shall be readily accessible. Temperature controls shall be located in a readily accessible enclosure in the Operator's cab, readily accessible from inside the cab. The temperature control box shall have within it a direct interface for a portable test unit, with a control port readily accessible to maintenance personnel.

N7.3. DESIGN REQUIREMENTS

The Heating, Ventilating and Air Conditioning System shall meet the following requirements and accompanying design documents shall be submitted for approval:

Car Level Thermal Loads Analysis: A car level thermal loads analysis for heating and cooling shall be performed, including all carborne heat loads, solar load, radiant heat loads, conducted heat loads, and infiltration heat loads. Passenger heat (AW2) loads shall be considered for air conditioning analysis (CDRL N701). Passenger heat load shall assume 525 Btu/hr/passenger at a sensible heat ratio of 0.49.

Refrigeration Circuit Performance Analysis: An analysis of the refrigeration circuit shall be provided, showing the refrigerant compressor capacity, evaporator capacity, condenser capacity, and expansion valve selection (CDRL N702).

HVAC System Qualification Test: A test procedure shall be prepared specifying the test method, test equipment, test chamber, and data collection for the qualification of the HVAC system. This test shall demonstrate the capability of the HVAC system to comply with the requirements of the contract. This test will be witnessed by the Engineer (CDRL N703).

System Component Data: Design information, drawings, catalog sheets, and supporting performance data shall be provided for all HVAC system components (CDRL N704).

Air Flow Design Calculations: The air flow rate for each HVAC system shall be calculated, based upon the system cooling capacity, for the car interior. Static pressure criteria shall be presented for the revised air distribution system (CDRL N705).

Stress Analysis: Stress analysis for the unit frames shall be provided (CDRL N706).

Qualification Test Procedure: A qualification test procedure shall be provided, listing those tests that will be performed on the first production unit (CDRL N707). The qualification test shall also include an on-vehicle test, measuring air flow and interior temperature at a minimum of 24 locations as approved by the Engineer. This test shall also monitor interior humidity.

Acceptance Test Procedure: A factory test procedure shall be provided, listing those tests that will be performed on each unit as it is accepted after factory production (CDRL N708).

N7.3.1. INTERIOR CONDITIONS

The HVAC system shall be capable of maintaining the following interior temperatures:

Outside Temperature	Interior Temperature
35 to 55° F	67° F (interior variation plus or minus 3°)
56 to 85° F	67° F minimum to 71 °F maximum
86 to 95° F	71° F maximum (average interior temp.)
> 95° F	Maintain 24° F below outside temperature

The HVAC System shall also be able to maintain interior temperatures during the conditions specified above with 200 passengers while opening and closing doors for 30-second intervals on 4-minute cycle. Interior thermostats shall be provided at a minimum of 2 locations within the car interior. The coordination scheme for HVAC logic and thermostat placement shall be approved by the Engineer.

The HVAC System shall be able to maintain the required interior temperatures during winter conditions specified above with no passengers while opening and closing doors for 30-second intervals on a 4-minute cycle. For cooling and heating, with no passenger load, the system shall be capable of the following:

a. Cooling interior of car from 120°F to 83°F in 1 hour with outside temperature of 100°F.

b. Heaters shall be AC powered by the auxiliary inverter.

c. Heating car interior from 40°F to 67°F in 1 hour with outside design conditions of 40°F.

Interior humidity during the cooling cycle shall not exceed 60% at all times. Provisions for reheat of the air stream to maintain humidity limits shall be included.

Fresh makeup air shall be provided in the volume of 10% of the total air flow.

N7.4. HEATING

Heating is required for a short duration cool season. The primary function of the heater elements is for reheat/dehumidification. Heating shall be provided by electric resistive heaters contained within each evaporator blower unit.

Heaters shall:

a. Be arranged to operate in two stages. Additionally, heater staging shall be proportioned to provide optimal operation during the reheat cycle and the normal heating cycle.

b. Have heater elements located downstream from cooling coils.

c. Withstand Hi-pot testing in accordance with APTA SS-E-001-98.

d. Be of stainless steel and designed to preclude corrosion of the resistive element or fins.

e. Be mounted in high temperature elastomeric material to prevent damage from vibration, and to allow for expansion.

In addition, the evaporator coil and heater functions shall be designed to provide dehumidification capabilities sufficient to meet the interior conditions as specified herein.

To prevent damage in the event that air circulation is interrupted, 3 levels of protection shall be provided, as follows:

a. Air Flow Sensing – An air flowing sensing device shall be provided that shall open the heating contactors in the event that air flow falls below a safe minimum.

b. Over-Temperature Thermostat – A thermostat shall be located adjacent to the heater elements and, upon detection of temperatures higher than normal, shall open the heater contactor and shut down the evaporator blower.

c. Fusible Link – In event of failure of the first two levels of protection, a fusible link shall be provided in the primary voltage supply to the heaters to open circuit before hazardous temperatures are reached.

N7.4.1. VENTILATION

Air flow from the evaporator shall be sufficient to support the cooling capacity of the system without moisture transfer to the air stream. The air distribution system shall be designed to provide balanced air distribution throughout the car interior.

Ductwork shall meet the following requirements:

- Flexible insulated ducts shall be provided wherever there is relative motion between operating elements. Duct materials shall comply with TPN19.
- The air velocity through fixture grilles shall not be less than 500 fpm nor greater than 800 fpm. Adjustable baffles or other means shall be provided to achieve balanced air flow from the system.
- The air flow share from the ventilation system plenum to the Operator's cab shall be designed to provide an air flow rate sufficient to meet the interior temperature conditions specified

herein, adjustable by the Operator. Multiple vents throughout the cab area shall be provided to accomplish this.

- One smoke detector shall be located in each of the return air ducts, one in the ceiling in the middle of the car, and one in the Operator's Cab. When activated, the smoke detector shall annunciate an alarm through the VMS to the Operator's Control Panel. This shall also annunciate an alarm to Central Control.

Filters shall be provided for all air flow, and be disposable, 2-inch thick, pleated media filters of cardboard frame type, in a commercially available standard size from at least two suppliers. Face velocity shall not exceed manufacturer recommendation. Initial clean filter pressure drop shall be a maximum of 0.28 inches of water. Filters shall provide arrestance of 90% per ASHRAE 52.1. Filters shall allow for no less than 30 days of normal operation between changes. The filters and filter holders shall be sealed at their edges to prevent filter by-pass. Support of the filter elements shall be provided to prevent blowout of the filter elements under clogged conditions. Air filters shall meet the requirements of UL Standard 900 Class 2. Filters shall be readily accessible for maintenance from within the vehicle.

N7.4.2. COOLING

There shall be 2 identical cooling systems per car, one at the F-end, and one at the R-end. Each cooling system shall consist of a condenser, a compressor(s), an evaporation unit, piping, and service components. The Contractor shall propose an environmentally safe refrigerant, otherwise, this system shall utilize refrigerant 407C per ANSI/ASHRAE 34-2004 or Engineer approved substitute as the refrigerant (CDRL N709).

Cooling systems shall be provided with the following accessories:

a. Liquid line and suction line refrigerant filter dryers.

b. Combination sight, flow, and moisture indicator.

c. Solenoid valves to allow for pump-down.

d. High side charging valve.

e. Manual control switch.

f. Nonadjustable expansion valve.

g. Valving of refrigerant lines to prevent loss of refrigerant when replacing major components. Valves shall be selected to eliminate refrigerant leakage.

N7.4.2.1. COMPRESSOR

The compressor(s) shall be an AC power driven commercially available scroll type unit, with a proven history of transit performance, as approved by the Engineer.

Vibration isolation at the compressor shall be of a design as approved by the Engineer. Vibration absorbers, if used, shall include stainless steel bellows, and be as approved by the Engineer. Components of the compressor/condenser unit shall be designed for ready access and removal for maintenance.

N7.4.2.2. CONDENSER UNIT

Condenser coils shall be constructed of copper tubes and copper plate-type fins, or other similar type construction approved by the Engineer. Fins shall be expanded to provide permanent mechanical bond between the fins and the tube. The condenser coil shall have flat fins of minimum thickness of 0.010 inch or alternatively, coated corrugated fins of 0.0075 inch minimum thickness, and utilize at least 9 fins per inch of coil.

N7.4.2.3. RECEIVER

A refrigerant receiver, if required for the design, shall:

a. Be provided with capacity to hold 100% of the refrigerant in the system.

b. Be mounted to the condenser/compressor unit.

c. Be designed and fabricated in accordance with ASME, Code for Unfired Pressure Vessels, for 450 psi maximum service or higher if system design indicates.

d. Have 2 refrigerant level sight glasses with float balls.

N7.4.2.4. FILTER DRYER

A filter drier shall be provided with:

a. Replaceable core.

b. Refrigerant flow sight glass and system moisture indicator on down side of the drier.

c. Design provisions to isolate the filter drier when cartridge replacement is required.

N7.4.2.5. EVAPORATOR UNIT

The evaporator portion shall include the evaporator coil, evaporator fan, and evaporator fan motor in an integral unit. The evaporator unit shall have a drain pan designed to collect and drain evaporator condensation and any condensation from valves or other components to the road bed

and to prevent carry over to the air stream under all conditions of vehicle motion.

Evaporator coils shall be constructed of copper tubes and copper plate-type fins, or other similar type construction approved by the Engineer. Fins shall be expanded to provide a permanent mechanical bond between the fins and the tube. The Evaporator coil shall have flat fins of minimum thickness of 0.010 inch or alternatively, coated corrugated fins of 0.0075 inch minimum thickness, and utilize at least nine fins per inch of coil.

The construction of the evaporator assembly shall be designed to allow ready access to components from beneath the evaporator when installed in the Metrorail vehicle ceiling. The evaporator assembly shall be designed for ready removal of the blower motor unit and the heater unit. The drain pan and drain tubing shall be designed for ready cleaning and maintenance.

The evaporator unit, and associated piping shall be mounted and insulated such that condensation within the interior of the vehicle is prevented. The evaporator drain pan shall be stainless steel.

N7.4.3. PIPING

The overall design of piping and connections shall include avoidance of refrigerant leaks.

Refrigerant lines shall comply with ASTM B280. Joints in refrigerant lines shall be accessible and serviceable with standard hand tools.

The suction line shall be free of traps and low points throughout its length at any normal car roll and pitch attitude. The suction line shall be insulated over its entire length with 0.5 inch minimum thickness, closed-cell foam tubing.

Where suction and liquid lines run parallel, both shall be routed in an insulation jacket with pipes firmly clamped to prevent chafing. Refrigerant piping insulation shall be a silicon foam type, subject to approval of the Engineer.

Technicians performing soldering shall be qualified according to AWS B2.2 Standard for Brazing Procedure and Performance Qualification.

Procedure(s) for soldering refrigerant piping shall be submitted (CDRL N710).

N7.4.4. CONTROLS

Control apparatus shall be provided to control coordinated operation of heating, ventilation, and cooling functions to produce interior conditions specified.

Equipment shall be designed to minimize operational adjustments. Additionally, adjustments shall not be required during routine maintenance.

Temperature sensors shall be located in positions where they can be easily removed for maintenance, and for optimal sensing of interior conditions.

Normally closed contacts, to indicate heating and cooling modes are operating, shall be provided to interface with the vehicle annunciator system.

A service switch shall be provided for each unit to override thermostatic control and heating or cooling and turn off heating or cooling.

A refrigeration control box, readily accessible to maintenance personnel, shall contain pump down switching, charging ports, and associated valves.

N7.4.4.1. TEMPERATURE SENSING

Temperature sensing and control devices shall be solid state.

Electronic Logic control shall be microprocessor based to monitor and control the HVAC System. Temperature control shall be integrated into a single unit containing dedicated power supplies, diagnostic subsystem, and programmable logic circuitry.

The HVAC Logic shall interface with the car fault monitoring system described in TPN20.

N7.4.4.2. MOTOR CONTROLS

Unit Control shall consist of all motor starters, relays, and switches, and shall be installed on each HVAC Unit or in auxiliary control box.

N7.4.4.3. TRAIN LINE CONTROL

Train Line Control of the HVAC system shall be provided such that each HVAC system in the consist can be energized by depressing the "AUXILIARIES ON" button or operating console key switch on any car in a consist.

Similarly, each HVAC system in the consist can be de-energized by depressing the "AUXILIARIES OFF" button at any car or by "AUXILIARIES OFF" timer. When de-energized, cooling controls shall provide any necessary time delays for proper shutdown. Additionally, lack of proper shutdown shall not cause damage to any equipment when re-energized.

N7.4.5. SPECIAL TEST EQUIPMENT

Special test equipment for maintenance, repair, troubleshooting, and diagnostics shall be provided by the HVAC system contractor. This shall include equipment for charging, evacuation, and other repairs.

Test ports for connection to a car level PTU shall be provided within the temperature control unit, and integrated with the VMS.

- The HVAC PTU shall be capable of interfacing with the HVAC controller, and of monitoring and logging the following:
- Compressor Status.
- Evaporator Fan Status.
- Condenser Fan Status.
- Refrigeration modulation status, as applicable.
- Hi Pressure.
- Low Pressure.
- Set Temperature.
- Start/Shut Down History.
- Cooling Request History.
- Heater Request History.
- Equipment Faults.

TABLE OF CONTENTS

N8. LIGHTING 8-1
N8.1. GENERAL 8-1
N8.1.1. CITED REFERENCES 8-1
N8.1.2. SUBMITTALS – CDRLS 8-1
N8.2. INTERIOR LIGHTING 8-2
N8.2.1. INTENSITY REQUIREMENTS 8-2
N8.2.2. BRIGHTNESS RATIO 8-3
N8.2.3. GLARE 8-3
N8.2.4. NOISE 8-3
N8.2.5. FIXTURE ASSEMBLY AND INSTALLATION 8-3
N8.2.6. LED LIGHT FIXTURES 8-3
N8.2.7. LENSES AND BEZELS 8-4
N8.2.8. POWER 8-4
N8.2.9. CONTROL 8-4
N8.2.10. CAB LIGHTING 8-4
N8.2.11. OPERATOR'S CONTROL PANEL LIGHTING 8-5
N8.3. EXTERIOR LIGHTING 8-5
N8.3.1. HEADLIGHTS 8-5
N8.3.2. TAILLIGHTS 8-6
N8.3.3. DOOR OPEN INDICATOR 8-6
N8.3.4. INDICATOR LIGHT ASSEMBLY LEDS 8-7
N8.3.5. MARKER LIGHTS 8-7
N8.3.6. DESTINATION SIGN LIGHTS 8-7
N8.4. EMERGENCY LIGHTING 8-7

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N8. LIGHTING

N8.1. GENERAL

This section defines the requirements for lighting for the Miami Metrorail vehicles. The vehicle lighting system shall include exterior and interior lighting fixtures as described herein. Access to interior lamps shall be provided by a bezel, or other type of approved enclosures secured by captive fasteners. There shall be no fasteners exposed to the passengers. The lighting system design shall meet all applicable standards requirement for car lighting. Where a conflict exists, the most restrictive condition will apply. All fixtures shall be water tight, dust-proof to minimize the accumulation of airborne dirt and dust within the fixture. Lighting fixture housings or sockets shall not be used as a ground return. Ground isolation shall be provided for both electrical feeds to the lamps. A separate car safety ground wire shall be connected to each lighting fixture. LED lighting shall be used in the car interior.

N8.1.1. CITED REFERENCES

The following specifications are referred to within these Lighting requirements.

Source/Section	Title
49 CFR 221.14	Rear End Marking Device – Passenger, Commuter, and Freight Trains
49 CFR 238.115	Passenger Equipment Safety Requirements Emergency Lighting
APTA SS-E-013	Standard for Emergency Lighting System Design for Passenger Cars

N8.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is listed for reference.

CDRL No.	Title	TP Reference
N801	Computer Analysis of Illumination	TPN8.2.1.
N802	Data and Test Results of the Ballasts	TPN8.2.6.
N803	Specifications and Data Sheets on all Exterior Lamps and Lights, including LEDs	TPN8.3.
N804	Headlight Visibility Data	TPN8.3.1.

N8.2. INTERIOR LIGHTING

Vehicle interior lighting shall consist of main interior lights, emergency lights, and Operator's cab lights. The maximum degree of commonality shall be maintained between fixtures in order to minimize the number of spare parts and maintenance practices.

If interior lighting fixtures are designed to serve the dual purpose of lighting and air distribution, the air velocity at the discharge point shall be between 500 and 800 fpm.

N8.2.1. INTENSITY REQUIREMENTS

The average intensity of illumination within the vehicle at an elevation of 33 in. above the floor on a 45° plane centered on the front edge of any seat, and 55 in. above the floor on a 45° plane for passengers standing anywhere in the aisles shall be at least 30 Foot candles (Fc). The average illumination intensity on the floor in the passenger aisles shall not be less than 20 Fc. All of the specified light intensities shall be achieved at the rated primary voltage.

The vehicle interior lighting system shall provide an average intensity at unlit platforms of at least 2 Fc at all points perpendicular to the door threshold for a distance of 3 ft.

The two lighting fixtures adjacent to the Operator's cab shall be designed to emit a reduced light level in such a manner as to cause no glare in the Operator's cab on the windshield, side windows, or displays and associated glare for nighttime operation.

The Contractor shall submit a computer analysis of illumination using IESNA illumination principles or luminance files to perform the analysis, to the Engineer for review and approval (CDRL N801). As a part of this submittal, the Contractor shall include a test plan for the measurement of

these parameters on the pre-production vehicles as part of the vehicle acceptance testing.

N8.2.2. BRIGHTNESS RATIO

The average brightness ratio between lighting fixtures and adjacent areas shall not exceed 40:1. The brightness ratio between any adjacent areas in the passenger's normal field of view shall not exceed 20:1. The brightness ratio between maximum and average fixture brightness shall not exceed 5:1.

N8.2.3. GLARE

Fixture light output in a zone 60° to 90° (degrees) from the fixture shall not be greater than 12% of the total output of the fixture.

N8.2.4. NOISE

When in operation, the lighting must be inaudible to passengers and the train crew.

N8.2.5. FIXTURE ASSEMBLY AND INSTALLATION

Light fixture housings (and integrated air diffusers if applicable) shall be manufactured from aluminum or stainless steel and finished in a manner integral with the vehicle interior scheme and be corrosion resistant. Metallic fixture housings and reflectors shall be grounded.

Bezels and lenses shall be designed for even, glare-free light distribution.

Lock-type plug connectors shall be utilized at the fixtures for ease of maintenance. In addition to the support obtained from lock-type terminal pins and sockets, the lamps shall be supported by the ferrule rather than placing the load on the lamp pins in such a way that vibration shall not cause the lamp to fall.

Lamp sockets shall be removable from below fixtures with the use of ordinary hand tools.

N8.2.6. LED LIGHT FIXTURES

The average life of the LED light fixtures shall be a minimum of 50,000 hours.

N8.2.7. LENSES AND BEZELS

Light fixtures shall utilize diffusers contained in a hinged door, or other approved low maintenance design with either locking devices or captive fasteners. Lens material shall be clear, prismatic, non-yellowing polycarbonate meeting the flammability requirements specified in TPN19.

N8.2.8. POWER

All fluorescent or LED lights shall be powered by the 37.5 VDC low-voltage power supply. At a minimum, the emergency lighting shall meet the light performance levels according to APTA SS-E-013 section 5.2, table 1. The emergency lighting fixtures shall be arranged to provide uniform lighting throughout the vehicle, the emergency fixtures shall alternate from side-to-side from front to rear. There shall be at least one emergency lighting fixture above each doorway. Circuit breakers for normal lighting circuits shall be located in the low voltage circuit breaker panel in the Operator's cab.

N8.2.9. CONTROL

Main interior lighting shall be trainline controlled via a switch in the lead cab of the consist. The switch shall be functional in the operating cab when the Master Controller Key Switch (KS) is in the "ON" position. In addition, a separate lighting "Aux On" switch shall be provided for maintenance personnel.

If the vehicle is not powered by the third rail, then the non-emergency lighting shall be shed to conserve battery power.

N8.2.10. CAB LIGHTING

Operator cabs shall be equipped with a focused, ceiling-mounted, LED reading light and dome light both located in the ceiling above the Operator's control panel controlled by separate switches.

The LED dome light shall be powered by the emergency lighting circuit.

A ceiling LED mounted flood light shall be provided to illuminate the end door area.

Fluorescent lighting in the cab vestibule area and the end door area flood light shall have separate control for increased Operator visibility and reduction of glare.

The cab reading light fixture is to provide an average intensity of 20 Fc over a 15-inch diameter reading panel tipped at 45° at 33 in. above the floor.

N8.2.11. OPERATOR'S CONTROL PANEL LIGHTING

LED backlighting, with dimming control, shall be provided for all analog instruments and Operator's control panel lighting. Operator's control panel lighting shall be able to be tested via a single "Lamp Test" momentary switch, as specified in TPN5.

N8.3. EXTERIOR LIGHTING

Exterior lighting shall be provided as an integrated set of fixtures, maximizing the use of common parts, and providing a highly aesthetic end appearance.

The exterior lighting shall include headlights, taillights, marker lights, door indicator lights, and indicator lights.

The Contractor shall submit data on all lamps and lighting devices to the Engineer for review and approval (CDRL N803). LED, sealed units shall be used whenever possible in preference to other methods. Only LED, sealed units with a service-proven history in transit service shall be used.

Lamp and sealed LED unit replacement shall be accomplished from the outside, except for destination signs. All exterior lights shall operate from low-voltage DC with each lamp having its own dropping resistor, if required.

Lights that determine the "Front" and "Rear" of the married pair shall be interlocked with front-end controls to enable proper operation of headlights and taillights. Control of all exterior lights shall be interlocked so that lights determining the "Front" of a train are illuminated on the front of the first vehicle of the train. Lights determining the "Rear" of the train shall be illuminated on the rear of the last vehicle of the train. Lights between the vehicles of the consist shall remain off.

N8.3.1. HEADLIGHTS

The F-end of each vehicle shall be equipped with dual sealed-beam, headlights. The units shall be capable of revealing a person or object in clear weather at a distance of 350 ft without interfering with the line-of-

sight and view of drivers of other consists. High and Low beam control shall be provided (CDRL N804).

Headlights shall be removable and adjustable from outside of the vehicle and shall be adjusted and aimed. Headlights shall have a minimum of ±4° of adjustment in all directions. Replacement of a headlight shall not require readjustment of its aiming position.

Headlight control shall be through relay logic and interlocking. A two-position switch on the Operator's console shall control the high and low beam function. The headlights shall be operational in the lead car when the Master Controller Key Switch is energized.

A circuit breaker for the headlight circuit shall be provided in the low voltage circuit breaker panel in the Operator's cab.

N8.3.2. TAILLIGHTS

Two, rail transit service-proven, taillights with an integral red LED cluster arrangement shall be provided at the F-end of each vehicle, next to and outboard of the headlights. The taillights shall meet the requirements of 49 CFR 221.14.

The taillights shall emit a red light that is plainly visible in clear weather from a distance of at least 500 ft.

All taillights on the front and rear of a consist shall be illuminated whenever the Operating cab's master controller key switch is in the "OFF" position and the train is in the "AUX ON" position. When the master controller key switch is in "ON" the taillights on the front of the train shall be extinguished and the taillights on the rear of the train shall remain illuminated.

Circuit breakers for the taillight circuit shall be provided in the low voltage circuit breaker panel in the Operator's cab.

N8.3.3. DOOR OPEN INDICATOR

Door Open Indicators shall be provided at each door panel. Indicators shall be LED sealed units, located on the exterior just above the upper corner of the door opening and include a red lens that is sealed from debris, watertight, and shall not be damaged during car wash. These indicators shall be visible from the Operator's cab.

N8.3.4. INDICATOR LIGHT ASSEMBLY LEDS

Indicator Light Assemblies shall be provided on the exterior at the F-end of each car above the sliding sash window. Indicators shall contain 3 different colored lights representing different fault or status conditions of the vehicle. The Indicator Light Assembly shall have three different colored bayonet-base 37.5V LED units (blue, amber, red). These indicators shall be visible from the Operator's Cab side windows.

- The blue colored indicator is the "IC Call" indicator and will utilize a blue-colored indicator and blue lens.
- The amber colored indicator is the "Brakes On" indicator and will utilize an amber-colored indicator and amber lens.
- The red indicator is the "ATP By-Passed" indicator and will utilize a red colored indicator and red lens.

N8.3.5. MARKER LIGHTS

Marker Lights shall be provided at the end of the vehicle in the upper corners of the car end. Control shall be such that whenever the consist is activated either by energizing the "AUX ON" circuit or by the master controller key switch, the amber marker LEDs, at each end of the train only, shall illuminate.

The marker LEDs shall be powered by the exterior light circuit breaker located in the low voltage circuit breaker panel in the Operator's cab.

The marker lights shall meet the requirements of 49 CFR 221.14.

N8.3.6. DESTINATION SIGN LIGHTS

Destination signs are specified in TPN13.

N8.4. EMERGENCY LIGHTING

In the event of the loss of the main power system, the lights described in the FRA and APTA documents identified below shall be automatically switched or remain functional from the battery powered system. The light distribution system within the car shall be evenly distributed to meet or exceed the emergency lighting requirements in 49 CFR 238.115 and APTA SS-E-013-99, Standard for Emergency Lighting System Design for Passenger Cars. These requirements shall include compensation for the decrease in light intensity due to aging.

In addition the following lights shall remain functional and be powered by the storage battery under the loss of Low Voltage Power Supply output:

- Cab Lights.
- Headlights.
- Taillights.

The interior emergency lighting shall meet the minimum performance criteria for rail equipment as specified in APTA SS-E-013-99. Testing of the emergency lighting system shall be performed in accordance with Section 6 of APTA SS-E-013-99.

TABLE OF CONTENTS

N9. AUXILIARY ELECTRICAL EQUIPMENT 9-1
N9.1. GENERAL 9-1
N9.1.1. OVERVIEW 9-1
N9.1.2. CITED REFERENCES 9-1
N9.1.3. SUBMITTALS – CDRLS 9-1
N9.1.4. CIRCUIT REQUIREMENTS 9-3
N9.2. PRIMARY POWER COLLECTION AND DISTRIBUTION 9-4
N9.2.1. GENERAL 9-4
N9.2.2. CURRENT COLLECTOR 9-4
N9.2.3. THIRD RAIL SOURCE 9-5
N9.2.4. GROUND BRUSHES 9-5
N9.2.5. PRIMARY POWER DISTRIBUTION ASSEMBLY 9-5
N9.2.6. CIRCUIT PROTECTION COORDINATION 9-7
N9.3. DUTY CYCLE 9-7
N9.4. AC POWER DISTRIBUTION ASSEMBLY 9-7
N9.4.1. GENERAL 9-7
N9.4.2. FEEDER BREAKERS 9-8
N9.4.3. BRANCH CIRCUIT BREAKERS 9-8
N9.4.4. CONTACTORS AND STARTERS 9-8
N9.4.5. PNEUMATIC PUMP AND HVAC SYSTEM INTERLOCK 9-8
N9.4.6. UTILITY OUTLET 9-9
N9.5. LOW-VOLTAGE POWER DISTRIBUTION 9-9
N9.5.1. LOCATION 9-9
N9.5.2. CIRCUIT BREAKERS 9-9
N9.5.3. CONTACTORS 9-9
N9.5.4. LOW-VOLTAGE GROUND PLATES 9-10
N9.5.5. INSULATION REQUIREMENTS 9-10
N9.6. AUXILIARY INVERTER 9-11
N9.6.1. GENERAL 9-11
N9.6.2. ELECTRONIC LOGIC 9-11
N9.6.3. DIAGNOSTICS 9-12
N9.6.4. SELF-TEST 9-13
N9.6.5. FAULT ANNUNCIATION 9-13

N9.6.6. SOFTWARE 9-13
N9.6.7. POWER CIRCUIT DEVICES 9-13
N9.6.8. REGULATION AND CONTROL 9-14
N9.6.9. CAPACITY/EFFICIENCY 9-15
N9.6.10. FAULT OUTPUT 9-15
N9.6.11. PROTECTION 9-16
N9.6.12. INSTALLATION 9-16
N9.6.13. COMPONENTS 9-16
N9.6.14. COOLING 9-17
N9.7. LOW-VOLTAGE POWER SUPPLY (D.C.) 9-17
N9.7.1. POWER SOURCE 9-17
N9.7.2. LOW-VOLTAGE OUTPUT 9-17
N9.7.3. CAPACITY 9-18
N9.7.4. REGULATION 9-18
N9.7.5. PROTECTION 9-18
N9.7.6. CONTROL 9-18
N9.7.7. AUXILIARY CONTACTS 9-18
N9.7.8. INSTALLATION 9-19
N9.8. STORAGE BATTERY 9-19
N9.8.1. GENERAL 9-19
N9.8.2. DESIGN REQUIREMENTS 9-20
N9.8.3. BATTERY ENCLOSURE 9-21
N9.9. GROUNDING 9-22
N9.9.1. GENERAL 9-22
N9.9.2. SAFETY 9-22
N9.9.3. GROUND BRUSH WIRING 9-22
N9.9.4. CARBODY GROUND 9-23
N9.9.5. EQUIPMENT SAFETY GROUNDS/BONDS 9-23
N9.9.6. LOW-VOLTAGE GROUND 9-24
N9.9.7. INVERTER GROUND 9-24
N9.9.8. SHIELDED CIRCUITS 9-24
N9.10. PORTABLE TEST UNIT 9-24

N9. AUXILIARY ELECTRICAL EQUIPMENT

N9.1. GENERAL

N9.1.1. OVERVIEW

This section specifies the requirements for auxiliary electrical equipment for the vehicle, including primary power collectors, alternating current conversion equipment, Low-Voltage Power Supply (LVPS), low-voltage breaker panel, protection devices, grounding methods, and testing.

The auxiliary power system shall be designed in accordance with IEC 61287-1 and APTA RP-E-009-98. The auxiliary power system shall be tested in accordance with IEC 61287-1 including optional sudden variation in load test and effectiveness of filter test. The Contractor shall perform vehicle acceptance tests per TPN17.

N9.1.2. CITED REFERENCES

Source/Section	Title
APTA RP-E-009-98	Recommended Practice for Wire Used on Passenger Rolling Stock Equipment
APTA SS-E-005-98	Standard for Grounding and Bonding
ASTM B584	Copper Alloy Sand Castings for General Applications
IEC 60623	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells
IEC 61287-1	Power Converters Installed on Boarding Rolling Stock

N9.1.3. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

N902	Operating Characteristics and a Load Analysis for the AC Voltage Power Supply	TPN9.1.4.2.
N903	Operating Characteristics and a Load Analysis for the Low-Voltage Power Supply	TPN9.1.4.3.
N904	Current Collector Design Details	TPN9.2.2.
N905	Fuse Mounting Location and Details	TPN9.2.5.2.
N906	Information to Show that Contactors Operate in Severe or Heavy Storm Conditions with Moisture Present	TPN9.2.5.4.
N907	Spare Studs or Threaded Bolt Holes on Ground Plate for Connections	TPN9.2.5.5.
N908	Coordination Analysis of Protection Devices	TPN9.2.6.
N909	AC Power Distribution Assembly Load Sequencing	TPN9.4.1.
N910	Breaker Identification and Labelling Plan	TPN9.4.1.
N911	Feeder Breaker Location	TPN9.4.2.
N912	Branch Circuit Breakers	TPN9.4.3.
N913	Pneumatic Pump & Interlock Design	TPN9.4.5.
N914	Utility Outlet Installation Procedure	TPN9.4.6.
N915	Operating Characteristics, Load Analysis, and a Voltage Interruption Analysis for the Auxiliary Inverter	TPN9.6.1.
N916	Functional Description of Diagnostic Methods for Troubleshooting/Fault Isolation	TPN9.6.2.
N917	Details of Diagnostic/Data Logging Capabilities, Storage Capacity, Self-Test, and Level of Fault Reporting	TPN9.6.3.
N918	Self-Tests	TPN9.6.4.
N919	Characteristics of Power Circuit Devices (including comparison of maximum capabilities vs. Design values)	TPN9.6.7.
N920	Evidence of Cooling System Reliability	TPN9.6.7.
N921	Analysis of Proposed Battery and Associated Circuits	TPN9.8.2.

CDRL No.	Title	TPN Reference
N922	Analysis of Emergency Load Requirements and Battery Capacity	TPN9.8.2.2.
N923	Grounding Plan (including details and functional diagram)	TPN9.9.1.
N924	Grounding Arrangement with Sufficient Redundancy for Safety and Operational Reliability	TPN9.9.3.

N9.1.4. CIRCUIT REQUIREMENTS

Electrical materials and installation methods to be used in the fabrication of auxiliary electrical equipment, including wire, cable, printed circuit boards, and circuit protective devices, shall conform to the requirements of TPN19.

The three basic groups of vehicle circuits shall be primary 750 volt DC power circuits, AC power circuits, and low-voltage DC circuits, as specified herein.

N9.1.4.1. PRIMARY POWER CIRCUITS

Primary power circuits shall be nominal 750 VDC circuits. Current capacities of all primary power conductors shall be per APTA RP-E-009-98. Current capacities of primary power return cables to ground brushes shall be 150% of RMS load. Minimum cable and wire size shall be per TPN19.

The Contractor shall submit operating characteristics and a load analysis for the primary power supply to the Engineer for review and approval (CDRL N901).

N9.1.4.2. AC POWER CIRCUITS

AC power circuit conductors, including cabling from the auxiliary inverter, shall meet the current capacity per APTA RP-E-009-98. Conductors shall be per TPN19. Current capacities of conductors between AC Auxiliary motors and Auxiliary inverter shall be per APTA RP-E-009-98.

The Contractor shall submit operating characteristics and a load analysis for the AC-voltage power supply to the Engineer for review and approval (CDRL N902).

N9.1.4.3. LOW-VOLTAGE CIRCUITS

Low-voltage circuits shall be all circuits powered from the low-voltage power supply or battery, including feeders from the low-voltage power supply or battery to the distribution panel. All low-voltage equipment shall operate satisfactorily under all operating conditions, including battery operation with a failed LVPS.

The Contractor shall submit operating characteristics and a load analysis for the low-voltage power supply to the Engineer for review and approval (CDRL N903).

N9.2. PRIMARY POWER COLLECTION AND DISTRIBUTION

N9.2.1. GENERAL

Primary power collection and distribution shall include the power collector shoes, ground brushes, distribution system and assemblies, insulation requirements, and circuit protection devices and coordination. Electrical equipment shall be energized from the following power sources:

a. 750 VDC from the third rail.

b. 120/208 or 120/230 VAC 60 Hz distribution system operating on third rail power.

c. Nominal 37.5 VDC from an LVPS and nickel cadmium battery system.

N9.2.2. CURRENT COLLECTOR

All vehicle power shall be collected from 4 current collectors mounted on each car, with one collector mounted on each side of each truck positioned properly to interface with the MDT third rail / running rail geometry. Each current collector will have a current collector fuse. The Contractor shall submit for approval by the Engineer design details of the current collection system (CDRL N904).

N9.2.3. THIRD RAIL SOURCE

Third rail voltage shall be used for propulsion, via inverters for AC drive and as input to the auxiliary inverter and low voltage power supply.

N9.2.4. GROUND BRUSHES

Three isolated ground brushes in separate housings, with insulated holders and support assemblies, shall be provided for each axle. Primary power ground shall be provided by two ground brushes per axle. Car safety ground shall be provided by one ground brush per axle.

N9.2.5. PRIMARY POWER DISTRIBUTION ASSEMBLY

A primary power distribution system shall be provided that shall include the following:

- Collector shoes and fuses.
- Knife Switch Box as described in TPN10. The Knife Switch Box will contain an auxiliary power fuse which will feed high voltage power to the auxiliary systems. The knife switch will also directly feed the High Speed Circuit Breaker (HSCB). The HSCB will feed power to the two propulsion inverters. The knife switch will have four positions: RUN, THIRD-RAIL TEST, OFF, and SHOP TEST.
- High Speed Circuit Breaker (HSCB) shall safely interrupt the maximum load and fault current as described in TPN10.
- A Circuit breaker distribution panel.
- Line contactors as required to isolate the individual propulsion inverters, auxiliary inverter, and low voltage power supply and to provide line filter charging.
- A Primary power ground plate.

N9.2.5.1. ELECTRICAL DISCONNECT SWITCH

The HSCB shall act as the disconnect switch as described in TPN10 for propulsion fault currents.

N9.2.5.2. PRIMARY CURRENT COLLECTOR FUSES

Current collector assemblies shall be provided with fuses. The collector shoe fuses shall be rated to provide protection for all primary power circuits at full circuit loading. A separate fuse shall be provided in series

with the parallel collector shoe fuses to protect primary auxiliary power loads. The HSCB will protect the propulsion equipment. Fuses shall have blown fuse indicators as per TPN19. All fuse mounting locations, ratings, fuse curves and details shall be submitted to the Engineer for review and approval (CDRL N905).

N9.2.5.3. CIRCUIT BREAKERS

The Contractor shall ensure that adequately rated sensing and fault clearing devices are provided to protect auxiliary system circuits and components from faults and over-current damage, ground faults, and any other circuit protection deemed necessary.

N9.2.5.4. POWER CONTACTORS

The Contractor shall ensure that all primary system contactors are rated and coordinated for maximum current capacity and overload interruption capability as required by the system design.

Only electromagnetic contactors shall be used. The Contractor shall provide, for the Engineer's approval, documentation and test results to confirm that the contactors operate properly in severe or heavy rain conditions (CDRL N906).

Contactors shall be capable of interrupting current in both directions and over the full range of current, unless the circuit design precludes this action. Adequate ventilation and clearance of arcing products shall be provided.

The design shall not permit contact welding under any circumstance.

When contactor arcs are extinguished within an equipment enclosure, the Contractor shall ensure that all devices are adequately protected against blowout of contact material and contamination.

If the contactor arc is extinguished outside the equipment enclosure, the Contractor shall assure adequate arc clearance distance from adjacent equipment enclosures and provide adequate space to service archutes.

N9.2.5.5. PRIMARY GROUND PLATE

A primary power ground plate shall be provided isolated from the carbody, insulated for 3,000 volts minimum, and shall be located for easy accessibility. The plate shall have studs or threaded bolt holes for

connection of F-end and R-end truck ground brush cables, propulsion return cable, and high voltage auxiliary inverter return. Only one wire or cable shall be connected per stud. At least three spare studs shall be provided with at least one for each stud size used as approved by the Engineer (CDRL N907).

A cover shall be located over the ground plate to prevent inadvertent contact by maintenance personnel. The cover shall contain large, easily visible warning labels.

N9.2.6. CIRCUIT PROTECTION COORDINATION

- All fuses, circuit breakers and cable/wiring shall be coordinated to provide specified operation and protection. The Coordination shall ensure that circuit interruption devices can localize any and all faults, and prevent damage to circuit components. The protective devices shall be capable of interrupting the maximum as well as minimum fault currents.
- The coordination analysis shall take into account the parallel operation of both third rail collector fuses, as well as coordination with one collector fuse in the circuit. The coordination analysis shall be submitted to the Engineer for review and approval (CDRL N908).
- Fuses and circuit breakers shall be adequately identified with function, voltage, and safety warning signs or labels, as approved by the Engineer.

N9.3. DUTY CYCLE

The auxiliary electrical system shall be rated for maximum continuous performance with parameters applicable to the operating environment of the vehicle as specified in TPN2, and as specified herein for one failed auxiliary inverter per married pair.

N9.4. AC POWER DISTRIBUTION ASSEMBLY

N9.4.1. GENERAL

The AC power distribution assembly shall receive 120/208 or 120/230 VAC, 60 Hz, three phase from the onboard AC inverter and provide distribution to all vehicle loads. In addition, load sequencing shall be

accomplished in this assembly as reviewed and approved by the Engineer (CDRL N909).

This assembly shall include feeder breakers, branch circuit breakers, contactors, and motor starters as required. All breakers shall be permanently identified and properly labeled as approved by the Engineer (CDRL N910).

N9.4.2. FEEDER BREAKERS

The high voltage feeder breakers shall be housed in an assembly located and accessible from the side of the vehicle. The design shall be reviewed and approved by the Engineer (CDRL N911).

Feeder breakers shall be rated to provide over current protection to feeder cables from the auxiliary inverter power cable, per APTA RP-E-009-98.

N9.4.3. BRANCH CIRCUIT BREAKERS

One branch circuit breaker shall be provided for each AC load and shall be rated to provide for short circuit and overload protection. Space for at least three spare breakers shall be provided. All branch circuit breakers shall be accessible from the side of the vehicle and located adjacent to the feeder circuit breakers. The design shall be submitted for approval by the Engineer (CDRL N912).

N9.4.4. CONTACTORS AND STARTERS

Contactors and starters shall be provided as specified in TPN19. Starters and contactors shall be controlled from low-voltage power. Timers shall be provided to sequence the start-up of loads as required by the overload capability of the auxiliary inverter and to disconnect unnecessary loads when the auxiliary inverter shutdown is delayed to supply HVAC system pump-down and battery charging loads.

N9.4.5. PNEUMATIC PUMP AND HVAC SYSTEM INTERLOCK

The Auxiliary Power Supply (APS) shall provide 120/208 or 120/230 VAC three phase to each of the vehicle's two (2) HVAC systems, interior duplex utility outlets (120 VAC single phase), equipment cooling blower motors (if used), and on the A-car only, a pneumatic compressor. The Contractor shall design and implement an interlock that will recognize a

failure of the A-car auxiliary inverter and automatically switch to feed the pneumatic compressor on the A-car from the B-car's APS unit.

Additionally, if a single auxiliary inverter failure occurs on a married pair there shall be an interlock designed to shed a half of HVAC units on both cars of the married pair and maintain a half of HVAC units on both cars, the blower motors on both cars, and the air compressor on the A-car from the remaining working APS.

The Contractor shall submit a design plan for the pneumatic pump and HVAC interlock to the Engineer for review and approval (CDRL N913).

N9.4.6. UTILITY OUTLET

A 120 VAC, 20 ampere, single-phase utility duplex outlet circuit shall be provided located in Operator's cab and two (2) locations in the interior of each car. The Contractor shall submit details of this installation to the Engineer for review and approval (CDRL N914).

N9.5. LOW-VOLTAGE POWER DISTRIBUTION

N9.5.1. LOCATION

Low-voltage power shall be distributed from a circuit breaker panel, located in a separate enclosure from other circuits in the electrical locker in the cab. The breakers shall be within reach and easily accessible by the Operator.

N9.5.2. CIRCUIT BREAKERS

Separate circuit breakers shall be provided for each low-voltage circuit. The circuit breaker rating shall be sized for the current capacity of branch circuit wiring and load requirements. Space for at least five spare circuit breakers shall be provided, located as specified herein.

N9.5.3. CONTACTORS

Lay-up and load shed contactors shall be provided. The Contractor shall provide additional contactors, if required, for proper operation of the auxiliary power system.

N9.5.3.1. LAY-UP CONTACTOR

A contactor shall be provided in series with all circuit breakers, with the exception of the door control breaker. The contactor trainline shall be energized and latched by the key switch in "ON" and de-energized by the key switch returning to "OFF" except that de-energization may be delayed for pump-down of AC equipment and battery charging.

N9.5.3.2. LOAD SHED CONTACTOR

A contactor shall be provided in series with non-emergency circuit breakers. This contactor shall be energized whenever the low-voltage power supply is operating within specified limits and de-energized 5 to 10 seconds after the loss of low-voltage power supply operation, unless normal output is reinstated within the selected time period of 5 to 10 seconds. The de-energized time period shall be adjustable between 5 and 10 seconds in 1-second increments.

N9.5.4. LOW-VOLTAGE GROUND PLATES

An isolated ground plate shall be provided within the low-voltage circuit breaker panel enclosure. The ground plate shall provide one stud for each branch circuit return and one stud for low-voltage feeder return. Three spare studs or threaded bolt holes shall be provided. A ground wire shall be provided between the ground plate and the carbody. This circuit breaker ground plate shall be connected to the car safety ground plate with two cables each sized for rated current.

The car safety ground plate shall be located under the car. A ground wire shall be provided between the car safety ground plate and the carbody.

The ground plates and interface wiring shall be part of the electrical coordination analysis.

N9.5.5. INSULATION REQUIREMENTS

Insulation shall comply with the requirements of TPN19, including the fault conditions of ground wire removed from ground bus, and high side connected to ground plate, all circuit breakers closed, and lay-up and load shed contactors blocked closed in order to simulate a worst case condition.

N9.6. AUXILIARY INVERTER

N9.6.1. GENERAL

Each vehicle shall be equipped with an auxiliary inverter to supply AC and low-voltage power to onboard subsystems. The auxiliary inverter shall be Insulated Gate Bipolar Transistor (IGBT) based and capable of operating from 750 VDC primary power and capable of providing 120/208 or 120/230 VAC, 60 Hz, three phase, Y-connected power for AC loads. The inverter power circuit shall operate at a frequency above 10 kHz and meet the conformed electrical noise requirements as specified in TPN2. The AC loads and the LVPS loads shall be galvanically isolated from the primary power. The Contractor shall be responsible for the compatibility of the motors and all other auxiliaries with the AC voltage waveform characteristics. The inverter output rating shall be 110% of the connectable vehicle loads. The efficiency of the auxiliary inverter shall be no less than 90% for the power output range of 50-100%. The Contractor shall provide all supporting reports and analyses of the operating characteristics of the proposed inverter to the Engineer for review and approval. The inverter reports and analyses shall include acceptable load and voltage interruption data (CDRL N915).

N9.6.2. ELECTRONIC LOGIC

The electronic logic shall be microprocessor-based, incorporate fault monitoring, diagnostics, and control of the auxiliary inverter and low-voltage power supply functions within specified control and safety requirements. The Contractor shall submit to the Engineer for review and approval a description of the proposed diagnostic methods for troubleshooting and fault isolation (CDRL N916).

The auxiliary control logic shall be integrated into a single subsystem, containing a dedicated power supply diagnostic function unit and programmable logic circuitry. The dedicated power supply shall operate from the low-voltage circuit breaker panel. This power supply shall ensure proper operation of the electronics logic control when the voltage at the circuit breaker is within the limits specified in TPN2.

The auxiliary control logic shall control ventilation as required to cool heat-sinks and other external components. A method shall be provided to

detect ventilation failure or degradation. Detection of any cooling system failure shall result in annunciation on the fault annunciation panel.

Air intakes shall be screened and positioned on the outside of the equipment in order to prevent the entrance of water or debris. Filter cages shall be made of stainless steel. Air shall be filtered to better than 90% ASHRE dust-resistant and better than 30% dust-spot efficiency.

Equipment ventilation blowers shall be of a service-proven design. The blowers shall be driven directly by AC motors. The motors shall be of a type currently used in railroad or rail transit service. The blower and motor shall have permanently lubricated insulated bearings with rolling elements.

Within the control box enclosure, fans shall be used for the elimination of hot spots. When the power supply voltage drops below the minimum voltage specified in TPN2, the control circuits shall be isolated from the electronic hardware through isolation devices.

N9.6.3. DIAGNOSTICS

The diagnostics provided shall continuously monitor the operation of the auxiliary inverter and low-voltage power supply and shall identify problems down to the line replaceable unit (LRU). The level of the fault reporting shall be sufficiently detailed to allow operating and maintenance personnel to take prompt corrective action.

Memory of a minimum of 100 operational faults shall be provided as non-volatile memory with a minimum of 25 operational fault reserve capacity. The fault system shall also store no fewer than 6 fault traces, sampling data at a rate of no slower than 10 ms, and recording relevant data for 3 seconds before and 2 seconds after the fault. Operational data logging shall also be provided to monitor the system status on a continuous basis. The level of fault reporting is subject to the Engineer's review and approval (CDRL N917).

All fault, trace, and operational data shall be downloaded and reset-able from the Portable Test Unit (PTU). The Contractor shall provide serial port interfaces within the auxiliary inverter/LVPS for connection of the PTU. An additional serial port shall be made available in an agreed location inside the Operator's cab or passenger compartment. This port shall be clearly and permanently identified with the subsystem function. All fault data shall

be timed, dated, and recorded in Eastern Standard Time (EST), automatically adjusted for Daylight Saving Time (DST). Time-stamping devices shall be synchronized by means of a microprocessor systems clock as specified in TPN20.

N9.6.4. SELF-TEST

System level power-up self-tests shall be provided to check the integrity of the auxiliary inverter and low-voltage power supply. Failure conditions detected during the power-up self-tests shall be stored as faults for later downloading to the PTU. The PTU shall also have a series of self-test capabilities testing its various internal components during initial power-up.

All self-tests shall be submitted to the Engineer for review and approval (CDRL N918).

N9.6.5. FAULT ANNUNCIATION

The Contractor shall implement a comprehensive fault annunciation system that consists of local and trainline subsystem and general fault indications. Each vehicle subsystem, including the Auxiliary Power Supply (APS), shall provide a fault indication output. The APS fault indication output shall, upon de-energization, result in the illumination of a local APS fault light, appropriately labeled, in the Operator's cab of the vehicle on which the fault occurs. Corresponding to the illumination of any of the local vehicle fault lights in the Operator's cab, general fault light shall illuminate on the Operator's control console in the leading cab of the consist (TPN5). Fault information shall be transmitted to the lead vehicle's VMS as in TPN20.

N9.6.6. SOFTWARE

Programming techniques and software requirements shall be as specified in TPN19. Software escrow requirements are specified in GP5.

N9.6.7. POWER CIRCUIT DEVICES

The power semiconductor assemblies shall be functionally grouped, and mounted in modular form to facilitate cleaning, repair and replacement. The use of Insulated Gate Bipolar Transistors (IGBT) shall be used in auxiliary power control circuits.

The design shall be such that the maximum junction temperature of power semiconductor devices shall be at least 18 oF below the Manufacturer's maximum allowable junction temperature under the worst-case duty cycle conditions. The Contractor shall submit the characteristics of power circuit devices, including a comparison of maximum capabilities vs. design values, to the Engineer for review and approval (CDRL N919).

Heat sinks shall be used to cool power semi-conductor devices. Externaly forced air may be used for heat sink temperature stabilization. However, the reliability of fans, their control equipment, and power supply shall be such as to have negligible impact upon auxiliary system availability. The cooling arrangement, control system, and auxiliary system design shall be such that failure of the fan shall not cause damage to the devices being cooled. The Contractor shall provide evidence of cooling system reliability and ability to withstand fan failure to the Engineer for review and approval (CDRL N920).

Power electronic devices and firing circuit modules shall be readily accessible for inspection, maintenance, replacement, and testing. Modules shall be interchangeable.

Where ventilation is required to cool the heat sinks, temperature sensors that detect failure or degradation of cooling shall be provided to protect the equipment. The detection of a cooling system failure shall result in annunciation on the Operator's console.

The inverter power circuit shall meet the conformed electrical noise requirements specified in TPN2.

N9.6.8. REGULATION AND CONTROL

Steady-state voltage regulation shall maintain inverter output voltage within ±5% over the entire range of connected loads and over an input voltage range between 450-900 VDC.

Steady-state frequency regulation shall maintain inverter frequency at 60 Hz, ±3 Hz.

The RMS value of the harmonic voltages shall be compatible with all permanently connected loads. Electromagnetic interference suppression requirements shall be as specified in TPN2.

The inverter output waveform shall not exceed 8% total harmonic distortion.

The inverter shall be controlled through trainlines and shall start when a key switch is placed in the "ON" position on any console in a train. Shutdown shall occur after the key switch is placed in the "OFF" position, and the "AUX-OFF" momentary signal is received from the "AUX-OFF" push-button, except that shutdown shall be delayed as required by any pump-down requirements of the cooling system and the battery-charging requirements of the low-voltage power supply.

Transient response shall be adequate to prevent damage or performance degradation. The voltage or frequency shall return to steady-state value within 3 seconds after an input voltage step change of a 100 volts or a 50% step change in the output current.

If the vehicle storage battery is dead, it shall be possible to start the auxiliary power supply using only the 750 VDC primary power. The dead battery start circuit's high-voltage input shall be galvanically isolated from the low-voltage output. Dead battery start shall not require any maintenance technician action.

N9.6.9. CAPACITY/EFFICIENCY

The auxiliary inverter shall have sufficient capacity to start any compressor individually and to simultaneously supply loads of auxiliary systems without load shedding. The inverter output rating shall be at least 110% of the connectable vehicle loads. The efficiency of the auxiliary inverter shall be no less than 90% for the power output range of 50-100%.

N9.6.10. FAULT OUTPUT

The auxiliary inverter shall incorporate a contact for fault annunciation usage. This contact shall be open when the output voltage is within voltage and frequency limits and closed when limits are exceeded for any reason. Auxiliary inverter fault protection systems shall minimize the need for an external reset of overload or fault conditions. If such a reset is required, it shall be accessible at the local vehicle indicator panel.

In addition it shall also be possible to reset the auxiliary inverter either from the "AUX-ON" or other trainline, or through a self-resetting system up to 3 attempts in a given time window.

Fault conditions shall be annunciated at the vehicle local indicator panel. Built-in diagnostics shall be provided to aid in maintenance and repair of the auxiliary inverter.

N9.6.11. PROTECTION

The auxiliary power system shall include a circuit or device to protect the auxiliary power electronics and other devices from third rail voltage transients. This protective device or circuit shall function independently without software control.

An input filter shall be provided that is independent of any propulsion system filtering devices. The input filter resonant frequency components shall comply with TPN2.

The input filter shall also act as a storage device. It shall allow for continuous operation during primary power interruptions lasting a minimum of 40 milliseconds. During a primary power interruption, it is acceptable for the auxiliary power supply's output voltage to dip, provided that the auxiliary power supply or any of its connected loads do not shut down.

Bleeder resistors shall be provided to discharge the capacitor bank to less than 50 volts within 2 minutes when disconnected from the line voltage. Warning labels of an approved design shall be provided and installed on filter capacitors.

All vehicle equipment shall be protected from damage due to 3rd rail over and under-voltage conditions, which may exist in the actual operating environment or as a result of the Contractor's design. Unless otherwise specified, the Contractor and its Suppliers shall be expected to provide under and over-voltage protection on all equipment based on their testing and evaluation of the actual 3rd rail voltage of the MDT system.

N9.6.12. INSTALLATION

The auxiliary inverter shall be mounted under the vehicle floor and shall conform to the requirements as specified in TPN3.

N9.6.13. COMPONENTS

Components shall be as specified in TPN19 and shall meet the reliability requirements specified in TPN18.

N9.6.14. COOLING

The Contractor shall provide product data for any blowers and associated controllers and power supplies. The Contractor's reliability data for auxiliary systems shall include the reliability of associated forced ventilation equipment, if used.

Air intakes shall be screened and positioned high on the outside of the equipment in order to preclude the ingestion of water or debris. Air intakes shall not require cartridge-type filters.

Equipment ventilation blowers, if used, shall be of a service-proven design. The blowers shall be directly driven by motors. The motors shall be of a type currently in railroad or rail transit service. The blower and motor shall have permanently lubricated bearings with rolling elements. Blower motors shall have insulated bearings.

N9.7. LOW-VOLTAGE POWER SUPPLY (D.C.)

N9.7.1. POWER SOURCE

At least one LVPS per married pair shall be provided to power all vehicle low-voltage systems, power all emergency lights, charge batteries, and power all vehicle essential and non-essential loads as may be defined in the course of the vehicle design. One LVPS on per married pair shall be capable of supplying all essential loads in the event the other LVPS fails. The LVPS shall supply the low-voltage DC loads to all vehicles in the consist. In addition battery voltage shall be trainlined throughout the consist to allow sharing of all low-voltage DC loads and charging of all batteries from all operating LVPSs. The LVPS shall be capable of starting when 750 VDC is applied to the system and be able to charge a dead battery without battery damage or LVPS overload. The LVPS shall provide full performance for primary power source voltages between 450-900 volts. Below 450 VDC, the output voltage may be decreased to maintain the output current at a level corresponding to full performance. A shutdown can occur below 430 VDC.

N9.7.2. LOW-VOLTAGE OUTPUT

The LVPS output shall conform to the following requirements:

- The output shall be galvanic and transformer-isolated from the input.

- The nominal output voltage shall be as specified herein.
- Output transient response of ±10% for any step load change returning to regulation band within 0.1 second.

N9.7.3. CAPACITY

Power supply capacity shall be rated for continuous operation to supply 120% of worst-case combinations of peak loads of the vehicle, as determined by the Contractor's load analysis, and shall recharge a fully discharged battery to a minimum of 35% within 2 hours and 85% capacity within 5 hours.

N9.7.4. REGULATION

The low-voltage power supply shall maintain a constant output voltage, ±0.5 Volt of the nominal value specified herein as compensated for temperature, for any combination of input voltage and output load. The power supply shall have an output ripple of less than 3% peak-to-peak from zero to full load with battery connected. Means shall be provided to allow output voltage adjustment. The charge (float) current shall enable the battery electrolyte servicing requirements of at least 180 days to be met as specified herein.

N9.7.5. PROTECTION

The low-voltage power supply shall have overload protection; output voltage shall be reduced to limit the output current at 110% of the rating. Over voltage protection shall be provided for output voltage exceeding the maximum voltage as specified in TPN2. Reverse polarity protection shall be provided. A current limiting feature shall be provided either separately or as an integral part of the LVPS to limit charging current as recommended by the battery manufacturer.

N9.7.6. CONTROL

Upon activation of "Auxiliaries Off", the power supply shall monitor battery-charging current. If the battery charge is less than 70%, the LVPS shutdown shall be inhibited.

N9.7.7. AUXILIARY CONTACTS

The power supply shall incorporate a contact for use by the annunciator system. This contact shall be closed when the output voltage is ±0.5 VDC above the minimum value specified in TPN2 and open when output is ±0.5 VDC below the minimum value specified in TPN2. This contact may provide the load shed function.

N9.7.8. INSTALLATION

The Low Voltage Power Supply shall be mounted under the vehicle as part of the auxiliary power supply unit and shall meet the maintainability requirements specified in TPN18.

N9.8. STORAGE BATTERY

N9.8.1. GENERAL

Each married pair shall be equipped with a nickel cadmium battery of see-through flame retardant plastic case construction, sized to power all emergency loads, that is commercially available in the United States. The battery shall have a minimum of 25 cells. Each cell shall have a flame retardant plastic case, and shall have sufficient excess water capacity to be able to provide at least 180 days of normal service. The specification of ampere-hour capacity shall be the Contractor's responsibility subject to the limitation that the capacity shall be at least 180 ampere hours at the 5 hour rate per IEC 60623 and with cut-off at 1.0 to 1.08 volts per cell. The normal service life of the battery shall not be less than 15 years.

The electrolyte level shall be visible through the case, and limits shall be permanently marked on each cell. Electrolyte levels shall be maintained with an auto-fill system as approved by the Engineer. Electrolyte reservoir capacity shall be such that additional distilled or de-ionized water is required only at regular maintenance intervals. The batteries shall be located in a stainless steel enclosure and mounted on a grated stainless steel rollout battery tray for ease of installation, removal and servicing of the batteries from the side of the vehicle. This roll out tray shall be subject to the review and approval of the Engineer.

The LVPS shall provide a constant voltage battery charging with adequate temperature compensation. The battery shall be equipped with an approved over-temperature and over-current protective system to

prevent possible damage to the battery, battery enclosure, and other car components resulting from excessive battery charging. This protective system shall open the battery's circuit breaker when an over-temperature condition is detected. The battery circuit breaker shall be mounted on the battery box in a position that is accessible from the side of the vehicle. The battery circuit breaker shall incorporate a shunt trip coil and a trip indicator that shall be visible from the side of the vehicle.

N9.8.2. DESIGN REQUIREMENTS

The Contractor shall perform a load analysis for the battery and all associated circuits. This analysis shall consider the charge/discharge characteristics, including temperature of the battery, the charging requirements, and battery load requirements during normal and emergency operation and circuit and protective device coordination. This analysis of the proposed battery and associated circuits shall be submitted to the Engineer for review and approval (CDRL N921).

N9.8.2.1. OPERATING CONDITIONS

Under normal service conditions, the battery shall not require electrolyte servicing more than once every 180 days of vehicle operation.

N9.8.2.2. LOAD REQUIREMENTS

In the event of LVPS shutdown, the battery, at full charge and a temperature of 40°F, shall be capable of powering all LVDC loads for 10 seconds or until load shedding is complete, whichever is greater. After load shedding is complete, the battery shall be capable of supporting the following essential loads on both cars of a married pair for the following time durations:

- Emergency Lighting (90 minutes).
- CCTV and DVR (120 minutes).
- Door control (25 cycles, 60 minutes).
- Communications/Radio (60 minutes).
- Propulsion and braking control (60 minutes).
- Operator's console indicators, lighting, and interlocks (60 minutes).
- Coupler controls for three couple/uncouple operations (60 minutes).

- Horn and beeper (20 operations each) (60 minutes).
- Air compressor control (if applicable) (60 minutes).
- HVAC system controls (60 minutes).
- VMS (60 minutes).
- ATO and ATC systems (60 minutes).

During this time, the vehicle shall be capable of normal service operations from the point on the line furthest from the maintenance shop to the maintenance shop. Unless otherwise previously noted, it shall be assumed that all equipment is operated for the number of cycles that is consistent with this operation.

At the end of two hours the voltage measured at the battery terminals shall be above the minimum voltage as specified in TPN2. An analysis of emergency load requirements and battery capacity shall be submitted to the Engineer for review and approval (CDRL N922).

N9.8.2.3. BATTERY IDENTIFICATION

Individual battery cells shall be legibly and permanently marked with the following information:

- Name of manufacturer.
- Date of manufacture.
- Ampere-hour capacity.
- Type designation or part number.
- Polarity of terminal posts.
- High-low electrolyte level indicators.

N9.8.3. BATTERY ENCLOSURE

The battery installation and enclosure design shall facilitate maintenance and safe operation of the vehicle. The Contractor shall insure proper clearance such that batteries can be installed with a fork truck or a lift table. The battery shall be installed so that regular maintenance can be accomplished easily. The battery enclosure shall be stainless steel. The battery enclosure cover shall have a safety protection feature to ensure that the cover is properly shut. The battery enclosure shall be provided with a cover that is hinged at the top and can be easily removed for

battery servicing. The enclosure cover shall have a safety catch and a means of locking in the "Up" position as an aid in battery inspection.

- The battery enclosure shall be 10% oversized with universal battery hold-down brackets to accommodate batteries of various sizes. The enclosure design shall have a stainless steel rollout tray to easily access each cell for inspection, filling, removal and installation from the side of the vehicle with the tray extended. The battery enclosure shall have adequate ventilation and drainage.

The rollout tray shall be designed to lock the tray in place in both the Closed (Running) position and in the Open (Extended) position. The rollout tray shall be interlocked, if open, to prevent the vehicle from being moved accidentally. Locking or unlocking the tray position shall not require any tools. The rollout tray shall have adequate strength to satisfactorily support the batteries in the extended position without deformation. The tray's material shall withstand the environmental conditions to which it will be subject without pitting, corroding, or other physical damage.

N9.9. GROUNDING

N9.9.1. GENERAL

The vehicle and truck grounding system shall be designed to prevent return current passing through bearings and gears while providing adequate electrical safety. The Contractor shall submit for the Engineer's review and approval a grounding plan, including details, wire and cable sizes, termination details and a functional diagram, of the proposed grounding scheme (CDRL N923).

N9.9.2. SAFETY

Vehicle safety grounding to the track shall be provided using one ground brush per axle. The grounding shall preclude stray currents in the carbody.

N9.9.3. GROUND BRUSH WIRING

Connection between each ground brush and the ground bus bar shall be made by compression ground lugs and a flexible conductor.

A single ground brush failure shall not reduce performance capability. The impedance of ground brushes and associated connectors shall be low enough to prevent current return through bearings and unintentional paths. Individual ratings of ground brushes shall consider worst-case current sharing, including single-point failures, in the current return path.

The brushes shall make contact with rings made of cast brass, per ASTM B584, or other Engineer-approved material, assembled on the axle with an interference fit. The brushes shall be spring-loaded against the contact ring, be designed to maintain constant spring force during normal brush life, and shall include a condemning limit mark.

The brush contact area shall have a current capacity sufficient to carry full load with one ground brush disconnected on the truck. The brush and its holder shall be protected from mechanical injury, dirt, and oil by a housing with a cover easily removable for access. Ground brushes shall have a minimum life of 50,000 mi. Ground brush rings shall have a minimum life of 500,000 mi. The ground brushes shall be mounted to allow for inspection without removal from the truck.

The grounding arrangement shall provide sufficient redundancy for safety and operational reliability; it shall be submitted to the Engineer for review and approval as part of the grounding plan in this section (CDRL N924).

N9.9.4. CARBODY GROUND

The carbody ground shall comply with the requirements for use of dissimilar metals specified in TPN19. All ground bonds must be accomplished using appropriately sized studs or threaded bolts and ring terminals.

N9.9.5. EQUIPMENT SAFETY GROUNDS/BONDS

Safety grounding shall meet the following requirements:

a. Grounding conductors shall be provided in accordance with APTA SS-E-005-98.

b. The truck side frames and bolster shall be joined and bonded to the traction motor frames. They shall be connected to the low-voltage ground bar.

c. Equipment shock mounted to, or otherwise isolated from, the carbody shall be bonded to the carbody with compression ground lugs and a flexible conductor.

d. Equipment rigidly mounted to the carbody structure shall be considered grounded through the support bracket.

N9.9.6. LOW-VOLTAGE GROUND

The ground plate for the low-voltage circuit breaker panel shall be connected to the carbody.

N9.9.7. INVERTER GROUND

The neutral of the Y-connection of the auxiliary AC inverter output shall be connected to the low-voltage ground. Neutral of Y-return paths shall not use the carbody structure as a return line.

N9.9.8. SHIELDED CIRCUITS

Shielded circuits shall have continuous, unbroken shields that are the full length of the circuit; they shall be grounded only at one point of the circuit to convenient points on the carbody ground. Shields shall be terminated using soldersleeves.

Shields shall not be connected at the coupler. Trainline circuits shall have their shields grounded to the carbody ground through connections at the trainline isolation switch.

N9.10. PORTABLE TEST UNIT

In addition to the portable test unit requirements specified in TPN15, the auxiliary system PTU software shall be developed to meet the requirements listed as follows.

The auxiliary electronics and PTU system shall allow the following to be adjusted:

- Control parameters.
- Continuous monitoring and display of system operating status.
- Parameters for static and dynamic diagnostic tests.

TABLE OF CONTENTS

N10. PROPULSION SYSTEM 10-1
N10.1. GENERAL 10-1
N10.1.1. OVERVIEW 10-1
N10.1.2. CITED REFERENCES 10-1
N10.1.3. SUBMITTALS – CDRLS 10-2
N10.1.4. ACCEPTABLE CONFIGURATIONS 10-4
N10.1.5. GENERAL DESIGN STANDARD 10-4
N10.1.6. INTERFACES WITH OTHER SYSTEMS 10-4
N10.2. SYSTEM REQUIREMENTS 10-4
N10.2.1. GENERAL 10-4
N10.2.2. PERFORMANCE 10-5
N10.2.3. PRIMARY POWER VOLTAGE 10-5
N10.2.4. BRAKING 10-5
N10.2.5. STALL AND ROLLBACK PROTECTION 10-6
N10.2.6. DUTY CYCLE RATING 10-6
N10.2.7. THIRD-RAIL VOLTAGE VARIATIONS AND OPERATIONS DURING STORM CONDITIONS 10-7
N10.2.8. TOWING REQUIREMENTS 10-7
N10.3. VARIABLE VOLTAGE, VARIABLE FREQUENCY (VVVF) INVERTER 10-7
N10.3.1. INVERTER 10-7
N10.3.2. STATIC POWER DEVICES 10-8
N10.4. CONTROL SYSTEM 10-8
N10.4.1. GENERAL 10-8
N10.4.2. CONTROL LOGIC 10-9
N10.4.3. DIAGNOSTICS 10-10
N10.4.4. SELF-TEST 10-11
N10.4.5. FAULT ANNUNCIATION 10-11
N10.4.6. PROPULSION CUTOUT 10-11
N10.4.7. SOFTWARE 10-12
N10.4.8. DIRECTION CONTROL 10-12
N10.4.9. SPEED SENSING 10-12
N10.4.10. LOAD WEIGH 10-13
N10.4.11. ODOMETER AND HOUR METER 10-13
N10.5. POWER CIRCUIT AND SWITCHING DEVICES 10-13
N10.5.1. CIRCUIT PROTECTION 10-13
N10.5.2. CONTACTORS 10-14
N10.5.3. OVER-VOLTAGE PROTECTION 10-15
N10.5.4. LINE FILTER 10-15
N10.5.5. DYNAMIC BRAKE RESISTORS 10-16

N10.5.6. KNIFE SWITCH 10-16
N10.6. TRACTION MOTORS 10-17
N10.6.1. GENERAL 10-17
N10.6.2. MOUNTING REQUIREMENTS 10-18
N10.7. TRACTION GEAR UNITS 10-19
N10.7.2. DESIGN REQUIREMENTS 10-19
N10.7.3. BEARINGS 10-19
N10.7.4. LUBRICATION 10-20
N10.8. MOTOR/GEAR COUPLING 10-20
N10.9. MECHANICAL PACKAGING 10-21
N10.9.1. GENERAL 10-21
N10.9.2. INSTALLATION 10-21
N10.10. WIRING AND CABLE 10-21
N10.10.1. GENERAL 10-21
N10.10.2. CIRCUIT REQUIREMENTS 10-22
N10.11. TESTING 10-22
N10.11.1. GENERAL 10-22
N10.11.2. COMBINED SYSTEM TESTING 10-22
N10.11.3. FAULT LOGGER 10-23
N10.12. PORTABLE TEST UNIT 10-24

N10. PROPULSION SYSTEM

N10.1. GENERAL

N10.1.1. OVERVIEW

This section specifies the requirements for the design, manufacture, installation, and performance of the vehicle propulsion system. The propulsion system shall be Alternating Current (AC) drive and includes traction motors, drive gear units, power conditioning and power electronics circuits, microprocessor-based propulsion control logic, circuit protection devices, and all other materials, components, and accessories that are necessary to ensure that these vehicles meet the highest transit-industry standards for performance, efficiency, reliability, and maintainability for transit vehicle propulsion equipment. The power shall be supplied from the 750 VDC third-rail systems.

N10.1.2. CITED REFERENCES

Source/Section	Title
AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings
AGMA 2004	American Gear Manufacturer's Association: Materials and Heat Treatment Manual
IEC 60077	Rules for Electric Traction Equipment
IEC 60322	Rules for Power Resistors of Open Construction
IEC 60349	Electric Traction – Rotating Electrical Machines for Rail and Road Vehicles
IEC 61071	Power Electronic Capacitors
IEC 61133	Electric Traction – Rolling Stock – Test Methods for Electric and Thermal/Electric Rolling Stock on Completion of Construction and Before Entry into Service

Source/Section	Title
IEC 61287-1	Power Converters Installed Onboard Rolling Stock – Part 1, Characteristics and Test Methods
IEC 61377	Electric Traction – Rolling Stock – Combined Testing of Inverter Fed Alternating Current Motors and their Control
IEEE 11	Rotating and Electrical Machinery for Rail and Road Vehicles
IEEE 112	Standard Test Procedure for Polyphone Induction Motors and Generators
IEEE 835	Power Cable Ampacity Tables

N10.1.3. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TPN Reference
N1001	Propulsion System Interface Description	TPN10.1.6.
N1002	Flow Chart Describing the Intercommunication between Microprocessors Used to Control Subsystems Interfacing with the Propulsion System	TPN10.1.6.
N1003	Main Component Technical and Functional Descriptions	TPN10.2.1.
N1004	Curves of Vehicle Tractive Effort vs. Speed for Propulsion and Braking Modes	TPN10.2.1.
N1005	Power Circuit Schematic Diagram, Control, Logic Functional, Schematic, and Wiring Diagrams	TPN10.2.1.
N1006	Dynamic Brake Operation and Friction Brake Blending Design	TPN10.2.4.
N1007	Propulsion System Duty Cycle Calculation	TPN10.2.6.
N1008	Thermal Analysis and Motor Winding Temperature Rises for the Worst-Case Duty Cycle	TPN10.2.6.

CDRL No.	Title	TPN Reference
N1009	Voltage Interruption Analysis Describing the Start-up and Shutdown Control Circuits and their Algorithms	TPN10.2.7.
N1010	Inverter Operating Characteristics and Analyses	TPN10.3.1.
N1011	Layout and Configuration of the Power Semiconductor Assemblies	TPN10.3.2.
N1012	Power Devices and Comparison of Maximum Capabilities vs. Design Values	TPN10.3.2.
N1013	Propulsion System Fault Description Document	TPN10.4.1.
N1014	Control Logic Hardware Fan Location	TPN10.4.2.
N1015	Diagnostic, Data Logging, and Storage Capabilities	TPN10.4.3.
N1016	Self-Test Details and Capabilities	TPN10.4.4.
N1017	Details of the Load Weigh Panel and its Integration with the Propulsion and Brake Systems	TPN10.4.10.
N1018	Function of Dynamic Brake IGBT and Crowbar Device with Associated Resistor in	TPN10.5.3.
N1019	Line Filter Characteristics and Analysis of Interference with Signaling Track Circuits	TPN10.5.4.
N1020	Filter Capacitor Warning Label Design and Location and the Maintenance Safety Procedure	TPN10.5.4.1.
N1021	Traction Motor Electrical and Mechanical Characteristics	TPN10.6.1.
N1022	Structural Analysis of Traction Motor Mounting	TPN10.6.2.
N1023	Traction Motor Drawings and Suspension Data	TPN10.6.2.
N1024	Traction Motor and Gearbox Coupling Details	TPN10.8.
N1025	Equipment Box Location and Mounting Details	TPN10.9.1.
N1026	Component Qualification and Acceptance Test Specifications and Results	TPN10.11.1.
N1027	Listing of Faults and Parameters to be Recorded by The Subsystem Fault Loggers and Details of the Fault Logger Memory, Capacity, and Data Reading Method	TPN10.11.3.

N10.1.4. ACCEPTABLE CONFIGURATIONS

The vehicle shall be propelled by means of AC induction motors controlled by Variable Voltage, Variable Frequency (VVVF) inverters, utilizing Insulated Gate Bipolar Transistor (IGBT) technology. An independently controlled inverter with associated control equipment shall be provided for each powered truck. Each powered truck shall be provided with an independent inverter control logic and power supply. All traction motors and gear drive units provided shall be identical and interchangeable.

N10.1.5. GENERAL DESIGN STANDARD

The propulsion equipment shall comply with IEC 60077. All clearance and creepage distances shall comply with this standard as applicable to the environmental criteria described in TPN2.

N10.1.6. INTERFACES WITH OTHER SYSTEMS

The Contractor shall submit to the Engineer for review and approval a detailed description of interfaces between the propulsion control and the friction brake control, master controller, side-door interlocks, no-motion (zero speed) circuitry, and of all other interfaces with the propulsion system (CDRL N1001). This submittal shall identify clearly which subsystem will provide command and control signals for load weight compensation, brake blending, spin/slide control, all microprocessor systems clock synchronization, and safety interlocking. The propulsion and friction brake control units can be separate control units or can be combined into one control unit.

The intercommunication between microprocessors used to control each of these subsystems, detect/transmit faults, and the software control algorithms shall be clearly explained. The Contractor shall submit a flow chart illustrating this control hierarchie to the Engineer for review and approval (CDRL N1002).

N10.2. SYSTEM REQUIREMENTS

N10.2.1. GENERAL

The propulsion system shall be designed for and tested to confirm compliance with the requirements of TPN2. The Contractor shall submit general arrangement and assembly drawings, rating and performance

calculations, and qualification and acceptance test specifications for all main components, including the High Speed Circuit Breaker (HSCB), line contactors, inductors, capacitors, traction motors, inverters, control electronics, and resistors, to the Engineer for review and approval (CDRL N1003).

In addition to the speed and distance curves required in TPN2, the Contractor shall also submit curves of vehicle tractive effort vs. speed, acceleration vs, speed, and line current vs. speed for propulsion and braking modes at vehicle weights AW0, AW1, AW2, and AW3 and line voltages of 750 VDC, 650 VDC, and 455 VDC to the Engineer for review and approval (CDRL N1004).

The Contractor shall submit power circuit, control, block, logic schematic diagrams, wiring diagrams, wire lists, and logic functional diagrams to the Engineer for review and approval (CDRL N1005).

N10.2.2. PERFORMANCE

The vehicles shall meet the requirements for operating speed, acceleration, deceleration, mode change times, response times, and jerk rates specified in TPN2. At low speeds, the Operator shall be able to accurately position a consist of one (1) to four (4) married pairs. Propulsion response, friction brake response, mode change response time, and brake blending shall not hamper the Operator's ability to position the consist accurately.

N10.2.3. PRIMARY POWER VOLTAGE

The propulsion system shall be able to operate any number of cars from a single-married pair, through an eight-car consist successfully and reliably on 750 VDC nominal third-rail power systems with high voltage transients, extensive arcing, and repetitive occurrences of intermittent contact conditions.

Propulsion and control equipment shall be designed to include a 450 VDC low-voltage cutout.

N10.2.4. BRAKING

Controlled electric braking shall be continuously available from 70 mph down to a vehicle speed of 3 mph. Brake fade shall commence at 5 mph. At 3 mph or less braking shall be friction only. Dynamic braking shall also be regenerative. The regenerative brake control algorithm shall return the

maximum practicable amount of electric power to the third-rail, until the maximum voltage of 900 VDC is reached. Regeneration shall not cause the third-rail voltage to exceed 950 VDC.

The propulsion system shall be capable of providing the electric braking contribution to the full-service brake rate specified in TPN2. This electric braking rate shall be available from 70 mph down to 3 mph at all vehicle weights up to AW2. The design of dynamic brake and friction brake blending, including fail-safe interface signals and spin/slide control, shall be submitted to the Engineer for review and approval (CDRL N1006).

N10.2.5. STALL AND ROLLBACK PROTECTION

The Contractor shall provide for the removal of power from the traction motors if vehicle motion does not occur within five seconds after the propulsion mode is commanded. The propulsion system shall not respond to subsequent power commands until reset by a brake command.

The Contractor shall provide for the removal of power from the traction motors and application of friction brake if vehicle motion in direction opposite of commanded motion is occuring three seconds after the propulsion mode is commanded. The propulsion system shall not respond to subsequent power commands until reset by a brake command.

N10.2.6. DUTY CYCLE RATING

The continuous thermal rating of the propulsion system shall be based on the worst-case duty cycle derived from the operating profile on the routes of the Miami-Dade Metrorail system as described in TPN2. (Reference Exhibit 10-1 for the surface line profiles).

The propulsion system worst-case duty cycle shall be calculated and submitted to the Engineer for review and approval (CDRL N1007).

The propulsion system's continuous rating shall accommodate the towing requirements of TPN2. The Contractor shall perform a thermal analysis of the power circuits and motor winding temperature rises for the worst-case duty cycle. The analysis shall include the maximum ambient temperature. The analysis shall be submitted to the Engineer for review and approval (CDRL N1008).

N10.2.7. THIRD-RAIL VOLTAGE VARIATIONS AND OPERATIONS DURING STORM CONDITIONS

The propulsion system shall be capable of operating over the full range of third-rail voltage specified in TPN2. The propulsion equipment shall be able to accept, without damage, intermittent third-rail voltage. Activation of electromechanical protective devices under such conditions shall be minimized by the propulsion logic. A voltage interruption analysis that describes the shutdown and start-up control circuits and their algorithms in detail shall be submitted to the Engineer for review and approval (CDRL N1009). This function shall be demonstrated at the time of the propulsion system qualification test.

N10.2.8. TOWING REQUIREMENTS

The propulsion system shall be designed to meet the abnormal operation condition specified in TPN2.

N10.3. VARIABLE VOLTAGE, VARIABLE FREQUENCY (VVVF) INVERTER

N10.3.1. INVERTER

Inverters utilizing VVVF three-phase AC control shall modulate power to the vehicle's traction motors. Two independent inverters shall be provided per vehicle, for a total of 4 inverters per married pair. The inverters on each vehicle may be packaged together or as separate units. Each vehicle inverter shall be totally independent after the High Speed Circuit Breaker. The logic cradles shall be positioned to allow for easy access and shall be well protected from the public. Provisions shall be made to preclude torque pulses at all speeds. The diameters of wheels will be maintained on the same axle to a 0.125 inch maximum difference and to a 0.25 inch maximum difference axle-to-axle on same truck. Wheel diameters between trucks will range from new to fully worn.

The Contractor shall perform a load analysis, voltage interruption analysis, and failure modes analysis for the inverter and submit these analyses and the inverter operating characteristics to the Engineer for review and approval (CDRL N1010).

N10.3.2. STATIC POWER DEVICES

In order to facilitate repair and replacement, the power semiconductor assemblies shall be:

- Functionally grouped.
- Mounted in modular form.
- Easy to remove and replace LRUs.

Insulated Gate Bipolar Transistors (IGBT) shall be used in static power control circuits. The Contractor shall submit to the Engineer for review and approval the layout and configuration of the power semiconductor assemblies (CDRL N1011).

The Contractor shall utilize power semi-conductor devices as part of the propulsion system with a proven history of reliable transit performance in an application no less severe than the Miami-Dade Metrorail system environment. This operating history, including a list of properties, number of units, MDBF, and contract name shall be included with the Contractor's proposal.

The design shall be such that the maximum junction temperature of power semiconductor devices shall be at least 18°F (10°C) below the Manufacturer's maximum allowable junction temperature under the worst-case duty cycle conditions, except for towing requirements. The Contractor shall submit to the Engineer for review and approval the characteristics of all power circuit devices and include a comparison of maximum component capabilities vs. design values (CDRL N1012).

Heat generated by power semi-conductor devices shall be dissipated by heat sinks. Heats sinks shall be cooled by natural convection or forced air over the cooling fins. No forced-air shall pass through the equipment enclosures.

Firing circuit modules shall be readily accessible for inspection, maintenance, replacement, and testing. Modules shall be interchangeable.

N10.4. CONTROL SYSTEM

N10.4.1. GENERAL

In managing and controlling tractive and dynamic braking effort, the propulsion system shall:

- Respond accurately to Master Controller and ATO logic commands as transmitted through the trainlines.
- Adjust tractive effort in proportion to passenger load weight up to AW2.
- Jerk limit (TPN2).
- Minimize wheel spin or slide.

The propulsion control system shall continuously monitor all relevant parameters to ensure that the propulsion system operates within safe and normal ranges. If the control system detects a parameter beyond these limits, the system shall automatically:

- Shut down affected parts of the propulsion system.
- Annunciate the failure on the fault annunciation panel.

For faults that are not critical to the safe operation of the vehicle, the control system may automatically reset. The Contractor shall limit the number of automatic resets. The Contractor shall submit to the Engineer for review and approval a propulsion system fault description document listing the faults detected the criteria for detection of each fault, and the recovery requirements for each fault (CDRL N1013).

Safe and reliable control shall be provided to ensure accurate response to both internal and external conditions. The propulsion system shall be designed to prevent a single control circuit fault from resulting in an unintended motoring application.

N10.4.2. CONTROL LOGIC

A Portable Test Unit (PTU) connection shall be provided in the Operator's cab. The control logic shall use microprocessors to control propulsion and dynamic braking effort with the following considerations:

- In proportion to passenger load up to AW2.
- To minimize wheel spin or slide.

While the vehicle is stationary, the microprocessor and associated input/output devices shall be arranged to permit a PTU (e.g., a laptop computer) to observe and record parameters required to troubleshoot, to verify proper operation of the propulsion system, and to initiate diagnostic tests.

With the vehicle in motion, the microprocessor and associated input/output device shall permit a PTU to observe and record operation parameters.

The software used to operate the microprocessor shall be written in a high-level language and described by means of flow charts or other approved means that readily convey the logic and sequence of control algorithms.

Propulsion control logic for each powered truck shall contain a dedicated power supply, diagnostic function unit, and programmable logic circuitry. All control circuits shall be isolated from the electronic hardware through isolation devices.

The dedicated power supply shall operate from a low-voltage circuit breaker panel. This power supply shall ensure proper operation of the propulsion control logic when the voltage at the circuit breaker is between the minimum and maximum low-voltage DC system voltages specified in TPN2. When the voltage at the circuit breaker drops below the minimum low-voltage DC system voltage, the control system shall ensure a proper shutdown.

If fans are used for airflow across control logic hardware for cooling or hot-spot removal, filters shall be provided to prevent conductive dirt deposits from accumulating on printed circuit boards. The location of the fans shall be reviewed and approved by the Engineer (CDRL N1014). Fans shall be readily accessible for filter replacement.

N10.4.3. DIAGNOSTICS

Diagnostics shall continuously monitor the operation of the propulsion system and must identify problems down to the line replaceable unit (LRU). The level of the fault reporting shall be sufficiently detailed to allow operating and maintenance personnel to take immediate and accurate corrective action.

There shall be capacity for a minimum of 100 different operational faults to be stored in non-volatile memory with a minimum of 25 fault reserve capacity. The fault logging system shall also record no fewer than 6 fault traces, be capable of sampling all data at a rate of no slower than 20 ms and recording relevant data for 3 seconds before and 2 seconds after the fault. Operational data logging shall also be provided to monitor the system status on a continuous basis.

All fault, trace, and operation data shall be able to be downloaded and reset from a laptop PC PTU. The Contractor shall provide port interfaces in the propulsion electronics for connection of the PTU.

An additional network (Ethernet) port shall be made available in an agreed location inside the Operator's cab. All fault data shall be timed, dated, and recorded in Eastern Standard Time (EST) and automatically adjusted for daylight saving time.

The Contractor shall submit details of the diagnostic and data logging capabilities and of the data storage capacity to the Engineer for review and approval (CDRL N1015).

N10.4.4. SELF-TEST

System level power-up self-tests shall be provided to check the integrity of the inverter, other propulsion system components, and all other microprocessor controlled vehicle subsystems and interfaces. Failure conditions from propulsion power-up self-tests, shall be stored as propulsion faults for later downloading to the PTU. The PTU shall also have a series of self-tests capable of testing different components under a variety of conditions. The Contractor shall submit details of the self-test capabilities to the Engineer for review and approval (CDRL N1016).

N10.4.5. FAULT ANNUNCIATION

The Contractor shall implement a comprehensive fault annunciation system (TPN5) that consists of local and trainlined subsystem and general fault indications. Each vehicle subsystem, including propulsion, shall provide a fault indication output. The propulsion fault indication output shall, upon de-energization, result in the illumination of a local propulsion fault light, appropriately labeled, in the Operator's cab of the vehicle on which the fault occurs. Corresponding to the illumination of any of the local vehicle fault lights in the Operator's cab a trainlined, general fault light, shall illuminate on the Operator's control console in the leading cab of the consist (TPN5). Fault information shall be transmitted to the lead vehicles's VMS (Vehicle Monitoring System) as in TPN20.

N10.4.6. PROPULSION CUTOUT

A 4-position cutout switch shall be provided in each cab to determine the cutout status of the inverter propulsion systems. The 4 positions of the cutout switch shall include the following:

- "All In".
- Cutout F Only.
- Cutout R Only.
- Cutout F and R.

The cutout shall allow the system to be freewheeled in either direction.

Trainlined cutout of the regenerative brake shall be capable of being applied from the lead cab.

N10.4.7. SOFTWARE

Programming techniques and software requirements shall be as specified in TPN19 and TPN22. Software escrow requirements are set forth in GP5.

N10.4.8. DIRECTION CONTROL

It shall not be possible to command a change of direction, unless the vehicle has attained zero speed and the brakes have been applied. The forward and reverse trainlines shall be interlocked so that if both are energized or de-energized simultaneously, it shall be impossible to apply power to the traction motors or to release the brakes (reference TPN5). The Propulsion system on any car shall not allow power to be applied if the system direction is not confirmed.

N10.4.9. SPEED SENSING

Required speed sensing device(s) shall be installed on motor or gear unit(s). Speed sensors shall be readily accessible for routine maintenance and shall meet all the mechanical requirements of truck-mounted equipment. Speed sensors shall be connected to the carbody by screened, flexible cable terminated in a waterproof, multi-pin, positive locking connector to facilitate truck removal. In designing, installing, and wiring sensors, the Contractor shall consider the severity of the moisture conditions encountered in MDT operation. To the extent possible, the speed sensors on all trucks shall be identical.

Speed sensors and their associated circuits shall be reliable and able to successfully perform under the adverse environment of motor transients, electrical noise, shock, vibration, and ambient temperatures. The sensors shall bolt on using an integral flange. The depth of the sensor head shall

be OEM pre-set and non-adjustable. The flange mounting shall be keyed for proper orientation.

Rotating type traction motor or axle mounted optical speed encoders shall not be used. The sensors proposed shall be required to have a successful history of transit application.

N10.4.10. LOAD WEIGH

The propulsion system shall respond to load weigh information obtained from the suspension equipment. The Contractor shall submit details of the load weigh equipment and its integration with the propulsion and brake systems to the Engineer for review and approval (CDRL N1017).

N10.4.11. ODOMETER AND HOUR METER

Mileage and hour compilation shall be performed by the propulsion system processor units and continuously displayed by either an electronic or mechanical gauge. The mileage meter and the hour meter shall be installed in the Operator's cab of each vehicle. The odometer shall be permanently installed in each vehicle and it shall not be possible to reset the odometer. A replaced propulsion logic unit shall be able to read and assume the vehicle's odometer value. The use of hub-mounted odometer assemblies is not permitted.

The Contractor shall ensure that the Supplier and/or Manufacturer of the propulsion system shall also supply and integrate the odometer unit.

N10.5. POWER CIRCUIT AND SWITCHING DEVICES

N10.5.1. CIRCUIT PROTECTION

Adequately rated sensing and fault clearing devices and any other circuit protection deemed necessary shall be provided to protect propulsion system circuits and components from over current damage, ground faults, and any other fault that could be hazardous to the circuits. A High Speed Circuit Breaker shall be provided and shall be capable of safely interrupting maximum load and fault current. The propulsion logic shall have the ability to trip the circuit breaking device. The circuit breaking device may be retained in the closed position at zero speed if the Contractor's design precludes inadvertent motoring under control system fault conditions.

Protection against the supply or return of propulsion current through paths other than the normal paths shall be provided. Failure detection circuits shall be provided to indicate propulsion or dynamic brake failure.

A High Speed Circuit Breaker (HSCB) with instantaneous magnetic overload devices shall be capable of interrupting the full-system short-circuit current. The Contractor shall provide a means of closing the breaker under dead battery conditions. The HSCB shall not be susceptible to nuisance tripping.

The HSCB shall be capable of interrupting current in both directions. Adequate ventilation of arcing products shall be provided to prevent accumulation of gasses during normal or fault duty. All efforts shall be made to provide a HSCB that has internal fault clearing capability. The propulsion logic shall limit the number of HSCB resets that can be performed after an overload condition. The propulsion logic shall protect the propulsion inverter and traction motors through multiple levels of overload protection. The propulsion logic shall have the ability to open the HSCB under overload conditions. The propulsion logic shall have the ability to turn off all inverter IGBTs to protect the power system.

The current-carrying and arcing contact materials used in the circuits shall be sufficiently heat-resistant so that it shall be unlikely for the circuits to be welded by the current. The thermal time constant of the fuse and the response of the high-speed circuit breaker shall be coordinated to minimize or eliminate avoidable fuse openings.

N10.5.2. CONTACTORS

All propulsion system contactors shall be rated for maximum current capacity and overload interruption capability as dictated by the system design. Electro-magnetic contactors shall be used. Metal Oxide Varistors (MOV) shall protect all coils.

The Contractor shall provide sufficient information to the Engineer to establish that contactor operation is acceptable in heavy storm conditions and moisture levels. Contactors shall be capable of interrupting current in both directions, unless the contactor only has single direction current flow. Adequate ventilation of arcing products shall be provided to prevent residual accumulation of tarnished stains or dust during normal or fault duty.

Materials used in current carrying and arcing contact parts of contactors shall resist weldeding by fault current.

If contactors are ventilated inside an enclosure, the Contractor shall ensure that other devices, especially auxiliary contact blocks, are protected against dust, arcing, and other contamination.

N10.5.3. OVER-VOLTAGE PROTECTION

Vehicles shall be provided with circuits and devices to protect power electronic and other devices from excessive line voltage. The dynamic brake circuit shall be used to control overvoltage conditions. This function shall be demonstrated at the time of the propulsion system qualification test (CDRL N1018).

N10.5.4. LINE FILTER

A line filter shall be provided for transient voltage protection to filter power frequency components of the inverter and to suppress high-frequency voltage transients for reduction of electromagnetic interference. The Contractor shall submit the characteristics of the line filter and associated components, including an analysis demonstrating compatibility with signaling track circuits, to the Engineer for review and approval (CDRL N1019).

N10.5.4.1. FILTER CAPACITORS

Current inrush to the filter capacitors during initial charging shall be limited to a value that will not damage or adversely affect the system. Filter capacitors shall be in accordance with IEC 61071.

Filter capacitors shall be designed and fixed to allow expansion if an internal short circuit occurs. The propulsion control system shall utilize capacitor counter circuitry or capacitor charge time checks to detect filter capacitor failure.

A discharge resistor shall be permanently connected across each capacitor bank. The voltage at the terminals of the capacitor bank shall be reduced to 50 volts or less, 5 minutes after primary voltage is removed from the bank by the charging resistor as a backup to the dynamic brake circuit. Normally, the dynamic brake chopper and resistor bank shall discharge the filter capacitors to less than 50 V within 2 minutes after primary voltage is removed. Appropriate warning labels shall be provided on the filter capacitor access panels. The warning label design and

location and the maintenance safety procedure shall be submitted to the Engineer for review and approval (CDRL N1020).

N10.5.4.2. INDUCTORS

Line filter inductors may be air or iron core and shall be suitably shielded and oriented under the vehicle to minimize inductive coupling with running rails, track circuits, and other equipment and to minimize magnetic fields in passenger areas.

N10.5.5. DYNAMIC BRAKE RESISTORS

Dynamic brake resistors shall be the edge-wound ribbon type or an approved, equally durable alternative. They shall have sufficient capacity to provide full-service braking power dissipation during continuous operation over the worst-case operating profile at a vehicle weight of AW3 and regenerative brake cutout. Dynamic brake resistors shall be cooled by natural convection.

Resistor frames and elements shall be corrosion resistant steel. Shielding (as applicable) shall be provided to protect adjacent areas from damage due to excessive heat. Resistor units shall be electrically isolated from frames. Frames shall be isolated from the carbody with high-temperature insulation material. In addition, provisions shall be made for expansion to prevent warping.

Connecting cables shall be protected from excessive heat. Resistors shall be protected against wheel spray and debris.

Resistors shall comply with IEC 60322. When applicable, the resistors shall be type tested for (or test data provided for) short circuit, and withstand hydroscopic and rain tests.

N10.5.6. KNIFE SWITCH

A knife switch shall be provided to permit manual disconnection of the propulsion and auxiliary systems from the third-rail power supply and connection of auxiliaries to a 750 VDC shop power source.

The knife switch shall be housed in a non-metal enclosure.

The knife switch shall have the following four operating positions:

- RUN: In this position, the propulsion inverters, auxiliary inverter, and all other high-voltage auxiliary equipment shall be connected to the third-rail power supply. This is the normal operating position of

the switch. The knife switch enclosure shall not close and latch, unless the knife switch is in this position.

- THIRD-RAIL TEST: In this position, only the auxiliaries shall be connected to the third-rail power supply. The propulsion inverters shall be isolated from the third-rail power supply.
- OFF: In this position, the propulsion inverters and auxiliaries shall be isolated from the third-rail power supply.
- SHOP TEST: In this position, the auxiliaries shall be connected to a shop power stud within the knife switch box and disconnected from the third-rail power supply. The shop power stud provides the connection point for the 750 VDC shop power supply. This stud must be of the break away type so as not to damage the box assembly if the train is moved from the maintenance shop while connected. The propulsion inverters shall be isolated from the third-rail power supply and the shop power supply in the "SHOP TEST" position of the knife switch.

N10.6. TRACTION MOTORS

N10.6.1. GENERAL

The continuous thermal rating of the propulsion system shall be based upon the worst-case duty cycle as specified in this section and TP2. The propulsion motor temperature rise for the worst-case duty cycle shall be limited to the temperature rise allowed in IEEE 11 for Class F insulation. The minimum insulation class actually provided shall be Class H. The latest available version of the IEC 60349 shall apply for AC traction motors. Resins and other insulating materials shall be readily available in the United States. Motor stator coils shall be vacuum pressure impregnated (VPI). The Contractor shall submit information on the proposed VPI process and the insulating resin used in the VPI process to the Engineer for approval.

The Contractor shall manufacture two simulated sections of the stator and winding assemblies to verify the VPI process. These simulated stator assemblies shall undergo the VPI process simultaneously with production stators. The Contractor shall section these assemblies to establish freedom from insulation voids and to verify that there is sufficient bonding. This VPI verification test shall be conducted on the first two stators and

one additional stator selected at random by the Engineer. If voids are found, then the sample size shall increase as directed on a case-by-case basis by the Engineer.

Traction motors shall be three-phase induction machines with squirrel cage rotor construction. The motor slip shall be selected to minimize losses while accommodating wheel diameter variation. Safe motor speed shall be at least 10% above normal maximum operating speed with fully worn wheels. Inverters shall incorporate a frequency limit to prevent motor over-speed. Full performance shall be obtained with all wheel diameters on each truck maintained within 0.25 inch maximum mismatch.

Traction motor characteristics shall be based on specified performance criteria, wheel size, and gear ratio, showing the relationship between motor current, motor voltage, speed, tractive effort (torque), slip, and efficiency. The Contractor shall submit electrical and mechanical characteristics of the traction motor to the Engineer for review and approval (CDRL N1021).

Anti-friction motor bearings shall be designed in accordance with AFBMA 9 and 11, as applicable, for a L10 rating life of 1,000,000 miles minimum, shall utilize labyrinth seals and grease fittings, and shall have lubricant cavities sufficient for 250,000 miles of operation. The motor bearings shall be insulated to prevent conductive and circulatory ground currents.

Traction motors shall be self-ventilated.

Traction motors shall conform to the applicable requirements of IEC 60349 or IEEE 11 and tested, per IEEE 112.

Cable from the traction motors on each truck shall run from a protected terminal block located on top of the motor frame to a quick-disconnect mounted on a support attached to the carbody near the truck.

N10.6.2. MOUNTING REQUIREMENTS

A structural analysis of the traction motor mounting, including hardware, shall be submitted to the Engineer for approval (CDRL N1022).

The Contractor shall submit cross section and outline drawings of the traction motor, including suspension details, to the Engineer for review and approval (CDRL N1023).

N10.7. TRACTION GEAR UNITS

Gear unit duty cycle, torque ratings, maximum speed, and other applicable factors shall equal or exceed dynamic requirements of TPN2.

N10.7.1.1. MAINTENANCE

Disassembly, reassembly, and service maintenance shall be accomplished to the maximum extent possible with tools and maintenance equipment in use at MDT. If special tools are required, they shall be provided in accordance with the requirements of TPN15, even if MDT already possesses such special tools.

N10.7.2. DESIGN REQUIREMENTS

The dynamic characteristics of the assembly and its mountings shall be coordinated with the various sources of vibration to minimize resonance. The support and torque reactions of gear units and propulsion motors shall be transmitted to the truck frame using resilient mounts. These mounts and associated hardware shall not restrict the individual axle movements allowed by the design of the truck. All major mechanical joints shall be accessible for visual inspection.

Gear units shall be numeric and have a hunting tooth design; that is, they shall be designed such that any ratio of the number of teeth on any two gears in mesh shall not be an integer.

The gear unit shall have a minimum design life of 30 years.

Gears shall be designed to require inspection and adjustment no more frequently than once every 500,000 miles and rehabilitation no sooner than 1,000,000 miles. One break-in type of inspection during the first such interval will be acceptable. Gears shall have a minimum fatigue design life of 1,000,000 miles with no degradation of performance. All main drive gears shall be fabricated from high-quality gear steel, designed, heat-treated, and hardened in accordance with the AGMA 2004, Gear Materials and Heat Treatment Manual.

The gear unit design and mounting shall preclude the ingress of water and egress of oil through the labyrinth seals.

N10.7.3. BEARINGS

Gear units shall be equipped with anti-friction bearings designed in accordance with AFBMA 9 or 11, as applicable, for an L10 rating life of

1,000,000 miles minimum. The bearings shall require a minimum inspection or adjustment interval of 500,000 miles. It shall be possible to add and purge lubricant without removing the truck from the vehicle.

Seals on rotating members shall prevent lubricant leakage. Cork gaskets shall not be used.

N10.7.4. LUBRICATION

The gearbox shall be provided with sufficient baffles, dams, passages, and similar structures to ensure an adequate flow of lubricant to all bearings and gears under the conditions specified. Scuffing and abnormal wear shall be prevented under the most severe operating conditions for the class of service specified. Lubricant capacity shall be sufficient to ensure adequate cooling at minimum filling level. All seals on rotating parts shall be of the labyrinth type and designed to preclude seepage.

The gearbox shall have at least one oil drain opening, located at the lowest point in the case or sump. The drain plug shall have magnetic particle collectors, located for maximum contact with the lubricating oil, and shall be readily removable for cleaning. All fill drain and inspection plugs shall be safety-wired.

The quantity and grade of lubricant shall be indicated either on the filler cap or on the gearbox housing adjacent to the caps. Seasonal changes of lubricants shall not be required. The gearbox lubrication system shall be readily accessible without de-trucking and designed to prevent overfilling.

No gearbox leakage shall in any way affect the operation of any equipment in the area of the gearbox and means shall be taken by the Contractor to prevent this in the case of leakage, specifically the ground brush assembly.

N10.8. MOTOR/GEAR COUPLING

A geared or flexible coupling shall be provided between traction motor and gear unit shafts. The coupling shall be designed to withstand maximum torque, torque reversals, shocks, vibrations, and misalignment encountered during performance of the worst-case duty cycle indicated in this section.

The details of the traction motor/gearbox coupling shall be submitted to the Engineer for review and approval (CDRL N1024).

N10.9. MECHANICAL PACKAGING

N10.9.1. GENERAL

The propulsion system inductors, capacitors, and power devices shall be housed in weatherproof underframe enclosures suitable for tropical environment service. Underframe enclosures shall utilize top hinged, removable covers held positively in place with stainless steel spring-loaded latches or quarter-turn fasteners and include a safety catch to prevent inadvertent opening beyond the dynamic outline. The propulsion equipment shall be designed for the shock and vibration conditions that are specified in TPN2.

Access doors and covers shall be fitted with appropriate warning notices as approved by the Engineer.

Enclosures for control equipment mounted in the vehicle interior shall be constructed to protect the equipment from dirt, conductive dust, and spilled liquids, including corrosive cleaning fluids and other solvents, cleaning solutions, and debris that may commonly be encountered in normal operation. Details and the general arrangement of equipment box location and mounting shall be submitted to the Engineer for review and approval (CDRL N1025).

N10.9.2. INSTALLATION

The inverter(s) shall be mounted under the car as specified in TPN3 and shall meet the maintainability requirements specified in TPN18.

N10.10. WIRING AND CABLE

N10.10.1. GENERAL

All propulsion system wire and cable shall be rated for maximum design and fault currents and minimum voltage drop throughout the expected voltage range. Cable shall be in accordance with the requirements of TPN19.

All control and low-voltage power connections to underframe equipment boxes shall be via connectors in accordance with the requirements of TPN19.

"Out" and "Return" power cables shall be tie-wrapped together to minimize magnetic field and circuit inductance.

Traction motor cables shall be appropriately cleated as described in TPN19 and rolling of phases between every 2 cleats will be permitted if required to minimize EMI.

N10.10.2. CIRCUIT REQUIREMENTS

Electrical materials and installation methods to be used in the fabrication of electrical equipment, including wire, cable, printed circuit boards and circuit protective devices, shall conform to the requirements set forth in TPN19.

N10.10.2.1. PRIMARY POWER/HVDC CIRCUITS

Current capacities of conductors between traction motors and traction power control equipment shall be per IEEE 835.

N10.11. TESTING

N10.11.1. GENERAL

All equipment shall be tested in accordance with TPN17 using the relevant US or international standards as determined and submitted by the Contractor and reviewed and approved by the Engineer.

The Contractor shall submit qualification and acceptance test specifications and results for all major components to the Engineer for review and approval (CDRL N1026).

N10.11.2. COMBINED SYSTEM TESTING

The Contractor shall demonstrate, to the Engineer's satisfaction, the electromagnetic compatibility, performance capability, operation, and fault handling of the propulsion system per the requirements of TPN2 and TPN10. Factory testing of the complete system configuration, using simulated loads on the traction motors, shall reflect, as far as practicable, the layout of equipment on the vehicle.

Propulsion system testing shall be in accordance with IEC 61287-1 and IEC 61377. The following tests shall also be applied:

- Effectiveness of filters IEC 61287-1.
- Voltage step and interruption test, per IEC 61133.
- Acceleration and deceleration vs. speed rate.
- Direction command response.

- No motion detection (if performed by Propulsion System).
- Propulsion cut-out.
- Friction brakes on.
- Filter capacitor discharge.
- Dynamic brake feedback.
- Emergency brake response.
- Dynamic brake cut-out.
- Speedometer and odometer.
- Speed vs. time and distance vs. time.
- Mode change reaction time.
- Jerk rate.
- Overspeed.
- Overvoltage and undervoltage.
- Battery voltage extremes.
- Rail gaps.
- Overtemperature detection.
- Load weigh failure.
- Illegal trainline response.
- Stall and Rollback.
- Spin/Slide Detection.
- Profile performance temperature measurements.

N10.11.3. FAULT LOGGER

Each microprocessor-based subsystem shall have fault logging capabilities. Fault logging shall be accomplished by fault detection at the HRV, subsystem, and component levels. All fault logger data shall be accessible via the PTU. The system shall account for the following data for each fault:

- HRV/subsystem/component name.
- Type of fault.
- Time of fault.
- Duration of fault.

The Contractor shall submit to the Engineer for review and approval a proposed listing of faults and parameters to be recorded by the subsystem fault loggers and details of the fault logger memory, capacity, and data reading method (CDRL N1013).

N10.12. PORTABLE TEST UNIT

In addition to the portable test unit requirements specified in TPN15, the propulsion electronics and PTU system shall allow adjustment of control parameters and continuous monitoring and display of system operating status and parameters for static and dynamic diagnostic tests.

There shall also be an "Engineer's level" of adjustment that is password protected that will allow the following:

- Support ATP block design verification.
- Other adjustments as determined by the Engineer.

The "Engineer's level" shall only be able to be activated with a password and shall only be active while the PTU is connected. Disconnecting of the PTU during, or exiting, an "Engineer's level" PTU session shall cause all control parameters to return to prior state. Brake rates shall not be changeable during the Engineer level PTU session.

Exhibit N10-1

SURFACE LINE PROFILES FOR DUTY CYCLE ANALYSIS

MIAMI-DADE TRANSIT LINE PROFILE (TABLES 1, 2, 3, AND 4)

Table 1: **Station and Safety Stop Locations**

Distance, in feet, of stations stops starting at Dadeland South and ending at Palmetto on track 2.

Table 2: **Grade Profile**

Grade in effect over distance ranges listed. Distances, in feet, are from Dadeland South station north to Palmetto station on track 2.

Table 3: **Speed Profile**

Speed limit, in miles per hour, in effect over distance ranges listed. Distances, in feet, are from Dadeland South station on track 2.

Table 4: **Curve And Spirals Data**

All measurements are from Dadeland South of Track 2: Point of tangent to spiral, spiral to tangent, and radius of curve is in feet. Super-elevations are given in inches.

TABLE 1: STATION AND SAFETY STOP LOCATIONS

Station/Safety Stop	Distance (feet)
Dadeland South	0
Dadeland North	4256
South Miami	11344
University	16636
Douglas Road	25093
Coconut Grove	32293
Vizcaya	41906
North-South Line	
Brickell	49986
Government Center	54284
Overtown/Arena	55983
Culmer	60726
Civic Center	64328
Santa Clara	66546
Allapattah	71242
Earlington Heights	77094
Brownsville	83526
Dr. Martin Luther King, Jr. (MLK)	86423
North-Hialeah Line	
Northside	94065
Tri-Rail	97396
Hialeah	104484
Okeechobee	111934
Palmetto Extension Line	
Palmetto	119568

TABLE 2: GRADE PROFILE

Distance From Dadeland South Station (feet)	Grade (%)
0 to 1235	0.35
1235 to 1909	-0.50
1909 to 2675	1.40
2675 to 3385	-1.50
3385 to 5885	0.00
5885 to 6385	-0.10
6385 to 12795	0.00
12795 to 13095	-0.50
13095 to 17250	0.00
17250 to 17630	0.50
17630 to 27233	0.00
27233 to 27630	0.10
27630 to 43539	0.00
43539 to 44469	0.25
44469 to 45179	-3.00
45179 to 46770	0.00
North-South Line	
46770 to 47176	0.00
47176 to 47903	3.00
47903 to 48313	0.00
48313 to 49064	0.81
49064 to 49986	0.00
49986 to 51487	3.00
51487 to 52103	-1.00
52103 to 52503	0.00
52503 to 53236	-3.00
53236 to 54453	0.00
54453 to 55236	-3.00
55236 to 57503	0.00
57503 to 58603	-3.00

Distance From Dadeland South Station (feet)	Grade (%)
58603 to 59258	3.00
59258 to 59858	-0.20
59858 to 61303	0.00
61303 to 62103	0.60
62103 to 63079	0.00
63079 to 63503	1.61
63503 to 65653	0.00
65653 to 65953	0.15
65953 to 66888	0.00
66888 to 68253	-0.99
68253 to 69703	0.00
69703 to 70103	0.50
70103 to 71846	0.00
71486 to 72403	2.88
72403 to 73223	-2.38
73223 to 75297	-0.02
75279 to 75758	0.00
75758 to 76298	0.72
76298 to 80274	0.00
80274 to 81003	1.00
81003 to 81628	-1.00
81628 to 82753	0.70
82753 to 83953	0.00
83953 to 84533	-2.00
84533 to 84923	0.00
84923 to 86423	1.00
86423 to 87851	0.00
87851 to 88703	-1.29
88703 to 89273	0.00
89273 to 89653	0.57
North Hialeah Line	
89653 to 90318	0.57

Distance From Dadeland South Station (feet)	Grade (%)
90318 to 91168	-1.65
91168 to 92148	0.00
92148 to 93018	1.64
93018 to 94368	0.00
94368 to 94858	-2.40
94858 to 96828	0.00
96828 to 97396	2.00
97396 to 97948	-1.75
97948 to 101748	0.00
101748 to 102108	1.65
102108 to 102711	-1.75
102711 to 104818	0.00
104818 to 105534	0.70
105534 to 105955	-0.75
105955 to 106622	0.00
106622 to 106968	1.70
106968 to 107408	-1.70
107408 to 109835	0.00
108935 to 110548	1.70
110548 to 113525	0.00
Palmetto Extension Line	
113525 to 113948	0.00
113948 to 114433	2.07
114433 to 115021	-2.00
115021 to 116568	0.00
116568 to 117566	-3.00
117566 to 119568	0.00

TABLE 3: SPEED PROFILE

Distance From Dadeland South Station (feet)	Speed Limit (MPH)
0 to 456	46
456 to 1120	70
1120 to 3305	58
3305 to 4256	46
4256 to 9555	70
9555 to 10065	58
10065 to 11344	46
11344 to 15294	70
15294 to 16636	46
16636 to 24436	70
24436 to 26415	46
26415 to 28035	58
28035 to 30975	70
30975 to 32293	46
32293 to 40555	70
40555 to 41906	46
41906 to 43007	58
43007 to 45698	70
45698 to 46480	58
46480 to 46770	46
North-South Line	
46770 to 49756	46
49756 to 51083	58
51083 to 55158	46
55158 to 58015	38
58015 to 58823	58
58823 to 60037	46
60037 to 63872	38
63872 to 64328	46
64328 to 65790	58

Distance From Dadeland South Station (feet)	Speed Limit (MPH)
65790 to 66546	46
66546 to 69223	70
69223 to 70003	58
70003 to 73223	46
73223 to 75758	70
75758 to 77094	46
77094 to 77480	58
77480 to 81003	38
81003 to 81853	70
81853 to 82603	58
82603 to 84103	46
84103 to 84353	70
84353 to 85223	58
85223 to 86839	38
86839 to 87295	46
87295 to 88096	70
88096 to 89103	58
89103 to 89653	46
North-Hialeah Line	
89653 to 92843	46
92843 to 93344	58
93344 to 94065	46
94065 to 96118	58
96118 to 98968	46
98968 to 102711	38
102711 to 103228	58
103228 to 104484	46
104484 to 105878	58
105878 to 108693	38
108693 to 110893	58
110893 to 111478	46
111478 to 111934	38

Distance From Dadeland South Station (feet)	Speed Limit (MPH)
111934 to 113019	28
113019 to 113525	15
Palmetto Extension Line	
113525 to 113768	15
113768 to 116021	46
116021 to 117996	38
117996 to 118255	28
118255 to 119075	15
119075 to 119568	15

TABLE 4: CURVE AND SPIRALS DATA

LEGEND:

Ts = Point of Tangent to Spiral

Sc = Point of Spiral to Curve

Cs = Point of Curve to Spiral

St = Point of Spiral to Tangent

Ea = Superelevation

Rc = Radius of Curve

(Ft) = Foot Unit

(In) = Inch Unit

Curve Number	Starting (Ft)	Ts (Ft)	Sc (Ft)	Cs (Ft)	St (Ft)	Ea (in)	Rc (Ft)
S - 36	62179	62032	61894	61794	61656	2.00	5187.50
		147	285	385	523		
S - 34		61557	61419	61319	61181	2.75	5187.50
		622	760	860	998		
S - 32		60572	60422	60322	60172	3.00	3441.00
		1607	1757	1857	2007		
S - 30		60070	59920	59820	59670	3.00	3437.70
		2109	2259	2359	2509		
S - 29		58754	58629	58529	58404	2.50	5650.00
		3424	3550	3650	3775		
S - 28		58304	58179	58079	57954	2.50	5650.00
		3875	4000	4100	4225		
S - 23		48000	47875	47775	47650	2.50	5650.00
		14179	14304	14404	14529		

Curve Number	Starting (Ft)	Ts (Ft)	Sc (Ft)	Cs (Ft)	St (Ft)	Ea (in)	Rc (Ft)
S - 22		47550	47425	47325	47200	2.50	5650.00
		14629	14754	14854	14979		
S - 17		36421	36058	35591	35228	4.00	2387.30
		25758	26121	26588	26951		
S - 15		32243	32143	32043	31943	2.00	7327.60
		29936	30036	30136	30236		
S - 14		31843	31743	31643	31543	2.00	7327.60
		30336	30436	30536	30636		
S - 7		21159	20925	20512	20278	4.00	2438.10
		41020	41254	41667	41901		
North-South Line							
N - 103	46335	4188	4188	5752	5952	4.00	1675.00
		46335	46335	47899	48099		
N - 101		6703	6890	7030	7218	3.75	5088.00
		48850	49037	49177	49365		
N - 1		7577	7677	7777	7877	2.00	4720.00
		49724	49824	49924	50024		
N - 3		8941	9104	9304	9466	3.25	6047.00
		51088	51251	51451	51613		
N - 5		9568	9730	9929	10092	3.25	6047.00
		51715	51877	52076	52239		
N - 7		11154	11304	11304	11454	0.00	11613.50
		53301	53451	53451	53601		

Curve Number	Starting (Ft)	Ts (Ft)	Sc (Ft)	Cs (Ft)	St (Ft)	Ea (in)	Rc (Ft)
N - 9		11554	11704	11704	11854	0.00	11613.50
		53701	53851	53851	54001		
N - 11		12899	13099	14472	14672	4.00	1000.00
		55046	55246	56619	56819		
N - 13		15033	15233	15533	15533	4.00	3228.30
		57180	57380	57680	57680		
N - 15		15878	16028	16130	16280	3.00	3200.00
		58025	58175	58277	58427		
N - 17		16568	16730	16837	17700	3.25	1975.00
		58715	58877	58984	59847		
N - 19		17779	18029	18631	18881	4.00	1000.00
		59926	60176	60778	61028		
N - 21		19469	19719	20328	20578	4.00	1000.00
		61616	61866	62475	62725		
N - 23		22358	22459	22459	22559	0.00	4909.00
		64505	64606	64606	64706		
N - 25		24230	24430	24630	24830	4.00	4228.20
		66377	66577	66777	66977		
N - 27		25087	25287	25387	25587	4.00	3287.40
		67234	67434	67534	67734		
N - 29		26351	26489	26589	26727	2.75	5187.50
		68498	68636	68736	68874		

Curve Number	Starting (Ft)	Ts (Ft)	Sc (Ft)	Cs (Ft)	St (Ft)	Ea (in)	Rc (Ft)
N - 31		26827	26965	27065	27203	2.75	5187.50
		68974	69102	69212	69350		
N - 33		28196	28416	29791	30011	4.00	1015.20
		70343	70563	71938	72158		
N - 35		31651	31751	31851	31951	1.25	17046.70
		73798	73898	73998	74098		
N - 37		32358	32496	32596	32734	2.75	5436.60
		74505	74643	74743	74911		
N - 39		32834	32972	33072	33210	2.75	5437.00
		74981	75119	75219	75357		
N - 41		34476	34576	34676	34776	2.00	7327.60
		76623	76723	76823	76923		
N - 45		35692	36322	37733	37783	4.00	1065.00
		77839	78469	79880	79930		
N - 47		40707	40737	40837	40868	0.62	10743.00
		82854	82884	82984	83015		
N - 49		43349	43380	33380	43411	0.00	12737.10
		85496	85527	75527	85558		
N - 51		45983	46115	46115	46247	0.00	11459.10
		88130	88262	88262	88394		
North-Hialeah Line							
H - 29	89050	10338	10518	10518	10598	0.00	2701.00

Curve Number	Starting (Ft)	Ts (Ft)	Sc (Ft)	Cs (Ft)	St (Ft)	Ea (in)	Rc (Ft)
		89050	89230	89230	89310		
H - 1		10741	10941	12557	12757	0.00	1203.20
		89453	89653	91269	91469		
H - 3		19135	19335	19636	19836	4.00	3098.90
		97847	98047	98348	98548		
H - 5		20108	20343	20739	20974	4.00	1000.00
		98820	99055	99451	99686		
H - 7		21615	21850	22408	22643	4.00	1000.00
		100327	100562	101120	101355		
H - 9		24662	24862	24997	25197	4.00	2406.40
		103374	103574	103709	103909		
H - 11		25325	25525	25687	25887	4.00	2600.00
		104037	104237	104399	104599		
H - 13		27214	27450	27567	27802	4.00	1000.00
		105926	106162	106279	106514		
H - 15		27925	28160	28312	28547	4.00	1000.00
		106637	106872	107024	107259		
H - 17		30244	30344	30344	30444	0.00	12606.60
		108956	109056	109056	109156		
H - 19		30546	30646	30646	30746	0.00	12390.90
		109258	109358	109358	109458		
H - 21		32021	32158	32302	32440	2.75	2333.50

Curve Number	Starting (Ft)	Ts (Ft)	Sc (Ft)	Cs (Ft)	St (Ft)	Ea (in)	Rc (Ft)
		110733	110870	111014	111152		
H - 23		33029	33293	33397	33661	4.00	1604.30
		111741	112005	112109	112373		
H - 25		34048	34148	34388	33488	2.00	3179.80
		112760	112860	113100	112200		
Palmetto Extension Line							
H - 27		35131	35331	35654	35854	4.00	327.40
		113843	114498	114366	114566		

TABLE OF CONTENTS

N11. TRUCK ASSEMBLIES 11-1
N11.1. GENERAL 11-1
N11.1.1. CITED REFERENCES 11-1
N11.1.2. SUBMITTALS – CDRLS 11-1
N11.1.3. CONFIGURATION 11-3
N11.1.4. INTERCHANGEABILITY 11-3
N11.1.5. SCOPE OF WORK 11-4
N11.2. STRESS ANALYSIS 11-4
N11.2.1. TRUCK DESIGN LOAD REQUIREMENTS 11-5
N11.2.2. STRESS ANALYSIS REPORT 11-5
N11.2.3. FINITE ELEMENT ANALYSIS 11-7
N11.2.4. COMPARISON WITH TEST RESULTS 11-8
N11.3. RIDE QUALITY 11-8
N11.4. PERFORMANCE 11-9
N11.5. MECHANICAL TRUCK COMPONENTS 11-9
N11.5.1. TRUCK FRAMES 11-10
N11.5.2. TRUCK BOLSTERS 11-10
N11.5.3. AXLES 11-10
N11.5.4. WHEELS 11-11
N11.5.5. JOURNAL BEARING RETAINER 11-11
N11.5.6. WHEEL/AXLE SUBASSEMBLIES 11-12
N11.5.7. DISC/TREAD BRAKE UNIT 11-12
N11.5.8. GROUND BRUSH RING ASSEMBLY 11-12
N11.5.9. SUSPENSION COMPONENTS 11-12
N11.5.10. WHEEL FLANGE LUBRICATION 11-14
N11.6. MISCELLANEOUS ELECTRICAL COMPONENTS 11-14
N11.6.1. CLEAT BLOCKS 11-14
N11.6.2. GROUNDING 11-15
N11.7. INSPECTION AND TESTING 11-15
N11.7.1. INSPECTION 11-15
N11.7.2. TESTING 11-15
N11.8. TRUCK MAINTAINABILITY 11-16
N11.8.1. TRUCK COMPONENT MAINTENANCE 11-16

N11.8.2. TRUCK CHANGING 11-17
N11.8.3. TRUCK INSPECTION 11-18
N11.8.4. CLEANING 11-18
N11.8.5. TRUCK LUBRICATION 11-18

N11. TRUCK ASSEMBLIES

N11.1. GENERAL

The design of the trucks shall provide Miami-Dade Transit with a truck that is of a proven design, light weight, low noise and vibration generation, minimal wheel flange and rail wear and ride quality conforming to the requirements of TPN2. The truck design shall be free of sliding metal-to-metal surfaces and shall not have lost motion or free play in any area.

Truck frames and bolsters shall be designed to maintain stresses within the endurance limits for the specified operational environment over the design life of the car while minimizing the weight of these components. The design life goal for elastomeric components shall be no less than 7 years.

N11.1.1. CITED REFERENCES

Source/Section	Title
AAR M-942	Specification for Axle Journal Grease
AFBMA L-11	Load Ratings and Fatigue Life for Roller Bearings
APTA-SS-M-012-99	Standard for Wrought Steel Wheels for Passenger Cars and Locomotives
ASTM D3359-02	Standard for Test Methods for Measuring Adhesion by Tape Test
AWS D1.1	Structural Welding Code, Steel

N11.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TP Reference
N1101	Alternative Truck Configuration Analysis	TPN11.1.3.
N1102	Truck Conceptual Design Documentation	TPN11.1.5.
N1103	Truck Structural Analysis Program	TPN11.1.5.

CDRL No.	Title	TP Reference
N1104	Axle Design Evaluation	TPN11.5.3.
N1105	Wheel Design	TPN11.5.4.
N1106	Journal Bearing Retention Method	TPN11.5.5.
N1107	Proposed Bearing Specifications, Reliability Data, Service Requirements	TPN11.5.5.1.
N1108	Journal Bearing Installation Procedure	TPN11.5.5.1.
N1109	Procedure for Assembly and Inspection of Components Fitted on to each Wheel/Axle Assembly	TPN11.5.6.
N1110	Procedures for Qualification Testing to be Performed on Assembled Axles with Wheels, Bearings, and Brake Equipment	TPN11.5.6.
N1111	Design Data for the Primary Suspension Member	TPN11.5.9.1.
N1112	Qualification Test to Verify the Spring Characteristics and the Resulting Graphs or Charts	TPN11.5.9.1.
N1113	Evaluation the Vehicle Suspension Configuration	TPN11.5.9.2.
N1114	Reports Containing the Technical Specifications of the Air Spring Secondary Suspension	TPN11.5.9.2.
N1115	Design Data that Completely Defines the Tubing Configuration, Routing and Clamping Points	TPN11.5.9.4.
N1116	Analysis of the Proposed Lateral Stop to Carbody Interface Including Engineering Drawings, Test Reports and Measures Proposed to Minimize Lateral Displacement and Improve Ride Quality	TPN11.5.9.5.
N1117	Documents Detailing the Method of Aligning the Bolster with the Carbody	TPN11.5.9.6.
N1118	Inspection Procedure for Completed Truck Assemblies	TPN11.7.1.
N1119	Qualification Test Procedure	TPN11.7.2.1.
N1120	Acceptance Test	TPN11.7.2.2.

N11.1.3. CONFIGURATION

The trucks and suspension subsystem shall be formed by all truck components from the rail up to the body bolster, including any suspension subsystem components rigidly mounted to the car body. It does not include gears, motors, wiring, brake system or current collectors. Any mechanical interface requiring welding or drilling on the truck shall also be considered part of the truck. The Contractor shall ensure that all truck mounted equipment can be accommodated without physical interference. On each truck shall be mounted two traction motors, two reduction gears, brake equipment/piping, tachometers, and third rail power collectors. On specific trucks, cables shall be installed and provisions shall be made for mounting ATC components.

Each truck shall be equipped with an air spring secondary suspension. The truck frame and bolster shall be an inboard bearing design of cast or fabricated steel. Truck elements shall be heat treated if required by the supplier of the material, for stress relief or strength attainment. Longitudinal forces from traction and braking, between truck bolster and truck frame shall be transmitted through long life elastomeric elements. The truck wheel base shall comply with Section 2. Clamps for piping, cables, etc. shall be attached to tapping plates or raised bosses.

Truck serial numbers shall be applied to both sides of each truck at the center of the side frame. The figures shall be ¾-inch (19 mm) high, with the bottom on the figures ¼-inch (6.4 mm) above the tangent point of the bottom of the member and shall be distinctly stamped into the frame with low stress steel dies. The starting serial number for trucks will be assigned by the Engineer. Serial number plates shall not be obstructed by adjacent equipment.

Alternative truck configurations shall be service proven, with full structural, performance, and maintainability analysis provided illustrating the details of the application of the configuration to the Miami Metrorail. Such analysis shall compare the proposed truck to the existing truck configuration for weight, balance, rotational moment of inertia, wheel/rail interface, performance in curves, and performance in switches for all applicable speeds. The proposer shall also provide a maintainability comparison to the existing MDT truck, wheel, and axle maintenance program, including available equipment (CDRL 1101).

N11.1.4. INTERCHANGEABILITY

Trucks shall be interchangeable between ends of the cars, with no modifications to the truck except for installation and removal of parking brake rigging, leveling valve connections, truck piping and ATC truck equipment. No welding, drilling, tapping, riveting, or cutting shall be necessary for application or removal of the aforementioned equipment. Any parking brake, leveling valve, piping assembly or ATC truck

equipment to be installed or removed from a truck shall be attached with bolted or screwed connections. The truck assembly shall be identical for all R-ends of all cars, and include provisions for mounting parking brakes, valves, piping, etc. to aid in interchangeability.

Truck frames, bolsters, wheels, axles, bearings, gear units, and motor assemblies (brake equipment/piping) shall be interchangeable between all trucks.

N11.1.5. SCOPE OF WORK

The scope of work shall include, at a minimum:

a. Creating a design concept for the new Metrorail Vehicle truck assembly (CDRL 1102).

b. Conducting preliminary, intermediate and final design reviews of the proposed Metrorail Vehicle truck assemblies.

c. Performing structural analysis of the proposed truck design and the interface between truck and carbody structure (CDRL 1103).

d. Conducting first article inspection and implementing an approved quality plan.

e. Performing dynamic truck and suspension system testing to include design qualification testing and acceptance testing.

f. Providing warranty and maintenance support.

g. Providing the maintenance training and all special tools required to maintain the truck and suspension system.

h. Creating new drawings and manuals where required.

N11.2. STRESS ANALYSIS

The Contractor shall submit a stress analysis of the truck, including the truck bolster. This analysis shall begin with a structural analysis plan, which shall be submitted at the PDR. The completed analysis shall be submitted not later than 60 calendar days prior to commencing manufacture of any truck assembly structural parts. The stress analysis shall be used to design the truck structure to obtain the lightest weight truck possible meeting the requirements of this Specification.

The stress analysis shall show the calculated stresses, allowable stresses, and margins of safety for all elements for all specified loading conditions. The stress analysis shall include calculations of stresses in all joints, joint elements, mounting brackets and other important elements.

During the design and manufacture of the truck, stress analysis shall be updated to reflect the as-built configuration. The initial stress analysis will require temporary assumptions as to configuration and weights; also manufacturing and other considerations may require design changes. As

these changes are made, the stress analysis shall be revised and submitted for review. The final submitted and approved stress analysis shall be for the truck in the as-built configuration.

Critical connections, which cannot be adequately analyzed, shall be prototyped and tested to demonstrate compliance with the requirements of the design and the Specification.

For any portion of the proposed design which is based on a service-proven truck, the Contractor may provide data from previous tests, historical data from operations, or stress analyses as required to satisfy the corresponding portion of these requirements.

N11.2.1. TRUCK DESIGN LOAD REQUIREMENTS

The Contractor is responsible for selecting truck design loads and design stresses. Design loads and stresses shall be submitted to the Engineer for approval.

The truck shall be capable of withstanding the maximum load imposed by the forces acting on the frame, including forces resulting from track shocks, motor torques (including electric braking), friction brakes, and any combination of these forces without developing stresses which are greater than the allowable stress.

For static load cases resulting from normal operation, design allowable stresses shall not exceed 60 percent of the yield strength of the material. For static load cases resulting from exceptional conditions, design allowable stresses shall not exceed the yield strength of the material.

Assessment of fatigue for truck structures shall be in accordance with AWS D1.1 using the S-N curve as defined in AWS D1.1.

Resistance to fatigue failure shall be demonstrated by analysis of individual fatigue load cases, and ensuring that the cumulative life fraction, in accordance with Miners Rule, shall be less than unity (1).

N11.2.2. STRESS ANALYSIS REPORT

A stress analysis report shall be prepared and submitted for review and approval. This report shall show that the structure satisfies the requirements of this Specification and good practice in the rail transit industry. The report shall be presented in sufficient detail and organized so that the Engineer can readily follow the theory and its application to this truck.

If a cited reference is not readily available to the Engineer, the Contractor shall provide the reference or copies of the pertinent pages. In addition to the pages that show the cited formula or data, the pages that show the development and interpretation of the formula or data must be included.

All references shall be in English. If an English reference cannot be found, an English translation shall be provided. Both the original and the translation shall be included in the report.

All stress analysis sheets shall be signed and dated by the author and checked by a second stress analyst who shall also sign and date each sheet checked.

The stress analysis report shall include, at a minimum:

- Truck structural drawings.
- Table of Contents.
- Wherever a formula or equation is used, it must first be stated algebraically with all terms defined and the values of these terms with units stated, before calculations are performed.
- All quantities wherever given must have their units given with them.
- References for all formulas, calculation procedures, material strengths, fatigue strengths, and other physical and mechanical properties must be cited where these items appear in the stress analysis.
- Diagrams displaying, for each load case, loads applied externally to the truck assembly and points of support.
- Detailed calculations of stresses with Margins of Safety (MS) in all structures with a summary of the results. Locations where the MS is less than 0.20 shall be shown in a table along with the design or operating conditions (loads) which cause the stresses.
- A diagram of calculated deflections of the truck assembly under full loading.
- An analysis of the strength of the truck frame-to-truck bolster, and truck bolster-to-car body bolster connections, including calculated vertical and horizontal connection capacities.
- A tabulation of the Contractor's selection of allowable fatigue stresses, with sources, and assumed applied fatigue stress ranges for structural members which are critical in fatigue.
- A table showing the engineering properties of each grade and temper of each material used in the truck structure. This table shall include the material designation, yield strength, ultimate strength, elongation, Young's modulus for tension, and compression and shear elastic moduli. In each case, minimum-guaranteed values from the specifications for the corresponding grade and heat treatment of the material shall be used. Materials, grades and tempers not used in the truck assembly construction shall not be included in the tables.

- Table(s) showing the minimum static and fatigue strengths of all welds. Values shall be given for each material, temper, weld size, and thickness combination used in the truck assembly. The source of the data shall be provided.

N11.2.3. FINITE ELEMENT ANALYSIS

The stress analysis shall include a linear-static Finite Element Analysis (FEA) of the complete truck assembly. The FEA shall be a performed using a computer program such as NASTRAN, ANSYS, ALGOR, or approved equal that according to its developer, and the developer of FEMAP generates both model and solution files compatible with FEMAP.

The Contractor shall submit and receive approval of the finite element model prior to performing the analysis. The initial model report shall be submitted not later than five months after NTP. The element grid, all assumptions, and a complete printed copy of the input file which includes input data, such as loads, boundary conditions, area properties and material properties, shall be included as part of this preliminary submittal and again as part of the complete analysis. Boundary reaction forces due to a gravity loading shall be included in the report.

Wherever required to be submitted, the input and output shall have each page numbered, and columns of data shall be clearly labeled on each page using terms, symbols, abbreviations, and units defined in the analysis report.

At the discretion of the Engineer, FE models and results shall be reviewed during live interactive sessions four weeks after each submittal. At these sessions, the Engineer shall have full access to the FE model input, output and software on the computer used for the analysis.

Color plots shall be prepared showing the following:

- Deflections in all three axes.
- Von Mises, or other approved combination stresses.
- Maximum and minimum principal stresses.
- Direction of maximum and minimum principal stresses.
- Strain-energy density, if available.
- Meshing accuracy index.

All plots shall show the maximum and minimum values and all values which are greater than 80% of the specified maximum value. Each drawing shall include a triad showing the direction of the truck assembly (global) axes. Plots at high magnification shall be keyed to a plot showing the structure to an extent sufficient to orient the high-magnification plots.

The FEA input and output data shall also be submitted on electronic media as approved by the Engineer. Submittal of the input file is required

with the model, and at any time the file is changed, but not more often than monthly. Criteria for final approval of the stress analysis shall include the Contractor's submittal of the fully configured input data files as required by this paragraph.

Upon completion of the final design, the FE model and analysis report shall be updated to represent the final configuration of the structure.

N11.2.4. COMPARISON WITH TEST RESULTS

The stress results from the truck static load test shall be compared with the corresponding stress analysis results. This information shall be tabulated and submitted with the truck structural test report.

The tables shall compare stresses calculated from the test strain gauge readings with analytical stresses from the FEA. Comparison shall be made for the highest-reading strain gauges, which shall not be less than half of the total number of strain gauges used during the test. The tables shall include the test stress value, the analytical stress value, the percent difference between the two values, and a space for annotation. The percent difference between the two values shall be within the following specified tolerance: for 75% of the compared values, test and analytical results shall agree within 15%.

If the analysis results do not agree with the test results within the above-specified tolerance, the builder shall revise the stress analyses, update the FE model, and re-run all FE analyses. This process shall be repeated until agreement of results is within the specified tolerance. All manual analyses using data from the FEA shall be recalculated using the corrected values. The stress analysis report shall be revised and re-submitted. All results from re-analysis shall meet specification requirements, and, if they do not, the design shall be corrected.

For any of the remaining 25% of the compared values where the analytical values disagree with the test value by more than 15%, and the test value is equal to or greater than 35% of the yield strength of the material, a detailed explanation of the reasons for the excessive variance shall be included in the truck test report. This explanation may include supporting manual calculations.

Approval of the truck test report shall depend, in part, on the adequacy of the analyses of excessive variance between analytical and test stress values.

N11.3. RIDE QUALITY

The truck shall be free of harmful oscillations at all operating speeds with new or worn wheel profiles.

To minimize low frequency ground-borne vibration and noise, unsprung weight should be minimized and truck frame on axle-wheel assembly resonance frequency shall not exceed 12 Hz.

The ride quality shall conform to the requirements of TPN2.7.

N11.4. PERFORMANCE

The truck shall meet the requirements under the track and operating conditions specified in TPN2.

- Motion – The suspension subsystem shall not permit car body motion to exceed, under all conditions, the dynamic outline.
- Clearance – All truck parts, except wheels, power collector shoes, and axle-mounted equipment, shall clear the plane of the top of the rails by not less than 3 inches under all conditions specified in TPN2.

Maximum wear is that condition in which a piece of equipment can be retained in service but beyond which it must be removed from service.

The Contractor shall provide for the clearances between the trucks and the car body and all its parts under all operating and loading conditions, including wheel and other wear. Clearances shall be provided for operation, body-truck cabling and piping, inspection, maintenance and repair.

The completely assembled truck with motors and other equipment shall not exceed the clearance limits required between truck parts with maximum wear and load, primary or secondary suspension deflection and/or rubber creep.

Provisions shall be made for vertical adjustment to compensate for wheel wear and other suspension tolerances to maintain the top-of-rail to floor height within the vertical tolerance. Four steps for wheel adjustment shall be furnished to accommodate 1-¼ inches of radial wheel wear. The design shall be subject to approval and shall permit adjustment with standard maintenance equipment and shall not impair the operation of the truck. Such adjustment shall not affect the leveling valve calibration and shall not be accomplished with loose shims. Wheel wear shall not be compensated at the primary suspension.

N11.5. MECHANICAL TRUCK COMPONENTS

The vehicle truck and suspension shall be designed for service on the MDT Metrorail system. The unique characteristics of the Metrorail transit system including track geometry, switch geometry, platform to vehicle interface, maintenance schedules, equipment, tools, and shop practices shall be given priority in the truck and suspension system design.

Conditions unique to the sub-tropic marine environment such as is found in South Florida shall be addressed in the truck design so that these conditions do not cause accelerated deterioration of the truck structure or circumstances that compromise the performance of the vehicle.

All truck frames, bolsters, axles and wheels shall be serialized. All materials used in the construction of the truck frames, bolsters, wheels and axles shall be of a known composition and accompanied by material certification reports. The reports shall be included in the vehicle history record. All fasteners shall be grade certified and be accompanied by material property reports identifying the composition of each lot of fasteners.

N11.5.1. TRUCK FRAMES

The vehicle trucks shall be of a proven design that has a proven passenger transit service record deemed sufficient by the Engineer to validate the reliability and maintainability aspects of said design.

The truck frame assemblies shall be of a one or two piece design. Casting, forging or fabricating via welding shall be recognized as acceptable methods of construction. All welding shall be performed by certified welders and equipment adhering to AWS standards. Truck frames or truck frame halves shall be serialized. Truck frames shall be painted in accordance with TPN19.

N11.5.2. TRUCK BOLSTERS

The vehicle bolster shall be of a proven design that has a proven passenger transit service record deemed sufficient by the Engineer to validate the reliability and maintainability aspects of said design. The vehicle bolster shall be of a one piece design. Casting, forging or fabricating via welding shall be recognized as acceptable methods of construction. All welding shall be performed by certified welders and equipment adhering to AWS standards.

N11.5.3. AXLES

The Contractor shall submit for review and approval reports to the Engineer for axle design evaluation. The proposed axle design shall comply with all applicable APTA standards and recommended practices. The reports shall include an analysis detailing axle stresses under static and dynamic loading, including a fatigue analysis demonstrating that the axle meets the requirements as described herein, material certification for the proposed axle, drawings and any other information requested by the Engineer (CDRL N1104). Axles shall be machined to be compatible with the MDT wheel truing facility.

N11.5.4. WHEELS

The new Metrorail vehicle shall use 28 in. diameter Class B multiple wear wheels, which comply with APTA SS-M-012-99 (Standard for Wrought Steel Wheels for Passenger Cars and Locomotives). Wheels mounted on a common axle shall be the same tape size. There shall be a maximum difference of two tape sizes between wheels on different axles of the same truck. Wheels shall have a condemnation line clearly visible on the front face of the rim.

The Contractor shall submit reports to the Engineer for review and approval of wheel design. The reports shall include an analysis detailing wheel stresses under static and dynamic loading, including a fatigue and thermal analysis demonstrating that the wheel meets the requirements as described herein. The reports shall also include material certification for the proposed wheel, drawings and any other information requested by the Engineer (CDRL N1105).

N11.5.5. JOURNAL BEARING RETAINER

The new vehicle truck design shall incorporate a primary suspension system design that has a proven passenger transit service record deemed sufficient by the Engineer to validate the reliability and maintainability aspects of said design. The journal bearing retention method shall be fail-safe so that the failure of a journal bearing shall not result in damage to the truck assembly.

The Contractor shall submit reports to the Engineer for review and approval of journal bearing retention methods. The reports shall also include material certification, drawings and any other information requested by the Engineer (CDRL N1106).

N11.5.5.1. BEARINGS

New vehicle journal bearings shall meet the requirements as described herein. Journal bearings shall have an L10 service life of 500,000 miles at 90% of AW2 car weight as calculated according to AFBMA L-11. Journal bearings shall lubricated with an AAR M-942 grease, and not require field lubrication.

The Contractor shall submit reports to the Engineer for review and approval that include proposed bearing specifications, reliability data, service requirements and any other information requested by the Engineer (CDRL N1107).

The journal bearing installation procedure shall be submitted to the Engineer for review and approval (CDRL N1108).

N11.5.6. WHEEL/AXLE SUBASSEMBLIES

Wheel/axle subassemblies shall comply with the requirements as described herein and shall meet the Existing rail vehicle OEM requirements for wheel back-to-back dimensions. Wheel diameters shall meet the requirements as described herein. Axles shall be coated with an approved coating system after assembly to protect against corrosion.

The Contractor shall submit to the Engineer a procedure for assembly and inspection of components fitted on to each wheel/axle assembly (CDRL N1109). The inspection record shall include but not be limited to:

a. Serial numbers and material composition reports for each axle, journal bearing, wheel, disc (if disc brakes) and drive gear assembled onto an axle.

b. Press graphs for each wheel, journal bearing, ground ring, and drive gear assembled onto an axle.

c. Back to back spacing measurements for journal bearings, wheels, axles, and drive gears assembled onto an axle.

The Contractor shall submit to the Engineer procedures for qualification testing to be performed on assembled axles with wheels, bearings, and brake equipment applied. The testing shall demonstrate the adequacy of the assembled axle design throughout all operating conditions. The results of the testing shall be reported to the Engineer (CDRL N1110).

N11.5.7. DISC/TREAD BRAKE UNIT

Each truck shall have supports for the mounting of four disc or tread brake units. The brake units shall be removable without the need to de-truck.

N11.5.8. GROUND BRUSH RING ASSEMBLY

The new rail vehicle shall be equipped with one ground brush ring assembly per axle.

N11.5.9. SUSPENSION COMPONENTS

The rail vehicle has a primary and secondary suspension system that includes a primary suspension system and a pneumatic spring secondary. The air springs are connected to a leveling system that maintains constant air spring height under varied loading. Vertical and lateral shock absorbers are included in the suspension system to mitigate vibration and excessive suspension travel, respectively.

N11.5.9.1. PRIMARY SUSPENSION

The Contractor shall submit to the Engineer for review and approval design data for the primary suspension member (CDRL N1111). The

elements of the primary suspension shall be capable of operating in MDT's Rail System environment without degradation and shall conform to TPN19.

Any primary suspension element used shall be qualification tested in accordance with the requirements in this section. The Contractor shall use an Engineer approved qualification test to verify the spring characteristics in all three directions. The resulting graphs or charts shall be submitted to the Engineer for approval prior to primary suspension installation (CDRL N1112). The primary suspension testing shall include the determination of creep rate.

N11.5.9.2. SECONDARY SUSPENSION

The original 22 Miami Metrorail station platforms were constructed with a nominal floor height of 43.0 in. The Contractor shall evaluate the vehicle suspension configuration in order to match the vehicle operating floor height to the station platform height. The results shall be submitted to the Engineer for approval (CDRL N1113).

Under no circumstances shall a failed air spring or "cut-out" air supply to the truck air springs necessitate performance restrictions that prevent the vehicle from operating at full speed in revenue service.

The Contractor shall submit to the Engineer for review and approval reports containing the technical specifications of the proposed air spring secondary suspension. The reports shall include spring rates, operating pressures, maximum loadings, maintenance requirements and any other information requested by the Engineer (CDRL N1114).

N11.5.9.3. LEVELING VALVES

Leveling valves shall be provided on trucks to provide the vehicle with three point control of the pneumatic suspension to achieve proper floor height at maximum vehicle load in accordance with the table below. Conversely, leveling valves shall support sufficient flow/exhaust to allow a vehicle to fall to the proper floor height when a heavy load has exited the vehicle. All turnbuckles, ball ends, and associated hardware shall be corrosion resistant. The exterior surfaces of the valve body shall be protected with an approved corrosion-inhibiting coating. Valves shall be tested in accordance with the requirements of this section. An approved lubrication shall be applied to the finished assemblies as required.

Position	Elapsed Time
Leveling from AW0 to AW2	15 to 25 seconds
Leveling from AW2 to AW0	15 to 25 seconds

N11.5.9.4. PNEUMATIC TUBING

The truck-mounted pneumatic tubing shall be stainless steel tubing. The truck tubing shall be mounted using cleats or mechanical clamps. All cleats shall be constructed of an approved polymer material. The Contractor shall submit to the Engineer for review and approval design data that completely defines the tubing configuration, routing and clamping points (CDRL N1115).

All tubing and fitting installations shall conform the standards outlined in TPN19.

N11.5.9.5. LATERAL STOPS

The carshell displacement at maximum lateral stop deflection shall not exceed 0.75 in. The Contractor shall provide to the Engineer for review and approval analysis of the proposed lateral stop to carbody interface including engineering drawings, test reports and measures proposed to minimize lateral displacement and improve ride quality (CDRL N1116).

N11.5.9.6. RADIUS RODS

All radius rods or truck bolster alignment devices shall be approved by the Engineer. The Contractor shall submit to the Engineer for review and approval documents detailing the method of aligning the bolster with the carbody. The documents shall include drawings of the carbody to bolster interface and calculations and test results demonstrating the arrangements ability to maintain alignment and dampen shock loads between the bolster and carbody (CDRL N1117).

N11.5.10. WHEEL FLANGE LUBRICATION

The trucks shall be provided with service proven wheel flange lubrication, installed such that lubrication elements are readily replaced from the side of the vehicle. Lubrication shall be grease and oil free and shall not contaminate friction brake elements.

The flange lubrication system shall minimize wheel wear, providing a wheel life no less than 250,000 miles.

N11.6. MISCELLANEOUS ELECTRICAL COMPONENTS

N11.6.1. CLEAT BLOCKS

All cleat blocks shall be made of a polymeric material complying with TPN19.

N11.6.2. GROUNDING

Truck grounding cables shall be jacketed cables. All mating surfaces shall be thoroughly cleaned. At assembly, electrical joint compound shall be applied between joints. The conductivity of these joints shall be verified using an approved procedure.

N11.7. INSPECTION AND TESTING

N11.7.1. INSPECTION

The Contractor shall prepare an inspection procedure for completed truck assemblies defined as follows. These procedures shall address, at a minimum, the guideline conditions noted herein and the accept/reject criteria being used. When possible, existing industry standards shall be utilized. Sufficient detail shall be recorded in the inspection reports to provide the Engineer with a means of assessing the condition of the subsystem or component. All inspection procedures shall be submitted to the Engineer for approval prior to the start of such work (CDRL N1118).

The guideline inspection requirements include:

a. Truck Frames: Truck frame geometry shall be verified using OEM measurement data.

b. Truck Bolsters: Same as point "a". Bolster geometry shall be verified using OEM measurement.

c. Radius Rods or Bolster Alignment: Radius Rod/Bolster alignment shall be verified using OEM measurement.

N11.7.2. TESTING

The following tests are required for the truck assemblies and related components. The Contractor shall prepare test procedures in accordance with TPN17. All test procedures shall be submitted for Engineer review and approval prior to the start of such work.

N11.7.2.1. QUALIFICATION TESTING

The following qualification tests shall be conducted on the truck assembly using approved procedures. The Contractor shall be responsible for the thoroughness and completeness of all tests (CDRL N1119). The required tests include, but are not limited to, the following:

Component Level:

a. Primary Suspension Qualification Test (three directions): Verify the spring characteristics of the Primary Suspension in all three directions.

b. Leveling Valve Qualification Test: Verify the deadband range under typical system pressures and establish the time to level the vehicle during a weight change from AW2 to AW0.

c. Pneumatic Piping Leakage Test: Check piping circuits for leaks under system operating pressure and over pressure conditions. Leakage identification shall be achieved through pressure readings from the main reservoir. Compressor units must not operate during the testing period.

d. Lateral Stop Pad: Verify spring characteristics of the lateral stop pads.

e. Ground Ring: Verify continuity in the ground ring.

f. Paint Adhesion Test: Verify paint adhesion on truck frames and bolsters per ASTM D3359-02, test method A, with a minimum rating of 3A.

N11.7.2.2. ACCEPTANCE TESTING

The following acceptance test shall be conducted on all components or subassemblies. The Contractor shall be responsible for the thoroughness and completeness of all tests (CDRL N1120). The required tests include, but are not limited to, the following:

a. Primary Suspension Acceptance Test (vertical direction only): Verify the spring characteristics of the Primary Suspension in the vertical direction on all Primary Suspension elements.

b. Leakage Test of Truck-Mounted Pneumatic Piping: This is part of the vehicle piping test.

c. Truck Grounding Shunt Test: Verify conductivity of the all truck ground straps.

d. Leveling Valves: Verify deadband and response times at operating pressures.

e. Truck Clearance Test: Verify that the trucks do not interfere with other vehicle or system-mounted components.

N11.8. TRUCK MAINTAINABILITY

N11.8.1. TRUCK COMPONENT MAINTENANCE

The design of the truck shall support ready maintenance, consistent with the following:

a. All truck components shall have a minimum design life equal to a multiple of the maintenance period of the truck. Truck design shall require overhaul at no less than a 6 year interval or 500,000 miles.

b. Overhaul of truck components and assemblies such as motors, gear boxes, coupling, journal bearings, elastomers, wheels and axles, brake cylinders, and leveling valves must coincide with periodic truck overhauls.

c. Provisions shall be made for alignment of the truck and the carbody when replacing the truck such that damage does not occur to any component of the truck.

d. The truck design shall permit wheels to be turned to a minimum diameter of at least 25.50 inches, using MDT's existing wheel turning equipment.

e. All truck lubrication fittings are to be easily accessible without the removal of other equipment or removing the truck from the vehicle.

f. All truck pneumatic components for which maintenance access is required shall be readily accessible from the side of the truck without removing other equipment or removing the truck from the vehicle. This includes adjustment of suspension leveling.

g. Brake shoes shall be easily exchanges and there should be no need to remove any truck components in order to replace brake shoes.

h. All electrical connections with the exception of third rail high-voltage cables and carbody ground, shall be connected by a quick disconnect type of connector. This connector shall allow easy and quick disconnect of all truck wiring in order to facilitate truck removal and replacement. Connector type and method of support shall be approved by the Engineer. The contractor must demonstrate its application during design review.

i. Speed sensors shall not need gear to sensor gap adjustment. When sensors are properly mounted, the gap between the gear and the tip shall be automatically achieved.

N11.8.2. TRUCK CHANGING

Trucks shall be capable of being disconnected and reconnected easily and with a minimum of operations by personnel working in pits or alongside the trucks. It shall be possible to easily inspect for correct reconnection without the need for special tools or instruments.

The design of the truck shall provide for ease of interchanging of trucks. The truck suspension shall be integral with the truck and allow complete truck suspension adjustment prior to installation under a car. It shall be possible to change either truck on a car and release the car for service using existing MDT shop facilities within four hours using two trained mechanics/technician. Trucks shall be completely interchangeable between cars without the need to adjust suspension components. The Contractor shall demonstrate to the satisfaction of MDT in design review and by physical exercises that the above our hours time for truck removal

and replacement can be achieved. Final pilot car trucks shall be used to facilitate the above demonstration using MDT's facilities and spare trucks.

The truck design shall provide ease of truck changing using the MDT's existing facilities. Following a truck change-out, it shall be possible to restore the car to a condition fit for service operation at the same location as the truck change-out occurred.

N11.8.3. TRUCK INSPECTION

It shall be possible for personnel working in pits or alongside the truck to visually inspect the condition of truck components, such as brakes and wheel treads, easily and without the use of special tools.

N11.8.4. CLEANING

Trucks shall be capable of being cleaned using high pressure hot water and steam jet cleaning equipment.

N11.8.5. TRUCK LUBRICATION

All equipment of the truck that require periodic lubrication shall have lubrication points or access that will not require removal of the assembly or any other parts to allow easy access for adding lubrication.

All grease nipples shall also be easily accessible. Traction motor couplings shall be equipped with quick lubrication access without the need for dipping or installing of grease nipples on demand.

Journal bearings shall be sealed for life to dust and moisture and shall need no periodic lubrication at less than a 6 year intervals.

TABLE OF CONTENTS

N12. FRICTION BRAKING 12-1
N12.1. GENERAL 12-1
N12.1.1. CITED REFERENCES 12-1
N12.1.2. SUBMITTALS – CDRLS 12-1
N12.1.3. SCOPE OF WORK 12-2
N12.2. AIR SUPPLY SYSTEM 12-2
N12.2.1. AIR COMPRESSOR 12-2
N12.2.2. AIR RESERVOIRS 12-4
N12.3. BRAKING SYSTEM 12-4
N12.3.1. FRICTION BRAKING 12-4
N12.4. TESTING 12-8

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N12. FRICTION BRAKING

N12.1. GENERAL

This section specifies the technical requirements for components of the friction brake system. Included are requirements for the air compressor, air reservoirs, actuators, service brake control, emergency brake control, friction brake system interface with propulsion and dynamic brake controls, the wheel spin/slide control, parking brake controls, and all other hardware, components and consumables required for friction braking. The resulting friction brake system shall be configured and manufactured for fail-safe operation and shall comply with all applicable APTA standards and recommended practices for new passenger rail equipment. Basic performance requirements and tolerances are defined in TPN2.

N12.1.1. CITED REFERENCES

Source/Section	Title
49CFR 661	Buy America Requirements
APTA SS-C&S-002-98	Standard for Static Strength of Attachment of Major Equipment to the Car Body Structure of Railroad Passenger Equipment
APTA SS-M-011-99	Standard for Compressed Air Quality for Passenger Locomotive and Car Equipment
ASME, Section VIII	Boiler and Pressure Vessels Code

N12.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TP Reference
N1201	Friction Brake System Plan	TPN12.1.3.
N1202	Air Supply System Design Documentation	TPN12.2.1.
N1203	Air Dryer System Design Documentation	TPN12.2.1.
N1204	Air System Qualification Test Procedures and Report	TPN12.2.1.

CDRL No.	Title	TP Reference
N1205	ECU Diagnostic Design, Data Logging Signal Monitoring Capability, and Storage Capacity	TPN12.3.1.1.
N1206	Spin/Slide Control Design	TPN12.3.1.1.
N1207	Brake System Component Acceptance Testing Procedure and Report	TPN12.4.
N1208	Brake System Qualification Testing Procedure and Report	TPN12.4.

N12.1.3. SCOPE OF WORK

The friction brake system design, construction and component mounting shall be executed in accordance with all applicable APTA Standards and Recommended Practices and comply with all current Buy America requirements per TPN16. The friction brake system shall meet the performance requirements specified in TPN2.

The Contractor shall submit a Friction Brake System Plan to the Engineer for review and approval (CDRL N1201). The System Plan shall provide the design and layout data of the proposed system. The System Plan shall include a listing of all friction brake system components, technical data required to define the operations, maintenance, and interfaces for all components and software and arrangement drawings showing the location of components and system test port locations. The Friction Brake System Plan shall contain a Systems Integration Outline to insure the seamless operation of vehicles regardless of the make-up of a consist. The Systems Integration Outline shall include the VMS operation and the interface between sensors, necessary to extract the individual point data and transmit it to the onboard VMS Central Control Unit.

The System Integrator shall be responsible to review, correct and use all subsystem designs to develop completely assembled integrated drawings and diagrams that are deemed necessary and as specified in TPN13, TPN14, and TPN20.

N12.2. AIR SUPPLY SYSTEM

N12.2.1. AIR COMPRESSOR

The air supply system shall be provided in compliance with APTA SS-M-011-99 specified standards. The compressor arrangement shall incorporate one air supply system complete with air dryers on each married pair. Each air supply system shall be powered by 208 VAC or 230 VAC from the auxiliary inverter of its respective car.

Each compressor system shall consist of a service proven heavy-duty, oil-less, low maintenance compressor, cooling system, safety pressure relief valve, automatic drain valve, governor, heavy-duty moisture separator, and air dryer. All components of the compressor system shall be of a Service-Proven design with reliability data that meets the requirements specified in TPN18.

The air supply system shall supply air at a volume sufficient to support the braking and pneumatic needs of a married pair or standard train consist and maintain adequate volumetric reserve to satisfy the requirement for improved leveling response specified in TPN11. The volumetric output of the air supply system shall be adequate to meet system demand at all operating pressures up to 150 psi. The maximum system pressure shall not exceed 160 psi. The air supply system shall be capable of continuous operation at maximum capacity and the duty cycle of each individual compressor, under normal operating conditions, shall not exceed 50%. A compressor management system may be employed to meet duty cycle requirements and maximize the performance of the air dryers. The Contractor shall submit to the Engineers for review and approval reports containing technical specifications, maintenance requirements and reliability data for all components of the air compressor system (CDRL N1202). A compressed air consumption analysis demonstrating the ability of the air supply system to meet specified requirements shall be provided to the Engineer for review and approval as part of CDRL N1202.

The air dryers shall provide a minimum of 30°F dew point depression. The above dew point depression shall be maintained while pumping up a married pair pneumatic system from zero to 150 psi, in the range of environmental conditions referenced in TPN2. The air dryer systems shall be of a Service-Proven design with reliability data that meets the requirements specified in TPN18. The Contractor shall submit to the Engineer for review and approval reports containing technical specifications, maintenance requirements and reliability data for the air dryer system (CDRL N1203).

The Contractor shall submit procedures to the Engineer for review and approval of qualification testing to be performed on the air compressor system (CDRL N1204). Testing shall be performed in accordance with TPN17 and will measure the performance of the new system. Testing will include but not be limited to:

a. Capacity testing to demonstrate the ability of the system to adequately meet all pneumatic demands while simultaneously leveling at a rate sufficient to satisfy the requirements of TPN11. This test shall also demonstrate the ability of the system to operate and meet all performance requirements with one of the two compressors inoperative.

b. Shock and vibration testing to demonstrate the equipment operates

within limits established in TPN2.

Leakage testing to establish that the brake subsystem does not leak more than 5 psi after the subsystem is charged to 150 psi and allowed to dwell for 15 minutes.

N12.2.2. AIR RESERVOIRS

Air reservoirs shall be provided to allow sufficient pneumatic capacity for operation of the friction brake system, air suspension and all other pneumatic devices required for rail vehicle operation. The main and service reservoirs shall have sufficient storage capacity after failure of a compressor unit to permit five (5) friction brake only applications, full service brake application to a full stop from 70 mph with an AW3 loaded vehicle without initiating an emergency brake application due to low system air pressure. It shall be assumed that the compressor failure occurs when the system pressure is at the cut-in pressure setting of the air compressor governor. In addition, the parking brake reservoir shall be sufficiently sized to allow five applications and releases of the parking brake from the previously mentioned air compressor failed state.

Each car shall have one main reservoir and at least one supply reservoir. The reservoirs shall comply with current ASME Section VIII, division 1 code standards for unfired pressure vessels and be provided with witness holes. The reservoirs shall be certified and bear serial numbers on a certification plate affixed by welding to the reservoir. The reservoirs shall be attached to the carbody structure in accordance with APTA SS-C&S-002-98 standards. The air supply to the service reservoir and the parking brake reservoir shall be protected by check valves. The system shall utilize a separate main reservoir trainlined pipe separate from the brake pipe. The main reservoir shall be fitted with an automatic drain valve with a manual override.

N12.3. BRAKING SYSTEM

The vehicle braking system shall consist of an electrically controlled and applied dynamic brake system coupled with an electrically controlled pneumatically applied friction brake system. The system shall be capable of functioning in a blended friction/dynamic mode or in a mode with either the friction or dynamic braking cut-out. In either mode, the control system shall provide slide protection to protect the wheels from damage.

N12.3.1. FRICTION BRAKING

The friction braking system will consist of an electro-pneumatically controlled, pneumatically applied disc or tread brakes.

N12.3.1.1. **ELECTRONIC BRAKE CONTROL AND ANTI-SLIDE UNIT**

The Friction Brake System shall use an Electronic Control Unit (ECU) with Anti Slide capability to meet or exceed the following requirements.

- The units shall comply with all applicable requirements of this Specification.
- The ECU shall be a microprocessor-based device.

Each logic unit shall have sufficient capacity to solve the relevant control equations and provide diagnostic capability while permitting expansion of computer function.

The control unit and all related software and devices shall be sufficiently responsive to detect and remedy all erroneous or potentially damaging conditions such that equipment damage is prevented or minimized.

Electronic control equipment shall be segregated from power equipment except for power semiconductor drive circuits which may be located where required to achieve necessary drive signal characteristics. Control circuitry and control voltage sources shall be optically or transformer isolated from power circuitry and high voltage sources.

The friction brake control logic shall be securely mounted in environmentally protected enclosures with adequate provisions for maintainability and safety. Special attention shall be given to the design to provide easy access to, and installation and removal of, control apparatus. Control electronics may be located in one area, but controls for each truck shall be segregated within the enclosure.

The ECU shall be functionally transparent to have no negative impact upon other friction brake system components and vehicle subsystems, including propulsion control logic, spin/slide control, trainlines, low-voltage DC power supply, and Operator's cab indications and controls.

As an alternative to an independent friction brake system control, the functional requirements of the friction brake system ECU described herein may also be integrated with the propulsion system control electronics.

Zero Speed (No-Motion) shall be detected in a manner such that a single point failure shall not result in a false zero-speed indication. In all automatic and manual modes full service brakes shall be applied if a speed greater than 2 mph is achieved in either the forward or reverse direction while in a no-motion mode of operating.

The pneumatic portions of the service brake and emergency brake controls shall be mounted externally on a common manifold. The manifold mounting shall comply with APTA SS-M-011-99. Components shall be mounted separately, identified, and serviceable as Line Replaceable Units (LRU's).

The unit shall provide the same capability in the areas of self-test and

diagnostics. A VMS and Portable Test Unit (PTU) interface integrated with the overall car systems shall be located in the vehicle cab and outside the vehicle for improved troubleshooting capability. The PTU shall comply with the requirements provided in TPN15.

In addition to the self diagnostic and test feature, the ECU and anti-slide unit shall provide system diagnostics through the interface to the PTU and VMS. The diagnostics shall include operational status of all friction brake components and identification of all malfunctioning LRU's.

The ECU and anti-slide software shall provide all diagnostic information to the vehicle communication BUS.

Test equipment shall comply with the requirements provided in TPN15 and TPN17.

The ECU shall have features noted below.

- The Contractor shall guarantee a replacement unit component availability period of at least 10 years starting from the completion of the warranty periods.
- The ECU shall perform the spin/slide control function in accordance with the performance requirements of TPN2.
- The diagnostic design, data logging signal monitoring capability, and storage capacity shall be submitted to the Engineer for review and approval (CDRL N1205).
- Structured programming techniques shall be used with at least two levels of documentation above the source code level. Programming techniques and software requirements shall be as specified in TPN19 and TPN22. Software escrow requirements are set forth in GP5.

The environmental conditions present during the various seasons in Miami renders the operation of the spin/slide system critical. The spin/slide control shall be carefully integrated between the friction brake and propulsion control systems. The design of the spin/slide control system shall be submitted to the Engineer for review and approval (CDRL N1206).

N12.3.1.2. PNEUMATIC BRAKE CONTROL UNIT

The pneumatic brake control shall function in concert with the propulsion control system and provide blended braking, speed taper, jerk limiting, wheel spin/slide protection, and load weighing function.

Friction brake effort shall be controlled on a per car, or per truck level. The friction brake control unit design shall be fail-safe so that no single failure or combination of common mode or common cause failures shall result in less than 50% of the emergency braking effort per car being available.

The friction brake pneumatic control system shall meet or exceed all vehicle operating system requirements specified in TPN2.

N12.3.1.3. **PRESSURE SWITCHES**

All pressure switches shall be of an Engineer approved design.

N12.3.1.4. **TEST FITTINGS**

All test fittings shall be of an Engineer approved design.

N12.3.1.5. **CHECK VALVE**

All check valves shall be of an Engineer approved design.

N12.3.1.6. **QUICK-RELEASE VALVE**

All quick-release valves shall be of an Engineer-approved design.

N12.3.1.7. **MAGNET VALVES**

All magnet valves shall be of an Engineer-approved design.

N12.3.1.8. **BRAKE ACTUATOR/CALIPER ASSEMBLY**

The actuator/caliper assembly mounting provisions shall facilitate mounting on a truck assembly. The actuator/caliper shall be capable of:

- Generating sufficient forces on the brake pads to achieve the braking rates specified in TPN2.
- Meeting all other performance requirements defined in TPN2.
- Meeting the fail-safe redundancy and degraded performance requirements noted herein.
- Functioning as a parking brake with the ability to hold the vehicle on maximum grade at maximum vehicle loading as identified in TPN2.
- Release of the parking brake in the event of a loss of compressed system air shall be readily feasible when in trackside and station conditions.

Brake pads shall be readily removable for maintenance without actuator/caliper disassembly. Pad life shall be no less than 40,000 miles. Pads shall include an indication groove or other feature to illustrate when the pad should be replaced.

N12.3.1.9. **ASSOCIATED SYSTEM COMPONENTS**

The requirements for associated system components include the following:

- All underfloor piping for the friction braking system shall be Type K copper tubing. All associated fittings shall be solder type copper,

compatible with the tubing utilized. The entire system shall be qualification tested. The piping on each vehicle shall successfully pass a leak test.

N12.4. TESTING

All components used in the friction brake system shall undergo testing to verify acceptability. The Contractor shall include a test plan that shall specify all testing to be performed on the brake system components and the friction brake system. The Contractor shall submit to the Engineer for review and approval an acceptance testing procedure and report for each component of the friction brake system (CDRL N1207).

All new components shall be tested at the place of manufacture.

The Contractor shall perform friction brake system qualification testing as required by TPN17. The Contractor shall submit to the Engineer for review and approval a qualification test procedure and report for the friction brake system (CDRL N1208). The qualification testing shall include but not be limited to measurement of system performance and actual data recorded throughout the normal and extreme service regimes of the friction brake system. The system shall meet all requirements of this Specification when operated at the service limits specified in TPN2. Recorded test data shall include but not be limited to:

- Blended brake stopping distances throughout the operating speed range.
- Full friction brake stopping distances throughout the operating speed range.
- Emergency brake stopping distances throughout the operating speed range.
- Blended brake stopping rates throughout the operating speed range.
- Full friction brake stopping rates throughout the operating speed range.
- Emergency brake stopping rates throughout the operating speed range.
- Service braking test with inoperative blended brakes.
- Friction Surface temperature monitoring during dynamometer brake testing.
- Brake system noise monitoring during brake testing.
- Partial system brake testing (portion of brake system inoperative).
- Slide efficiency testing.

TABLE OF CONTENTS

N13. COMMUNICATIONS 13-1
N13.1. GENERAL 13-1
N13.1.1. CITED REFERENCES 13-2
N13.1.2. SUBMITTALS – CDRLS 13-4
N13.2. SCOPE 13-5
N13.2.1. REQUIREMENTS FOR EQUIPMENT INTEGRATION AND WAYSIDE INTERFACES 13-7
N13.3. ONBOARD COMMUNICATION SYSTEM REQUIREMENTS 13-8
N13.3.1. INTEGRATOR CAPABILITY 13-8
N13.3.2. COMMUNICATION SYSTEM OVERVIEW 13-9
N13.3.3. SHARED SYSTEM AND EQUIPMENT 13-10
N13.3.4. PUBLIC ADDRESS SYSTEM 13-17
N13.3.5. PASSENGER INFORMATION SYSTEM 13-21
N13.3.6. INTERCOM (IC) SYSTEM 13-25
N13.3.7. CLOSED CIRCUIT TELEVISION/SECURITY SYSTEM 13-28
N13.4. RADIO AND CONTROL EQUIPMENT 13-34
N13.4.1. GENERAL 13-34
N13.4.2. RADIO AND CONTROL EQUIPMENT REQUIREMENTS 13-36
N13.4.3. TRANSIT CONTROL HEAD 13-37
N13.4.4. RADIO SPEAKER 13-37
N13.4.5. HANDSET - MICROPHONE 13-37
N13.4.6. RADIO SYSTEM INTERFACE 13-37
N13.5. GENERAL INFORMATION VIDEO SYSTEM 13-38
N13.6. PORTABLE TEST UNIT 13-39
N13.6.1. GENERAL 13-39
N13.7. TESTING REQUIREMENTS 13-39
N13.7.1. TESTING 13-39

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N13. COMMUNICATIONS

N13.1. GENERAL

The Contractor shall furnish, install, and test all communications equipment as specified herein. Communications system shall integrate and process onboard audio, video and data points. All trainlined communications functions shall be fully compatible with other trainline functions being installed in these cars.

The Contractor shall perform a detailed analysis of the communication interfaces in the existing wayside, using existing MDT information and via test measurements on-site in Miami. At the completion of the analysis, a report shall be prepared detailing the Contractor's findings, the interfaces schemes by which interoperability will be achieved, and any recommendations for improvements or changes. This report shall be submitted for approval to the Engineer (CDRL N1301).

All protocols, both hardware and software, and descriptions of all communication equipment shall be provided to the Engineer, such that any subsequently procured equipment may be engineered to interoperate correctly when trainlined with vehicles provided under this contract.

In general, the Communication System shall consist of:

- Communications Control Units (CCU),
- Passenger Information Screens (PIS),
- Passenger Emergency Intercoms (PEIC), along with associated passenger intercoms, amplifiers, interface circuitry,
- Vehicle Logic Units (VLU),
- Train voice and data radios,
- GPS units,
- Public Address (PA) system,
- Communication Control Heads (CCH),
- Train Operator Displays (TOD),
- CCTV cameras,

- Digital Video Recorders (DVR),
- Wireless communication to the wayside,
- Cab-to-cab Intercom,
- DC to DC converter for power sources,
- Passenger WiFi,
- Integrated PIS and General Information Video System,
- Dual redundant Ethernet backbone.

The train voice radio shall allow the Operator to communicate with the Central Control Dispatcher, the Yard Tower, and with maintenance personnel. The Train Data Radio also transmits an Operator-initiated "silent alarm", and vehicle location and alarm information to Central Control. The PA system shall allow one-way voice announcements from the energized cab to all vehicles in the train. The PA system shall be capable of broadcasting announcements received on the train radio and pre-recorded station announcements.

The passenger intercom shall provide a two-way intercom to allow passengers to initiate hands-free, full duplex communications with the train Operator.

The Communications equipment shall conform to all applicable FCC regulations.

The system's hardware and software shall be field upgradeable.

N13.1.1. CITED REFERENCES

The Contractor shall provide a Communication System that shall be in full compliance of the following standards, criteria and recommended practices:

Source/Section	Title
49 CFR 37, 38	Americans with Disabilities Act (ADA) Accessibility Specification for Transportation Vehicles
EIA-SE-101-A	Amplifiers for Sound Equipment
EIA-SE-103	Speakers for Sound Equipment

Source/Section	Title
TIA/EIA-603	Land Mobile FM or PM Communications Equipment Measurement and Performance Vibration and Shock Stability Requirements • Method 514.4 Procedure II Category 3 Vibration (loose transport) • Method 514.4 Procedure I Category 10 Vibration (minimum integrity) • Method 516.4 Procedure VI Shock (bench handling) • Method 516.4 Procedure I Shock (functional) • Method 516.4 Procedure V Shock (crash hazard) • Method 506.3 Procedure I (rain, wind driven) • Method 509.3 Procedure I (salt fog)
FCC Regulations	Federal Communications Commission Regulations (as applicable)
IEEE 730	Standards for Software Quality Assurance
IEEE 730.1	Software Quality Assurance Plans
IEEE 802.3	Standard for Information technology-Telecommunications and Information Exchange Between Systems-Local and Metropolitan Area Networks--Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
IEEE 802.11	Local and Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
IEEE 802.16	Broadband Wireless Metropolitan Area Networks (MANs)
IEEE 1473	Standard For Communications Protocol Aboard Trains
IEEE 1478	Standard for Environmental Conditions for Transit Rail Car Electronic Equipment
MIL-STD-1472	Human Engineering Design Criteria
TIA Telecommunication Bulletin	TSB-102.BACC, TSB-102.BAEA TSB-102.BAEB

N13.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TP Reference
N1301	System Interface Report & Recommendations	TPN13.1.
N1302	System Integration Documentation	TPN13.2.1.
N1303	Communication Link between Stations. Communication Room and the Platform	TPN13.2.1.
N1304	Proposed Operator Interface Equipment Layout	TPN13.3.3.1.
N1305	CCU Designer Qualifications	TPN13.3.3.1.1.
N1306	Communication Port for PTU	TPN13.3.3.1.1.
N1307	Proposed CCU System Block Diagram	TPN13.3.3.1.1.
N1308	CCU Location, Installation, and Replaceable Filter Requirements	TPN13.3.3.1.1.
N1309	Design and Configuration for Vehicle Silent Alarm	TPN13.3.3.1.6.
N1310	Onboard (shared) Trainline Design, including configuration, topology, and block diagram	TPN13.3.3.2.
N1311	PA System Design and Specifications	TPN13.3.4.1.
N1312	Door Chime Proposal and Schematic	TPN13.3.4.1.
N1313	Proposed Messages, Audio Announcements, and Corresponding Textual Messages	TPN13.3.4.2.
N1314	PA Microphone station Design and Location	TPN13.3.4.3.2.
N1315	Speaker Calculation and Mounting Details	TPN13.3.4.3.3.
N1316	Passenger Information System Design, Signs, Mounting and Programming Details	TPN13.3.5.1.
N1317	Proposed Interior Signs and Mounting Details	TPN13.3.5.3.3.
N1318	Passenger's Display Signs Protocol and Interface to the Local Area Network	TPN13.3.5.3.4.
N1319	All Display Interfaces, Application Software, and Software Protocols	TPN13.3.5.3.4.
N1320	Noise Control Plan, Location and Installation details for the IC System	TPN13.3.6.2.
N1321	CCTV/Security System Design and Block Diagram	TPN13.3.7.2.

CDRL No.	Title	TP Reference
N1322	DVR Placement Details Inside the Vehicle	TPN13.3.7.3.1.
N1323	Complete Radio System Block Diagram	TPN13.4.1.
N1324	Radio Equipment Location, Mounting & Cable Lengths	TPN13.4.1.
N1325	Installation Details and Location for Emergency Transit Switch	TPN13.4.1.3.
N1326	Radio System Interface Plan	TPN13.4.6.
N1327	Radio Software Functionality Plan & Flow Charts	TPN13.4.6.
N1328	Digital Radio Triggering Requirements	TPN13.4.6.
N1329	List of Alarm Condition Messages	TPN13.4.6.
N1330	Design and Block Diagrams for the General Information Video System	TPN13.5.
N1331	EMI Susceptibility Analysis	TPN13.7.
N1332	Manufacturer's Test and Inspection Procedures	TPN13.7.1.
N1333	Test and Inspection Plan of System Components	TPN13.7.1.

N13.2. SCOPE

The Contractor shall use these Specifications to design and supply the Communication System. The Contractor shall install and interface all Communication System components and test the Communication System on the vehicles, including the qualification testing of the overall Communication System. The Contractor shall provide all equipment necessary to provide the indicated functions. At a minimum, the onboard communications equipment shall include the following:

- Public Address (PA) System.
- Passenger Information Screens (PIS).
- Intercom (IC) System that shall include:
  - Full Duplex Passenger Emergency Intercom (PEIC).
  - Cab-to-lead cab Intercom.
- Close Circuit Television System (CCTV)/Security System.

- Radio System with built-in modules for CAD/AVL inclusive of all required equipment, wiring and antennas.
- Fixed Graphic Signs.
- Communications Control Units (CCU).
- Communications Control Heads (CCH).
- Train Operator Displays (TOD).
- 2 Wireless Communication networks, one for public access and one for the train network.
- General Information Video System.

All communication equipment, including audio, video, and data wiring shall be provided with adequate shielding and subsystem isolation necessary to keep noise and interference from other car equipment and cross talk to inaudible levels. The signal-to-noise ratio shall be a minimum of 70 dB unweighted.

All communication equipment not installed on the cab console or in the passenger compartment shall be installed in interior lockers. Except for vehicle wiring harness components, communications equipment shall be modular in nature, mechanically installed in the vehicle and connected such that the removal of any communications system equipment for maintenance and repair shall not require disassembly or removal of other vehicle components. Removal of any communications equipment component for maintenance or repair shall be achievable by one person using simple hand tools within ten minutes. It shall not be necessary to remove communications components to perform routine maintenance or any other vehicle subsystem or part.

The final design and configuration of the Communication System shall meet the current ADA requirements as applicable.

The overall communications work shall include, but is not limited to, the following:

a. Provide interface equipment between the communications control unit, train radios, and GPS.

b. Ensure that the Communication System provided interfaces with the wayside and remote monitoring and control equipment.

c. Provide and coordinate all communication links, including inter-car and intra-car trainline connections, transmission and receiving equipment, cabling and testing to achieve a seamless operation of onboard devices with remote control and monitoring location(s) as defined utilizing the existing MDT wayside Ethernet and wireless network.

d. Verify, through testing, that the Communication System in any lead vehicle is capable of providing adequate signal (drive) to circuits in up to an eight-car consist.

N13.2.1. REQUIREMENTS FOR EQUIPMENT INTEGRATION AND WAYSIDE INTERFACES

It shall be the Contractor's responsibility to provide proper communication equipment interfacing with the wayside MDT network to perform the functions stated herein.

VMS is specified in TPN20 and includes the type and categories of points that are required to be monitored. MDT and other Sub-Suppliers may add additional points as part of the vehicle design review as the detailed design is developed. It is intended that the individual subsystem suppliers shall provide the sensors necessary to extract the data and transmit them to an onboard VMS Central Control Unit. It is the responsibility of Vehicle Contractor's System Integrator to ensure that adequate subsystem data points are designed, received, assembled, interfaced and configured using the necessary sensing devices, protocols, wiring, connectors and terminations to provide the overall VMS functioning as intended by the VMS Specifications. The System Integrator shall be responsible to review, correct and use all subsystems design to develop completely assembled integrated drawings and diagrams that are deemed necessary and as specified in the (CDRL N1302).

The Communication System shall be integrated with the Vehicle Monitoring System (VMS) on a train wide basis. The Contractor shall provide a communications interface document to define the vehicle/wayside message protocol for the Engineer's approval (CDRL N1303).

The VMS equipment specified in TPN20 shall be required to operate and interface with the EAMS system. Information about the EAMS system will be provided from MDT to the Contractor.

The vehicle carried wireless equipment shall operate at a wireless data transfer rate of a minimum of 74 Mbps.

N13.3. ONBOARD COMMUNICATION SYSTEM REQUIREMENTS

This section highlights the Integrator qualification requirements and the Communication systems functional and performance requirements.

N13.3.1. INTEGRATOR CAPABILITY

The Communications Integrator shall, as a minimum:

- Have integration experience providing complete turnkey design and installation of Communications subsystems e.g., PA, PIS, Intercom, Passenger Information and CCTV/Security in Rail/Transit applications.
- Deploy an open architecture design approach with experience in integrating 3rd party or sub-tier subcontractor's equipment.
- Provide database development, testing, and commissioning support for both hardware and software with the full capability for programming, troubleshooting and repairs.
- Have in-house expertise for manufacturing design and system development (builds hardware as well as software).
- The Contractor shall provide a state-of-the-art system with a modular design allowing for future expansion without sacrificing the main controller enclosure.

N13.3.1.1. REFERENCES

The Integrator shall have a proven track record of delivering quality products with field-tested reliability in the Rail/Transit application. The Contractor shall provide at least five Rail/Transit Client references for the Integrator along with the point of contact and direct phone numbers for the referenced installations.

N13.3.2. COMMUNICATION SYSTEM OVERVIEW

N13.3.2.1. GENERAL

The Contractor shall use the performance and functional design requirements defined herein, to provide the intended Communication System suitable for revenue operation in the Metrorail system.

The Communication System shall be a microprocessor-based system, its equipment shall represent an integrated design that complies with the communications requirements specified herein and shall be capable of interfacing with the future Ethernet and Wireless Networks.

The Contractor shall provide the following Communication subsystems:

- Public Address System providing one-way communication and designed to provide a door closing annunciation chime initiated by the door control unit.
- Passenger Information System providing one-way communication for passenger information shall include:
  - Passenger information announcement for next station and other special advisement.
  - Front, side and rear destination signs per married pair.
- Run number identification sign.
- Passenger Emergency Intercom System, and cab-to-lead cab communication, each providing full duplex two-way communication.
- CCTV/Security System with synchronized audio features whenever a PEIC is activated. The CCTV System shall be capable to record, store onboard digital recordings as well as process the alarm conditions immediately using a wireless network regardless of the train position along the right-of-way. The TCS will also provide the means for routing one audio channel per car to the associated hard drive. When a PEIC call is active, the recorded audio channel in the car from which the call has been placed will consist of the PEIC and Train Operator's audio.
- Radio system equipment and antenna with wiring.
- Train Operator Interface Equipment at the Operator's console located in each cab shall consist of a Communication Control Head

(CCH) that provides the Train Operator control of the communication system.

- Two Train Operator Displays (TOD) with touch screen capability.
- A General Information Video System to play pre-recorded advertising or general MDT system information to passengers.
- Interface to the VMS.
- Trainlines and car wiring for facilitating Inter- married pair and Intra-married pair communication connections.
- Onboard devices for secure wireless communication to the Station wireless equipment that interface with Lehman Center and Central Control.

The Communication system shall be ADA compliant and synchronized to simultaneously provide audio and visual messages.

TPN3 specifies the fixed safety signs and decals as well as system maps and graphics, including ADA requirements.

The Contractor shall utilize communication devices, equipment, and systems that comply with IEEE 1473 and IEEE 1478 for onboard equipment wiring. This shall include the provisions for necessary protocols to interface all new equipment with the MDT existing networks and EAMS.

The communication devices and the equipment's electronic components shall comply with the requirements of IEEE 1473 and IEEE 1478.

The Contractor shall utilize the 37.5 VDC power supply source for the operation of the Communication System.

It is the Contractor's responsibility to provide the necessary vehicle equipment to operate the equipment proposed including what is required to utilize the P25/OpenSky Radios and GPS CAD/AVL Systems.

All equipment shall be designed, constructed and installed to allow easy access for removal and maintenance.

N13.3.3. SHARED SYSTEM AND EQUIPMENT

The Contractor shall ensure that an approved System Integrator reviews and integrates the functions of Communication System to achieve a fully integrated communication system. To that end, the Contractor shall

configure the system such that equipment and devices, offering redundant functions can be avoided by combining their functions. The Contractor shall design a communication system that will combine the control and data signals, thereby minimizing the number of trainlines and wiring within a married pair required for the PA, intercom, PIS, CCTV, radio, and VMS.

N13.3.3.1. OPERATOR INTERFACE EQUIPMENT

The requirements for the Operator Interface Equipment required for the PA, PIS, Intercom, radio and CCTV are specified in the respective sections along with their technical requirements. Additionally, the other subsystems, including VMS, address cab console requirements based on their needs. The System Integrator and Communication Supplier shall work together to develop the cab layout for submittal to the Engineer for approval (CDRL N1304).

N13.3.3.1.1. Communications Control Unit

The CCU shall be a centralized unit controlling audio, video, and data-communication. The Contractor shall submit the qualifications of the designer of the proposed CCU to the Engineer for review and approval (CDRL N1305).

The CCU shall be a microprocessor-based control unit capable of processing and routing audio signals and digital data among the various sources and destinations in the Communications System, such as:

- System level control of the Train Communication System,
- Storage, management, control and broadcast of pre-recorded announcements,
- Intercar communication via a trainlined Ethernet over a redundant IEEE 1473-E IP network,
- Vehicle Media Controller functionality,
- Collection, logging and reporting of diagnostic data for the Train Communication System equipment as well as sharing this information with the vehicle Monitoring System (VMS) through the Ethernet/UDP interface and the wireless network,
- DHCP server for TCS units and IP addressing,

- Network Video Recorder hardware in support of the CCTV security system,
- GPS (CAD/AVL) interface,
- Control for the Passenger Information Announcement System,
- An 802.11 Wireless network Interface for communication with the wayside.

The CCU shall be designed for the life of the vehicle, and for easy diagnostics, troubleshooting, and reprogramming and component replacement. The CCU shall be the central control and signal processor for the Communication System. There shall be one CCU unit per married Pair.

The distribution of functions shall be implemented in the computer software. The CCU shall provide interfaces to the audio trainlines, digital trainlines, Communications Control Head (CCH), Train Operator Displays (TOD), passenger intercom, handset, PA amp, radio, passenger information and route signs, CCTV and PTU. The communication ports shall be suitable for the PTU interfaces, as per TPN15 and as approved by the Engineer (CDRL N1306). The Contractor shall ensure that VMS and CCU are integrated and configured for intended data processing.

The PA/IC amplifier for the conversion of digital and analog signals for voice communication shall be part of the CCU.

Input and output data shall be transmitted utilizing an error detection and correction scheme to assure security and accuracy of the transmission throughout the train.

The CCU design shall be flexible enough to accommodate future adaptation and expansions to the Communications System. A proposed system block diagram, showing the general architecture, shall be submitted to the Engineer for review and approval (CDRL N1307).

The CCU shall contain a dedicated power supply and shall operate from the low-voltage circuit breaker panel. This power supply shall ensure proper operation of the electronics.

If muffin-type fans are used to facilitate airflow across the CCU hardware, (for cooling or hot spot removal), replaceable filters shall be required at all entry points to prevent conductive dirt deposits from accumulating on

printed circuit boards. The CCU location, installation, and details of the filters shall be submitted to the Engineer for review and approval (CDRL N1308).

A self-test routine shall be performed whenever the system is energized. The self-test shall include a lamp test to verify the operation of all system lamps and sign LEDs. Provision shall be made to enable maintenance personnel to delay turn-off of lamps and LEDs during lamp test.

N13.3.3.1.2. **Communications Control Head**

A Communications Control Head shall be installed in the console of each Vehicle. The CCH shall provide the Operator with a control interface to the entire Communications System. The CCH shall interface with all voice communications and shall provide the following functions for CCU voice-communication operations.

- Control/reset passenger intercom.
- Select cab-to-cab communications.
- Control PA announcements.
- Select and control automatic announcements.
- Interface with Radio functions.

The CCH shall contain communication equipment status indicators, and be of a modular design with connectors to facilitate repairs. The communications subsystem shall remain operational if one of the two CCHs in a married pair has failed.

N13.3.3.1.3. **Train Operator Display**

Two Train Operator Displays (TOD) shall be provided in each cab. The TODs shall interface with the CCU. The TOD screen shall be touch screen, shall have a minimum screen size of 12 inches, and shall be glare proof. The minimum resolution of the TOD screen shall be 800 by 600 pixels. The displayed image shall be clearly visible under all daylight conditions in the Miami environment. The TODs shall be redundant in such a way that when one display fails the other display will present all highest priority information that was displayed on both TODs prior to the malfunction. When the error is repaired and both displays are operational, the TODs will return to their normal state. CCTV images of a passenger

call to the operator via a PEIC shall have the highest priority under the condition of a failed TOD.

N13.3.3.1.4. **Handset**

The Contractor shall provide a Handset in each cab to support the operation of the train radio, passenger intercom, cab-to-cab communications, and PA equipment.

N13.3.3.1.5. **Monitor Speakers**

Monitor speakers shall be provided in each cab for the train radio and the intercom. When the radio is activated, incoming calls shall be routed to the cab radio speaker. When the handset is off-hook, the call shall be routed to the handset. The passenger emergency intercom shall have a dedicated speaker mounted in the cab area. The audio response for the monitor speakers shall be ±8 dB in the range of 100Hz to 13,000Hz.

N13.3.3.1.6. **Emergency Alarm**

The Contractor shall install a "Silent" Emergency Alarm, with a hidden microphone, which is discretely placed and shall have the ability to transmit over the radio system using the emergency priority. The Contractor shall provide corresponding visual external signage or indication, indicating the emergency condition. The Contractor shall include a covert return message to the Operator confirming the acknowledgement of receipt of the message (CDRL N1309).

N13.3.3.2. **TRAINLINE REQUIREMENTS**

The Contractor shall design and configure an approved trainline(s) capable of supporting multiple analog and digital channels, audio, video, and data applications. It shall interface and integrate the devices using 100BaseT Ethernet as specified by IEEE 802.3. A data transmission speed of 100Mbs required to facilitate real-time onboard audio, video, and VMS functions.

The network topology configuration shall be designed in such a way to minimize transmission errors and to achieve high dependability. The nodes on the network shall be connected in such a way that communication within the system is possible even if one or multiple nodes fail. For Ethernet shielded twisted copper pair CAT5 cable with M12, or approved equal connectors shall be utilized and the length shall be limited

to 200 ft. and comply with TPN19. The trainline architecture shall use a building block approach with each function having a different block to afford maximum flexibility of maintenance and repair. The Contractor shall submit a complete trainline design including; functions of each block, configuration drawings, network topology and a block diagram for approval by the Engineer (CDRL N1310).

N13.3.3.3. INTERFACING EQUIPMENT FOR REMOTE MONITORING

N13.3.3.3.1. General

Communication equipment for the PA, PIS, Intercom, CCTV/Security, and the VMS system shall provide control, indication, and alarm processing from remote locations. The Contractor shall configure the Communication System such that all onboard points that need remote processing, shall exit from an onboard Vehicle Media Controller (VMC) unit.

N13.3.3.3.2. Vehicle Media Controller

The VMC shall be used to process the control and monitoring points as well as the vehicle's passenger displays. The VMC shall be capable of interfacing with the GPS, Radio, Ethernet, IEEE 802.11 wireless, the latest ATT cellular broadband technology (e.g., 4G WiMax IEEE 802.16, 802.3), and hardwired networks. One of the VMC functions shall be to store and play pre-recorded audio announcement messages as programmed. The VMC shall be modularized. It shall be based on an industrial ruggedized PC architecture equipped with Flash type memory that shall contain the software, data and a hard-drive that stores the multimedia database.

The Central Processing Unit (CPU) core shall be based on state of the art microprocessor technology, and the operating system (OS) shall utilize a reliable Graphical User Interface Application software.

During normal automatic operation the VMC shall perform the following tasks:

- Determines current train position based on input from the GPS receiver or the mechanical odometer mounted on the axles in case of GPS unavailability.
- Shows current station name and next station stop message on vehicle interior LED displays.

- Shows train ID and destination on exterior LED displays.

Data flow and functionality from the VMC towards the LED displays shall include:

- Processing of predefined messages into the message buffer of the LED displays.
- Triggering the display of messages according to the scheduling and routing data.
- Processing of software/firmware updates transmitted by a ruggedized laptop computer.
- Processing of configuration, diagnostic and control commands transmitted by a ruggedized laptop computer.

The LED display shall return the following to the VMC:

- Diagnostic/fault conditions.
- Alarm conditions and status.

Communication with the GPS includes the initialization sequence and the reception of geographical coordinates and current time.

The VMC shall be designed to transmit and receive wireless communication for train-to-wayside and wayside-to-train communication for immediate database, messages, audio, logs, and health status collected from the Vehicle Monitoring System (VMS), and for software updates without the need for manual connection to the VMC. The wireless link shall be based on IEEE 802.11. The system shall be capable of providing seamless handoff between the various wireless access points along the wayside and the service facility. Also, the VMC shall manage discrete input and output from and to external devices.

N13.3.3.3.3. **Database Management**

The VMC shall maintain the onboard database. This database contains:

- Route definitions.
- Station definitions.
- Audio and Video message clips.
- Text messages.

N13.3.3.3.4. **Wireless Network Interface**

An 802.11 wireless interface with minimum of 74 Mbs speed rate, that supports persistent connectivity, shall be integrated into the Vehicle Media Controller to provide wireless communication with the wayside including all necessary wiring, cables, and antennas. This wireless interface shall be an integral part of the Manufacturer's software system that has a proven track record of successful implementation in rail/transit application.

The software system shall provide the following functions via the wireless link:

- Update of embedded software for the VMC.
- Update of embedded media files (including audio and video pre-recorded messages).
- Transfer of train data (vehicle ID, time, vehicle mileage obtained from the vehicle's digital odometer, and accumulated hours of vehicle operation).
- Maintenance and diagnostic logs.
- Software system shall be able to continue file downloads for updates and any data transfers even after encountering gaps in wireless coverage. System will perform a check of file integrity of updates sent via wireless before initiating software or firmware upgrades.

The wireless network includes an antenna suitable for use in a rail environment. The installation details shall be finalized during the design phase.

In addition it shall be possible for the passengers to access the IEEE 802.11 wireless network via a separate secure wireless network onboard the vehicles.

N13.3.4. PUBLIC ADDRESS SYSTEM

N13.3.4.1. GENERAL

The Contractor shall be responsible for providing a complete PA system in each married pair. When vehicles are coupled to form a train, the PA systems in each pair of vehicles shall be automatically interconnected to

form a single operating system. The PA system shall provide the capability to make public address announcements to all passengers in the consist by the Operator in the controlling cab. PA system design, Central Control interfaces and PA system specifications be submitted for review and approval of the Engineer (CDRL N1311).

The PA system shall be a part of Software-driven Digital PA/PIS System. It shall have a built-in order, as approved by the Engineer, of hierarchy to make announcements by:

- Train Operator.
- Station Manager (if applicable in the future).
- Emergency Personnel.
- Central Control Operator.

Announcements shall be in any order and type of messages, either of: Live, Pre-Programmed, automatic and canned, special events as needed, and/or Emergency in nature.

The PA system shall include an ambient noise monitoring circuit on each vehicle that can determine and adjust the volume for the ambient just prior to making any announcement.

Alternate Speakers shall be wired on separate channels as needed.

The Operator interfacing equipment for the local control of PA/PIS system shall be provided through the TODs.

The stored messages shall include, but shall not be limited to, route and destination information, transfer information, next station, and station arrival. The stored messages unit shall be an integral part of the CCU. Manual announcements shall always override the stored messages. The stored messages shall play automatically when the vehicle approaches a station.

The PA system shall provide an appropriate door chime signal on the interior PA speakers. The chime shall be initiated by a door-closing signal from the Door System. MDT shall approve the door chime tone proposal and schematic (CDRL N1312).

The PA system shall not emit audible noise when not in use.

N13.3.4.2. **FUNCTIONAL REQUIREMENTS**

The PA system shall use stored, predefined, digital messages and present these messages to the passengers at the designated times. Digitally recorded messages shall broadcast over the PA system. Text messages shall be triggered by a message sent through the MDT network or by train location and a predefined message displayed on the appropriate Passenger Information Screen. The audio and text messages shall be synchronized with each other. A method to test messages shall be provided such that, when activated, causes a test announcement and text message to be displayed.

The message storage location shall not be a battery-backed Random Access Memory (RAM) or hard disk. All messages will be stored in flash memory. Sufficient message storage capacity shall be provided to store up to 25 routes of up to 65 stations each, plus 50 user selections of 30-second durations each. A stored message, advising passengers that doors are closing, shall be provided. It shall be possible to modify recorded messages via a serial link, USB, or Ethernet connection and the wireless network from a portable computer. The messages, audio announcements, and corresponding text messages shall be submitted to the Engineer for review and approval (CDRL N1313).

N13.3.4.3. **ONBOARD PA INSTALLATION**

Shared equipment (CCU, CCH and microphones) requirements are included herein. Additionally, the PA equipment shall satisfy the following requirements:

N13.3.4.3.1. **Controls**

All of the PA facilities in a consist shall be automatically interconnected into a single PA system when the consist is coupled together. Control of the PA system shall be from the CCU in the controlling cab of the lead vehicle in the consist. The communications control panels in other than the controlling cab in a consist shall be inhibited from being connected to the PA control lines and the amplifiers except for cab-to-cab intercom. Power shall be connected to the PA amplifier at all times. Switching of audio signals ON/OFF shall not cause noise on the speakers.

N13.3.4.3.2. **Public Address Microphone Stations**

Unless otherwise indicated based on the cab layout, the Operator shall have three options available for making a PA announcement, left microphone station, right microphone station and the CCU handset. One microphone station shall be mounted on each side of the cab to be used as required by the Operator to talk over the PA system while operating the door controls. The Contractor shall submit location and designs of the microphone station for approval (CDRL N1314). Each microphone station shall include, but not be limited to, the following:

- Microphone.
- Push-to-talk switch.
- Each microphone station shall be marked with appropriate legends.

N13.3.4.3.3. **Interior Speaker Assemblies**

Using the following specifications, in order to provide clear, intelligible announcements without echo, the Contractor shall determine how many interior ceiling speakers per vehicle shall be provided that shall be evenly spaced in the passenger seating area. The speakers spacing shall provide even distribution of sound throughout the passenger area. The variation in sound shall be less than 5 dB measured from a height of 5.8 ft.

All interior speakers shall be transportation grade, direct radiating, permanent magnet field type, and approximately 8 inches in diameter. The frequency response shall be ±5 dB from 300 to 8,000 Hz (AB proposed a speaker with a diameter of 4 in. with a frequency response from 100 to 13000 Hz, accordingly, with a plateau of at least 8 dB in the 2,500 Hz to 3,500 Hz band compared to 1,000 Hz responses. There shall be a gradual roll off in response above 7,000 Hz. The dispersion angle shall be at least 120 degrees. The nominal axial sensitivity shall be a minimum 90 dB at 1 m (3.3 ft) with 1-watt input. The average power handling capacity shall be a minimum of 5 watts continuous sine wave input without breakup. The speakers shall be capable of handling 20 watts of power, per EIA-SE-103.

The Contractor shall get approval from the Engineer regarding the Speaker calculation and mounting details (CDRL N1315).

A non-corrosive metal cover or plastic enclosure shall protect the interior speakers from the effects of dust, moisture, and vandalism. Speakers shall be installed such that the mounting hardware is readily accessible for ease of service and maintenance. Exposed hardware is not permitted, unless approved by the Engineer.

N13.3.4.3.4. **Power Amplifier**

A power amplifier, meeting the requirements of EIA-SE-101-A, shall be supplied. The power amplifier shall be capable of delivering a minimum of 35 watts configured as a constant voltage distribution system at not more than 1 percent total harmonic distortion in the range of 100 Hz to 8,000 Hz. The input required to drive the power amplifier to full-rated output shall not be more than 500 mV. The frequency response shall be within ± 1 dB from 100 Hz to 8,000 Hz with provision for a 6 dB per octave roll off below 100 Hz. The signal to noise ratio of the amplifier below the compression threshold shall be at least 75 dB. Each amplifier shall be stable with no oscillation present during any normal operation. The output circuit and power supply shall include short circuit protection without the use of fuses. The amplifier power supply shall have transient protection for voltage spikes of up to 2,500 volts peak with a total energy of 80 watt-seconds.

N13.3.5. PASSENGER INFORMATION SYSTEM

N13.3.5.1. GENERAL

The Contractor shall be responsible for designing, installing, and testing a software-driven digital PIS system in each married pair. When vehicles are coupled to form a train, the PIS systems in each unit of the consist shall be automatically interconnected to form a single operating system. The PIS system shall be integrated fully with PA system as discussed above, and with the wireless network, and shall be ADA compliant and shall have the capability to make passenger information, destination and other special announcements to all the passengers. It shall be possible to update and upgrade the PIS system via the wireless network.

The PIS system shall use LED screens strategically mounted inside and at the front of the vehicles and shall be programmable. The destination messages shall be stored in suitable flash memory devices and shall be easily updated by a plug-in, hand-held device or laptop/PTU. In case of a

hand-held device, the Contractor shall supply two such devices. The destinations shall be selected from a communications control unit interface. PIS system design, all signs, mounting locations, messages and hand-held devices shall be submitted to the Engineer for review and approval (CDRL N1316).

The route and passengers' destination displays shall be capable of displaying stored messages when requested by the Communication Control Unit.

N13.3.5.2. PIS FUNCTIONAL REQUIREMENTS

The Contractor shall provide heavy-duty LED driven PIS signs suitable for railroad/transit use in the Miami, Florida environment. LED arrays shall have features to remain functional despite a failure of an individual LED. LED shall have life in excess of 10 years and shall have high self-adjusting intensity without being impacted by bright sunlight. The PIS shall be as follows and provided to achieve ADA Compliance:

- The PIS shall be mounted on the front of each vehicle to indicate Train Route/Destination.
- Signs visible/legible from inside and outside of the Vehicle or double face signs, if possible, on the top of side windows legible from inside and outside of the vehicle to indicate train route and destination. A minimum of 4 inside signs (one on each end of the vehicle and a minimum of one on each side) per vehicle shall be provided with the exact quantities to be defined as part of the vehicle interior design by the Contractor.
- The Vehicle interior PIS shall simultaneously display the audio PA announcements. Those PIS shall be a single-faced design mounted at each end of the car.

Front and side PIS shall have specified message storage capacity that is controllable depending upon the route assigned either by the Train Operator or from the Central Control.

All PIS units and associated digital devices shall be trainlined using a dedicated onboard video LAN bus having a high degree of reliability. The CCTV system, shall use same video LAN bus. The PIS design shall be an onboard system only, without requiring any wayside tagging devices.

For the Operator interface, the System Supplier shall integrate the PIS console into the Communication Control Unit (CCU) and utilize a TOD for reviewing/sending messages to interior signs. The Contractor shall coordinate the TOD requirements with the CCTV and VMS requirements, as specified in TPN20. The desired TOD display and control for the Operator shall be defined later.

N13.3.5.3. ONBOARD PIS INSTALLATION

N13.3.5.3.1. Interior Signs

All interior PIS signs shall be of the LED type. An all-electric alphanumeric, LED message display shall be installed in the ceiling of each front and rear body section of the vehicle in an Engineer-approved location. There shall be no glare from the mounting frame or from the car's interior that could impair the display's readability.

The display shall be capable of displaying a minimum of 15 characters that are ADA compliant and with a minimum height of 2.3 inches. The display shall also have scrolling capability. Scrolled messages shall repeat as approved by the Engineer. The sign shall store programmed messages and display, when triggered by the CCU, the next station stop messages as well as secondary messages as may be required by the Engineer.

The display shall communicate with the Communication Control Unit via Engineer approved network ports. Each side of the message display shall be pitched slightly downward to allow maximum visibility to passengers.

N13.3.5.3.2. Exterior Signs

- A minimum of six watertight destination signs shall be provided per married pair, if full front end controls are installed in each car.; one on each end above the windshield, and one on each side of each car.

Side signs shall be free from glare and readable from the outside of the vehicle. It shall be possible to change all the signs in a vehicle or in a consist from a controlling unit on the Cab Console. All destination signs shall be ADA-compliant.

N13.3.5.3.3. **Mounting and Location for Interior and Exterior Signs**

The signs shall be mounted as described below. Signs shall be designed without exposed fasteners. Method of mounting the signs, together with the materials proposed for all fabrication shall be submitted to the Engineer for approval.

Side Mounted Signs: There shall be a minimum of two (2) side mounted interior destination signs per vehicle. The side-mounted signs on all vehicles shall be visible from the interior of the car. The installation shall be designed in conjunction with the design of the exterior signs, in order to obtain a practical, maintainable and durable unit of an appearance that blends with the interior and exterior of the car. Wiring harnesses to the signs shall be designed such that the wires are not under stress when the cover is opened for access to the sign. Detailed installation drawings shall be submitted to the Engineer for approval.

End Mounted Signs: The end-mounted signs in all vehicles shall be located as described in the section above. The material used for the housing can be FRP or aluminum alloy or other Engineer approved material. Detailed installation drawings shall be subject to MDT approval.

The appearance of the signs mounted in the vehicle shall be compatible with the interior decor and finish. The Contractor shall submit details of the proposed signs and mounting to the Engineer for review and approval (CDRL N1317).

The exposed materials used for the LED displays shall be such that they are resistant to vandalism including graffiti.

N13.3.5.3.4. **Display Interfaces**

The CCU shall communicate to the display signs over a suitable local area network interface. Protocols and interfaces to the LAN from the communications control unit shall be based on IEEE 802.3. The Contractor shall submit the details to the Engineer for review and approval (CDRL N1318).

It shall be possible to update, change or configure the system from the wayside through the wireless network.

The Contractor shall ensure that all software is developed in accordance with IEEE 730.1 standards as per TPN19 and TPN23. All interfaces,

application software, and software protocols shall be submitted to the Engineer for review and approval (CDRL N1319).

N13.3.6. INTERCOM (IC) SYSTEM

N13.3.6.1. GENERAL

The Contractor shall be responsible for providing a complete IC system in each married pair. When vehicles are coupled to form a train, the IC units in each vehicle shall be automatically interconnected to form a single operating IC system. The IC system shall provide the following over separate channels:

a. Passenger Emergency Intercom System (PEIS) to have a 2-way full duplex point-to-point conversation:

   (1) Between a train Operator and a passenger.

   (2) With Queuing Capacity.

   (3) Providing 4 intercom stations in each car.

b. Cab-to-lead cab 2-way communication using the handsets.

Passenger Emergency Intercom, and cab-to-cab intercom devices shall be trainlined using a dedicated onboard LAN that has a high degree of reliability.

N13.3.6.2. FUNCTIONAL REQUIREMENTS

The passenger emergency intercom stations design and installation shall comply with ADA requirements. The passenger intercom stations shall consist of a speaker, microphone, latching activation push-button, and any required auxiliary components and shall be enclosed in a vandal- and moisture-resistant enclosure. Both the passenger and the Operator shall be clearly audible to each other over average interior noise levels, as defined in TPN2, when using the passenger intercom system. Upon activation by a passenger, an audible chime shall occur at the energized cab, and an indicator on the CCH shall be illuminated. This shall be electronically latched until reset. A press-to-reset button shall be available at the CCH to permit the Operator to reset any of the activated passenger intercom stations. Passenger notification to the Operator and operator reset shall be consistent with MDT's vehicle Fleet. Simultaneous activation of all passenger intercom stations of a consist shall not be

possible. The press-to-activate button at the passenger intercom station shall illuminate when activated and shall turn off when the intercom is reset.

Passenger intercom stations shall be easily accessible to wheelchair bound patrons. The noise control plan and the location and installation details of these intercom stations shall be submitted to the Engineer for review and approval (CDRL N1320).

Cab-to-cab and Crew communication shall be accomplished by having the Operator select this mode on the CCH and lifting the handset. The Operator shall be able to receive a call at anytime without interfering with any other functions. Radio calls shall take priority over the cab-to-cab calls.

N13.3.6.3. ONBOARD IC SYSTEM INSTALLATION

N13.3.6.3.1. Passenger Emergency Intercom System

Four PEIC units per vehicle shall be installed. The PEIC units shall consist of; a microphone, speaker and push-button housed in a stainless steel enclosure. The push-button shall be recessed to prevent an inadvertent activation by a passenger leaning against it. All of the components other than the line terminal shall be mounted on the panel, which shall be covered by a decorative protective cover. These components shall be connected to the line terminal through a single cable having a socket and plug connection and shall permit easy replacement of the intercom terminal as a unit. The front panel shall be attached to the metal case by tamperproof screws. The car number, engraved and also in Braille, shall be identified on a permanently affixed plate adjacent to each intercom unit.

All PEIC units shall be identical and as small as possible due to the limited space at the R-end of the car.

Speaker: The speaker shall be cushion mounted to the sub-panel. The speaker shall have a frequency response within ± 5 dB from 300 Hz to 5,000 Hz. The THD shall not exceed 2% over this range. The speaker shall be designed to provide an output, which is clear to the listener, but localized so as to provide a degree of privacy to the user in situations where the conversation between the train Operator and a patron could pose a security risk.

Baffle: The baffle in front of the speaker unit shall have at least 25% grill opening uniformly distributed over the speaker cone area. The baffle shall be designed to minimize the possibility of damage to the speaker cone by sharp instruments passing through the openings in the baffle.

Microphone: A microphone shall be mounted on the sub panel as defined herein.

Push-Button: One heavy-duty push-button switch with LED indicator shall be mounted on the sub panel. The push-button switch shall be capable of 1,000,000 operations without failure.

When the button is pressed by the passenger requesting help, the push-button light shall flash. As soon as the Operator presses the "PASSENGER" button on the CCU the push-button shall become illuminated continuously to show that the call has been acknowledged. Verbal two-way communication between the passenger and the Operator shall be possible at that time.

IC Controls: The IC control functions shall be located within the CCU module. This equipment shall be designed to function as the IC master station for a consist when the cab in which the equipment is installed becomes active; otherwise, the equipment shall be available to function as a slave station for cab-to-cab communications. In either mode of operation, the IC system shall use the communications handset.

Amplifier: The IC compressor and amplifier shall be assembled from solid-state components. The amplifier shall have a frequency response within 2 dB from 300 Hz to 5,000 Hz. The amplifier shall furnish sufficient power to provide the specified acoustical output at any other IC station in a six-car consist or individual amplifiers at IC stations with sufficient power to provide the specified acoustical output. The hum and noise level shall be at least 70 dB below the normal output. The amplifier inputs and outputs may be open circuited or short-circuited without causing damage to the amplifier.

N13.3.6.3.2. **Cab-To-Cab Intercom**

The IC system shall operate in the following emergency situation. The master cab IC system shall be located in the activated cab. The Operator in the active cab shall be able to conduct a two-way conversation with

MDT crew personnel in any inactive cab in the train when the trains are mechanically and electrically coupled in a consist as long as 8 vehicles.

Full duplex voice communications shall be provided between the Operator in the active cab and MDT crew personnel in any other cab in the consist. When the handset is lifted from the cradle switch and "CAB" is selected in the non-active cab, the call alarm in the Operator's cab shall be initiated via the intercom speaker. The Operator shall select "CAB" and talk through the handset microphone and receive audio from the slave unit through the intercom speaker. When the Operator selects "CAB", the IC network shall be isolated from all passenger IC stations. In both modes, the passenger IC stations and the non-active Cab station shall be slave stations to the Operator's control cab.

N13.3.6.3.3. **Operator Interface Controls**

The communications control unit in the control cab of the consist shall be the master IC station. The IC system shall become active as soon as the cab is energized. The controls shall be at the locations as similar as possible to the existing cars and shall be submitted to the Engineer for review and approval.

The train IC system shall include a pre-set volume control at each IC station to permit a technician to align and balance the system. This control shall be readily accessible to the technician when the protective cover is removed, but otherwise shall be secure from tampering.

N13.3.7. CLOSED CIRCUIT TELEVISION/SECURITY SYSTEM

N13.3.7.1. GENERAL

The Contractor shall be responsible for designing, providing, and testing a complete CCTV system in each married pair. When vehicles are coupled to form a train, the CCTV system in each vehicle shall be automatically interconnected to form a single operating CCTV system.

The Contractor shall provide a heavy-duty digital CCTV system and devices that are suitable for Railroad/Transit application in the Miami, Florida environment.

Each married pair shall be equipped with a minimum number of cameras to provide full surveillance and avoid any blind spots in the passenger compartment. In addition there shall be one camera in the Operator's Cab

to monitor the Operator and cab area. There shall also be one camera facing outward from the Operator's point of view. The outward facing camera shall be protected from capturing any interior images and be protected from glare. Cameras shall easily allow alignment adjustment by qualified MDT personnel, but tamperproof for passengers.

N13.3.7.2. FUNCTIONAL REQUIREMENTS

The CCTV/security system shall have an audio option to provide synchronized audio during image monitoring and playback. Any video recorded shall be retrievable on demand by either wired or wireless methods. The Digital Video Recorder in the vehicles shall be installed in an outer housing, and the cameras shall be enclosed in vandal proof camera housings. There shall be a minimum of one DVR per married Pair.

The CCTV system shall have low latency and features of automatic detection and reporting of faults including camera obstruction such as by spraying of paint.

The system shall be designed for a specified/random normal viewing as determined by the Train Operator and by Central Control as well as recording capability using the digital recorders. The DVR shall be capable of recording and play back of recorded video up to 30 FPS for each of the cameras that are installed in each vehicle. The DVR shall have the capability of recording at an aggregated rate of 240 FPS. Recorded video shall be stored for a minimum of 30 days at 240 FPS whenever the vehicle is functionally operational and powered up. The Media storage shall be expandable, provide disk mirroring capability and provide for temperature control. The media storage shall be easily swappable and use SATA 2 interface or approved equal.

All CCTV cameras onboard each car within a train consist shall be networked with all other vehicles in the consist using an architecture eliminating single point failures. This video LAN bus shall allow implementation of standard (User Datagram Protocol) UDP/IP protocol.

A minimum of one Digital Video Recorder (DVR) shall be installed on each married pair and have the following built-in user-defined minimum interfaces:

- Sufficient inputs to meet or exceed the number of cameras.

- Two outputs for local monitoring, alignment and calibration; in alternative this function can be performed using the TOD and/or PTU.
- A minimum of two audio inputs.
- Configuration Port (Data Port Plug).
- Two Ethernet ports (M12, or approved equal).
- A global positioning system source input.

The Digital Video Recorder shall have capability to download video by either extraction of the hard drive or by connecting via Ethernet using a laptop. The Digital Video Recorder shall also have the capability of interfacing with an on-board Wireless bridge to allow for the following:

- Remote retrieval and downloading of video.
- Remote alarm monitoring.
- Remote system configuration.
- Remote scheduling of video downloads.
- Remote system software patches and updates.

For the train operator's interface, CCTV video shall only be displayed when a call is received from a Passenger Emergency Intercom (PEIC). The video from the two cameras viewing the PEIC location shall be displayed on one of the TODs. The image on the other TOD shall be modified to show the highest priority information that was displayed on both TODs prior to the call. When the call is ended, the two TODs shall return to their normal state.

The Contractor shall forward a complete CCTV/Security system design, including trigger events and a block diagram for the Engineer's review and approval (CDRL N1321).

N13.3.7.3. ONBOARD INSTALLATION

N13.3.7.3.1. Digital Video Recorder

The DVR shall possess enough hard disk memory to satisfy the 30-day, 240 FPS storage requirement at 18 hours per day recording time. It shall be protected to withstand a shock of 30g. It shall capture images at a rate of thirty frames per second (NTSC/PAL) for any individual camera. Under

normal operation, images that are tagged because of the activation of the system's inputs shall be protected from automatic overwriting and shall be deleted only after a preprogrammed time period or until such images are retrieved from the DVR by either a manual or automated download of all tagged video associated with the triggering event. Stored images shall be retrieved and viewed at the central station. The DVR may be powered using a filtered 12 or 24 VDC input. Power to cameras shall be derived from the DVR. In the event of an electrical short-circuit is caused by either a camera or the wiring supplying power to that camera, the DVR shall detect such a condition and remove power from the port to which the affected camera is connected. All other cameras shall continue to function normally. An alarm denoting the above condition shall be transmitted to Central Control.

The DVR shall operate on an embedded operating system platform and shall have an onboard, real-time clock able to be synchronized with the system clock. The DVR shall be capable of recording video using the MPEG-4 video compression method from a minimum of eight (8) sources. The DVR shall record and play back a minimum of one (1) channel of audio simultaneously with the recorded images.

GPS information shall be embedded with the recorded video from each connected camera.

The DVR shall be signaled to begin image capture when the vehicle has been powered and the cab is energized. The system shall remain fully functional for a user-defined period, based on battery life as specified in TPN9, after the vehicle has been de-energized. The system shall recognize when the available storage for surveillance images has reached capacity and automatically purges the oldest image data in sequential fashion, making room for additional images without the Operator's intervention. Images that are tagged because of the activation of the system's inputs are protected from automatic overwriting until the relevant images are manually deleted, the images have been retrieved, or until all available space is filled with tagged images, at which time the system performs a "first-in, first-out" (FIFO) overwrite.

The DVR shall capture additional pre-alarm and post-alarm information for alarm events. The DVR shall log daily activity with time and date

logging of start-up, self-diagnostics, temperature, error or exceptions, events, shutdowns and restarts.

The DVR shall be contained in an inner and outer enclosure and shall have an M12, or approved equal compatible Ethernet port. The outer enclosure shall be shock and vibration resistant. The inner enclosure shall house the DVR and shall have a "quick disconnect" for easy removal, insertion, and maintenance. The DVR shall have a programming lockout feature for security.

Each DVR shall be configured through the communications PTU that shall be connected to the DVR using an Ethernet interface or connection, which shall enable the user to navigate through the programming menus. The PTU shall be used to test connections during the installation process for configuration once the system has been completely installed. It shall also be used for troubleshooting and status indication. The PTU shall also save configuration information for the entire fleet to be uploaded or downloaded.

The control and power cables, which shall be used for the DVR, cameras and other equipment, shall be installed in conduits inside of the vehicle panels, in order to prevent vandalism. The Engineer shall approve the placement of the DVR inside the vehicle (CDRL N1322).

N13.3.7.3.2. **Internal Video Cameras and Video Recording**

The system shall support a minimum of eight day/night color video cameras. Both analog and high resolution IP digital cameras shall be supported by the DVR. The captured and stored analog images shall be recorded at 4CIF resolution, or approved equal. Digital cameras shall be recorded at their native resolution. All cameras shall produce a viewable image at a minimum of 0.51 lux ambient light. The cameras shall be mounted in low profile, vandal-resistant housings (flush- or surface-mount) inside the vehicle. The cameras shall be positioned to allow, jitter free full monitoring of all passengers inside the vehicle without any dead (blind) spots. Each camera shall be programmed to capture images independently at a configurable rate and configurable resolution.

The CCTV/Security system shall be designed specifically to record anti-social behaviour of passengers as well as allow real time visual communication with all cars in the consist by the Operator to reduce

vandalism and criminal activities, particularly late at night or on lightly loaded trips.

Internal cameras shall be integrated into the ceiling so as to present a clean, neat, but vandal resistant installation. The internal camera housings shall be finished to match the interior color.

The Contractor shall place the cameras so that there are no blind spots in camera coverage.

This coverage shall be initially confirmed by use of a three dimensional interior model of the vehicle.

Camera viewing areas shall include the area with the Passengers and Operator Intercom (PEIC) units, the adequacy of coverage shall be confirmed by the Engineer in the Mock-up evaluation model.

In the event of the activation of a Passenger to Operator Intercom or the passenger emergency manual door release handle, the system shall automatically select the two internal cameras that best cover this area and display it on one of the TODs until the Operator deactivates the intercom connection. These methods of activation shall always override normal operation of the TODs in the lead cab.

Efficient video compression techniques shall be utilized to reduce bandwidth requirements and simplify the transmission of signals through the consist; while ensuring an adequate level of detail and movement is displayed on the TOD display. Transmission of video signals may be via the trainline or other suitable means.

Local status indicators and test points shall be provided to assist in local troubleshooting.

N13.3.7.4. STATION AND CENTRAL CONTROL CCTV INTERFACE

Depending upon the availability of a wayside communication link, MDT may decide to initially use the onboard recording and storage features having the capability defined herein. However, the Contractor shall provide vehicle interfacing equipment suitable to transmit/receive and execute the CCTV functions using an MDT Ethernet or wireless network at the stations to get on the MDT network as specified herein.

N13.4. RADIO AND CONTROL EQUIPMENT

N13.4.1. GENERAL

MDT has standardized radio and control equipment system-wide. The MDT radio system features Computer Aided Dispatch (CAD) and built-in interfaces for the Automatic Vehicle Locator (AVL) system. The Contractor shall provide a compatible radio, antennas and antenna cables, relays and wiring for the DVR interface, and all wiring, connectors, brackets, other materials and software to install a complete system that interfaces with MDT's existing communication infrastructure. The train voice radio shall be a P25 radio capable of transmitting at 700/800 Mhz. The data radio shall be compatible with the County's "Opensky" system. Prior to proceeding with manufacturing, the Contractor shall prepare a complete radio system block diagram for submittal to the Engineer for the review and approval (CDRL N1323). All radio equipment location, accessibility, mounting, and cable lengths, for items such as TCH, Handset Assembly, Cab speaker and antenna shall be submitted for approval by the Engineer (CDRL N1324).

Regulated 13.6 VDC power shall be provided by the Contractor for the radio system by the output of a dedicated electronics systems power supply.

The Contractor shall provide and install a 2-½ inch conduit or an equivalent inner wall channel space from the radio box to the radio control head mounting location. Conduit or channel design shall facilitate installation of the radio control cable by the "pull through" method in both initial and future installations to facilitate repair and replacement. Conduit shall be rust and water-proof in compliance with the requirements of TPN19.

N13.4.1.1. HANDSET AND CAB SPEAKER

The Handset shall be mounted at waist level (driver seated) requiring minimal body movement, located in front of the operator, and requiring minimal eye movement when locating the handset. The Cab speaker shall be mounted so the driver can hear an announcement when the volume has been lowered.

N13.4.1.2. ANTENNAS

The Contractor shall supply and mount a low profile 700/800MHz antenna with RG58 coax cable and TNC connector to the radio.

The Contractor shall supply and mount an antenna with a gasket and RG58 coax cable, and an F-Type male connector to the VLU.

The Contractor shall mount the antenna and cable supplied with the Stop Announcement System. All antenna cables shall be run in 1-inch diameter or larger metal conduit to the radio box. Removable access covers shall be provided in the ceiling of the car to allow access to the antenna and conduit.

N13.4.1.3. EMERGENCY TRANSMIT SWITCH

The Contractor shall provide and install a Silent Alarm switch. The switch shall activate the Silent Alarm function of the radio system and destination sign. The switch shall be a red push-button double pole switch with a guard ring. The push-button shall be red and have a protective collar to prevent accidental activation. Installation and location of the switch shall be approved by the Engineer (CDRL N1325).

The intent of these specifications is to have the Contractor provide and install a complete and functional radio system.

The Contractor shall provide one mobile voice and one mobile data radio that will carry voice and data to and from MDT's Control Center, utilizing a duplex mode of operation. In addition, the radio shall provide an interface for communications between the vehicle and other MDT radios, utilizing an MDT approved frequency mode of operation. The radios shall be located in each end of the vehicle.

One radio will be utilized for each operating end of the car (A or B). The radio at the operating end of the car shall be the voice channel for the car, and the radio at the non-operating end shall provide the data channel. The voice radio shall power up to the default voice channel, and the data radio shall power up to the default data channel. The active radio channel selection (voice/data) shall be automatically switched and interlocked between the car's A and B end using the car "ON" position of the transfer switch. The Contractor shall provide a switch or add a contact to the transfer switch to properly select each radio for either voice or data.

N13.4.2. RADIO AND CONTROL EQUIPMENT REQUIREMENTS

N13.4.2.1. GENERAL

At a minimum, the radio shall comply with, MIL-STD-1472, TIA/EIA-603 standard, TIA Telecommunication Bulletins and the following requirements.

a. Radios shall be a trunked type with the TCH remotely located on the Operator's control panel.

b. The radio enclosure/compartment shall be provided with a lock, as approved by the Engineer that can be opened by maintenance personnel. Adequate cooling and drainage shall be provided. There shall be no accumulation of water, moisture, or condensation in the radio compartment.

c. The radio compartment may accommodate other communications equipment, such as the relays, control unit, or trainline pre-amps.

d. Cables into the radio compartment shall have a minimum of 3 ft. slack. The Contractor can lessen the slack if the location of the component allows for sufficient access for servicing and maintenance with the Engineer's review.

e. The Contractor shall supply connector installation features on the back of the TCH for the necessary system interface between Central Control and the Operator.

f. Each car shall be equipped with two identical UHF, seven-active talk group mobile radios.

N13.4.2.2. TECHNICAL

All communication equipment supplied under this Specification shall use state-of-the-art integrated circuits and microprocessor control.

The communication equipment shall transmit and receive in both, the analog and digital modes or a mixed analog and digital mode. It shall be capable of operating in a totally compatible manner with the existing Miami-Dade County radio system and shall be approved by the Engineer.

The radios shall be rugged, weatherproof, and designed for public safety and transit service.

The mobile radio shall have a switch to manually select any pre-assigned talkgroup.

N13.4.3. TRANSIT CONTROL HEAD

Adequately sized TCH shall be mounted in such a way that the operator will have a full view of the TCH display and the mounting of this unit will not impede the view of the right-of-way. The TCH shall:

a. Be a remote type with full radio functions and remote cabling.

b. Have an alphanumeric dot matrix display.

c. Be made of a high impact material and have remote mounting capability.

d. Have a connector on the backside of the control head. The Contractor shall use this interface from the control head to connect the radio and CCU control switch.

e. Transmit and receive.

f. Select radio for PA announcements and other applications.

N13.4.4. RADIO SPEAKER

The radio speaker shall be:

- Independent of the TCH and remotely mounted.
- Capable of handling 15 watts of continuous audio.

N13.4.5. HANDSET - MICROPHONE

The microphone shall be:

- A telephone-type handset with a latching cradle.
- Supplied with a muting switch to mute the speaker when the handset is removed from the cradle.

N13.4.6. RADIO SYSTEM INTERFACE

Each of the two radios shall interface with the CCU using the radio data interface. The Contractor shall submit an interface plan to the Engineer for review and approval (CDRL N1326).

The audio output of each radio shall be routed to the onboard trainlines via the radio control head for the purpose of remote OCC announcements as selected by the OCC.

The CCU shall have two independent interface ports, one for each radio. The interface shall be fully compatible with the new radio data interface. The software used to operate the CCU and all interface software shall be written in a high-level language and described by means of flow charts or other approved means that readily convey the logic and sequence of control algorithms. The specification describing the software functionality and flow charts shall follow the guidelines of TPN22 and shall be submitted to the Engineer for review and approval (CDRL N1327).

The radios, with the CCU, shall transmit alarm condition messages in real time over the data channel. Add Vehicle Odometer failure(s) to the alarm transmission list. The Contractor shall provide any special triggering requirements for the digital radio, such as lead control character(s). The Contractor shall submit the proposed triggering requirements to the Engineer for review and approval (CDRL N1328).

There shall be nine alarm conditions required to be transmitted upon occurrence. The Contractor shall submit the alarm condition messages to the Engineer for review and approval (CDRL N1329).

The following messages shall be sent in real time each time a radio is keyed to transmit:

- The run number and payroll number (five-digits) shall be transmitted with each alarm.
- Vehicle ID (four-digit number).
- The radio TCH shall interface to the vehicle through the transfer switch to provide channel selection for communication interface (data or voice).

N13.5. GENERAL INFORMATION VIDEO SYSTEM

The Contractor shall supply two widescreen LCD monitors with speakers in each vehicle. The monitor will be used to display recorded video and audio from a player. The screen shall be a minimum of 32 inches, glare and vandal proof. The screen resolution shall be 1080p (1920×1080) or greater. The player shall contain a minimum of 50 GB of hard drive

memory. The Contractor shall supply one player per car to drive both monitors and speakers. The player shall be located in an equipment locker within the vehicle. The player shall be able to load Hi-Definition video content that is usable by the LCD monitors onto the hard drive memory. A USB 2.0 port shall also be provided to download video/audio files directly onto the hard drive. The player shall play video/audio directly from the hard drive and shall be programmable to cycle through any video/audio selections stored on the hard drive. Connectivity between the player and the monitor shall be with cable and connectors that meet HDMI specifications. The system shall contain any and all power supplies required in order to operate using the vehicle low voltage power. The system shall operate properly within the electromagnetic environment of the vehicle. It shall be possible to update, change or configure the system from the wayside through the wireless network.

The Contractor shall forward a complete General Information Video System design and a block diagram for the Engineer's review and approval (CDRL N1330).

N13.6. PORTABLE TEST UNIT

N13.6.1. GENERAL

The Contractor shall supply Communication System Portable Test Units with software (PTU) in accordance with the requirements of TPN15.

N13.7. TESTING REQUIREMENTS

The Contractor shall develop an EMI susceptibility analysis of the Communication System and an EMC analysis and plan to limit both conducted and radiated emissions from the communications control system for the Engineer's review and approval (CDRL N1331).

The Contractor shall meet the communications integration testing requirements of TPN17 to the Engineer's satisfaction prior to the system installation on the vehicle.

N13.7.1. TESTING

All components of the Communication System shall be tested at the Manufacturer's facility. The Contractor shall submit the Manufacturer's test and inspection procedures for all components to the Engineer for

review and approval (CDRL N1332). Refer to TPN17 for the Testing Requirements.

The Contractor shall submit a test and inspection plan for all system components without the assembly testing of the entire communications control system prior to installation in the vehicle (CDRL N1333).

TABLE OF CONTENTS

N14. AUTOMATIC TRAIN CONTROL 14-1
N14.1. GENERAL 14-1
N14.1.1. CITED REFERENCES 14-1
N14.1.2. SUBMITTALS - CDRLS 14-1
N14.1.3. SCOPE OF WORK 14-2
N14.1.4. DESIGN REQUIREMENTS 14-3
N14.1.5. MANUFACTURING & TESTING REQUIREMENTS 14-4
N14.1.6. EXISTING ONBOARD & WAYSIDE ATC SYSTEM 14-4
N14.1.7. MATERIAL REQUIREMENTS 14-5
N14.1.8. POWER REQUIREMENTS AND TERMINATIONS 14-5
N14.1.9. REQUIREMENTS FOR EXISTING EQUIPMENT AND WAYSIDE INTERFACES . 14-6
N14.2. DESCRIPTION OF EXISTING ATC SYSTEM AND EQUIPMENT 14-6
N14.2.1. GENERAL 14-6
N14.2.2. AF-400 SYSTEM 14-7
N14.2.3. ATO SYSTEM 14-11
N14.2.4. COMMUNICATIONS AND VMS CROSS-REFERENCE DATA 14-12
N14.3. NEW ONBOARD ATC EQUIPMENT 14-12
N14.3.1. GENERAL REQUIREMENTS 14-12
N14.3.2. ATC DESIGN PARAMETERS 14-12
N14.3.3. PHYSICAL DESCRIPTION OF ATP EQUIPMENT 14-17
N14.3.4. ATP OPERATION 14-21
N14.3.5. ATP SYSTEM CONFIGURATION AND DIAGNOSTICS 14-22
N14.3.6. ATO SYSTEM & EQUIPMENT 14-26
N14.3.7. TRAIN TO WAYSIDE COMMUNICATION (TWC) 14-26
N14.3.8. TEST EQUIPMENT 14-27
N14.4. VEHICLE INTERFACE REQUIREMENTS 14-28
N14.4.1. INSTALLATION INTERFACES 14-28
N14.4.2. VMS INTERFACE PROVISIONS 14-29
N14.4.3. TRAINLINES 14-29

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N14. AUTOMATIC TRAIN CONTROL

N14.1. GENERAL

The Contractor shall provide an integrated onboard Automatic Train Control (ATC) system and equipment as specified herein procured from a single supplier. The onboard ATC system shall be fully compatible with the MDT's existing infrastructure, wayside systems, System interfaces, and operations and maintenance practices.

N14.1.1. CITED REFERENCES

Source/Section	Title
AAR	Association of American Railroads
AREMA	American Railway Engineering and Maintenance-of-Way Association

N14.1.2. SUBMITTALS - CDRLS

Unless otherwise specified, the following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No	Title	TP Reference
N1401	Preliminary Design Description	TPN14.1.4.
N1402	Intermediate Design Description	TPN14.1.4.
N1403	Final Design Reports	TPN14.1.4.
N1404	Electrical and Mechanical Details, Drawings and Proposed Wire Tag Designation	TPN14.1.8.
N1405	Manufacturer's product literature and specifications of onboard ATC equipment	TPN14.3.2.
N1406	Vehicle Modifications, Interface specifications and documentation as defined.	TPN14.3.2.
N1407	Design Configuration details for ATP card file and PCBs.	TPN14.3.3.2.2.

CDRL No.	Title	TP Reference
N1408	Drawings Showing all Proposed Installation Locations and Mounting Clearance of the onboard ATC equipment components including installation manuals and procedures	TPN14.3.5.2.1.
N1409	Trainlines and Non-Trainlined Interfaces	TPN14.3.5.2.4.
N1410	Details for ATO design features & operating parameters including manuals and test procedures	TPN14.3.6.
N1411	Design, configuration, features and functions of TWC and Wayside Interfaces	TPN14.3.7.
N1412	Operator's TWC Interface	TPN14.3.7.1.
N1413	List and Definition of all Required Trainlines	TPN14.4.3.

N14.1.3. SCOPE OF WORK

The ATC system shall include the following:

a. Microprocessor based ATP, ATO and Train-to-Wayside (TWC) equipment.

b. A built-in daily departure test feature.

c. Multiple ports for accessing via a Portable Test Unit control Laptop PC or other MDT approved PDA devices.

d. 3-sets of complete Test/Calibration equipment with simulation features.

The Contractor shall be responsible for the installation of breakers, wiring to breakers and cutout switches, conduit, supports, and all other apparatus required for the installation of antennas and electronic equipment.

The Contractor shall be responsible for testing all wiring installed on the vehicles and for the proper termination of any wiring installed or designated for "future use".

It is intended that the sensors necessary to extract the data points and transmit them to the onboard VMS Central Control Unit, shall be provided by the individual subsystem suppliers. It is the responsibility of the Contractor's System Integrator to ensure that adequate subsystem data points are designed, received, assembled, interfaced and configured using the necessary sensing devices, protocols, wiring, connectors and terminations to provide the overall VMS functioning as intended by the

VMS Specifications. The System Integrator shall be responsible to review, correct and use all subsystem designs to develop completely assembled integrated drawings and diagrams that are necessary and as specified herein, and in TPN13 and TPN20.

N14.1.4. DESIGN REQUIREMENTS

The Contractor shall submit to the Engineer, a preliminary design description for approval (CDRL N1401). It shall describe the concepts to be used for all functions of the onboard ATC equipment and all interfaces to the MDT's existing wayside system and wayside system for the Metrorail extension as described herein.

An intermediate design description for each of the onboard ATC subsystems and for the complete system shall be included in the intermediate design description and shall be submitted for approval (CDRL N1402). This design description shall identify the source of all pertinent design information, assumptions made, and tests planned to verify the accuracy of the design as well as providing a clear understanding of the design.

Final design reports shall be submitted for approval (CDRL N1403) after design verification tests are concluded and any required design changes are incorporated. The final design reports shall be full and complete reports of the design including all development, verification and safety test reports and results of final analysis conducted such as reliability, safety and maintainability. The final design reports shall also include sufficient manufacturing drawings to identify the configuration to the component level. The approved final design reports shall serve as the production baseline.

The design of vital circuits shall be in accordance with the accepted signal system design practices and applicable sections of AREMA Signal Manual recommendations or approved equivalent, and shall comply with the fail-safe design requirements. Synchronous logic shall be used for all logic circuits. Where unsynchronized signals are applied to digital logic circuits, they shall be synchronized with the logic clock at the point of entry. All inputs and outputs of the ATC system that connect to digital logic and other low energy level circuits shall be isolated with noise rejection circuitry.

N14.1.5. MANUFACTURING & TESTING REQUIREMENTS

Manufacturing, QA surveillance, material and workmanship shall be monitored and documented per plant practices and shall be provided if requested. Testing shall be performed as specified herein.

N14.1.6. EXISTING ONBOARD & WAYSIDE ATC SYSTEM

The existing Metrorail vehicles are equipped with onboard Automatic Train Control (ATC) equipment consisting of Union Switch & Signal Co. (US&S) supplied Automatic Train Protection (ATP) system and a Westinghouse Electric Corporation, Inc. supplied Automatic Train Operation (ATO) system.

The onboard ATP system operates in conjunction with the wayside Automatic Block System (ABS), which provides for train detection within a given track circuit block, and when the block is occupied, supplies the ATP equipment with a cab signal to maintain safe train operation. The cab signal information is detected by the ATP equipment for the purpose of imposing train speed limits within the constraints of civil speed restrictions, occupancy of adjacent track circuits, etc., thereby maintaining optimum train separation.

The onboard ATO provides the following functions subordinate to the ATP functions (i.e., speed commands and overspeed protection):

- Start-up logic.
- Tractive effort request.
- Automatic speed regulation.
- Performance level adjustment.
- Programmed station stops.
- Diagnostics.

The functions of ATO are implemented by electronic hardware installed on vehicles, in stations, and at strategic wayside locations.

There are 9-interlockings along the right-of-way. At interlockings, the ATP equipment ensures that train movement is permitted only when a route is available through the interlocking, and interlocking switches are locked in the desired position. Further, the ATP equipment responds to cab berthing signals that permit train door-open commands provided the train

is properly berthed at the station platform and track circuit blocks on either side of the station block are unoccupied.

Married Pairs are equipped for full ATO operation with a programmed stop profile. However, it is disabled in both manual and yard modes (yard mode restricted to15 MPH) of operation. The door opening decisions are made by the wayside ATC system. The wayside ABS system, also supplied by the US&S Co., utilizes AF-400 analog track circuits.

At present, MDT has decided to maintain its existing wayside AF-400 system. New lines are expected to have a track circuit system that is compatible with the existing AF-400 system. The Contractor shall ensure that the new equipment mirrors the existing operating functions associated with the US&S AF-400 analog track circuits, AF-400 compatible track circuits with six (6) additional speed codes as shall be required for the EHT-MIC Metrorail extension. The vehicle ATO system will also provide seamless transitions between the two wayside systems without Operator intervention or the requirement to stop or slow down trains at the transition points between the two systems. The vehicle shall also provide program stop using the existing Westinghouse wayside program stop signal for the existing system and the future Metrorail extensions. The Contractor will be provided access to the existing vehicle maintenance manuals in order to understand the operation of the existing Westinghouse ATO.

N14.1.7. MATERIAL REQUIREMENTS

Electrical materials and installation methods to be used in the fabrication of train control equipment, including wire, cable, printed circuit boards, and circuit protective devices, shall conform to the requirements specified in TPN19.

N14.1.8. POWER REQUIREMENTS AND TERMINATIONS

The Contractor shall install separate low-voltage DC and AC circuit breakers and install junction boxes, conduit, wiring, and terminations as necessary to support the onboard Train Control (TC) equipment. The Contractor shall install conduit and cabling from the TC equipment control logic and relay interface racks, to each powered truck for speed sensing and to transponders locations.

The Contractor shall provide relays or solid state devices to energize the transponder coils on the lead or operational end of each married pair only and junction boxes with terminals for connection to conduit, cabling, and quick disconnects.

The Contractor shall mark wiring and equipment connections from the interface rack to the Married Pair trainline connections for service braking and propulsion inhibit functions. All systems shall derive power from the batteries in the event of low voltage power supply failure or loss of third rail power.

All wiring shall meet the requirements of TPN19. The Contractor shall submit all electrical and mechanical details, drawings, and all proposed wire tag designations to the Engineer for approval (CDRL N1404).

N14.1.9. REQUIREMENTS FOR EXISTING EQUIPMENT AND WAYSIDE INTERFACES

The Contractor shall supply ATC equipment that shall interface with the wayside ATC system on any segment of the MDT system including the extensions.

N14.2. DESCRIPTION OF EXISTING ATC SYSTEM AND EQUIPMENT

N14.2.1. GENERAL

The present onboard ATC system consists of ATP and ATO equipment. The ATC system incorporates equipment to permit operation with the existing US&S AF-400 audio-frequency wayside track circuit, and the Westinghouse wayside ATO equipment.

For the existing track circuitry, the vehicle ATP equipment receives signal inputs from the rails via cab pickup coils tuned to a frequency of 990 Hz. This cab signal is modulated by a speed command code rate generated by the audio frequency (AF) track circuit transmitter equipment, provided the respective track circuit block is occupied and certain route selection criteria are met.

N14.2.2. AF-400 SYSTEM

The existing wayside AF-400 system will remain in place. The Contractor shall coordinate to ensure that interfacing work associated with installing the new onboard equipment is provided.

The existing AF-400 System which is part of the Automatic Block Subsystem, contains the AF track circuit transmitter circuits responsible for the generation of coded train detection and cab signal frequencies, and the AF receiver circuits responsible for the synchronous decoding of the train detection frequencies to indicate track circuit block occupancy.

N14.2.2.1. TRAIN DETECTION

To properly implement the train detection function within a given track circuit block, the AF-400 system shall always receive a speed command code rate. This code rate is determined by external vital relay logic representing train routing, as dictated by interlocking considerations and civil speed restrictions and/or the occupancy status of adjacent track circuit blocks. Each adjacent track circuit block is assigned an exclusive track circuit frequency. This coded frequency is applied to the rails at the track circuit exit boundary via an integral minibond-coupling unit. However, in continuous rail territory, since the exit boundary for one given track circuit block is also the entrance boundary for the adjacent track circuit block, the minibond-coupling unit shall be tuned to two track circuit frequencies, plus the cab signal frequency of 990 Hz. Where precise track circuit definition is required, such as at station platforms and/or interlocking approaches, insulated joints are used to provide separation of track circuit blocks. Since different train detection frequencies must be used in adjacent track circuits, the minibond-coupling units on each side of the insulated joints are not tuned to any common train detection frequencies. In this case, the minibond-coupling units are tuned to just two frequencies, a single train detection frequency, plus the cab signal frequency of 990 Hz, and the system is thus capable of detecting a broken-down insulated joint, which has the same effect on commanded train movement as track circuit block occupancy. The train detection frequency applied to the rails is transmitted on alternate half-cycles of the selected speed command code rate.

N14.2.2.2. CAB SIGNALING

The cab carrier frequency of 990 Hz is always applied to the AF-400 transmitter circuits; however, the cab signal output to the rails is suppressed until the AF transmitter receives a high cab enable input from the external cab enable vital relay logic. This occurs when the associated track circuit block is occupied. When this is the case, the 990 Hz cab signal is also modulated by the speed command code rate on the other half-cycle, and a composite AF transmitter output to the rails is produced, with the speed command modulating the train detection and cab signal frequencies on alternate half-cycles. It is this modulated 990 Hz signal to which the vehicle ATP equipment responds.

N14.2.2.3. VEHICLE ATP EQUIPMENT

The ATP equipment is responsible for translation of cab signal and actual speed inputs to suitable control signals for the supervision of train safety. These circuits operate in conjunction with the cab pick-up coils, the speed sensor, the vital and non-vital relays, the decelerometer, and the train Operator's control console to perform the following functions:

a. Cab signal reception.
b. Overspeed detection.
c. Zero velocity detection.
d. Motion detection.
e. Brake assurance.
f. Train berthing.
g. Operational Mode Control, including:
   (1) Automatic mode.
   (2) Manual mode.
   (3) Yard mode.

N14.2.2.4. CAB SIGNAL RECEPTION

The cab signal reception function accepts the 990 Hz signal from the cab pick-up coils to determine the vital speed signal.

N14.2.2.5. OVERSPEED DETECTION

The overspeed detection function accepts an actual vehicle speed input from the speed sensors and translates this input into actual velocity. The actual velocity is then compared to commanded velocity, as detected via

the decoder, and to sense an overspeed condition if one exists. If an overspeed condition is present, the overspeed function requests a service brake application, sounds an alarm, and lights the "OVERSPEED" lamp on the train Operator's control console. If the overspeed condition is not acknowledged by the train Operator by moving the master control lever (MCL) to a brake position within 3 seconds, or the brake assuring deceleration rate of 1.5 mphps is not achieved, an irrecoverable emergency brake application is requested until the train is stopped. If the train Operator does acknowledge the overspeed condition by service brake application within 3 seconds after the alarm sounds, the alarm is silenced, however the "OVERSPEED" lamp remains lit on the control console until an under-speed condition is achieved.

N14.2.2.6. ZERO VELOCITY DETECTION

This function is an integral part of the overspeed detection function, and causes the zero velocity (VZ) (see TPN1) vital relay to energize when train is stopped. The train doors may be operated under this condition, provided a berthing command is detected.

N14.2.2.7. BRAKE ASSURANCE

The entire overspeed system is supervised by a brake assuring system; if the system does not detect a brake rate application of 1.5 mph/sec within 3 seconds after an overspeed condition is detected, an emergency brake application is requested and is irrecoverable until the train is stopped and a zero speed condition is detected. The overspeed and brake assuring functions are active in all modes of operation except ATP bypass.

N14.2.2.8. TRAIN BERTHING

When the train is within the station limits imposed by the station track circuit, and the track circuits in front of and behind the occupied track circuit are unoccupied, the AF-400 track circuit logic transmits two signals, one followed by the other. The first signal is the 990 Hz carrier coded by any cab speed command up to and including 46 mph. The second is the 990 Hz carrier coded by the berthing command. These two signals are continuously transmitted in succession, are received and decoded by the ATP equipment, and result in both speed command and berthing relays being energized continuously, thereby enabling door

operation when the VZ relay energizes. If the speed command is 0 mph, then only the berthing code will be transmitted and received.

N14.2.2.9. OPERATIONAL MODES

This section describes the operational modes of the AF-400 system. Mode changes shall take place at Zero Speed.

N14.2.2.9.1. Automatic Mode

When cab signal territory (AF-400 track circuits) is entered while in the yard mode, the train Operator must stop the train, thereby energizing the zero velocity (VZ) relay to permit the control console mode select switch (MSS) to be moved to the "ATO" position. The "ATO START" pushbutton is then pressed, and the automatic speed regulation equipment takes over and regulates train speed to whatever speed command is present. The ATP equipment then monitors train speed for an overspeed condition.

N14.2.2.9.2. Manual Mode

Manual mode is selected by the console MSS being placed in the "MAN" position, when train speed is zero and the MCL is in a brake position. In "MAN" mode, train speed is controlled by the train Operator and is subject to the same overspeed condition and effects as above.

N14.2.2.9.3. Yard Mode

The "YARD" mode can be selected via the MSS only when train speed is zero. With the MSS in the "YARD" position, a train speed command of 15 mph is initiated. In addition, all other train speed commands are eliminated and cab signal speed command indications are not furnished to the train Operator's control console. Train speed in this mode is limited to 15 mph, and the overspeed function is still enabled as outlined above.

N14.2.2.10. SPEED DISTANCE PROFILES

When a vehicle enters a new track circuit, it receives the coded signal from the wayside system. This is vital information calculated from the safe braking profile analysis on a track circuit by track circuit basis.

N14.2.3. ATO SYSTEM

ATO equipment provides functions for automatic speed regulation, program station stopping, and tractive effort generation. These functions are carried out non-vitally subordinate to the ATP subsystem that is responsible for the command speeds and overspeed regulation. The functions of ATO are implemented by electronic hardware located onboard, in the stations and at wayside as follows:

N14.2.3.1. STATION AND WAYSIDE ATO EQUIPMENT

Station and wayside ATO equipment includes the following:

- Program Stop Transmitter Assembly.
- Program Stop Platform Transmitter Antenna Tape.
- Program Stop Marker Transmitter Antenna.

N14.2.3.2. ONBOARD ATO EQUIPMENT

- ATO Module.
- P & BRK Signal Generator.
  - ATO type (1 on each B-car).
  - Manual type (1 on each car, A or B).
- Program Stop Receiver Antenna.
  - 1 assembly on each side of B-car rear truck.
- Termination Board.
- Speed Sensors.

The CPU uses its various inputs to determine:

- The level of P-Signal Request, which demand tractive effort from the ATO P & BRK Signal Generator.
- The mode of tractive effort, Propulsion or Brake (P/BRK mode).
- The enabling of start-up circuitry.
- The level of performance provided for various commanded speeds.
- The adherence to programmed slowdown in preparation to station stopping (Programmed stop) when that feature has not been manually disabled (Programmed Stop Cancel) at the Operator's Console.

The main purpose of the Station and Wayside ATO equipment is the generation (Program Stop Transmitter Assembly) and transmission of 7.07 KHz signal in transverse antennas (Program Stop Platform and Marker Antennas) which the CPU of the ATO module uses in determining brake profile and accurate stopping position.

N14.2.4. COMMUNICATIONS AND VMS CROSS-REFERENCE DATA

Refer to TPN13 and TPN20 for the details of intended Communication System and VMS System and Interfaces with MDT networks.

N14.3. NEW ONBOARD ATC EQUIPMENT

N14.3.1. GENERAL REQUIREMENTS

The Contractor shall perform ATC system design using the requirements defined herein, manufacture, assemble, test, furnish, install, and commission the new microprocessor based onboard ATC equipment that shall mirror the performance of onboard ATP, ATO equipment on the existing vehicles. The new onboard ATC equipment shall be compatible with the existing wayside ATC system and also the future ATC system to be used on the extension.

The Contractor shall ensure that the new onboard ATC functions shall interface with existing wayside train control devices without negatively impacting MDT operations and maintenance. Additionally, the ATC system shall be adequately coordinated with Vehicle Monitoring System (VMS) to function as covered in TPN20. Overall, the new equipment shall improve the Operations, Maintenance, diagnostic, and troubleshooting capability.

N14.3.2. ATC DESIGN PARAMETERS

The Contractor shall continue final design, configure, assemble, furnish, install, and test the onboard equipment to allow for safe and convenient operation in the manner and to the extent as detailed herein:

a. A continuous Automatic Train Protection (ATP) system, with cab signal reception, overspeed detection and brake assurance monitoring.

b. A continuous ATO system to provide automatic speed regulation, programmed station stopping, door control, and tractive effort

generation. Overall, the ATC system shall be able to function, as intended should MDT decide to operate the train in Manual mode.

c. Train-to-Wayside Communications System (TWC).

d. Other equipment, appurtenances, spare parts, manuals, warranty and warranty phase services as specified in the specifications.

The Contractor shall provide manufacturer's product literature and specifications of onboard ATP, ATO and TWC equipment (CDRL N1405). In addition, the design and selection of the equipment shall be subject to approval by MDT.

Door control for the new vehicles shall differ from that on the existing vehicles. For the new vehicles, the doors shall open automatically instead of manually as is presently done of the existing vehicles. To further ensure that the doors will be automatically opened on the platform side of the train, the ATO shall determine which of the two program station stop antennas is receiving the 7.07 kHz program station stop tone. The wayside program stop antenna is mounted on the cover board over the third rail. At all stations the third rail is on the side of the train opposite the platform and a determination of the platform side shall be determined as being the side from which no 7.07 kHz tone is being received. The ATO shall compare the platform side determination from the program stop antennas with the right or left berthing signal received from the track signaling system. If the two do not agree the doors shall not automatically open. Door closing shall always be performed manually by the Operator.

The Contractor shall provide design documents and interfacing drawings, documentation of the design and interface between Contractor furnished onboard Train Control equipment, including an interface specification and interface schematic diagrams for review and approval (CDRL N1406). The interface specification shall include:

a. Detailed design description of functionality and how the design achieves each requirement as described in these specifications.

b. Drawings illustrating electrical devices, mechanical mounting arrangements and wiring layout with Wire Tag Designations on the vehicles.

c. Power requirements.

d. Voltage and current levels.

e. Signals formats, and signal timing constraints as applicable.

f. Signal load characteristics.

g. Wiring requirements, including wire types and sizes, shielding and conduit provisions.

h. Number and type of electrical conductors.

i. Spare wiring and/or connector requirements.

j. Provisions to connect ATP, ATO and TWC test equipment.

k. Equipment ventilation and cooling requirements.

l. Electromagnetic/other types interference will be designed out of the system between all vehicle components, especially with the AC propulsion system and the existing AF-400 track circuit system and the modified AF-400 as specified for the system extensions.

The new ATP, ATO, and TWC equipment shall consist of separate functional modules to provide the integrated functions of the desired TC. Train control modules shall consist of the following sub-modules:

- Train control equipment rack and associated mounting brackets.
- Train control under car equipment.
- ATP track receiver coils.
- ATO equipment.
- TWC coils.
- Program Stop receiver antenna.
- Speed Sensors.
- Associated mounting bracket assemblies.
- Cab & car controls, indicators, and test panels.

The Contractor shall provide all ATC functions necessary for system operation, including but not limited to:

- Speed Command / Code Rate detection and decoding.
- Speed Sensing.
- Overspeed Protection.
- Brake Assurance.
- Data Logging.
- Automatic, Manual, Yard, and Road (optional) Mode Operation.
- ATO functions with wayside ATO interfacing devices.
- Portable Test Units.

- Bench Test Units with simulation features.
- Departure Test.
- By-pass Operation.
- Door Interface.
- Propulsion/Braking Interface.

The ATC equipment shall be capable of operating with existing AF-400 system having the characteristics shown below. For the extensions the same 990 Hz carrier frequency will be used with the speed and berthing commands shown below. In addition, the extensions will have 6 additional speed commands with six additional corresponding speed codes. The ATP shall respond properly to all 12 speed codes and the two berthing commands which will allow it to operate on either the exiting line or the extensions. No handover signals will be needed at the boundaries between the existing line and the extensions. The ATP will simply not detect the new speed codes while operating on the exiting line.

Cab Carrier Frequencies		
Train Speed vs. Speed Command Code Rate	Train Speed (mph)	Code Rate (Hz)
990Hz Carrier	6	Not defined
	15	5.0
	20	Not defined
	28	6.6
	32	Not defined
	38	8.6
	43	Not defined
	46	10.8
	52	Not defined
	58	13.6
	64	Not defined
	70	16.8
Right train berth signal	20.4 Hz code rate added to the prevailing speed command rate when train is in station track circuit block and adjacent track circuit blocks to either side are unoccupied. Permits the right doors to be opened	

Cab Carrier Frequencies	
Left train berth signal	27.5 Hz code rate. Same as above permits the left doors to be opened
Speed sensor output	Actual train speed
Overspeed detection accuracy 28 to 70 mph Below 28 mph	 Speed Command + 2 mph ± 1 mph* Speed Command + 1 mph ± 1 mph*
Zero speed verification	When train speed is less than 1 mph
Brake assurance delay period	Between 2.0 and 3.0 seconds
Deceleration rate detection point	1.5 mphps, nominal
Yard mode speed command	15 mph – Onboard generated signal (5.0 Hz), maximum
Ambient operating temperature	-40°F to +158°F
Relative humidity	≤ 95%

It shall be only possible to bypass the ATP using the sealed ATP bypass switch, while in the Yard mode. Under this condition the vehicle speed shall not be limited. When the bypass switch is used a radio alarm shall be sent to Central, a light shall illuminate on the Operators console, and lights shall illuminate on both sides of the vehicle with the ATP cutout. To reset the ATP bypass at zero speed, it shall be necessary to both place the ATP toggle switch back to the Not Bypassed position and depress an ATP bypass reset button.

The Operator shall be able to select reduced performance modes that modify the maximum acceleration, maximum command speed, and the program stop rate.

The PERF MOD switch shall do the following:

- Position 1 – Maximum acceleration as specified in TPN2 and Command Speed equal to the ATP wayside to vehicle limit.
- Position 2 – Maximum acceleration 50% of that specified in TPN2 and Command Speed equal to the ATP wayside to vehicle limit.
- Position 3 – Maximum acceleration 50% of that specified in TPN2 and Command Speed equal to 70% of the ATP wayside to vehicle limit.

The PRGM STOP switch shall do the following:

- Position 1 – Program station stop braking rate of 2.0 mphps.
- Position 2 – Program station stop braking rate of 1.5 mphps.

N14.3.3. PHYSICAL DESCRIPTION OF ATP EQUIPMENT

N14.3.3.1. EQUIPMENT ENCLOSURE

The Contractor shall provide state-of-the-art microprocessor-based solid-state ATP equipment in a welded steel enclosure designed for mounting in the vehicle equipment rack. The enclosure shall contain the following major components:

- Card file with plug-in printed circuit boards for the microprocessor-based vital logic, interfaces to other equipment and subsystems (e.g. speed sensors, pick-up coils).
- Decelerometer for measuring vehicle braking rate.
- Vital relay, having lockable means shall be provided, for controlling power to the emergency brake system. Additional vital relays may be required for direction control, left berth, right berth, V=0, etc.
- Battery Conditioner PCB for filtering input power from the vehicle battery and protecting the vital processor circuits from voltage transients.
- Relay PCB providing safety and non-vital relays for controlling various functions.
- Amphenol type, ¼ turn quick-disconnect plug connectors for connecting external circuit/equipment wiring (power and data) to the card file.

N14.3.3.2. SYSTEM CARDFILE AND PCBS

N14.3.3.2.1. Card file

The vital processor card file shall contain the system's controlling vital logic (hardware and software) and interfacing circuits between the logic and peripheral devices/circuits both within the Enclosure and external to the enclosure. The logic and interfacing circuits shall be incorporated in plug-in printed circuit boards with integral front control/display panels. Each PCB shall be secured with top and bottom machine screws, and extracted with top and bottom ejector levers. The boards shall be installed

in a slotted card file with internal backplane connectors for board-to-board communications, distribution of PCB operating power and electrical interfaces to external circuits/equipment. Unused slots shall be covered with blank panels.

N14.3.3.2.2. **Printed Circuit Boards (PCBs)**

The Contractor shall provide the configuration characteristics, application, features and functions of all PCBs and Card file he intends to propose for the Engineer's review and approval (CDRL N1407).

Key functions of the PCBs shall include:

- Processing code rate (cab signal aspect) information and monitoring vehicle speed.
- Monitoring the Master Controller handle.
- Operating the indicators on the Aspect Display Unit (ADU) or equivalent display.
- Monitoring vital inputs and controlling vital outputs (e.g. brake system control).
- Conducting and monitoring the automated Departure Test.
- Managing user diagnostic and event data downloading procedures.
- Storing routine event and fault data in memory.
- Decoding existing AF-400 track circuits signals.
- Providing vital inputs.
- Providing vital outputs.
- Receiving existing AF-400 track circuits signals.
- Multi-Functions including:
  - Departure Test.
  - Decelerometer.
  - Speed Sensor Input.
  - Vital Outputs.
  - Non-Vital Outputs.
- Conditional Power Supply.
- Power Supply.

N14.3.3.3. ELECTRONIC DECELEROMETER (BRAKE ASSURANCE MODULE)

A solid-state decelerometer shall be designed to measure a vehicle's rate of deceleration with grade compensation and provide a logic output to the vital processor cab signal system when a pre-selected deceleration rate has been exceeded. In the typical application, if the Operator fails to brake the vehicle at the minimum required rate, the resulting decelerometer output to the vital processor logic shall result in a penalty brake application request. The Decelerometer design shall take into account all track conditions and consecutive multiple speed command changes.

Deceleration measurement shall be performed in the same fashion as a pendulum decelerometer. The unit shall employ an electrolytic tilt sensor or solid state accelerometer to measure deceleration in either direction of travel, thus it can perform the same function as two uni-directional slosh tube decelerometers in most applications. Either 2 or 3 axis accelerometers shall be used.

The decelerometer shall be mounted in a suitable equipment enclosure. The physical orientation of the unit shall determine general orientation of the enclosure relative to the vehicle's longitudinal axis. The Decelerometer shall consist of a small, low profile steel enclosure with integral rack mounting bracket. Decelerometer adjustments shall be performed in conjunction with LED menu displays on the vital processor CPU logic board or other means approved by the Engineer.

Deceleration rates shall be selected over a range of 0.1 to 3.4 miles per hour per second (mphps) in increments of 0.05 mphps.

The decelerometer's electronics shall incorporate fail-safe design principles such that a component failure cannot result in the detection of a less than desired brake rate.

The decelerometer resolution shall be less than 0.05 mphps.

N14.3.3.4. VITAL RELAY

A vital relay, similar to US&S PN-159B, or approved equal shall be installed in the equipment enclosure to control power to the vehicle brake valve. In case of an ATP system vital fault, power shall be removed from the coil of this relay, resulting in emergency application of the vehicle

brakes. Power to the coil shall only be maintained when the ATP system ongoing diagnostics are satisfactory.

N14.3.3.5. **ASPECT DISPLAY UNIT**

The Contractor shall provide new ADU design, while including all the speed codes for both the AF-400, modified AF-400 Track circuit as is being specified on the EHT-MIC rail extension project. The present speed code and actual vehicle speed shall be clearly displayed to the Operator. The design of the ADU shall be approved by the Engineer.

N14.3.3.6. **CAB SIGNAL PICK-UP COILS**

N14.3.3.6.1. **General**

One set of cab signal pick-up coils shall be used to detect the 990 Hz signal from the existing AF-400 track circuit and modified AF-400 Track circuit as is being specified on the EHT-MIC rail extension project. The cab pick-up coils shall be required on both the B-car and the A-car, with the appropriate coils used as a function of travel direction.

N14.3.3.6.2. **AF-400 Style Coils**

On both cars, each pair of AF-400 and modified AF-400 Track circuit as is being specified on the EHT-MIC rail extension project cab signal pick-up coils shall be mounted on the lead truck, 6 inches above the respective running rail, just ahead of the first axle. Each coil and a spacer block shall be mounted with three stainless steel bolts to a shock-mounted aluminum bracket, thereby providing at least a 4-inch clearance in all directions from any ferrous metal. The selected (B cab and A cab) pick-up coils shall detect a minimum of 180 mA, 990 Hz signal, modulated by the speed command code rate, when the car occupies a given track circuit block. This modulated cab signal shall be supplied to the receiver PCB in the ATP rack of the B cab.

N14.3.3.6.3. **Speed Sensors for AF-400 and Modified AF-400**

The ATP system shall use two active speed sensors to provide a vital speed indication to the vital processor cab signal system running in either mode. This type of speed sensor shall generate the gear tooth detection field via an active (battery) power source. The cable from the speed sensors shall be terminated to a junction box, and then connected to the

Enclosure. The interconnecting wiring shall be shielded and routed through ferrous conduit.

Speed sensors and their associated circuits shall be reliable and able to successfully perform under the adverse environment of motor transients, electrical noise, shock, vibration, and ambient temperatures. The sensors shall bolt on using an integral flange. The depth of the sensor head shall be OEM pre-set and non-adjustable. The flange mounting shall be keyed for proper orientation.

N14.3.4. ATP OPERATION

N14.3.4.1. INTRODUCTION

ATP equipment activation and the ATP modes of operation shall be controlled from the train Operator's control console. The control console is identical in both the A and B cabs of the married car pair.

N14.3.4.2. FUNCTIONS OF ATP-RELATED CONTROLS AND INDICATORS

N14.3.4.2.1. ATP Equipment Modes of Operation

Although the ATP equipment contains no integral controls relative to system operation, the controls and indicators on the control console dictate its mode of operation. The following subparagraphs briefly outline the procedures for establishing these operating modes, including a pre-departure test.

N14.3.4.2.2. Pre-Departure (Daily Readiness) Test Procedure

A Departure Test shall be conducted similar to the existing AF-400 ATP system procedure.

N14.3.4.2.3. Manual Mode Operating Procedure

The manual-operating mode is entered when a failure in the car automatic speed regulation equipment is encountered. To initiate the manual mode, the following process shall be implemented:

a. At the control console, set "MCL" in a brake position and bring the train to a stop (train speed is 0 mph). Press the "ATO STOP" pushbutton if the train is in mainline cab signal territory.

b. Set "MSS" to "MAN" position.

c. Train operation can now resume under manual control, but is still subject to the speed commands and responses of the Vehicle ATP System.

N14.3.4.2.4. **Automatic Mode Operating Procedure**

The automatic mode is the normal operating configuration of the train. This mode is usually entered from the yard mode when the train is leaving the yard and entering mainline cab signal territory. To initiate the automatic mode, the following process shall be implemented:

a. Remain in yard mode until a speed command is indicated on the control console.

b. At the control console, set MCL in a brake position and bring train to a stop at the yard exit signal (train speed is 0 mph).

c. Verify that the "ATO START pushbutton" lights green.

d. Set MSS to the "ATO" position and press the "ATO START" pushbutton.

e. Proceed with normal train operation, under control of the ATP equipment speed commands and responses.

N14.3.4.2.5. **Yard Mode Operating Procedure**

The yard mode is engaged when the train is leaving mainline cab signal territory and entering the yard. To initiate the yard mode, proceed as follows:

a. At the control console, set MCL in a brake position and bring the train to a stop at the yard entrance signal (train speed is 0 mph).

b. Press "ATO STOP" pushbutton and set MSS to "YARD" position.

c. Resume train operation. In the yard, train speed is limited to 15 mph by the ATP equipment, and is subject to the same overspeed restrictions as in automatic or manual modes.

N14.3.5. ATP SYSTEM CONFIGURATION AND DIAGNOSTICS

N14.3.5.1. INTRODUCTION

The system shall be designed to provide the ability to configure and monitor the ATP system by the use of menus and toggle switches on the front panel of the ATP CPU board. System monitoring shall be performed in more detail using a Portable Test Unit (PTU). Fault data will also be reported to the VMS system for display to the TOD and wireless

transmission to the Lehman Center. The operation described below shall only apply when using the CPU board front panel controls and indicator.

The front panel switches shall be used to set:

- The current wheel size for each of the two speed sensors.
- The permanent vehicle ID (PVID).

The front panel switches shall be used to:

- Verify the current operating mode.
- Check the target speed and line speed.
- Verify which versions of software are installed in the ATP system.
- Check the total execution time for all processes during a cycle.
- Check the outputs of the output boards and the inputs of the input boards.
- Check the current active event and other events, count the events, and clear both the events and the count.

Monitoring of system events shall be done with switches on the ATP CPU board or by using a laptop computer set up as a Portable Test Unit (PTU). An RS-232, USB 2 or Ethernet connector on the front panel of the ATP CPU board, shall be provided.

N14.3.5.1.1. **Event Management System Details**

Each of the microprocessors in the carborne equipment shall record the occurrence of noteworthy events. Then, in order to simplify event viewing, all of these events shall be routed to the ATP CPU. Once there, they are stamped with the time and date, stored in battery-backed memory, and transmitted to the VMS.

Each ATP CPU shall maintain the events of the microprocessors within the same ATP, plus those from the AF and ADU. In other words, the Main ATP CPU shall manage the events for itself, the Main AF and the ADU.

Event Types: There shall be two types of events:

- Set/Reset Events.
- Pulsed Events.

Event Levels: The event manager shall maintain a list of active events as follows:

- INFO Level.
- WARN Level.
- FAIL Level.

Unloggable Failures: Shall be annunciated by the ATP fail indicator on the ADU.

N14.3.5.2. ATP MISCELLANEOUS REQUIREMENTS

N14.3.5.2.1. ATP Space Allocation

The Contractor shall allow sufficient space to accommodate the following ATP equipment:

- The equipment shall be located in the Operator's cab of the B car unless otherwise approved by the Engineer.
- Two Aspect Display Units (ADU), one located on each Operator's control panel. If LEDs are used in the ADU they shall be high intensity LED arrays with a minimum life expectancy of 100,000 hours of operation, and a warning alarm. In addition, the Contractor shall ensure that one LED failure shall not cause the whole array to fail. The ADU shall be located in close proximity to the speedometer.
- Two sets of receiver pickup coils.

The Contractor shall submit drawings clearly showing all proposed installation locations and mounting clearance of the ATP components to the Engineer for review and approval (CDRL N1408).

N14.3.5.2.2. ATP Wiring Installation

There shall be two separate speed sensors to calculate the actual train speed. The Contractor shall install conduit and twisted shield wiring from the equipment rack or relay interface rack to each powered truck for speed sensor connections, for the AF-400 transponder pickup coils and for the transponders pickup coils for the future digital track circuits. The Contractor shall install conduit and wiring from the ATP equipment rack locations to proposed mounting locations of the sensors and pickup coils.

N14.3.5.2.3. **ATP Control Wiring**

The ATP brake release relay contacts and the under-speed relay contacts shall interrupt the control signal to the full-service brake trainline. The emergency brake command shall be used to inhibit the propulsion command. The propulsion logic shall automatically disable propulsion whenever the emergency braking is requested.

The Contractor shall install series connections to the service brake trainline in two locations: one for connection to the ATP under-speed relay, and the other to the ATP brake release relay.

N14.3.5.2.4. **Relays and ATP Input Wiring**

The Contractor shall provide a vital means of determining the lead cab and for selection of leading pickup coils. In addition, the logic will only allow one cab in the train to be in control.

All trainline input signals shall be ground isolated. The Contractor shall submit trainlined and non-trainlined interfaces to the Engineer for approval (CDRL N1409).

N14.3.5.2.5. **ATP Event Management System (Recorder) Wiring**

The ATP speed codes shall be monitored by the event recorder. The vehicle event recorder shall interface to the vehicle subsystem signals through the vehicles' local area network. The Contractor shall install wiring and conduit to the ATP equipment rack. The Contractor shall integrate and modify the event recorder software, as required, to read and store speed commands, propulsion inhibits, and braking commands.

N14.3.5.2.6. **ATP Aspect Display Unit Wiring**

The Contractor shall install conduit and wiring from the ATP equipment rack location to the location of the ADU. The Contractor shall allow sufficient slack for all newly installed wiring to allow easy connection to ATP logic or relay interfaces.

N14.3.5.2.7. **ATP Cutout and Alarm Wiring**

The Contractor shall provide and wire a visual indication, located on the Operator's console, to indicate that the ATP system is in operation and provide an overspeed alarm. The overspeed alarm will sound to warn the Operator when the train speed exceeds the current speed limit. A sealed

cutout switch, labeled "ATP Cutout", shall be provided in the cutout panel, located behind the Operator in the cab area. The Contractor shall submit control console and cutout panel switch location and mounting drawings to the Engineer for approval.

N14.3.6. ATO SYSTEM & EQUIPMENT

The Contractor shall configure the Flexible ATO control logic software to offer speed regulation and station stop accuracy to mirror and improve upon the present functions of existing ATO system. It is preferred that ATP and ATO systems are manufactured and assembled by the same manufacturer.

The onboard ATC system shall be equipped with an Automatic Train Operation (ATO) subsystem to provide a speed control interface with the propulsion and brake systems.

The Contractor shall provide ATO configuration, features, functions, design and operating parameters of the proposed ATO System for the Engineer's review and approval (CDRL N1410).

N14.3.7. TRAIN TO WAYSIDE COMMUNICATION (TWC)

The Contractor shall design, furnish, and install onboard TWC equipment. TWC equipment shall be fully wired and tested. Complete details of design, configuration, features and functions for the TWC with wayside interfaces, shall be provided to the Engineer for review and approval (CDRL N1411).

The onboard TWC system shall be able to transmit vehicle information/data when the vehicle passes over a wayside TWC coil or a track circuits with a TWC receiver. The TWC wayside components are not part of this Contract. The TWC shall also have the capability to receive messages from the wayside.

The train to wayside data shall include the following:

- Train Route/Service.
- Train Number.
- Train Formation Number.
- TWC Status.

- Train Length.
- Train Mode (ATO, Yard, Manual).
- End in Control.
- Spare message capability.

The wayside to train information will be provided by MDT upon request from the Contractor.

The new TWC system shall consist of two carborne TWC units one at each end of the Married Pair. Each shall contain a code control panel, located in close proximity to the Operator's control console, and a transmitting antenna, located on the underbody at each end of the Married Pair.

When the mode selector switch is in the Yard, Manual, or ATO position, the TWC system will automatically activate. A visual indication shall be given to the Operator to confirm that the TWC is active and operational.

N14.3.7.1. TWC CONSIDERATIONS

Operator input for the TWC system shall be provided through either a TOD or a keypad/display. The Contractor shall provide details of the Operator's TWC interface to the Engineer for review and approval (CDRL N1412).

N14.3.7.1.1. TWC Interface

If a TOD is used to provide input to the TWC system then the Contractor shall coordinate the interface between the ATC system and the communications system as approved by the Engineer. If a keypad/display is used for TWC input, then the location and interface of the ATC shall be coordinated by the Contractor and shall be approved by the Engineer.

N14.3.8. TEST EQUIPMENT

N14.3.8.1. BENCH TEST UNITS

The Contractor shall provide 2 sets of Bench Test Units (BTU), suitable for the ATC equipment proposed. BTUs shall be in accordance with TPN15.

N14.4. VEHICLE INTERFACE REQUIREMENTS

Vehicle interfaces with the train control system(s) shall incorporate fail-safe design principles where required and appropriate. Vehicle circuits shall be designed such that any erroneous combination or sequence of commands shall cause the most restrictive of any of the possible interpretations of the commands to occur.

Where the term "vital" is used, the design shall conform to the requirements for a fail-safe design. Interface requirements shall be developed jointly, by the Contractor and the train control supplier or Engineer, as appropriate.

N14.4.1. INSTALLATION INTERFACES

Equipment installation interfaces with the train control equipment for Standard vehicles shall be as follows:

N14.4.1.1. TRAIN CONTROL ELECTRIC LOCKER

A train control electric locker shall be furnished for a train control equipment rack whose envelope shall accommodate the vehicle/train control interface terminal boards.

N14.4.1.2. ATP TRACK RECEIVER COILS

ATP track receiver coils shall be either body-mounted or truck-mounted, as approved by the Engineer.

N14.4.1.3. TWC COILS

TWC coils shall be at the front end of each the car. The TWC coils shall be mounted as stated earlier.

N14.4.1.4. SPEED SENSORS

One axle per car shall be configured to accept a speed sensor dedicated to the ATP. The Contractor shall provide the mounting hardware. The sensor shall be dedicated to the signal equipment, but may share a gear wheel if sufficient performance is achieved.

One axle of a motor truck shall be configured to accept an active reluctance type speed sensor. The Contractor shall provide the mounting equipment. The sensor shall be dedicated to the signal equipment, but may share a gear wheel if sufficient performance is achieved. If existing

gears are deemed inadequate, the Contractor shall provide a separate sensing gear conforming to the signal system requirements.

N14.4.2. VMS INTERFACE PROVISIONS

The Contractor shall provide a dedicated serial link to the Vehicle Monitoring System. The ATC supplier shall coordinate and provide necessary information to the VMS in the protocol requested by the supplier of the vehicle event recorder and VMS. Information to be supplied shall be at least:

- Actual Speed.
- Allowable Speed.
- ATC Mode.
- Audible Alarm.
- Bypass.
- Motion.
- Brake Release Relay Status,
- Accelerometer values in excess of 0.5 g, date - time synchronized with that in the event recorder as stated in IEEE 1482.1.
- Car number.

N14.4.3. TRAINLINES

Network trainlines shall be used for communications purposes only, to support the systems described in TPN13. All trainlines required for control purposes shall be discrete analog or PWM. The Contactor shall define all required trainlines and submit to the Engineer for approval (CDRL 1413).

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TABLE OF CONTENTS

N15. SYSTEM SUPPORT 15-1
N15.1. GENERAL 15-1
N15.1.1. CITED REFERENCES 15-1
N15.1.2. SUBMITTALS – CDRLS 15-1
N15.2. TECHNICAL SUPPORT 15-3
N15.2.1. ON-SITE PERSONNEL 15-3
N15.2.2. ON-CALL PERSONNEL 15-4
N15.2.3. TECHNICAL SUPPORT PLAN 15-4
N15.3. MANUALS 15-5
N15.3.1. GENERAL 15-5
N15.3.2. ELECTRONIC DOCUMENTATION SUPPORT SYSTEM 15-5
N15.3.3. MANUALS PROGRAM PLAN 15-6
N15.3.4. USE OF SUPPLIERS 15-7
N15.3.5. APPROACH 15-7
N15.3.6. TYPES AND QUANTITIES 15-7
N15.3.7. MANUALS STYLE GUIDE 15-8
N15.3.8. OUTLINES 15-8
N15.3.9. SUBMISSION SCHEDULE 15-9
N15.3.10. REVISIONS 15-9
N15.3.11. DESIGN AND FORMAT 15-10
N15.3.12. FUNCTIONAL REQUIREMENTS 15-12
N15.3.13. IN-PROCESS REVIEWS 15-15
N15.3.14. AUDITS 15-16
N15.3.15. MANUALS REVIEW AND APPROVAL 15-16
N15.4. TRAINING 15-16
N15.4.1. GENERAL 15-16
N15.4.2. ORGANIZATION 15-17
N15.4.3. TRAINING PROGRAM PLAN 15-18
N15.4.4. USE OF SUPPLIERS 15-19
N15.4.5. TRAINING STYLE GUIDE 15-19
N15.4.6. TRAINING OUTLINES 15-19
N15.4.7. MDT-FURNISHED RESOURCES 15-20
N15.4.8. TRAINING MATERIALS 15-20

N15.4.9. IN-PROCESS REVIEWS 15-22
N15.4.10. CAB TRAINING SIMULATOR 15-22
N15.5. EVENT RECORDER 15-25
N15.5.1. GENERAL 15-25
N15.5.2. MONITORING REQUIREMENTS 15-26
N15.6. SPECIAL TEST EQUIPMENT 15-27
N15.6.1. PORTABLE TEST UNIT 15-28
N15.6.2. PTU HARDWARE CONFIGURATION 15-28
N15.6.3. PTU SOFTWARE CONFIGURATION 15-29
N15.6.4. PTU DISPLAYS 15-30
N15.6.5. DIAGNOSTIC TEST EQUIPMENT 15-31
N15.6.6. SHOP TEST EQUIPMENT 15-32
N15.7. SPECIAL TOOLS 15-33
N15.8. SPARE PARTS 15-34
N15.8.1. CONTRACTOR'S RECOMMENDATIONS 15-34
N15.8.2. PROVISIONING CONFERENCE 15-35
N15.8.3. FUTURE AVAILABILITY 15-35
N15.9. BAR CODING REQUIREMENTS 15-36
N15.10. DRAWING REQUIREMENTS 15-36
N15.10.1. GENERAL 15-36
N15.10.2. TECHNICAL DOCUMENTATION MANAGEMENT 15-46
N15.10.3. DRAWING REVIEWS AND LIST OF DRAWINGS 15-47
N15.10.4. FINAL DRAWING SUBMITTALS 15-48

N15. SYSTEM SUPPORT

N15.1. GENERAL

This section specifies the requirements for technical support, operation and maintenance manuals, training, Special Test Equipment (STE), special tools, and spare parts to be provided by the Contractor. During the course of this Contract, the Contractor shall submit various CDRLs to the Engineer for review and approval. These CDRLs shall identify the activities, organization, schedule, and means for providing each element of system support as specified herein.

N15.1.1. CITED REFERENCES

Source/Section	Title
ANSI/IEEE 315A	Supplement to Graphic Symbols for Electrical and Electronics Diagrams
ANSI Y1.1	Abbreviations for Use on Drawings and Text
FDOT Rule 14-55.0013(8)	State of Florida, Department of Transportation
FS 119.071(1)	General Exemptions from Inspection or Copying of Public Records
IEEE 91-1984	Graphic Symbols for Logic Functions
IEEE 802.11	Wireless Local Area Networks
IEEE 1394A	High Performance Serial Bus
IEEE 1482.1	Rail Transit Vehicle Event Recorders
Signal Industry	General Signaling Practices

N15.1.2. SUBMITTALS – CDRLS

The following documents shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TPN Reference
N1501	Technical Support Plan	TPN15.2.3.

CDRL No	Title	TPN Reference
N1502	Electronic Documentation Support System	TPN15.3.2.
N1503	Manuals Program Plan	TPN15.3.3.
N1504	Manuals Style Guide (including an electronic version)	TPN15.3.7.
N1505	Table of Contents and Manual Samples	TPN15.3.8.
N1506	Manual and Parts Catalogue Submittals and Signed Review Sheets	TPN15.3.9. TPN15.3.15.
N1507	Manual Updates	TPN15.3.10.
N1508	Final Revision of All Manuals	TPN15.3.10.
N1509	Manuals CD	TPN15.3.10.
N1510	Manual Binder Covers	TPN15.3.11.2.
N1511	In-Process Review Agenda and Meeting Minutes	TPN15.3.13.
N1512	Audit Results	TPN15.3.14.
N1513	Training Program Plan	TPN15.4.3.
N1514	Training Style Guide	TPN15.4.5.
N1515	Training Outlines	TPN15.4.6.
N1516	Training Materials	TPN15.4.8.
N1517	Training Aids	TPN15.4.8.3.
N1518	In-Process Review Agenda and Meeting Minutes for Training	TPN15.4.9.
N1519	Event Recorder Details	TPN15.5.1.
N1520	Event Recorder Signal and Parameter Listing	TPN15.5.2.
N1521	Special Test Equipment Plan	TPN15.6.
N1522	Door System PTU Characteristics	TPN15.6.4.1.
N1523	Air Comfort System PTU Characteristics	TPN15.6.4.1.
N1524	Auxiliary Power PTU Characteristics	TPN15.6.4.1.
N1525	Propulsion PTU Characteristics	TPN15.6.4.1.
N1526	Friction Brake PTU Characteristics	TPN15.6.4.1.
N1527	Communications PTU Characteristics	TPN15.6.4.1.
N1528	ATC PTU Characteristics	TPN15.6.4.1.
N1529	Listing of all Diagnostic Test Equipment and Associated Design Details	TPN15.6.5.
N1530	Details of Electro-Mechanical Tester	TPN15.6.6.2.

CDRL No.	Title	TPN Reference
N1531	Details of Printed Circuit Board Testers	TPN15.6.6.3.
N1532	Details of Test Carts	TPN15.6.6.4.
N1533	Special Tooling List	TPN15.7.
N1534	Recommended Spare Parts List/Revisions	TPN15.8.1.
N1535	Final Spare Parts List	TPN15.8.2.
N1536	Bar Coding CD with Database	TPN15.9.
N1537	Electronic Drafting Support System	TPN15.10.1.1.
N1538	Drawing Submittals	TPN15.10.1.2.
N1539	Drawings and BOM on CD	TPN15.10.1.3.
N1540	All ECNs (as well as documentation and cost information)	TPN15.10.2.2.
N1541	List of Drawings and Diagrams	TPN15.10.3.2.
N1542	Final Complete List, in Both Paper and Electronic Format of all Drawings and Files Submitted	TPN15.10.4.
N1543	Cab Simulator Details	TPN15.4.10.

N15.2. TECHNICAL SUPPORT

The Contractor shall provide qualified personnel to assist in performing technical support both on and off MDT's property. This support shall be available from the time the first Pre-Production Married Pair is delivered until the issuance of the Acceptance Certificate. Also, personnel shall be available as needed before the first Pre-Production Married Pair is delivered in order to advise MDT about how to best prepare maintenance facilities to accommodate the HRVs.

N15.2.1. ON-SITE PERSONNEL

The Contractor shall provide full-time, on-site, and qualified maintenance personnel to provide on-site support of preventive maintenance and corrective maintenance to be performed by MDT and to respond to MDT questions related thereto, assist with testing, and to resolve operation and maintenance problems from the time the first Pre-Production Married Pair is delivered to MDT until the issuance of the Acceptance Certificate. The personnel shall provide support during the warranty period, set forth in GP5, by diagnosing failures and supporting MDT preventive and

corrective maintenance activities, providing spare parts, and responding to any warranty claims as required by GP5, including initiation and follow-up of remedial actions. On-site personnel shall include field-service engineers, technicians, and repair personnel as required to support MDT operations and maintenance activities. All expenses for providing this support shall be borne by the Contractor.

N15.2.2. ON-CALL PERSONNEL

During the period of acceptance testing through the completion of all of the warranty periods set forth in GP5, the Contractor shall provide engineering and technical specialists for technical assistance, warranty-related repairs, investigation and correction of repetitive or pattern failures or design defects.

The Contractor shall, within one working day from receipt of the Engineer's request for assistance, notify the Engineer as to its proposed course of action, including the names and titles of response personnel and the time and date of their arrival on-site. MDT shall have the right to take corrective action, at the Contractor's expense, if in MDT's opinion, the Contractor's corrective action plan inadequately addresses the Engineer's concerns. The Contractor will be informed of MDT's intent to take corrective action in order to afford the Contractor the opportunity to revise its plan to the Engineer's satisfaction.

N15.2.3. TECHNICAL SUPPORT PLAN

The Contractor shall submit a technical support plan to the Engineer for review and approval detailing how they intend to satisfy the technical support requirements of this Contract (CDRL N1501). The plan shall include:

- The Contractor's approach to technical support.
- An organizational chart indicating the organization and the technical support staff.
- The qualifications and resumes of the persons who shall provide the technical support. Only personnel approved by MDT will be permitted to provide on-site support.

N15.3. MANUALS

N15.3.1. GENERAL

Manuals and illustrated parts catalogs are an integral part of MDT's maintenance activity. Consequently, the Contractor shall develop manuals for this Contract following a very strict and systematic process and shall submit them to the Engineer for review and approval. The manuals shall be developed using the various reliability and maintainability analyses required for this Contract.

In addition to the printed versions of the manuals, the Contractor shall supply electronic versions of all manuals and the associated support system to allow MDT to maintain the manuals once the Contract is completed.

Unless specifically stated otherwise, the use of the word "manual(s)" shall mean any and all manuals and catalogs specified anywhere in this Technical Provision, including training materials and Integrated Vehicle Level Schematics and Narrative (IVLSN).

N15.3.2. ELECTRONIC DOCUMENTATION SUPPORT SYSTEM

The Contractor shall supply all manuals in both paper and electronic format. To support the electronic version, the Contractor shall supply an Engineer-approved electronic documentation support system to MDT (CDRL N1502). The system shall include the following:

a. Hardware – This shall include a workstation, complete with a state-of-the-art processor at the time of delivery:

   (1) 21 inch flat screen LCD color monitor.

   (2) CD/DVD Writer + RW drive.

   (3) 200-Gigabyte or larger hard disk.

   (4) 1024-Megabyte or larger internal RAM.

   (5) Integrated 100/1000 base network card.

   (6) IEEE 802.11 (all commercially available standards) compatible.

   (7) Keyboard.

   (8) Video card.

   (9) Sound card.

   (10) Speakers.

(11) Modem.

(12) Mouse.

(13) Two USB 2.0 ports.

(14) One parallel port.

(15) Laser-Jet printer with networking capability and that is capable of printing on 11 x 17 inch paper.

b. Software – This shall include the latest versions of Microsoft Windows, Microsoft Office (professional edition), the latest version of AutoCAD, virus scan, and all other software and licenses required to maintain, update or modify the manuals, illustrated parts catalogs, and training materials.

c. Warranty – See GP5.

d. Training – Unless approved in writing by the Engineer, the Contractor shall use both Microsoft Office and AutoCAD software to develop the manuals, illustrated parts catalogs, and training materials. In the event that other Engineer-approved software is used, the Contractor shall provide a minimum of 10 days of Engineer-approved training for up to five MDT personnel for each type of software that is used by the Contractor. The training shall ensure that MDT personnel are qualified to use the software to maintain, update or modify the manuals.

N15.3.3. MANUALS PROGRAM PLAN

The Contractor shall prepare and submit to the Engineer for review and approval a manuals program plan (CDRL N1503). The purpose of the plan is to identify all of the elements associated with the development of manuals for this Contract. At a minimum, the plan shall include:

a. A description of the process the Contractor intends to follow to develop the manuals.

b. The schedule for manuals development.

c. An organizational chart showing the person with primary responsibility for development, along with all persons, departments, or vendors who will be working on or developing the manuals.

d. The methods to be used to assure that the manuals reflect the reliability and maintainability analyses upon which they are based.

e. The revision tracking methodology to be used in the manuals.

f. The Contractor's approaches to using styles and developing a style guide.

g. The quality program to be used to assure the accuracy and completeness of the manuals.

h. The audit and sign-off sheets that shall be used during manuals development.

i. A plan for serializing and issuing each set of manuals.

N15.3.4. USE OF SUPPLIERS

If the Contractor utilizes a Supplier to develop manuals, all requirements of this Contract shall remain in effect and continue to be the sole responsibility of the Contractor. In addition, the Contractor shall manage the efforts of the Supplier and participate in any and all manuals-related meetings and in-process reviews attended by the Engineer.

N15.3.5. APPROACH

Maintenance manuals will be developed using word processing software for text, database software for illustrated parts catalogs, and CAD software for all illustrations (manuals, illustrated parts catalogs, training material, etc.). Alternate approaches shall only be used with the Engineer's approval.

N15.3.6. TYPES AND QUANTITIES

The Contractor shall provide printed versions in the following quantities and types of manuals, catalogs, and drawings. All types of manuals shall be uniquely numbered using four digits.

Manuals	Quantity of Each Manual			
	Review Copies	Review CDs	Final	Final CDs
Operator's Manual	25	2	300	5
Heavy Repair Maintenance Manual	5	2	25	5
Running Maintenance & Service Manual	5	2	25	5
Illustrated Parts Catalog	5	2	25	5
Special Tools Manuals	5	2	25	5

	Quantity of Each Manual			
Special Test Equipment Manuals	5	2	25	5
Manuals for Microprocessor-Based Product Components	5	2	15	5
Integrated Vehicle Level Schematics	5	2	25	5

N15.3.7. MANUALS STYLE GUIDE

The Contractor shall submit to the Engineer for review and approval a style guide, including an electronic version, and format for each of the manuals required under this Contract (CDRL N1504). The Contractor shall use the style guide to develop all manuals. All Subcontractors shall use the same style guide for the development of their manuals for use on this Contract. Supplier manuals may be in their original format as long as they meet all other requirements specified herein.

N15.3.8. OUTLINES

The Contractor shall submit to the Engineer for review and approval, tables of contents and samples for each type of manual and for the illustrated parts catalog in accordance with the style guide (CDRL N1505).

Manuals shall be subdivided into the following topics (as applicable), with safety related notes, cautions, and warnings included as appropriate:

a. Title Page – This includes MDT's name and logo, the Contract name and number, name of Contractor, date and revision of submittal.

b. Revision Tracking – This includes a listing and revision of all pages, as well as a list of each revision, date of revision, and associated explanation for the revision.

c. Table of Contents – This includes a list of all sections, a list of all figures, and a list of all tables. A table of contents shall be provided at the beginning of each manual and at the beginning of each manual section.

d. General Information and Specifications – This includes operational characteristics, performance specifications, and general non-technical subsystem/system descriptions.

e. Theory of Operation – This includes interface descriptions and electronic control circuit functional descriptions, supported by block diagrams and signal flow diagrams.

f. Inspection and Preventive Maintenance – This includes inspection and preventive maintenance requirements, including overhaul periods for equipment. All intervals shall be identified in miles and days and all equipment shall be grouped by frequency of activity. All inspection, preventive maintenance, and overhaul actions shall include condemning limits, settings, and tolerances.

g. Lubrication and Cleaning – This includes frequency in miles, methods, trade identification of recommended lubricants, solvents, and detergents, and location and description of components.

h. Troubleshooting, including troubleshooting flow charts – This includes reference to onboard and stand alone Special Test Equipment, manuals and associated flow charts, fault trees, tables, and symptom/cause/remedy charts for systems, subsystems, and components, including charts and tables for components in order to troubleshoot down to the lowest replaceable unit level.

i. Repair at Subsystem and Major Component Level – This includes step-by-step removal and installation procedures, techniques, use of Special Test Equipment, and use of special tools. Include test and evaluation procedures for systems and subsystems.

j. Index – This includes all relevant terms and page locations.

N15.3.9. SUBMISSION SCHEDULE

The Contractor may submit draft copies of manuals to the Engineer for review on a chapter-by-chapter basis; however, each manual shall be submitted as a complete unit before receiving Engineer's approval. All draft manuals shall be completed and submitted to the Engineer for review and approval prior to delivery of the first Pre-Production Married Pair to MDT along with review sign-off sheets designated in TPN15.3.15. Note that manuals to be used for training shall be submitted 90 days prior to the start of training in accordance with TPN15.4.8. Information initially gathered during acceptance testing, training, all warranty periods, and as a result of engineering changes shall be incorporated into the manuals and submitted as revisions (CDRL N1506).

N15.3.10. REVISIONS

After approval of the draft manuals, the Contractor shall issue revision "0" manuals. Subsequent revisions shall be submitted for review and approval every 180 days until issuance of the Acceptance Certificate (CDRL N1507). A final revision of all the manuals shall be submitted for review and approval prior to the completion of the Work as required by GP9 (CDRL N1508). Manual revisions shall be recorded on a revision list

in the front of each manual. The list shall be issued with each revision and shall show the revision number, revisions description, and the date of each revision for each page.

Revisions related to field alteration of subsystems or assemblies shall be issued with the associated service bulletin before the arrival of the components or retrofit packages.

In addition, the Contractor shall supply a list of all parts that have undergone a Class 1 change for 10 years after the end of all warranty periods.

The Contractor shall provide an electronic copy of all manuals on a CD, readable and editable by MDT equipment, with the delivery of the initial manuals. A new CD shall be provided with each revision, including those related to field alteration of subsystems and assemblies. A final CD shall be delivered to MDT prior to issuance of the Acceptance Certificate (CDRL N1509).

Revisions shall be made in accordance with the revision tracking methodology defined in the Manuals Program Plan specified in TPN15.3.

N15.3.11. DESIGN AND FORMAT

Manuals shall be designed for continuous, long-term service in a maintenance shop environment. Manuals shall lie flat when opened and shall permit adding and replacing pages.

N15.3.11.1. PAPER AND PRINTING MEDIA

Each page of all final manuals, including drawings and figures, shall be printed on approved high-grade paper with a reinforced binding edge and oversized punched holes for binding in loose-leaf form. Ten of the 25 final Heavy Repair and Running Maintenance Manuals shall be printed on Engineer-approved polyester sheets. These sheets shall be tear-proof, heat-stable, moisture- and oil-repellent, and soil- and dust-resistant.

N15.3.11.2. BINDING

The Operator's Manual binding shall be approved by the Engineer. All other manuals, with the exception of the Integrated Vehicle Level Schematics specified in TPN15.10.1.6.2, shall have a standard Letter (8.5 x 11 inch) page size.

All binders, other than the Operator's Manual binder, shall be a D-ring, locking style with five to seven posts. All binders shall be oil, water, and wear resistant. All binders, binder colors, cover wording, formatting, and artwork shall be submitted for approval by the Engineer (CDRL N1510). Review/draft copies of manuals may be submitted in standard 3-ring binders.

Binders shall not exceed 3 inches maximum overall thickness. Foldout pages may be permitted, with Engineer approval, when the information to be conveyed cannot be presented clearly on a single page. Foldout pages may not be more than 17 inches long and shall be Z-folded with the identification displayed on the top readable fold. Manuals shall be divided into as many books as required to stay within the maximum binder thickness, with each binder appropriately labeled (e.g., Volume 1 of 3). Each binder shall not be filled to more than 2/3 of its capacity. All covers shall be approximately 0.063 inches thick. All manual covers, with the exception of the Operator's Manual, shall contain see-thru pockets in the front and on the spine, wherein the manual title and associated artwork shall be placed. All Operator's Manual binders shall be silk-screened.

The overall dimensions of the Operator's Manual shall be 4.25 inches wide, 7 inches high, and not more than 1.25 inches thick. It shall be in horizontal format, bound along the 7 inches dimension. The cover shall be lightweight plastic so that it can easily be opened for revisions and shall be approved by the Engineer prior to delivery. It shall be bound using six-ring binding.

N15.3.11.3. PRINTING

Pages shall be printed on both sides. Pages intentionally left blank shall be so noted. Diagrams and illustrations shall be either 8.5 x 11 inches or 11 x 17 inches, as approved, and shall be bound to the central binder.

N15.3.11.4. INDEXING

Manual sections shall be indexed with heavy-duty, 90 lb minimum, white index dividers, having white, rounded-corner tabs. Dividers shall have a clear, reinforced binder edge. Tabs shall be laminated, have bold, black, printing with capital lettering on both sides and be in banks of five. Indexing of the pocket-size Operator's Manual may be abbreviated, as

required, to achieve condensation without impairing legibility. All sections shall be subdivided to the extent required by the subject matter.

N15.3.11.5. FIGURES

Figures, including diagrams, drawings, and illustrations, shall be labeled as figures. If approved, figures may be 11 x 17 inches and Z-folded with the identification displayed on the top, readable fold. Figures, including those reduced in size, shall be clearly legible. Dimensions used for illustrations shall be presented in English units. Metric units may be shown in parentheses. Figures shall not be loose or in pockets.

N15.3.12. FUNCTIONAL REQUIREMENTS

The Contractor shall develop the manuals in accordance with these Technical Provisions, the style guide, and as agreed to by the Engineer. In the organization of the manuals, the vehicle and/or married pair shall be treated as an integrated system and not as a group of disassociated parts. The manuals shall be organized logically with subsystems and elements presented in descending order of importance. The manuals shall specify torque values, patterns and procedures for all applications.

All material shall be indexed with an Engineer-approved standard numbering system in accordance with the Engineer-approved outline. All statements must be clear and accurate, with no possibility of incorrect implications or inferences. Simple declarative statements shall be employed to convey instructions. Revisions required by changes to equipment and procedures shall be incorporated into the manuals by the Contractor during the performance of the Work and through all warranty periods.

Safety-related notes, cautions, warnings, special procedures, or other information needed to maintain safe conditions shall be highlighted and included in all manuals. Block diagrams shall be used to facilitate the description of assemblies and the relationships of components, assemblies, and subsystems. Photographs shall not be used in the manuals.

N15.3.12.1. OPERATOR'S MANUAL

The Operator's Manual shall contain all information required for safe and efficient operation of the married pair, including the following:

- A general description to familiarize the reader with the basic components and features of the married pair.
- Location, function, and operation of all controls, gauges, indicators, and switches. Illustrations and drawings shall be depicted in color.
- Procedures to prepare the married pair for operation.
- Procedures to operate the married pair in the yard and in revenue service.
- Procedures to secure the married pair from operation.
- Emergency procedures.
- Safety-related notes, cautions, and warnings.
- Trouble symptoms and diagnosis methods, including flow charts, that allow the operator to recover the married pair or train during a failure or other incident.

N15.3.12.2. RUNNING MAINTENANCE AND SERVICE MANUAL

The Running Maintenance and Service Manual shall contain a detailed description of the married pair and train operation and general and detailed descriptions of each system, subsystem, and major component of the married pair. It shall present clearly all the information needed for onboard troubleshooting, servicing, including lubrication, inspection, running maintenance and adjustment, and on-line trouble diagnosis. The manual shall include a recommended schedule for the performance of all preventive maintenance procedures and shall include the frequency, duration, personnel hours, tools, and materials required for each procedure. The manual shall provide all information necessary to maintain the married pair.

N15.3.12.3. HEAVY REPAIR MAINTENANCE MANUAL

The Heavy Repair Maintenance Manual shall allow maintenance personnel to effectively inspect, troubleshoot, repair, replace, adjust, and overhaul each component, system, and subsystem of the married pair. The manual shall provide criteria explaining when maintenance personnel should replace, rather than repair, a major component or subsystem, including condemning limits, adjustments and any other information necessary to maintain the married pair. Any reference to a schematic must provide that schematic as an appendix to that section. The manual

shall include a recommended schedule for the performance of all maintenance procedures and shall include the frequency, duration, personnel hours, tools, and materials required for each procedure.

N15.3.12.4. ILLUSTRATED PARTS CATALOG

The illustrated parts catalog shall enumerate and describe every component with its related parts, including the original equipment Supplier's name and part number, the Contractor's part number, commercial equivalents, and quantities per assembly. Exploded isometric drawings shall be used to identify all parts. A part common to different components shall have the same Supplier's part number and, except for common hardware, cross-references shall be provided to other components in which the part is found. Space shall be provided for an MDT identification number. Each part or component shall be associated with the next larger assembly by using an indented format. An index of all part numbers shall be included at the back of the illustrated parts catalog.

Descriptions of parts, including size, material, and grade, must be adequate in order for MDT to procure parts independently. Adequate generic information for each part, including printed circuit board components and other electronic parts, shall be provided in the illustrated parts catalog. An appendix giving the original Supplier's name, address, and telephone number for parts ordering shall be included.

Prior to printing the final version, the illustrated parts catalog shall be supplied to the Engineer so that MDT can identify its own identification number for each part. This information will then be given to the Contractor who will enter it into the illustrated parts catalog prior to printing.

N15.3.12.5. SPECIAL TOOLS MANUALS

All special tools manuals shall be contained in a separate binder. The special tools manuals shall provide application, set up, operation, adjustment, inspection, maintenance, troubleshooting, repair, storage instructions, and calibration procedures and requirements for all special tools. The manuals shall also contain spare parts information. References to and for the specific use of special tools manuals shall be contained in the appropriate location of the repair maintenance manuals.

Drawings shall be submitted along with the special tools manuals from which fabrication of the specialized tools may be accomplished.

N15.3.12.6. SPECIAL TEST EQUIPMENT (STE) MANUALS

The Contractor shall provide a separate manual for each piece of special test equipment. The STE manuals shall provide application, set up, operation, adjustment, inspection, maintenance, troubleshooting, repair, and storage instructions. The manuals shall also contain replacement parts information. References to and for the use of special test equipment manuals shall be contained in the appropriate location of the repair maintenance manuals.

N15.3.12.7. MANUALS FOR MICROPROCESSOR-BASED EQUIPMENT

Manuals for equipment that contains microprocessor units shall include all the information required to properly maintain the microprocessor units. These manuals shall contain the microprocessor software requirements and shall indicate the document number, revision level, and the location where support is available.

All manuals shall refer to any automated design tools required to maintain any microprocessor component.

The software design description shall be the same as that described in TPN22 and contain all attributes as required.

N15.3.13. IN-PROCESS REVIEWS

The Contractor shall conduct in-process reviews of the manuals and all aspects of the manual development process during this Contract. The first review shall be conducted within 156 days after NTP and shall continue to be held until Engineer-approval of all draft manuals. Subsequent review dates shall be coordinated with the Engineer, but in no case shall they be held less than quarterly or once every 90 days. During these reviews, the Contractor shall:

- Present the status of the manuals program versus the Contract Document requirements, including action items status from previous reviews.
- Present all completed manuals chapters or portions thereof for Engineer review.
- Present the results of any audits.
- Present any issues related to the development of the manuals to be addressed by the Engineer.

- Make available for interview those persons who are developing the manuals at the Engineer's request.

These reviews shall be conducted at the location to be selected by the Engineer. An agenda and materials to be presented during the review shall be submitted to the Engineer prior to the review date. The Contractor shall keep minutes at the reviews and issue those minutes for review and approval by the Engineer prior to publication (CDRL N1511). The minutes shall include a running tabulation of all past and present action items assigned during the reviews and the disposition of each action item.

N15.3.14. AUDITS

The Contractor shall conduct periodic audits to assure that the manuals accurately reflect equipment design and the reliability and maintainability analyses upon which they are based. The results of these audits shall be presented at the in-process reviews (CDRL N1512).

N15.3.15. MANUALS REVIEW AND APPROVAL

All manuals shall be reviewed by the appropriate Contractor engineering personnel, manuals department head and/or the person responsible for manuals on this Contract, and program management personnel for accuracy and completeness before submittal to the Engineer. In addition, each document submitted to the Engineer shall include a sign-off sheet that includes the signatures (and date of signing) of all persons who conducted the review attesting to the accuracy and completeness of the submitted manuals (CDRL N1506).

N15.4. TRAINING

N15.4.1. GENERAL

The Contractor shall fully and completely train MDT personnel so as to enable MDT personnel to satisfactorily operate, service, troubleshoot, maintain, and overhaul at a level of competence that will ensure that work performed is in accordance with the procedures identified in the operator and maintenance manuals.

Training shall be based upon the material contained in the maintenance manuals identified in this section and shall consist of a combination of classroom instruction and hands-on training. Training of MDT personnel

shall emphasize troubleshooting techniques and the use of built in diagnostics and special test equipment when applicable for troubleshooting purposes.

Training shall commence upon delivery of the first Pilot Vehicles. All training shall be conducted in English, and all instructors shall be subject matter experts and have good command of the technical English language used in the transit industry.

A primary objective of the program shall be to train MDT's personnel to provide similar training subsequent to the Contractor's involvement. The training shall be designed to be delivered by an instructor in the classroom and, when appropriate, in the field or shop when actual equipment is used.

The Contractor's program shall include formal instruction, mock-ups, models, manuals, diagrams, and parts catalogs as applicable. All materials used in the programs, such as models, manuals, mock-ups, video cassettes, CDs, and drawings, shall be of durable construction and shall become the property of MDT.

Training materials shall be updated, as required, during the course of instruction and shall be provided on CD using software compatible with MDT's. The Contractor shall not assume that MDT personnel have knowledge of the features of the supplied equipment. However, the Contractor may assume that maintenance personnel have the basic skills pertinent to their crafts.

The Contractor shall provide a separate full-time, on-site training manager/coordinator to insure continuity of classes and proper distribution of training materials and to be responsible for coordinating instructors and training sessions. This person shall have no other duties or responsibilities other than on-site management of the training program.

N15.4.2. ORGANIZATION

Training shall be organized into the following courses:

a. Running Maintenance & Basic Vehicle Diagnostics
   (1) System Introduction.
   (2) Inspection and Servicing.
   (3) Theory, Troubleshooting, and Repair.

b. Heavy Maintenance (Train the Trainer).

(1) System Introduction.

(2) Inspection and Servicing.

(3) Theory, Troubleshooting, and Repair.

c. Vehicle Operation/Troubleshooting/Recovery.

d. Electronics Equipment Shop Repair.

e. Communications.

f. Factory Training.

g. Vehicle Familiarization for Rail Traffic Controllers.

Where applicable, the maintenance training shall be organized by system and the Contractor shall determine, where required, the exact distribution of the training hours identified in N15-1 on a system by system basis (e.g., the number of running maintenance training hours on the propulsion system).

In addition, the Contractor shall provide 10 days of factory training for up to 14 MDT personnel. This training shall consist of classroom and hands-on training. Factory training shall describe basic system operation, demonstrate all operating procedures, and shall demonstrate the use of all built-in diagnostics and special test equipment. Factory training shall be conducted twice for up to 7 personnel each time and shall be scheduled at a time mutually agreeable to the Contractor and MDT.

N15.4.3. TRAINING PROGRAM PLAN

The Contractor shall submit a training program plan to the Engineer for review and approval (CDRL N1513). At a minimum, the plan shall include:

a. A narrative description of all planned training for MDT personnel.

b. A training schedule developed in accordance with the requirements of Exhibit N15-1 or as recommended by the Contractor and agreed to by the Engineer. It shall include all the information required to facilitate planning and delivery of the training program, including factory training.

c. The Contractor's approach to training MDT instructors who will deliver training to MDT personnel subsequent to the Contractor's involvement. It shall describe the Contractor's approach, resources, hours required, and any training aids that might be included.

d. A description of the training experience of the department that will be chiefly responsible for preparing and implementing the training programs. The description shall include qualifications and resumes of the training personnel who will be delivering the training.

e. An objective testing/evaluation system to report on the progress of each trainee during training. The results of this system shall be kept confidential and furnished only to personnel designated by the Engineer.

N15.4.4. USE OF SUPPLIERS

If the Contractor utilizes a Supplier to develop or deliver training, all requirements of this Contract shall remain in effect and continue to be the sole responsibility of the Contractor. In addition, the Contractor shall manage the efforts of the Supplier and participate in any and all meetings and reviews related to training.

N15.4.5. TRAINING STYLE GUIDE

The Contractor shall submit to the Engineer for review and approval a style guide, including an electronic version, and format for the instructor guides and student guides required under this Contract (CDRL N1514). The Contractor shall use the style guide to develop all required training materials. All of the Contractor's major Suppliers shall use the same style guide for the development of their training materials to be used on this Contract.

N15.4.6. TRAINING OUTLINES

The Contractor shall submit to the Engineer for review and approval outlines of all planned training for MDT personnel, including factory training (CDRL N1515). The outlines for each training course shall include:

a. Performance objectives, the conditions under which performance will occur, and the measures and standards to be applied.

b. The sequence of learning activities.

c. An outline of the content.

d. The percentage of classroom versus hands-on training to be delivered.

e. Learning strategies to be used (e.g., classroom presentation, hands-on practice, and paper and pencil exercises).

f. Methods and criteria for evaluating the performance of trainees.

g. Resources required, such as equipment, shop space, and CDs.

h. The duration of each training course.

N15.4.7. MDT-FURNISHED RESOURCES

MDT will support the training program as follows:

a. Provide classroom space for lectures and practical training on equipment. The locations and class times shall be arranged at the convenience of MDT.

b. Provide or allow the use of actual equipment or spare parts furnished under this Contract for use as training aids in lieu of mock-ups. These training aids may be used for practical exercises in adjustment, testing, disassembly, and assembly of equipment. Any parts used during training must be submitted to the Engineer for acceptance inspection prior to returning to stock.

c. Provide shop space for instructional purposes upon prior written notification. The Contractor is responsible to schedule all instructional activities using MDT space according to its needs.

d. Provide married pairs and consists for instructional purposes outside normal service needs upon proper written notice from the Contractor and scheduling by MDT.

e. Arrange for track allocation for operations, including the provision of power, dispatching services, and operation supervisors.

All of the aforementioned are to be provided and scheduled at MDT's convenience.

N15.4.8. TRAINING MATERIALS

Prior to any training, all training materials shall be submitted to the Engineer for review and approval 90 days prior to the start of any training course (CDRL N1516). The CDRL shall include materials to support each course in the training program, including instructor guides, student guides, training aids, presentations, and operator and maintenance manuals. The Contractor shall provide each student with their own personal guides and copies of maintenance and/or operator manuals. All manuals shall be clearly marked "For Training Purposes Only." Additionally, the Contractor shall provide an electronic version on CD that is compatible with MDT equipment and software.

The instructor guides and student guides shall:

- Be easy to reproduce.
- Have loose-leaf binding.
- Be printed in black ink.
- Be printed double-sided on 8.5 x 11 inch white paper.

- Be printed on 11 x 17 inch paper for drawings and schematics.
- Be clearly identified for each unit of training.

All presentations such as PowerPoint presentations etc. used during training shall be supplied in their original format in addition to a CD copy.

N15.4.8.1. INSTRUCTOR GUIDES

The Contractor shall provide an instruction guide for each training course. The guides shall include the following:

a. Course agendas.

b. Course objectives.

c. Procedures for managing training sessions.

d. Resources and facilities required.

e. Guidelines for preparing for training.

f. Detailed lesson plans, including scripted or outlined presentations and discussion guides.

g. Training and job aids.

h. Criteria and methodology for measuring performance in the classroom and in the shop or field.

i. Instructions for using all audiovisual support, mock-ups, and scale models.

j. Detailed instructions for managing any on-the-job training.

N15.4.8.2. STUDENT GUIDES

The Contractor shall provide, for each course, student guides for each student that shall include a course syllabus, course objectives, a schedule of sessions, PowerPoint presentations, lecture outlines, lesson summaries, and any other information that will facilitate information retention and the training process. The guides must be suitable for reproduction and bound in a fashion approved by the Engineer.

N15.4.8.3. TRAINING AIDS

The Contractor shall provide to the Engineer for review and approval training aids, such as mock-ups, scale models, electronic presentations, videotaped demonstrations, special and diagnostic testing equipment, and any special tools required, 90 days prior to the start of training (CDRL N1517). Spare parts may be used during the training sessions as described in this section.

The Contractor shall provide enlarged copies of all panels in the vehicle cab for operator training.

N15.4.9. IN-PROCESS REVIEWS

The Contractor shall conduct in-process reviews of the training and all aspects of the training development process during this Contract. When possible, the training reviews should be held in conjunction with the manual in-process reviews. The first review shall be conducted within 156 days after NTP and shall continue to be held until commencement of training. Subsequent review dates shall be coordinated with the Engineer, but in no case shall they be held less than quarterly or once every 90 days. In-process reviews shall become more frequent as training approaches. During these reviews, the Contractor shall:

a. Present the status of the training program versus the Contract requirements, including action items status from previous reviews.

b. Present all completed training material or portions thereof for Engineer review, including action items status from previous reviews.

c. Present any issues related to the development of the training program to be addressed by the Engineer.

d. Make available for interview those persons who are part of the training program at the Engineer's request.

These reviews may be conducted at the same time and location as the maintenance manual reviews. If they are not, the location shall be determined by the Engineer. An agenda and materials to be presented during the review shall be submitted to the Engineer prior to the review date. The Contractor shall keep minutes at the reviews and issue minutes for review and approval by the Engineer prior to publication (CDRL N1518). The minutes shall include a running tabulation of all past and present action items assigned during the reviews and the disposition of each action item.

N15.4.10. CAB TRAINING SIMULATOR

The Contractor shall provide a full scale Engineer approved cab simulator. The simulator shall represent the real objects and functions of the vehicle and the effect of driving the train under normal and degraded modes, in an environment schematically representative of the Miami-Dade System and service conditions.

Training Tasks that shall developed with the cab simulator that include:

- Driver familiarization with Operator's Cab Console and Hostler Panel.
- Getting to know the train and its systems (for crew and maintainers).
- Driving under normal, ATC and degraded modes.
- Driver Reaction to fault injection and obstacles.
- Correct and clear communication with passengers and traffic management.

The full scale cab simulator shall be capable of emulating the following conditions:

- Train dynamics for proper stopping and acceleration distances (e.g., for station stops);
- Train subsystems, mainly:
  - ATP systems and speed supervision system through ATC.
  - Dead man device.
  - Train Management as far as needed for basic train operations.
  - Door system.
  - Communications: Public Address system, Intercom System, Radio.
  - Brake system.

The system shall be static and is not expected to emulate the movement of the vehicle.

An Instructor Station shall be installed close to the Student Station. The Instructor's Station shall allow at least the following functions:

- Preparation and loading of training scenarios.
- Start, stop and freeze of training session.
- Complete monitoring of all the train systems and Cab instruments.
- Malfunctions injection.
- Synthetic entities control (other trains, signaling devices, obstacles).

The cab simulator shall allow at a minimum simulation of the following conditions:

- HRV start-up, "pre-op" and shut down.

- HRV coupling and uncoupling.
- Operation in manual and automatic.
- Control of destination signs.
- ATP control and supervision.
- Operation of radio and PA.
- Operation of doors and steps.
- Simulation of diagnostic analysis.

The cab replicated environment shall replicate the driver's console as specified in TPN 5 and shall include all the main commands and switches; accordingly it shall be equipped as follows:

- One adjustable seat, preferably the same used on the operator cab (as defined in TPN 5.5).
- The most important cab controls installed in the same configuration of the proposed operator's consoles, interfaced with the simulator I/O-system.
- The other relevant cab controls or indicators as well as the two TODs will be mounted or graphically emulated on two touch-screens.
- The master controller, interfaced with the simulator I/O-system.
- The radio and communication system will be installed on the desk and interfaced with the simulator I/O-system.
- A single channel LCD screen (17" minimum size) providing the forward view and replicating the Operator's Field of View (FOV) of a representative simulated environment through Computed-Generated Imagery (CGI).

The simulation computer will manage the simulation and compute the train model as well as the CGI. It will be installed under the desk or other approved locations in a dedicated cabinet.

The CGI shall be connected to the real time simulation environment designed around the Instructor Station, and fully integrated in a way that each object in the visual database, such as a signal or ATC beacon, generates a real time representation in the Instructor's console which generates the signal logic and its interaction with the simulated train and

the correspondent control object on the Instructor's console man machine interface. In addition to the objects included in the database, the Instructor shall have the possibility to add in a scenario or in real time additional objects, such as temporary signaling, signs, obstacles etc. in the simulation.

The system shall allow to generate images on all the modeled tracks in both directions.

The headlights of the train, when on, are used as an additional light source used to compute the lighting of the scene. Headlights of other trains shall be represented with a white or red saturated color. Signs and signals plates reflect the light of the train's headlight.

The full scale cab simulator shall be equipped with a sound system that shall include a stereophonic reproduction of sounds (at least 2 loudspeakers) to provide a realistic simulation of the audio environment (left/right sound localization).

The sound system will be driven from the simulation computer with a sufficient response time of the overall system to ensure a perfect synchronism between any trainee or train action and its sound counterpart.

The detailed list of cab controls and devices installed on the cab simulator, and the list of emulated situations, events and sounds will be submitted to the Engineer for review and approval (CDRL N1543).

N15.5. EVENT RECORDER

N15.5.1. GENERAL

An onboard event recording system shall be provided. The Contractor shall supply one event recorder per IEEE 1482.1 for each Married Pair. Event recorder failure or failure to capture one car data or both cars data will generate and send and alarm.

The event recorder and VMS data logger (TPN20) can be an integrated system. All design aspects of the event recorder, including all required cabling, connections, wiring, and mounting details shall be submitted to the Engineer for review and approval (CDRL N1519).

The Contractor shall provide any software licensing that may be required for the operation of the event recorder. Software shall be provided to MDT on CD discs in a format approved by the Engineer.

N15.5.2. MONITORING REQUIREMENTS

The Contractor shall provide for Engineer's review and approval a proposed list of signals and parameters to be monitored and recorded by the event recorder (CDRL N1520).

The event recorders (or event recorders/VMS data loggers if integrated into one unit) in the consist shall automatically be activated when any cab in the consist is keyed into active status. The event recorders (or event recorders/VMS data loggers) shall automatically turn off when the console switch is deactivated.

The event recorders shall perform start-up and background self-tests and provide a pass/fail output to an indicator on the operator's control panel.

The event recorder shall maintain a record of the monitored signals and parameters in its internal memory. The memory shall be non-volatile to ensure that the contents shall be preserved during battery/LVPS failure. The memory shall be sufficient enough to store a record of signals for at least 72 hours before being overwritten.

The event recorder shall monitor and record the married pair operator's actions, the train control system commands, the resulting trainline states, and the married pair responses. All parameters shall be sampled as per IEEE 1482.1. Additional parameters will be sampled for the use of the VMS and need not be sampled per the IEEE 1482.1 requirements, but instead per the approval of the Engineer.

Any required input channels for the event recorder shall meet the requirements of IEEE 1482.1. Identification of the signals to be monitored shall be determined during the design review process installation.

The Contractor shall ensure that the event recorder is mounted in accordance with the Manufacturer's recommendations and complies with all applicable codes, laws, guidelines, and regulations.

All required wiring, including power wiring, for the event recorder shall reduce the possibility of signal interference between the sensors and the event recorder inputs.

The event recorder shall operate from a dedicated circuit breaker and be powered directly from the LVPS.

N15.6. SPECIAL TEST EQUIPMENT

The Contractor shall supply Special Test Equipment (STE) as follows:

- Portable Test Units (Qty = 25).
- Diagnostic Test Equipment (Qty = 10).
- Shop Test Equipment.
  - Electro-Mechanical Bench Tester (Qty = 2).
  - Printed Circuit Board / Cradle Bench Testers (Qty = 2).
  - Test Carts (Qty = 2).

Combining the functionality of the Electro-Mechanical Bench and Printed Circuit Board/Cradle Bench Testers into a single tester (Qty = 2) is also acceptable.

All Special Test Equipment shall be software-driven and PC-based, unless specifically approved otherwise by the Engineer. All design elements of all Special Test Equipment are subject to review and approval by the Engineer.

The Contractor shall provide all equipment specified in this section for in-service testing of cars. The Contractor shall perform all alterations to the test equipment required for car design modifications.

The capabilities of the onboard fault annunciation system, PTUs, Diagnostic Test Equipment, and Shop Test Equipment shall be integrated to form a cohesive maintenance system. Onboard fault annunciations shall be used in conjunction with PTUs, as required, to identify system, subsystem, or component failure. Shop test equipment shall aid in identifying failed components and shall be used to quickly verify that repaired equipment is ready for service.

Each piece of Special Test Equipment shall be accompanied by:

a. Complete diagrams, schematics, and maintenance and calibration instructions for the device itself.

b. Complete maintenance, calibration, and troubleshooting procedures for the associated carborne system and its circuit boards written around the use of the test device.

c. Software and hardware listings, with flow diagrams, in sufficient detail to enable MDT to modify and expand the diagnostic system.

All of these documents shall be supplied as part of and in accordance with the required manuals.

The Contractor shall submit a Special Test Equipment Plan for the Engineer's review and approval (CDRL N1521). The plan shall list and describe in detail all special and diagnostic test equipment required to run an effective and coherent maintenance program.

N15.6.1. PORTABLE TEST UNIT

The Contractor shall supply Portable Test Units (PTU) which shall enable one person, working alone, to identify failures down to the LRU level at a minimum. All design elements of all PTUs are subject to the Engineer's approval. All PTUs shall be suitable for use in the field as well as in MDT's shop facilities. PTUs shall be constructed of durable materials weighing less than 15 lbs and be completely housed in sturdy, Engineer-approved carrying cases.

The Contractor shall coordinate the efforts of Suppliers to minimize the PC software needed to meet the requirements of the Contract Document. The Contractor shall also ensure that the procedures for all subsystem tests are as similar as possible without sacrificing accuracy or detail.

The Contractor shall provide a single network PTU connection in the cab area whereby all subsystems can be accessed. In addition, each subsystem shall have a PTU connector at the equipment location. The PTU interface shall be RJ45 (Ethernet). Only one type of cable shall be required to connect the PTUs to any and all subsystems.

N15.6.2. PTU HARDWARE CONFIGURATION

The PTU shall be a ruggedized laptop computer controlled by a state-of-the-art microprocessor available at the time of delivery to MDT. The Contractor shall, at a minimum, configure the laptop with the following peripherals:

- CD Writer + RW/CDRW combo drive.
- 14 inch TFT color screen.
- Integrated Fax modem.
- Internal extended life battery.

- 80 Gigabyte or larger hard disk.
- 2 Gigabyte or larger internal RAM.
- 2 Megabyte or larger cache memory.
- Integrated sound, video, and 100/1000 base network card.
- IEEE 802.11 (all commercially available standards) compatible.
- Two USB 2.0 ports.
- IEEE 1394A (Firewire).
- PC Card type II slot.
- Intel Dual Core, 2 GHZ processor.
- Integrated Bluetooth.

With each PTU, the Contractor shall supply a carrying case and one cable assembly (15 ft. minimum) to connect the PTU from its test location to the test port at the subsystem level. An Ethernet PTU connection in the Operator's Cab shall be a single point allowing communication with all subsystems on the vehicle. Connection between the PTU and each subsystem at the equipment location shall be made via a cable, using one standard connector on each end, or wireless connection. All software shall be compatible. All installed software shall be provided on CD-ROM for back-up.

N15.6.3. PTU SOFTWARE CONFIGURATION

All PTUs shall have the following software configuration:

- Engineer approved version of Microsoft Windows operating system at the time of implementation and NTFS formatted hard drive.
- Engineer approved version of MS Office Professional at the time of implementation.
- Applications software operating within the Windows operating system environment.
- Open Database Connectivity (ODBC) compliant database for storage and display of fault data. The database shall provide data analysis and report tools.
- ODBC compliant database for storage, display, and graphing of trace data.

- ODBC compliant database for storage and display of operating parameters.

N15.6.4. PTU DISPLAYS

The Contractor shall provide display screens that contain the following:

- User selectable subsystem real time data.
- Software revision level of the subsystem monitored.
- Data dictionary access.
- Date and time displayed in Eastern Standard Time.
- Fault logger screen display.
- Menu screen display.
- Data logger screen display.
- Self-test screen display.
- Health monitor.

Each screen shall have the capability to use additional levels of subsidiary screens that may present extensive information as well as additional subsidiary screen choices. If several screens are used to display levels of primary and subsidiary data, the screens shall be arranged in a sequential hierarchy that shows the most important and general data first and then allows the user to move to subsidiary data from this point. If subsidiary screens of this sort are used, it shall be possible to return to the menu screen with one command.

The Contractor shall provide PTUs that will perform diagnostics for all of the following subsystems, at a minimum:

- Doors.
- HVAC.
- Auxiliary power.
- Propulsion.
- Friction brake.
- ATC.
- Communications.
- VMS.

Individual Technical Provision sections describing these systems may include further details relating to specific PTU requirements. In addition, each PTU shall:

a. Perform subsystem troubleshooting, calibrations, maintenance, and self-test procedures without requiring removal or disconnection of any component, printed circuit board, backplanes, terminals, or cable.

b. Produce the operating commands required to fully exercise functions and components of the particular subsystem that is being tested.

c. Display graphically measured data logger signals.

d. Enable the user to fully check and calibrate any subsystem that is being tested.

e. Have the capacity to monitor vehicle subsystems while the vehicle is in operation, without interfering with the operation of the vehicle.

N15.6.4.1. PTU SUBMITTALS

The Contractor shall submit PTU software characteristics for the doors, HVAC, auxiliary power, propulsion, friction brake, VMS, ATC, and communications subsystems to the Engineer for review and approval, as defined but not limited to, the following: CDRL N1522, N1523, N1524, N1525, N1526, N1527, N1528. All PTUs shall have installed the required software to monitor, service, or troubleshoot any and all of the subsystems.

- Screen display layout and menus.
- Samples of all screen layouts.
- Operation, maintenance, and training manuals.
- Any additional data, reports, drawings, or other information requested by the Engineer.

N15.6.5. DIAGNOSTIC TEST EQUIPMENT

Diagnostic Test Equipment (DTE) shall be provided for any on-board equipment testing beyond the capability of the portable test units. Ten sets of diagnostic test equipment shall be provided as required. The Contractor shall provide a listing of all diagnostic test equipment and associated design details to the Engineer for approval (CDRL N1529). All installed software shall be provided on CD-ROM for back-up.

N15.6.6. SHOP TEST EQUIPMENT

N15.6.6.1. GENERAL

The Contractor shall supply the following floor and bench test units for all subsystems, for testing, troubleshooting, and calibrating electric and electronic, mechanical, pneumatic, and electro-mechanical components of vehicle subsystems in accordance with the Engineer-approved maintenance procedures. The units shall:

a. Be designed for use in MDT's repair shop and test lab.

b. Facilitate rapid testing, troubleshooting, and calibration of electronic circuit boards, plug-in relays, sensors, transducers, control values, trainlines via the coupler, and similar type items used in carborne subsystems.

c. Have the capability to accommodate the internal connection of meters, oscilloscopes, signal generators, and other response indicators to simplify and expedite required work.

d. Be designed such that input signals or supplies, such as compressed air, can be varied over the full working and testing range of the unit.

e. Perform tests and calibrations to ensure that car equipment is acceptable for revenue service.

f. Be accurate enough to ensure readiness of any car for revenue service without need for further calibration.

g. Be self-contained and shall not require the use of any external test equipment or supplies (other than shop power, 120VAC, and compressed air).

h. Meet the calibration standards required for the equipment being tested and adjusted, at a minimum.

i. Have any meters, oscilloscopes, power supplies, or other similar measuring devices be rack-mounted and built into the test set.

j. Have tests performed either by program control or manual manipulation of dials, levers, buttons, or other appropriate controls.

Special test racks/bench testers shall be supplied to provide a means to test vehicle equipment that cannot be tested by any other supplied test equipment. All installed software shall be provided on CD-ROM for back-up.

N15.6.6.2. ELECTRO-MECHANICAL BENCH TESTER

The test benches shall be provided to test the electrical, mechanical, and pneumatic components and subassemblies of the vehicle as described

herein. Details of this equipment shall be submitted to the Engineer for review and approval (CDRL N1530).

N15.6.6.3. PRINTED CIRCUIT BOARD/CRADLE BENCH TESTERS

Two sets of bench test equipment capable of testing all printed circuit boards (singularly or as a cradle assembly) used in the married pairs shall be provided along with testing documentation allowing MDT to troubleshoot printed circuit boards down to a group of functionally related components. The testers shall be totally self-contained and shall include all test equipment manuals for maintenance of the tester. Detailed descriptions of these testers shall be submitted to the Engineer for review and approval (CDRL N1531).

N15.6.6.4. TEST CARTS

The Contractor shall supply MDT with two test carts to be used for troubleshooting the vehicle in the shop environment. Each cart shall contain at least the following equipment:

a. A PC programmed with PTU software.

b. A digital storage oscilloscope with the following minimum attributes:

   (1) Bandwidth: 400 MHz.

   (2) Input impedance selections: 1 MΩ in parallel with 15 pF or 50Ω.

   (3) Acquisition modes: Peak detect, envelope, and averaging.

   (4) Advanced waveform functions, such as FFT.

c. A printer for hard copy of test results.

d. A complete set of test interfaces, electrical and pneumatic, required for testing all functions and systems on a vehicle.

e. Storage compartments, including lockable doors with keys.

f. All equipment needed to determine the failed LRU.

All details of the test carts shall be submitted to the Engineer for review and approval (CDRL N1532).

N15.7. SPECIAL TOOLS

The Contractor shall supply quantities in accordance with TPN1.5 of all special tools required for maintaining the vehicle or its subsystems. Special tools provided to MDT shall be new. Special tools are defined as those tools that are not commercially available from at least three sources

in the United States. Lists of special tools to be supplied shall be included with each design review data submittal. The lists shall be grouped by subsystem and shall include:

- A description of the tool and facility requirements.
- Quantities commensurate with tool use.
- Any special requirements.
- Correlation with maintenance manuals.
- Calibration requirements and procedures.

The Contractor shall submit to the Engineer for review and approval a complete list of special tooling to be supplied (CDRL N1533).

N15.8. SPARE PARTS

Pursuant to the Contract Documents, the Contractor shall supply to MDT spare parts worth $18,000,000, including 16 fully assembled trucks and 4 sets of truck frames, 24 AC traction motors (with couplers) and 24 gear units. Each spare part shall be interchangeable with its corresponding part. All spare parts shall be configured to the latest revision during the performance of the Work and the warranty periods.

During the warranty period the Contactor may utilize MDT's spares. All spares used by the Contractor shall be replaced with new, unused spares by the Contractor.

N15.8.1. CONTRACTOR'S RECOMMENDATIONS

The Contractor shall submit the list of recommended spare parts to be supplied under this Contract to the Engineer for review and approval. The list shall contain the prices of all recommended spares. The list shall be supplied in both paper and electronic format (CDRL N1534). It shall be linked to and compatible with the Electronic System Assurance Support System identified in TPN18.

In identifying spare part requirements, the Contractor shall consider shelf life and parts that are highly reliable in service and that may not have a long shelf life. Spare part recommendations shall include the following:

a. Grouping by subsystem, test equipment, and special tooling for stocking identification.

b. Generic name, trade name, description, rating, accuracy, Contractor's part number, Manufacturer's name, Manufacturer's part number, drawing references, and correlation with the maintenance manuals.

c. Recommended quantities correlated with reliability requirements and lead time on the basis of the following classifications:

(1) Wear – Parts that may be expected to require regular replacement under normal maintenance schedules, such as mechanical parts subject to continuous operation (e.g., transducers, valves, contacts, and sensors).

(2) Consumables – Parts with an expected life of less than five years, such as incandescent lamps.

(3) One Shot – Parts that normally require replacement after performing their function one time, such as fuses.

(4) Long Lead – Parts with long lead times or may cease to be readily available from distributors or the Manufacturer, such as specially made components.

(5) Exchange Assemblies – Assemblies that will be exchanged with failed units on the supplied equipment and that must be inventoried as complete assemblies. This may include some printed circuit board assemblies and other plug in modules.

d. A cross-reference and indexing system for replacement components common to more than one subsystem (whether vehicle, DTE, or special tool). Such components shall have only one part number.

e. Alternate sources of supply for all commercially available spare parts.

f. Current prices and supporting documentation, which may include but not be limited to purchase records, for all spare parts.

N15.8.2. PROVISIONING CONFERENCE

The Contractor shall meet with the Engineer at the Final Design Review to determine the types and quantities of spare parts required to support revenue operations of the vehicles. The Contractor shall utilize the results of this conference to formulate the final spare parts list for the Engineer's review and approval (CDRL N1535).

N15.8.3. FUTURE AVAILABILITY

For 10 years after the completion of all warranty periods, the Contractor shall annually notify MDT of at least one alternative source of supply for all vehicle components that Suppliers have stopped manufacturing. If an alternative source of supply cannot be located, the Contractor shall

provide MDT with sufficiently detailed information that would allow MDT to have these parts specially manufactured, including any drawings, design and material information, and proprietary documentation.

N15.9. BAR CODING REQUIREMENTS

The Contractor shall bar code all serialized components. The bar coding scheme shall be consistent and compatible with MDT's Enterprise Asset Management System. Symbology shall be compliant with Code 128.

A database of all bar-coded equipment shall be furnished to MDT with delivery of the first married pair on a CD, utilizing a format/application approved by the Engineer (CDRL N1536). The database shall be updated and submitted with the delivery of each succeeding married pair. The database file format shall be Oracle, SQL, XML or ODBC compliant. This database shall allow cross-referencing based on the following:

a. Next higher assembly (when applicable).

b. Associated part number and Manufacturer.

c. Number of the vehicles upon which it was originally mounted.

N15.10. DRAWING REQUIREMENTS

N15.10.1. GENERAL

This section describes the format and organization of drawings that the Contractor shall submit to the Engineer. Whenever a discrepancy or potential difference of interpretation occurs between requirements of this section and requirements of another section, the Engineer will resolve that discrepancy at its own discretion. All drawings shall be in English. All drawings shall be done in an Engineer-approved format in the latest version of AutoCAD and shall be supplied to MDT in paper and electronic format. However, the Contractor may propose for Engineer approval an alternate approach to development of the Contract drawings. In such an event the Contractor must provide for approval a detailed description of the processes and procedures to be followed by the Contractor. Further, if the Contractor proposes to submit drawings for approval in an electronic format the Contactor shall provide five (5) sets of the software that would allow MDT to review and approve the drawings. In the event an alternate approach is approved all drawings shall still be provided in electronic and paper format in accordance with TPN15.10.4.

Regardless of the software used to develop the drawings the Contractor shall provide the final electronic version of all drawings in an Engineer-approved ".dwg" AutoCAD format. All electronic versions of all drawings supplied by the Contractor shall possess all of the necessary characteristics, properties, and formatting to allow MDT to maintain the drawings using AutoCAD software.

Note: All drawings shall contain the following label, "These documents may contain Miami-Dade Transit security sensitive information. Such information should not be publicly disclosed without the expressed written consent of Miami-Dade Transit under Florida Statute 119.071(1) and FDOT Rule 14-55.0013(8)".

N15.10.1.1. ELECTRONIC DRAFTING SUPPORT SYSTEM

The Contractor shall supply an Engineer-approved electronic drafting support system to MDT (CDRL N1537). The system shall include the following:

a. Hardware – This shall include an Engineer-approved micro-tower workstation, complete with a state-of-the-art processor at the time of delivery and:

(1) 21 inch flat screen LCD color monitor.

(2) CD/DVD Writer + RW drive.

(3) 200-Gigabyte or larger hard disk.

(4) 1024-Megabyte or larger internal RAM.

(5) 256-Kilobyte or larger cache memory.

(6) Integrated 100/1000 base network card.

(7) IEEE 802.11 (all commercially available standards) compatible.

(8) Keyboard.

(9) Video card.

(10) Sound card.

(11) Speakers.

(12) Modem.

(13) Mouse.

(14) Two USB 2.0 ports.

(15) One parallel port.

(16) Laser-Jet printer with networking capability that is capable of printing on 11 x 17 inch paper.

(17) Pen plotter that is capable of producing output on 34 x 44 inch paper.

b. Software – This shall include the latest versions of Microsoft Windows, Microsoft Office (professional edition), the latest version of AutoCAD, virus scan, and other software that may be required to maintain the drawings and perform drafting functions. All software shall be compatible. All installed software shall be provided on CD-ROM for back-up.

c. Warranty – See GP5.

N15.10.1.2. REQUIRED DRAWINGS

The Contractor shall submit drawings 30 days prior to the PDR, IDR, and FDR as part of the submittal requirements for each design review (CDRL N1538). The drawings that the Contractor shall submit include, but are not limited to, the following:

- Equipment outline drawings.
- Equipment layout and assembly drawings.
- System and Subsystem level schematics and block diagrams.
- Vehicle level schematics, including Interface control drawings (IDR & FDR only).
- Vehicle level schematic narrative (IDR & FDR only).
- Integrated wiring diagrams (FDR only).
- Electrical, electronic, pneumatic, and hydraulic system drawings.
- Drawing trees (to an Engineer-approved subassembly level).
- Paint specifications, graphics, decals, and labels drawings.
- Vehicle Wire List as a stand alone document package.

N15.10.1.3. DRAWING DIMENSIONS

The Contractor's drawings shall, when appropriate, be drawn to scale (e.g., not on schematics). All relevant dimensions shall be written on the drawing in numbers and letters and in the appropriate place (i.e., next to that which the written dimension describes). Each drawing shall include a descriptive Bill of Materials (BOM) and a blank column for entry of MDT stock numbers. Drawings shall be large enough to be easily read. Drawing sizes shall conform to the following specifications:

- A Size Drawing: 8.5 inches x 11 inches.

- B Size Drawing: 11 inches x 17 inches.
- C Size Drawing: 17 inches x 22 inches.
- D Size Drawing: 22 inches x 34 inches.
- E Size Drawing: 34 inches x 44 inches.

Specification for the Manufacturer's technical data shall be presented on drawings that can be reduced to 8.5 x 11 in. format on which all writing shall remain legible. The following standards shall apply:

- ANSI Y1.1 - Abbreviations for Use on Drawings and Text.
- IEEE 91-1984 - Graphic Symbols for Logic Diagrams.
- ANSI/IEEE 315A - Supplement to Graphic Symbols for Electrical and Electronics Diagrams.

The Subcontractors shall submit drawings for all parts supplied to the Contractor. Assembly, subassembly, and arrangement drawings shall include a complete BOM and parts list describing all items, including Subcontractor's parts, and all equipment and specialty details that form part of the assembly. All drawings and BOMs shall be provided to MDT on CD and shall be compatible with the electronic drafting support system identified in this section (CDRL N1539).

N15.10.1.4. INTEGRATED WIRING DIAGRAMS

Integrated wiring diagrams shall be submitted as a separate manual. Each drawing shall indicate all wire numbers and zone locations. Integrated wiring diagrams shall include the following items:

a. Piping and Instrumentation Diagram (P&ID) of pneumatic piping for a complete vehicle.

b. Trainline wiring diagrams with connector and wire designations.

c. Pin-to-pin connector terminal designations and wire designations at both sides of each connection for connectors and terminal blocks.

d. Power distribution diagrams for primary, auxiliary, and low-voltage power.

e. Wiring diagrams for each subsystem. These diagrams shall be compatible with the schematics and P&ID.

f. Printed circuit board connections and pin-outs for each subsystem.

g. Point-to-point signal data for troubleshooting.

N15.10.1.5. ELECTRICAL DRAWINGS AND SCHEMATICS

Electrical drawings and schematics shall be submitted as a separate manual. So that connections between electrical schematic drawings may be easily understood, each electrical schematic drawing shall indicate references to:

a. All other drawings of manufactured items and electrical schematics to which connections are made.

b. Nominal voltages, currents, and frequencies.

c. Significant resistance values.

d. Ratings of all loads.

Devices shall be labeled on the drawing in agreement with the identification appearing on the actual device.

The Contractor shall provide the Engineer with schematics for all active or critical carborne electronic apparatuses, including printed circuit boards. A functional description or users' guide to the apparatus shall accompany these schematics.

Drawings that refer to a Contractor's (or Subcontractor's) part or specification number shall also provide the commercial equivalent. If there is no commercial equivalent, then the Contractor shall provide a copy of the specification to the Engineer along with the drawing submitted. The specification shall be sufficiently detailed to enable MDT to contract manufacture of the part.

N15.10.1.6. INTEGRATED VEHICLE LEVEL SCHEMATICS AND NARRATIVE (IVLSN)

N15.10.1.6.1. General

The Contractor shall generate and submit an Engineer-approved Integrated Vehicle Level Schematics and Narrative detailing the whole electrical, electronic, and pneumatic systems, and including all components, wiring, and piping from the vehicles. The Integrated Vehicle Level Schematics and Narrative shall be clear and comprehensive in essence providing very ample and detailed data. The MDT shop electronics technicians, electricians, and pneumatic brake specialists shall use the IVLSN to troubleshoot and repair a problem down to a line replaceable unit (LRU).

N15.10.1.6.2. **Integrated Vehicle Level Schematics (IVLS)**

Integrated Vehicle Level Schematics shall be submitted as a separate manual. The drawing package shall be created as B-size (11" x 17") with a font size large enough to be easily read when reduced to A-size (8-½" x 11"). The IVLS package can be a single or multiple drawing packages with document management as described herein. The Integrated Vehicle Level Schematics shall contain the information necessary for a vehicle technician to be able to troubleshoot a problem down to an LRU. As a minimum, the vehicle level schematics shall contain an introductory section that contains instructions and supporting information to read the subsection schematics. As a minimum the introductory section shall contain the following:

- Title page.
- Subsection index.
- Revision page.
- Block diagrams of above and below floor equipment showing equipment name and acronym.
- Single line diagrams indicating interconnection with other equipment.
- Connectors and connector ID's to be shown.
- Device table.
- Equipment arrangement drawing.
- Acronym and a cross-reference table providing acronym, equipment name and location by zone.
- Device symbols table.
- Electric coupler pin arrangement drawing with table identifying the pin number and its corresponding trainline name and the vehicle to coupler connector pin number.

The remainder of the Integrated Vehicle Level Schematics shall be grouped into subsections. The subsections shall be divided as much as possible around the major systems. Examples of subsections desired are:

- Annunciators.
- Battery and Low Voltage Distribution.

- Control (signal trainlines controlled by manual and/or brake and propulsion logic).
- Brakes.
- HVAC.
- Propulsion.
- Auxiliary Power.
- Doors.
- Lighting.
- Communications.
- Event Recorder.
- CCTV.
- VMS.
- ATC, ATO.
- Miscellaneous.

The first sheet of each subsection shall include a plan view of the vehicle showing the location of the equipment included in the subsection. Each subsection shall include a legend for equipment and device acronyms and names of equipment within the subsection. After the title and legend pages schematics involving trainlines shall be the first priority of order followed by controls and interlocking, and I/O signals to LRUs are the lowest priority. In general, electronic LRUs shall be shown as empty boxes with the LRU schematic drawing number shown. To the extent possible, where I/O of an LRU can be represented as a relay contact or relay coil it shall be done to facilitate the tracing of signals through the LRU equipment.

All subsection sheets shall have an identifiable grid or zone system that allows easy referencing from one subsection page to another. All signals that leave a page or come from another page shall show the destination or origination page. Other detailed information on each page shall include:

- Relay and contactor contact location information shown at the bottom of the page that the relay or contactor coil is shown on.

- Relay or contactor contacts shall indicate the grid or zone location of the relay or contactor coil.
- All meaningful circuit components shall include fuses ratings, resistance, capacitance, inductance, transformer ratio and winding resistance, pneumatic pressures that would help to enhance the understanding of the electrical, electronic, or pneumatic system circuits shall all be provided in the Integrated Vehicle Level Schematics.
- As a general rule, the power source of a circuit shall be shown from the originating circuit breaker, and will flow from top to bottom of the page and be shown in the upper left corner of the schematic page. The return for low voltage DC circuits and single phase AC circuit shall be at the bottom and exit at the lower right corner of the page.
- The complete wire name and segment code will be shown for each wire.
- All segments of a wire shall be shown complete with terminal board and connector terminations, with terminal board and terminal identification and with connector and pin identification.
- Where possible, when vehicle wiring transitions to a panel through either a connector or terminal board that panel shall be indicated by a dashed line. The acronym of that panel shall be indicated. A single dashed line box shall surround items from the same panel and on the same page wherever possible.

N15.10.1.6.3. **Integrated Schematic Narrative**

The Contractor shall prepare and deliver for review to the Engineer a detailed, comprehensive, point-to-point, written narrative description covering the entire operation of the propulsion, braking, and all electrical, electronic, and pneumatic vehicle control systems included within the Integrated Vehicle Level Schematics. These descriptions shall follow the IVLS sequentially.

The Integrated Vehicle Level Schematic Narrative shall be found in a separate volume from the Integrated Vehicle Level Schematics; however, it shall be numerically linked to the IVLS on a page-by-page basis. The narrative being linked to the IVLS shall allow technicians, who are troubleshooting the Vehicle, to locate detailed and helpful explanation on any of the vehicle circuit systems.

All aspects of the electrical circuits and pneumatic diagrams depicted on any given page of the integrated schematic shall be covered in the narrative explanation. The narrative text shall use signal flow as a basis for the explanation. The function of all inputs shall be discussed, including their origins (referenced to page and zone in the IVLS), functions, and range of values, as well as their nominal values. Signal conditioning shall be thoroughly discussed. The narrative shall furnish detailed explanation for each time the signal is changed from AC to DC. The function of all outputs shall also be discussed. Output signals and drivers shall be given the same thorough treatment as input signals, including their destinations (referenced to page and zone in the IVLS), functions, and range of values as well as nominal values. Other significant circuit components to include waveforms, voltages, and currents shall also be provided with descriptive information in the narrative.

The Integrated Vehicle Level Schematic Narrative shall furnish adequate information related to microprocessor controllers. This information shall allow a technician to establish and comprehend the relationship between processor system inputs and outputs. The technician shall be able to identify processor system inputs on the actual equipment, and determine (via the integrated schematic) if the correct output signals are being generated by the processor system. This information shall also be structured, clear, and understandable to a technician not familiar with specific processor languages or techniques. Format and content of the processor schematic information shall be reviewed as part of the design development process.

The Integrated Schematic Narrative text shall be essentially tutorial; however, its sole and main purpose shall be to provide detailed and comprehensive explanation on the normal operation of the circuit in question without addressing any potential abnormalities, their causes or effects. The Integrated Schematic Narrative shall be configured physically in the same manner as the Integrated Schematic.

It shall not be necessary to provide narrative information corresponding to the Device Tables or the Integrated Wiring Diagrams.

N15.10.1.6.4. **Integrated Vehicle Level Schematics And Narrative Submittals**

The Contractor shall submit the Integrated Vehicle Level Schematics and Narrative 30 days prior to the PDR, IDR, and FDR as part of the submittal requirements for each design review. Formal acceptance of these

submittals is not required on a periodic basis; however, these submittals shall represent the latest stage of development at the time they are furnished as specified herein. Integrated Vehicle Level Schematics and Narrative shall be submitted in accordance with TPN15.3.9 and revised in accordance with TPN15.3.10.

N15.10.1.6.5. **Integrated Vehicle Level Schematics And Narrative Binders And Quantities**

The final product of the Integrated Vehicle Level Schematics and Narrative shall be in Engineer-approved notebook binders of high quality, rugged, and durable as described herein. Quantities of the Integrated Vehicle Level Schematics and Narrative shall be submitted in accordance with TPN15.3.6.

N15.10.1.7. ANIMATED SCHEMATICS

The Contractor shall provide Engineer approved Animated Electrical and Pneumatic vehicle level schematics to be used as training aids during the training courses and maintenance activities.

In order to facilitate the use of the design documentation for troubleshooting purposes the schematics shall be developed on schematic wiring diagram and pneumatic schematics, utilizing power point support or equivalent software, and shall provide an animated representation of the most important system functionalities using the design documentation and visualizing:

- Low or high line voltage, electrical component status and change of status.
- High and low pressures in pipes and/or pneumatic components.

The animated schematics shall include as a minimum the propulsion primary motor circuit, the friction brake pneumatic circuit, and signal paths for the automatic train control system ATP, ATO, and ATS subsystems.

The Animated Schematics will use the same page layout, graphic symbols, circuit notation, and terminology as the propulsion, friction brake, and ATC system schematic diagrams found in the maintenance manuals and make use of actual component photographs wherever applicable and useful.

N15.10.2. TECHNICAL DOCUMENTATION MANAGEMENT

N15.10.2.1. DRAWING RELEASE RECORDS

The Contractor's technical documentation shall accurately represent the configurations of all system equipment, tests, production processes, and operational uses related to work on these vehicles. Drawings shall represent all equipment in sufficient detail so that qualified personnel can analyze the feasibility of all designs.

The Contractor shall maintain release records that shall detail the relationships among drawings and shall allow MDT to accurately trace the history of revisions of any design. These release records shall identify engineering changes and retain the record of superseded versions. Drawings and release records shall only represent engineering design data and shall not represent manufacturing status.

The Contractor's release records and drawings (and any documentation required to accompany them) shall indicate the following:

- Composition of any part at any level in terms of the numbers of its constituent parts.
- A complete BOM for all assembled parts provided by Suppliers.

N15.10.2.2. ENGINEERING CHANGES

Any engineering changes proposed after a baseline design has been established shall require an Engineering Change Notice (ECN) and be controlled by the engineering change process. Approval of the final design by the Engineer shall constitute the baseline design of any system, subsystem, or component.

An engineering change to any part, assembly, or system shall be designated as a Class I change when the change must be made in order to meet any of the following requirements:

- Delivered product (retrofit).
- Electromagnetic interference characteristics.
- Form, fit, function, or interchangeability.
- Reliability or maintainability.
- Safety.
- Schedules or deliveries.

- Spares provisioning.

All other changes shall be designated as Class II changes.

All Class I ECPs, together with documentation and cost information, shall be submitted to the Engineer for review and approval prior to implementation (CDRL N1540). All class II ECPs shall be submitted to the Engineer for information. The Contractor shall maintain an Engineering Change Status Report that shall list all approved changes, their production incorporation status, and completion dates. Reports shall be submitted to the Engineer monthly. All approved changes shall be incorporated in all vehicles, unless otherwise approved by the Engineer.

N15.10.3. DRAWING REVIEWS AND LIST OF DRAWINGS

N15.10.3.1. REVIEW OF CONTRACTOR'S DRAWINGS AND DATA

Submittals requiring the Engineer's approval prior to implementation will be reviewed and classified by the Engineer as follows:

a. Approved – The Engineer concurs with the information in its submitted form. The material may be incorporated into the Work. An approval shall not be construed as:

   (1) Permitting any departure from the requirements of the Contract Documents.

   (2) Relieving the Contractor of the responsibility for any error, omissions, or negligence, including details, dimensions, materials, and calculations.

b. Not Approved – The Engineer does not concur with the submitted details. The Contractor shall not incorporate the material into the Work. The Engineer's objections must be reconciled and revised material must be resubmitted for review.

All technical data, test schedules, test results, progress schedules and reports, drawings, samples, and other data submitted by the Contractor shall be addressed in accordance with the Contract and shall require the Engineer's review and approval.

The Engineer will review and approve the Contractor's drawings and data for general detail and arrangement. The Contractor shall remain responsible for the conformity of its drawings and data to the requirements of the Contract Documents.

Except as provided below, the Engineer will return drawings "Approved," or with the exceptions noted. If more than one drawing is submitted at a time, the drawings shall be listed in the transmittal according to numerical drawing sequence.

Drawings shall be submitted in an orderly and logical sequence to enable the Engineer to readily determine and review the interfaces between all major structural elements and their subassemblies and also between the structural elements and any attached equipment, wiring, piping, or hardware. The Contractor shall provide review copies of drawings in the following quantities:

a. Five sets of original printed drawings.

b. Five sets of all files on CD.

N15.10.3.2. CONTRACTOR'S DRAWING LIST

The Contractor shall submit a list of drawings and diagrams for Engineer review and approval (CDRL N1541). A copy of this list shall be maintained by the Contractor and updated as required. Drawings in the list shall be identified by drawing numbers, titles, dates of preparation, dates of submission, and review and approval status (i.e., having passed or failed preliminary or final review). An updated version of this drawing list shall be submitted to the Engineer monthly.

The Contractor shall submit all drawings with a title block in the lower right hand corner. The title block shall include the drawing number, drawing title, date, revision number, scale, Contract number, weights of components (when appropriate), and be signed by the Engineer appointed by the Contractor to be responsible for that drawing. Drawings shall be submitted in separate packages for each discrete subject. Each package shall have an itemized transmittal letter. The drawing package shall be complete and shall include all interface and complementary drawings, including those used for lower order assemblies, unless these drawings have already been approved and are still current.

N15.10.4. FINAL DRAWING SUBMITTALS

Upon issuance of the Certificate of Acceptance of Final Inspection for the last married pair, the Contractor shall supply all drawings for review and approval in the following formats:

a. Five sets of original printed drawings.

b. Five sets of all drawings in Engineer-approved ".dwg" AutoCAD format on CD.

Final drawing submittals shall include:

a. All as-built Contractor's, Subcontractors', and Suppliers' drawing lists, drawings, details, bills of material, and catalog cuts that are required by MDT for future installation, maintenance, and repair purposes.

b. All as-built assemblies, subassemblies, and arrangements of the vehicle, including as-built integrated vehicle level schematics and narrative.

c. All items that are special-purpose or fabricated by the Contractor.

d. All materials furnished by the Contractor or by the Suppliers, down to and including the module and circuit board level. Outline drawings alone shall not be acceptable.

The Contractor shall provide MDT with a complete list, in both paper and electronic format, of all drawings and files supplied (CDRL N1542).

When processing drawings, the Contractor shall include an MDT title block in addition to the Contractor's title block. The drawings shall not include any references to proprietary rights, except for specialty items.

EXHIBIT N15-1

TRAINING PROGRAM BREAKDOWN

	Courses	Est. No. of Trainees	Course Size	No. of Courses	Hours/ Course	Hours/ Session	Sessions/ Course	Total Training Hours
A.	Running Maintenance Mechanical Basic Vehicle Diagnostic	46	10-12	4	240	4	60	960
A1.	Running Maintenance Electronics Basic Vehicle Diagnostic	55	10-12	5	400	4	100	2000
B.	Heavy Maintenance (Train the Trainer)	4	10-12	1	480	4	120	480
C.	Vehicle Operation/ Troubleshooting/ Recovery	25	5-6	5	80	4	20	400
D.	Electronics Equipment Shop Repair	22	10-12	2	80	4	20	160
E.	Communications	22	10-12	2	40	4	10	80
F.	Factory Training (Two Sessions)	10	7	2	80	8	10	160
G.	Vehicle Familiarization for Rail Traffic Controllers	5	10-12	1	16	4	4	16
								4,256

EXHIBIT N15-1

TRAINING PROGRAM BREAKDOWN (CONTINUED)

Persons to be Trained	Estimated Number of Trainees	Courses
Rail Vehicle Mechanics	30	A
Rail Vehicle Electronic Technicians/ATP Technicians	48	A1
Transit Electronic Technicians/Lab and Supervisors	15	D
Engineers	3	A, A1, D, E
Systems Maintenance Technicians	20	E
Vehicle Maintenance Supervisors and Chiefs	9	A, A1
Transit Instructor – Maintenance	4	A, A1, B, D, E
Transit Instructor – Operations	3	C, G
Train Operators	10	C
Rail Transportation Supervisors and Chiefs	12	C
Central Control Rail Traffic Controllers	5	G
Personnel who will attend Factory Training (are to be identified)	10	F
Total	169	

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TABLE OF CONTENTS

N16. MANAGEMENT PROGRAM 16-1
N16.1. GENERAL 16-1
N16.1.1. CITED REFERENCES 16-1
N16.1.2. SUBMITTALS – CDRLS 16-1
N16.2. CONTRACT MANAGEMENT 16-2
N16.2.1. MANAGEMENT PLAN 16-2
N16.2.2. PROJECT SCHEDULE 16-4
N16.2.3. PROGRESS REVIEWS AND REPORTS 16-5
N16.2.4. PAYMENT MILESTONES 16-5
N16.3. PRE-COMMENCEMENT CONFERENCE AND PROJECT STATUS MEETINGS 16-6
N16.4. DESIGN AND CONFIGURATION CONTROL 16-7
N16.4.1. INDUSTRY STANDARDS 16-7
N16.4.2. DESIGN REVIEWS 16-8
N16.4.3. DESIGN BASELINE 16-12
N16.4.4. PRODUCTION BASELINE 16-13
N16.4.5. CONFIGURATION CONTROL DOCUMENTATION 16-13
N16.5. WEIGHT CONTROL PROGRAM 16-13
N16.6. STRENGTH PROGRAM 16-14
N16.7. CAR HISTORY BOOKS 16-14
N16.8. HEAVY RAIL VEHICLE DELIVERY 16-16
N16.9. ACCEPTANCE AND WARRANTY 16-16
N16.9.1. GENERAL 16-16
N16.9.2. ACCEPTANCE REQUIREMENTS 16-16
N16.9.3. WARRANTY DATABASE REQUIREMENTS 16-16
N16.10. DECOMMISSIONING PLAN 16-17
N16.11. PILOT CAR PERSONNEL TRANSITION PLAN (PCPTP) 16-17

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N16. MANAGEMENT PROGRAM

N16.1. GENERAL

This section defines the requirements for the management program that shall plan, schedule, review, control, and report on the Work.

N16.1.1. CITED REFERENCES

Source/Section	Title
49 CFR, Part 38	Americans with Disability Act (ADA) Accessibility Specification for Transportation Vehicles
IEEE 1016	Recommended Practice for Software Design Descriptions

N16.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TPN Reference
N1601	Management Plan	TPN16.2.1.
N1602	Manufacturing Plan	TPN16.2.1.
N1603	Project Schedule and Monthly Updates	TPN16.2.2.
N1604	Monthly Progress Reports	TPN16.2.3.
N1605	Payment Milestones	TPN16.2.4.
N1606	Monthly Progress Status Updates	TPN16.2.4.1.
N1607	Sample Materials and Paint Chips	TPN16.4.1.
N1608	Preliminary Design Review Agenda and Data	TPN16.4.2.1.
N1609	Final Preliminary Design Review Report	TPN16.4.2.1.
N1610	Intermediate Design Review Agenda and Data	TPN16.4.2.2.
N1611	Final Intermediate Design Review Report	TPN16.4.2.2.
N1612	Final Design Review Agenda and Data	TPN16.4.2.3.

CDRL No.	Title	TPN Reference
N1613	Final Design Review Reports	TPN16.4.2.3.
N1614	Final FDR Results Report	TPN16.4.2.3.
N1615	Operator's Cab Mock-Up Review Report	TPN16.4.2.4.
N1616	Underfloor Mock-Up Review Report	TPN16.4.2.5.
N1617	Design Baseline Submittal	TPN16.4.3.
N1618	Modified Baseline Designs	TPN16.4.3.
N1619	Weight Control Program Plan	TPN16.5.
N1620	Weight Control Program Results	TPN16.5.
N1621	Strength Program Plan	TPN16.6.
N1622	Strength Program Results	TPN16.6.
N1623	Car History Books	TPN16.7.
N1624	Proposed Car History Book Format	TPN16.7.
N1625	Computer Database of Components Mounted on each Vehicle at the Time of Delivery	TPN16.9.3.
N1626	Decommissioning Plan	TPN16.10.
N1627	Pilot Car Personnel Transition Plan (PCPTP)	TPN16.11

N16.2. CONTRACT MANAGEMENT

The Contractor shall propose a project manager, lead engineer or engineering manager, and a field site manager to the Engineer for approval. The Contractor's management structure shall enable the project manager to manage the Work effectively. Communication shall primarily be between the project manager and the Engineer. All communication, written and verbal, and all documentation for the Contract shall be in English (U.S. terminology). All weights, dimensions, and measurements shall be stated in English units. Metric units may be identified in parentheses.

The approved project manager shall be the primary contact between the Contractor and the Engineer.

N16.2.1. MANAGEMENT PLAN

The Contractor shall submit a Management Plan to the Engineer for review and approval (CDRL N1601). The plan shall outline in explicit detail the organization, controls, planning, and schedules of the Work and shall be consistent with the Contractor's Quality Assurance Plan as

defined in TPN18. The Management Plan shall include the following specific information, including references to other plans as indicated:

a. An organizational chart, including identification of managers for significant departments.

b. A methodology for controlling the Project Schedule, including warranty requirements.

c. Contractor's Accident Prevention and Crisis Management Plan.

d. Highlights of the Project Schedule defined in this section and submitted as CDRL N1603.

e. A flow chart of the Work task schedule that depicts the integration of the Vehicle design and Subcontractors' tasks.

f. A schedule for the items of design and manufacture that require the Engineer's review and approval.

g. A Configuration Management Plan for all hardware, drawings and submittals including a method of control for any subsequent changes or revisions.

h. A systems integration plan defining the method of control.

i. A subcontract management plan, which identifies all proposed Subcontractors and Suppliers whose subcontract, agreement, or purchase order with the Contractor has a value in excess of $1,000,000. The plan shall identify the standards and criteria used to ensure Contract compliance by all Subcontractors and Suppliers, including Subcontractor organization charts and Management Plans.
Except as provided in GP8, a Subcontractor or Supplier identified in the subcontract Management Plan for a portion of the Work shall be the same entity or person identified as the proposed prime Subcontractor or Supplier for said portion of the Work upon which the Contract is awarded.

j. A bar code plan indicating methods to be utilized to meet the requirements of TPN15.

k. A serialization plan, by subsystem, indicating the items to be serialized, the location of serial number tags, and the method of revision control. The Contractor shall provide the serial numbers by subsystem to MDT on a CD and hard copy in an agreed format.

l. A shipping plan to indicate the carriers by name, the insurance carriers, the methods of shipment, the duration of each transit, quantities being shipped, and arrival dates at MDT facilities.

m. Highlights of the Quality Assurance Plan required in TPN18 and the Software Quality Assurance Plan required in TPN22.

n. Highlights of the Manufacturing Plan, which shall be submitted separately for Engineer approval (CDRL N1602). The Manufacturing Plan shall be compatible with the test and inspection plans required in TPN17 and shall define the production process and procedures to be followed, separately The Manufacturing Plan may be in a workflow block diagram format, showing all significant operations, including hold and inspection points. The Manufacturing Plan shall, at a minimum, contain the following:

(1) Designated hold and inspection points for the production process specific to this procurement.

(2) Methods to assure that all personnel in all aspects and all stages of design, procurement, manufacturing, fabrication, quality assurance, and testing are qualified.

(3) Requirements, including certifications, for personnel who will perform special processes, such as non-destructive testing (NDT) and welding.

(4) Corrective action procedures to prevent recurrences of nonconforming conditions or events.

(5) Instructions and procedures for control and revision of work and for timely release to the production floor of the latest released revision of the Work instructions, drawings, and procedures.

o. A Compliance Matrix to demonstrate that all Contract requirements have been satisfied in accordance with the Contract Documents. The matrix shall consist of a listing of all Contract requirements, a reference to the location of the requirement (e.g., GPxx, TPxx, etc.), the method of verification (e.g., plan, analysis, test, drawing, etc.), and the satisfying document (e.g., CDRL, Report, Letter, etc.)

N16.2.2. PROJECT SCHEDULE

The Contractor shall submit for Engineer approval a Project Schedule that is compliant with the requirements of GP8, the Technical Provisions, the Management Plan, and all other Contract Documents (CDRL N1603). The Project Schedule shall specifically and expressly incorporate each and all of the applicable, interim milestones set forth in GP8. It shall show key design, manufacturing, testing, training, and delivery milestones, including all CDRLs. It shall highlight significant Project events and shall include any and all payment milestones.

The Project Schedule shall include a Critical Path Method (CPM) analysis presented in Primavera. The CPM analysis shall include a network diagram. Additional requirements of the CPM submittal are defined in GP8 of the Contract Documents.

The Project Schedule shall be submitted for approval on a monthly basis.

N16.2.3. PROGRESS REVIEWS AND REPORTS

A kick-off meeting shall be held in conjunction the pre-commencement conference, identified in TPN16.4, within 21 days after NTP. Thereafter, progress review meetings shall be held on a monthly basis. The reviews shall be held as mutually agreed at either the Contractor's or MDT's facilities, or at a facility duly authorized and designated by MDT.

Commencing 30 days after the initial progress review meeting, the Contractor shall supply monthly progress reports to the Engineer for review and approval. These reports compare the actual with the planned progress, conforming to the requirements of GP8 and this section (CDRL N1604). This information shall be provided both verbally and in graphic forms, reporting the progress of scheduled activities, major procurements, subcontracts, submittals, design releases and reviews, Engineer-reviewed items, and other activities that may potentially impact the approved schedule. Problem areas with solutions and/or work around schemes and plans for the forthcoming period shall also be included.

Special reports may be requested by the Engineer. Topical reviews may be held to address problem areas.

N16.2.4. PAYMENT MILESTONES

The Contractor shall submit to the Engineer for review and approval a listing and schedule of all payment milestones (CDRL N1605).

N16.2.4.1. MONTHLY PROGRESS STATUS UPDATES

On a monthly basis, the Contractor shall submit for review and approval a monthly progress report (CDRL N1606), which shall include the following information.

a. An Executive Summary.

b. Schedule highlights including:

   (1) Activities started during the reporting period.

   (2) Activities completed during the reporting period.

   (3) Activities to be started during the next reporting period.

   (4) Activities to be completed during the next reporting period.

   (5) Schedule deviations and slippage.

c. A narrative overview covering, at a minimum:

   (1) A description of the progress for all scheduled activities and deliverables during the report period.

   (2) Estimated percent completion of all scheduled activities and deliverables in process.

   (3) Major problems, resolution, and status.

d. Delays and technical problems that incurred during the report period and an explanation of the delays/problems, including a description of delaying/problem factors, their impact, and the corrective actions taken or proposed to mitigate those delays/problems.

e. Project Action Items.

f. Correspondence Log during the reporting period.

g. CDRL Status Report.

h. Buy America Report.

i. Updates to the Life Cycle Cost Analysis required by RFP654, Appendix Q.

j. Progress Photographs.

k. Contract documents revision log as part of the revision tracking system defined in TPN18.2.4.4.

N16.3. PRE-COMMENCEMENT CONFERENCE AND PROJECT STATUS MEETINGS

A pre-commencement conference or kick-off meeting shall take place no later than 21 days after NTP at a location selected by the Engineer to accomplish the following:

a. Introduce MDT's and the Engineer's personnel to the Contractor's management team.

b. Establish formal channels of communication, procedures for correspondence and numbering meetings, numbering submittal copies of various documents, and general method of review.

c. Review the Contractor's Project control methodology and plans for initial activities.

d. Confirm the Contractor's management team and the scope of Subcontractors' tasks.

e. Confirm that the Contractor is familiar with MDT's intended operations and maintenance environment.

f. Provide early identification of the information and decisions required from MDT.

g. Provide orientation to MDT's personnel regarding the Contractor's engineering drawing and document format, numbering system, and method of revision.

h. Establish and confirm a date to hold the first and subsequent Design Reviews.

i. Establish a schedule for subsequent Project Status Meetings.

Subsequent Project Status Meetings will be held to review the status of the project or to address major issues. These meetings will be held at mutually agreed-upon times and locations. An agenda will be mutually prepared in advance of the meetings.

The Contractor will record minutes of all meeting proceedings as required in GP8.

N16.4. DESIGN AND CONFIGURATION CONTROL

N16.4.1. INDUSTRY STANDARDS

Industry-accepted design principles shall be employed throughout the design and manufacturing processes. These principles shall be applied in all areas, including:

- Design and Engineering.
- Manufacturing.
- Reliability, maintainability, and safety.
- Human factors, e.g., man-machine interfaces.
- Passenger comfort.
- Use of materials.
- Color schemes.
- Graphics.

Aspects of the Vehicle that relate to industrial design shall be reviewed during the design review meetings. Topical reviews to address key issues shall be held as needed.

Sample materials and paint chips shall be submitted to the Engineer for review and approval during the design process. The Contractor shall submit color renderings of the interior and exterior arrangement for review and approval (CDRL N1607).

Design calculations, layouts, and other documentation summarizing the engineering considerations given to human factors, such as passenger and Operator comfort, shall be submitted during the design reviews. The documentation shall include the following:

a. A description of the major assumptions made concerning human capabilities and limitations, including data ensuring that Operator performance and passenger considerations have been addressed.

b. The results of the Operator's cab mock-up layouts and simulation programs made to determine the requirements for design.

N16.4.2. DESIGN REVIEWS

Three distinct types of design reviews shall be conducted to evaluate the progress and technical adequacy of the system and subsystem designs and compliance with the performance requirements of the Contract Documents. These are the Preliminary Design Review (PDR), Intermediate Design Review (IDR), and the Final Design Review (FDR).

Prior to each review, a list of data and current revisions shall be submitted to the Engineer for review and approval that includes the drawings, technical data, analyses, CDRL items, and other items required for review. Approval status of each item shall be noted in order to formulate a working review meeting agenda.

In lieu of submitting paper drawings for the design reviews, the Contractor may elect to conduct 3-D solid modeling reviews. If the Contractor chooses to conduct 3-D reviews, the Contractor shall submit the drawing files to the Engineer for review and the software (in accordance with TPN15) required to view the files prior to the respective design reviews. The Contractor is still required to submit paper drawings for all First Article Inspections in accordance with TPN17. The Contractor shall submit a proposed meeting agenda to the Engineer for approval. The schedule of system and subsystem design reviews shall be included in the Project Schedule.

The Contractor will record minutes of each design review as set forth in GP8 and submit to the Engineer for review and approval prior to publication.

N16.4.2.1. PRELIMINARY DESIGN REVIEW

A formal Preliminary Design Review (PDR) shall be held for each subsystem and the Vehicle as a whole to evaluate the progress and adequacy of the proposed design approach and compliance with the Contract Documents' requirements. The PDR shall represent a conceptual review of the total design effort for each subsystem or Vehicle.

Information submitted for and addressed during the PDR shall include, but not be limited to, the following:

a. Underfloor layout.

b. Interior layout.

c. List of all interior components and materials requiring the Engineer's review and approval and not limited to only materials deemed combustible.

d. Functional descriptions of the Vehicle subsystems and major components.

e. Interface descriptions, including:

(1) Mounting arrangements and installation methods.

(2) Definition of all electrical connections with voltage, current, waveform, and impedance levels.

f. List of trainline and proposed coupler pin arrangements.

g. Heating and cooling load calculations for the HVAC system.

h. Engineering calculations, computer printouts, and other relevant data to verify that the propulsion and friction brake equipment meet the specified performance.

i. List of special tools for each subsystem.

j. Diagrams of man/machine interfaces in the Operator's Cab.

k. Roll center location and list of the following carbody roll motion limits, measured in degrees, in relation to the truck: vertical, lateral, longitudinal.

l. Suspension characteristics, including natural frequency and spring rate, of primary and secondary suspension.

m. Corrosion prevention program including all areas of concern requiring specific attention including possible areas of water entrapment, door threshold drainage, floor pans, and floor panel sealing of panels and between panels.

The Contractor is encouraged to submit as much PDR information as possible as it becomes available to the Contractor and as part of the Project Status Meetings. The Contractor shall submit PDR information in small, up-to-date installments so that most problems can be discussed and resolved in advance of the PDR meetings. The PDR shall be held at the Contractor's facility with attendance by Subcontractors as directed by the Engineer.

The Contractor shall submit a detailed agenda and data for each PDR to the Engineer for approval (CDRL N1608). The agenda should include a list of specific items to be discussed and a list of Subcontractors scheduled to attend. The Contractor shall also provide 10 copies of each drawing to the Engineer prior to the PDR; electronic copies may be submitted on a case by case basis when approved by the Engineer.

The Contractor shall submit a final report on the results of each PDR to the Engineer for review and approval (CDRL N1609). The Contractor may submit this report in sections, as work progresses. The final report shall consist of all latest revisions of any previous report sections.

N16.4.2.2. INTERMEDIATE DESIGN REVIEW

A formal Intermediate Design Review (IDR) shall be held for each subsystem and the Vehicle as a whole to evaluate the progress and adequacy of the selected design approach and compliance with

specification requirements. The IDR shall represent approximately 50 percent completion of the total design engineering effort for the subsystem or Vehicle.

Information submitted for and addressed during each IDR shall include the following items as applicable to each subsystem:

a. Latest revisions of the drawings and documentation submitted for the PDR.

b. Assembly drawings down to the component level. The Contractor shall propose the component level of each system and subsystem for the Engineer's approval.

c. Second level software documentation consisting of data flow diagrams written to the simplest level described in IEEE 1016. The tasks performed by the software shall be provided in module or elemental process descriptions, organized as coherent narratives. The second level of software documentation is one level above source code.

d. Load flow analyses, shut-down/start-up sequences, and details of any required load shedding for all electrical subsystems.

e. Electrical schematic drawings, down to the individual signal or wire level, for each electrical circuit.

f. Pneumatic schematics, or flow schematics for each fluid if applicable, showing control and check valves, test points, orifices, and other circuit details.

g. Brake failure mode analysis for the braking system.

h. Weight analysis for all subsystems.

i. Strength analysis for carbody, suspension, and structural components.

The Contractor shall submit a proposed, detailed agenda and data for each IDR to the Engineer for review and approval (CDRL N1610). The agenda should include a list of specific items to be discussed and a list of Subcontractors scheduled to attend. The Contractor shall also provide 10 copies of each drawing to the Engineer prior to the IDR; electronic copies may be submitted on a case by case basis when approved by the Engineer.

The Contractor shall submit to the Engineer for review and approval a report giving the results of each IDR, including any drawing, material, or other changes made at the IDR (CDRL N1611).

N16.4.2.3. FINAL DESIGN REVIEW

A formal Final Design Review (FDR) shall be conducted when the detailed design of a subsystem is complete and the production drawings

are ready for release. The FDR shall determine that the detailed design of the subsystem under review will satisfy the design requirements established in the Contract Documents and shall confirm the exact interface relationships between the subsystem and other items of equipment. The reviews shall be held at a location as selected by the Engineer.

The FDR of the Vehicle shall be conducted over the course of several FDRs, each specific to a system, subsystem, or major component. The Contractor shall submit a proposed agenda and data for the Engineer's review and approval (CDRL N1612). The Contractor shall also provide 10 copies of each drawing to the Engineer prior to the FDR; electronic copies may be submitted on a case by case basis when approved by the Engineer.

Information submitted for and addressed during each FDR shall include the following items as applicable to each subsystem:

a. Latest revisions of the drawings and documentation submitted for the IDR.

b. Assembly drawings down to the component level.

c. A final version of the second level software documentation.

d. Load flow analyses, shut-down/start-up sequences, and details of any required load shedding for all electrical subsystems.

e. Electrical schematic drawings, down to the individual signal or wire level, for each electrical circuit.

f. Pneumatic schematics or flow schematics for each fluid if applicable, showing control and check valves, test points, orifices, and other circuit details.

g. Final brake failure mode analysis for the braking system.

h. Weight analysis for all subsystems.

i. Strength analysis for carbody, suspension and structural components.

j. Vehicle arrangement drawings, color scheme, and graphics, including all 49 CFR ADA requirements.

k. Clearance diagrams that reflect all side or roof-mounted equipment, suspension limits, and wear.

l. Establish design baseline.

MDT, the Engineer, and their designated representatives shall have on-site access to drawings and other design and manufacturing information related to any part of the Work. This information shall include microprocessor source code and other proprietary technical data. On-site access shall be provided at the Contractor and Subcontractors' facilities.

The Contractor shall submit to the Engineer for review and approval a report giving the results of each FDR, including any drawing, material, or other changes made at the FDR (CDRL N1613).

The Contractor shall submit a final report on the results to the Engineer for review and approval (CDRL N1614). The Contractor may submit this report in sections, as work progresses. The final report shall consist of all latest revisions of any previous report sections.

N16.4.2.4. OPERATOR'S CAB & HOSTLER PANEL MOCK-UP REVIEW

The Contractor shall develop and provide to MDT full scale mock-ups of the Operator's cab and hostler panel to finalize the cab. When the mock-ups of the Operator's cab in the end cap and the hostler panel are complete, a formal review shall be held with representatives of the Contractor, the Engineer, and MDT. This review shall verify that the mock-ups meet the requirements of the Contract Documents and includes satisfactory engineering considerations given to human factors. These mock-ups will then be utilized by MDT for training purposes.

The Contractor shall submit the results of these reviews to the Engineer for review and approval of design, material, and layout (CDRL N1615).

N16.4.2.5. UNDERFLOOR MOCK-UP REVIEW

The Contractor shall develop and provide a full scale underfloor mockup. A formal review, at the Contractor's facility, of the underfloor working mockup shall be held with the Engineer, representatives of MDT, and the Contractor. This review shall verify whether component attachment methods, clearances, piping configuration, cabling configuration, and ease of access are compliant. The first Vehicle shall be used to finalize the underfloor configuration.

The Contractor shall submit the results of this review to the Engineer for review and approval. This mock-up will be used by MDT for training purposes (CDRL N1616).

N16.4.3. DESIGN BASELINE

The design baseline shall be established at the FDRs and shall serve as the premise for subsequent change control procedures. The design baseline configuration drawings, material specifications, and procedures shall be submitted to the Engineer for review and approval (CDRL N1617). The FDR submittals shall govern the execution of First Article Inspections (FAI) required in TPN17, production, and other baseline activities. Changes agreed to or presented at the FDR that affect the design characteristics shall be subject to documented configuration control and submitted to the Engineer for review and approval (CDRL N1618).

N16.4.4. PRODUCTION BASELINE

The production baseline shall be established at each FAI per TPN17 and again on a Vehicle level prior to shipping the Pre-Production married pairs. Production baseline configurations that have been changed in any way from the design baselines shall be submitted to the Engineer in the form of drawings, material specifications, and procedures. These submittals shall govern the execution of source or delivery (incoming) inspections, production, and other related activities. Changes after FAI shall be documented and submitted to the Engineer for review and approval and subsequent submittal to MDT for approval.

The FAI units, with the exception of the Vehicle, shall be retained at the FAI location to be used as a standard and only shipped as the last units.

N16.4.5. CONFIGURATION CONTROL DOCUMENTATION

The Contractor shall maintain accurate and current configuration documentation in accordance with the approved Configuration Management Plan. At a minimum, this documentation shall identify:

a. The composition of any part, component, subassembly, or assembly, at any level, and at any point of manufacture or test, in terms of subordinate and next higher parts numbers.

b. Approved engineering changes and records of superseded configurations.

N16.5. WEIGHT CONTROL PROGRAM

The Contractor shall prepare a weight control program to submit to the Engineer for review and approval (CDRL N1619). The program shall provide for the review and control of design efforts to ensure that the Vehicles comply with the weight and distribution requirements specified in TPN2. The Contractor shall communicate the program requirements to the Subcontractors.

At a minimum, the weight control program shall:

a. Set design weight goals for the major subsystems and components. All assembly drawings shall include estimated/actual weights to assure the Engineer that the weight will not increase beyond the present weight.

b. Provide monthly updates through the monthly reports throughout the design and production phases, including monthly reporting of revised weight estimates or actual achieved weight. A weight analysis shall be included as part of each design review.

c. Provide actual weight information no later than at the FAI for each major component or system.

d. Provide actual Vehicle weight prior to delivery of the first married pair.

e. Provide actual weight distribution prior to delivery of the first married pair.

A final report providing the information in the listed points (a) through (e) shall be submitted to the Engineer for review and approval (CDRL N1620).

N16.6. STRENGTH PROGRAM

The Contractor shall establish and maintain a comprehensive Vehicle strength program. The proposed program plan shall be submitted to Engineer for review and approval (CDRL N1621). The program shall provide for the review and control of structural design efforts and for the dissemination of relevant information within the Contractor's organization and to Subcontractors. The program shall ensure that the Vehicles comply with all strength requirements in the Contract Documents.

The Contractor shall, with the monthly report, submit design and test documentation that identifies the status of the Vehicle design effort with regard to strength, stiffness, and stress requirements. Reports shall include design loads and summaries of stress and deflection analyses. At a minimum, a strength analysis shall be included as part of each design review.

The Contractor shall submit the results of the Vehicle strength program to the Engineer for review and approval (CDRL N1622). This may be accomplished using several submittals as described previously, in which case, the Contractor shall specify on each submittal that it is a partial fulfillment of this CDRL requirement.

N16.7. CAR HISTORY BOOKS

At the time of delivery, a Car History Book (CHB) and CD shall be provided for each Vehicle for review and approval (CDRL N1623).

The Car History Book binding shall be approved by the Engineer. All binders shall be a D-ring, locking style with five to seven posts.

The Contractor shall be responsible for maintaining current, up to date, and complete CHBs for MDT.

The Contractor shall maintain CHBs until all warranty and reliability testing periods have been completed and all changes to the Vehicles are properly recorded. A CHB, provided in approved five post binders, and on a CD, shall accompany each Vehicle at the time of delivery.

Documentation and record changes made during the warranty and reliability testing periods by the Contractor, shall be immediately recorded for inclusion in the CHB as a normal part of the Work.

The Contractor shall submit to the Engineer for review and approval a proposed format and entire listing of all documents, certifications, and reports to be included in the CHB (CDRL N1624). The Contractor shall update the CHB until all designs, procedures, tests, and inspections have been defined and performed, the Vehicles have been accepted, and all warranty periods have been completed.

Each CHB shall contain, at a minimum, the following Vehicle-specific information and all sections shall be separated by labeled dividers:

a. Car number on the cover and in the binder.

b. Shipping documents.

c. An individual weight statement for each Vehicle.

d. Description of modifications implemented after FAI and implementation completion dates.

e. List of defects, including test and inspection items and the disposition of each along with MRB repairs, as required.

f. List of serially numbered apparatuses, including manufacturer's P/N, model number, and serial number.

g. Test results for each test performed on the complete Vehicle or on any major part or major subsystem thereof.

h. Wheel, journal bearing, and gearbox quill mounting records, including heat numbers, manufacturer name, and manufacturing dates for wheels, axles and journal bearings and results of inspections and tests.

i. Material certifications for components of the wheel set.

j. Configuration records, including the revision number and revision date of all assemblies/subassemblies and major components, including a list of deviations and unincorporated changes.

k. Certificates of Compliance for all air reservoirs.

l. Inspection records of all major components that have been checked by NDT methods, such as radiographic or magnetic particle.

m. Completed and signed inspection check sheets.

Upon delivery of the Vehicle the Contractor and MDT shall audit the CHB for completeness. The Contractor shall maintain a record of all findings. Upon completion of Acceptance Testing of each vehicle, its Car History Book shall again be audited by the Contractor and MDT. Previous audit findings shall be reviewed and the status of previous and new findings recorded and maintained by the Contractor.

After issuance of the Certificate of Acceptance of Final Inspection for the Vehicle by MDT the CHBs shall be maintained by the Contractor through the warranty period. The Contractor shall review the Car History Books and update any previously not closed audit items on a regular basis with MDT through the expiration of warranty. Upon completion of the warranty, the Contractor and MDT shall conduct a final audit and close all open items, whereupon the Car History Books shall be delivered to MDT.

N16.8. HEAVY RAIL VEHICLE DELIVERY

The Contractor shall deliver two Pre-Production married pairs to MDT for testing by the Contractor prior to the production of the balance of the order.

Specific requirements for Vehicle delivery are given in GP8.

N16.9. ACCEPTANCE AND WARRANTY

N16.9.1. GENERAL

Specific acceptance requirements for this Contract are detailed in GP8 and TPN17.

Specific warranty requirements for this Contract are detailed in GP5.

N16.9.2. ACCEPTANCE REQUIREMENTS

The Contractor shall perform all design, rework, and changes to the Pre-Production Married Pairs required as a result of the qualification and acceptance testing program.

The qualification and acceptance test results of the Pre-Production married pairs shall be delivered to the Engineer for review and approval in accordance with TPN17.

The acceptance test results for each subsequent Married Pair shall be delivered to the Engineer for review and approval in accordance with TPN17.

MDT will issue a Certificate of Acceptance of Final Inspection to the Contractor for each vehicle in accordance with TPN17.

N16.9.3. WARRANTY DATABASE REQUIREMENTS

The Contractor shall provide a computer database record containing detailed information on all serialized components mounted on each Vehicle at the time of delivery (CDRL N1625). This database is in addition to the Car History Book requirement of this section and shall be provided on standard CD/DVD for each Vehicle at the time of delivery. The

database shall be created using a file layout and format as approved by the Engineer.

N16.10. DECOMMISSIONING PLAN

The Contractor shall provide and submit for the Engineer's approval a Decommissioning Plan (CDRL N1626) for disposing of up to 132 existing Vehicles and all remaining spare parts. Decommissioning of vehicles will commence after delivery of a mutually agreed upon number of Married Pairs. Decommissioning of spare parts will commence in accordance with a mutually agreeable schedule. When delivered Married Pairs are accepted and ready for commissioning the Contractor will be required to decommission a number of Married Pairs equal to the number that is being commissioned by MDT. MDT will hold Married Pairs to be decommissioned for no more than 10 calendar days. The plan shall provide for removal of vehicles and spare parts from MDT property, transporting to the decommissioning site, and disposal as applicable in accordance with all Federal, State and Local government statutes and regulations. No decommissioning activities shall be performed on Miami-Dade County property except for the removal of Married Pairs. MDT will not provide any storage or decommissioning site or space for decommissioning the Married Pairs since providing such facilities or space will be the sole responsibility of the Contractor. The Contractor shall assume all responsibility and liability for decommissioning and disposal of the Vehicles and all remaining spare parts.

Note: The County assumes that the vehicles contain hazardous materials, including asbestos, which shall be disposed of by the Contractor in accordance with the requirements of GP7.5.

N16.11. PILOT CAR PERSONNEL TRANSITION PLAN (PCPTP)

The Contractor shall develop and submit a Pilot Car Personnel Transition Plan (PCPTP) (CDRL N1627) that describes at a minimum:

- The location where the Contractor will manufacture/assemble/test the Pilot Cars.
- The names, qualifications, and titles of key personnel from the Contractor's primary Engineering Design and Production Centers who will be relocated to the pilot car production/assembly facility during the production/assembly/test of the pilot cars.
- An organization chart and functional descriptions of key persons responsible for the manufacture/assembly of the pilot cars.
- How the Contractor will manage pilot car manufacturing and production car testing.

- What tests will be performed at the Contractor's pilot car manufacturing facility and which ones will be performed at MDT.
- The functional relationship between the Testing Area and the Quality Department.
- The process for qualification of subsystems before being mounted on the vehicle.
- The schedule for Pilot Car Personnel transition.

TABLE OF CONTENTS

N17. TESTING AND INSPECTION 17-1
N17.1. GENERAL 17-1
N17.1.1. CITED REFERENCES 17-2
N17.1.2. SUBMITTALS – CDRLS 17-2
N17.2. TEST PROGRAM 17-3
N17.2.1. GENERAL 17-3
N17.2.2. TEST FACILITIES 17-3
N17.2.3. NOTICE OF TESTING 17-3
N17.2.4. TESTING ON MDT PROPERTY 17-3
N17.2.5. ADDITIONAL TESTING 17-4
N17.2.6. TEST PLAN 17-4
N17.3. TEST PROCEDURES AND REPORTS 17-5
N17.3.1. TEST PROCEDURES 17-5
N17.3.2. TEST REPORT SUBMITTAL 17-7
N17.3.3. ADDITIONAL TEST REPORTS 17-7
N17.3.4. CORRECTIVE ACTION 17-7
N17.3.5. TESTING WAIVER FOR SERVICE-PROVEN EQUIPMENT 17-8
N17.4. QUALIFICATION TESTING 17-8
N17.4.1. GENERAL 17-8
N17.4.2. COMPONENT QUALIFICATION TESTING 17-9
N17.4.3. SUBSYSTEM QUALIFICATION TESTING 17-9
N17.4.4. VEHICLE QUALIFICATION TESTING 17-9
N17.4.5. SPECIFIC TESTS 17-10
N17.5. PRE-SHIPMENT AND POST-SHIPMENT TESTS 17-14
N17.5.1. PRE-SHIPMENT TESTS 17-14
N17.5.2. POST-SHIPMENT TESTS 17-14
N17.6. ACCEPTANCE TESTING 17-15
N17.6.1. PRODUCTION ACCEPTANCE TESTS 17-15
N17.6.2. VEHICLE ACCEPTANCE TESTS 17-17
N17.7. INSPECTION PROGRAM 17-18
N17.7.1. GENERAL 17-18
N17.7.2. INSPECTION PLAN 17-18
N17.7.3. INSPECTION PROCEDURES AND REPORTS 17-18

N17.7.4. INSPECTIONS 17-19
N17.7.5. INSPECTED COMPONENT DISPOSITION 17-20
N17.7.6. INCOMING INSPECTION 17-23

N17. TESTING AND INSPECTION

N17.1. GENERAL

This section defines the requirements for testing and inspection to be developed, managed, and implemented by the Contractor. All components, subsystems, and vehicles provided under this Contract shall be subject to all tests and shall meet all test requirements.

Testing shall ensure that each completed vehicle, as well as all components and subsystems, are provided in accordance with the requirements of the Contract Documents. A combination of qualification tests, production conformance tests, and acceptance tests shall be used to ensure the integrity of the design and manufacture of the vehicle, components, and subsystems.

To assure adequate environmental functionality of components, subsystems, and interfaces, a portion of the vehicle testing, as approved by the Engineer, shall be accomplished during the summer months from June through September.

Inspection shall ensure that all materials, subsystems, and components are manufactured and integrated into the vehicles according to the requirements of the Contract Documents.

The Engineer reserves the right to require that any component, subsystem, or vehicle test, or a portion thereof, not witnessed by the Engineer or a representative, be repeated in order to duplicate the test procedures record entries indicated in test procedure and/or test procedure summary sheets.

If, in the performance of any test on MDT's property, a fault, failure, or improper condition occurs, the Contractor shall immediately notify the Engineer. The decision to resume, correct the problem, or abort will be made by the Engineer.

All costs associated with testing and meeting the requirements of the Contract Documents shall be borne by the Contractor.

N17.1.1. CITED REFERENCES

Source/Section	Title
IEC 61133	Railway applications – Rolling Stock – Testing of rolling stock on completion of construction and before entry into service
IEC 61287-1	Power Converters Installed Onboard Rolling Stock – Part 1: Characteristics and Test Methods (formerly IEC 1287-1)
IEC 61377	Electric Traction – Rolling Stock – Combined Testing of Inverter Fed AC Motors and Their Control (formerly IEC 1377)
IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
ISO 2631-1	Evaluation of Human Exposure to Whole Body Vibration

N17.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No	Title	TPN Reference
N1701	Test Plan	TPN17.2.6.
N1702	Changes to the Test Plan	TPN17.2.6.
N1703	Test Procedure Summary Sheets	TPN17.3.1.
N1704	Test Report	TPN17.3.1.
N1705	Test Report	TPN17.3.2.
N1706	Inspection Plan	TPN17.3.4.
N1707	Inspection Procedures	TPN17.4.1.
N1708	Inspection Plan	TPN17.7.2.
N1709	Inspection Procedures	TPN17.7.3.
N1710	FAI Final Report	TPN17.7.3.

N17.2. TEST PROGRAM

N17.2.1. GENERAL

The Contractor shall plan, conduct, and maintain a test program in accordance with the requirements of an Engineer-approved Test Plan. Testing shall verify the conformance of components, assemblies, subassemblies, and subsystems to drawing, specification, and performance requirements.

The Test Plan shall be a top level document citing all testing and associated schedule parameters for the vehicle.

In general, all equipment, components, and systems shall be subject to Contract verification by testing. Personnel trained to properly perform tests shall conduct testing in accordance with Engineer-approved, written procedures using defined criteria.

N17.2.2. TEST FACILITIES

The Contractor and Suppliers shall provide personnel in appropriate technical disciplines to ensure an uninterrupted test program. When appropriate, tests shall be conducted on track or under simulated conditions. Electrical power sources shall have the characteristics specified in TPN2. The Contractor shall furnish equipment to be tested, all interfaces, special tools, test equipment, instrumentation, data processing, and spare parts required during testing. All testing costs shall be borne by the Contractor.

N17.2.3. NOTICE OF TESTING

The Contractor shall provide the Engineer at least 21 days written notice prior to the start of any test. No test shall be conducted until a procedure for said test is reviewed and approved by the Engineer.

N17.2.4. TESTING ON MDT PROPERTY

Subject to the Engineer's prior written approval, the Contractor may have access to MDT's test track to perform testing on vehicles. This testing may be supplemented, with the approval of MDT, on the MDT main line. Testing shall be performed per the Engineer-approved Test Plan and shall not interfere with MDT's revenue service activities.

N17.2.5. ADDITIONAL TESTING

In the event that a test is not passed or the results are not in accordance with the Contract, additional testing, may be required in order to diagnose and resolve issues. Additional tests, if required, will be requested prior to acceptance of a vehicle. The Contractor may be required to participate in, and supply technical assistance for such tests, including providing and installing instrumentation. If these additional tests are non-compliant with the Contract Documents, the Contractor shall then be responsible for all costs (including MDT's costs) associated with conducting any test that demonstrated said non-compliance. The Contractor shall be responsible for corrections and retests until compliance is demonstrated to the Engineer's satisfaction.

N17.2.6. TEST PLAN

The Contractor shall develop and submit a Test Plan to the Engineer for review and approval (CDRL N1701). This Test Plan shall ensure compliance with the provisions of this section and the Contract Documents. The plan shall provide details of how the requirements for each applicable section of these Technical provisions shall be met for each subsystem and component. If the Contractor intends to meet the requirements of this section through some means other than testing, each such instance shall be identified in the Test Plan.

The Test Plan shall be prepared in a manner reflecting the outline of these technical provisions, and include a detailed testing sequence that identifies and describes each test, identifies the specification requirements requiring verification, the order in which the tests are to be accomplished, the test equipment required, the facilities to be used, and the estimated duration of each test. The test sequence shall be provided in bar chart or precedence diagram format and shall be coordinated with the Project Schedule and Project control requirements specified in TPN16. The Test Plan shall be updated as necessary to reflect actual project test elements, schedules, and resources. Any changes to the Test Plan that affect delivery and/or Contract performance shall be resubmitted to the Engineer.

Approval by the Engineer of any or all of the Test Plan and Test Procedures shall not relieve the Contractor of responsibility for compliance with the Contract Documents.

N17.3. TEST PROCEDURES AND REPORTS

Following the completed test plan, test procedures and reports shall be submitted for review and approval.

N17.3.1. TEST PROCEDURES

The Contractor shall submit to the Engineer for review and approval procedures for each test described herein and for any tests proposed by the Contractor or Subcontractor to adhere to their own internal process requirements or by the Engineer. The Contractor shall submit all procedures to the Engineer for review and approval no less than 42 calendar days prior to the anticipated test notification date for the test that requires said procedures (CDRL N1702). Testing shall not proceed without the Engineer's approval and an approved test procedure.

The contents for all Contractor and Subcontractor test procedures shall be standardized and shall comply with the requirements herein. Test procedure submittals shall be listed initially in the Contractor's Test Plan as individual elements of CDRL N1702 (for example N1702.1, N1702.2, etc.).

Each test procedure shall be a separately controlled document and shall be identified by its own title, number, and revision level. All revisions shall be submitted to the Engineer for review and approval. All test procedure changes shall be submitted to the Engineer for review and approval prior to the implementation of the test procedure change.

A history of all test procedure revisions shall be contained within the test procedure. This history shall identify the revised sections and define the changes to those sections.

Procedures shall be written in an instructional manner. A qualified and experienced test technician shall conduct all testing.

The test procedure steps shall be denoted using a tiered numbering system comparable to this Specification. The tiers shall denote groups of steps necessary to accomplish the verification of each specification requirement for each component, subsystem, system, and the vehicle. The "heading one" tier of each Specification section shall state the requirement(s) that is being verified and shall reference the corresponding Specification section number.

All tools, instrumentation, and equipment required to conduct the test shall be listed at the beginning of the test procedure. Test equipment shall be identified by type, not model number, unless a specific Manufacturer and model number are required. If this is the case, the technical reasons for specifying the Manufacturer and/or model number shall be identified in a separate document that shall be submitted to the Engineer when the procedure is forwarded for review and approval. Test equipment and instrumentation shall be calibrated and carry a valid calibration certificate.

The front page of each procedure shall contain entry locations for the name, part number (with revision level as applicable), and serial number of the component to be tested, as well as the name and employer of the tester. The body of the procedure shall have data entry locations for each of the following items as is applicable to each step:

a. Initials of the test technician indicating that the step was completed.
b. Entry of measured parameter values, as required, determined during the test procedure and the range of acceptable values for these measured parameters.
c. A data entry location stating whether a measured value results in passing or failing based upon the range of values specified for the parameter.
d. Agreed upon pass/fail criteria for each "tier" of the test procedure.
e. Pass or fail entries for the top-level tiers that identify the specification requirement(s) being verified.

Test procedures or reports containing data entries for each test conducted on a component, subsystem, system, or vehicle shall be kept on file in the Contractor's office. Any documentation required to detail the test results, such as chart recordings or other testing instrumentation output, shall be kept on file. Copies of the completed test results and corresponding documentation shall be submitted to the Engineer with the test report CDRL (N1704).

These completed test procedures shall be made available to the Engineer at source inspection locations even if these locations are different from the testing location where the original documents are filed.

Each component, subsystem, system, or vehicle test procedure shall have a corresponding summary sheet(s) that lists, by test procedure tier number, all test steps that have pass/fail entry requirements. Summary sheets shall be submitted with the corresponding procedure to the Engineer for review and approval (CDRL N1703). The summary sheet for

each test procedure shall have the same identification number and revision level as its corresponding test procedure identification number, but with an "S" at the end. Summary sheets shall be completed based on the test results contained throughout the test procedure. Summary sheets shall be completed and signed by Contractor or Subcontractor quality assurance personnel who shall verify that all pass/fail entries reflect the test results and measured parameter values. Summary sheets shall also include provision for Engineer witness acknowledgement.

N17.3.2. TEST REPORT SUBMITTAL

Within 30 days of each individual test completion, a test report, including the completed test summary sheet for each test and test data, shall be submitted to the Engineer for review and approval (CDRL N1704). A copy of the test summary sheet for each tested component shall be attached to and shipped with the component. Test report submittals shall be listed initially in the Contractor's Test Plan as individual elements of CDRL N1704 (for example N1704.1, N1704.2, etc.).

The test reports shall be accompanied by a signed statement from the Contractor's quality assurance personnel indicating that information contained in the test summary sheets is accurate and demonstrates compliance with the specification requirements. This statement of compliance shall list the identification numbers of each test summary sheet contained in the submittal as well as the identification number, name, and serial number of each component tested under each summary sheet.

N17.3.3. ADDITIONAL TEST REPORTS

If a test procedure or report is inadequate in the Engineer's opinion, the Engineer reserves the right to require additional data, reports, or testing to insure that the requirements of this specification are met.

N17.3.4. CORRECTIVE ACTION

If specification requirements are not met in any test for which corrective action cannot be taken during testing, the Contractor shall submit to the Engineer for review and approval a proposed corrective action plan. If the Engineer approves the corrective action plan, the Contractor shall implement the corrective actions and rerun the test at its expense until specification compliance is demonstrated to the satisfaction of the

Engineer. At the Engineer's discretion, it may be permissible to continue a test after a failure and only require retesting of the failed portion.

All test reports containing "fail" entries shall be attached to the retest result reporting that the component ultimately passed the test.

N17.3.5. TESTING WAIVER FOR SERVICE-PROVEN EQUIPMENT

If a component, subsystem, or system is identical in design to service-proven equipment, the Engineer may, at his discretion, waive all or a portion of the testing requirements. To request a testing waiver for service-proven equipment, the Contractor shall submit:

a. A list of the sites where the equipment is currently utilized.

b. The quantity of the component utilized at each site.

c. The average amount of revenue service time logged for the component at each site.

d. The name, title, and phone number of a person at each site who the Engineer can contact to discuss the performance history of the component.

e. A description of the differences, if any, between the component implementation from site to site and the proposed implementation for the vehicles proposed to MDT.

f. Results of testing conducted on the component for the sites where it is currently in revenue service.

g. A specific cost breakdown of MDT's potential cost reduction, on a test type-by-test type basis, if the waiver is granted.

h. Any additional information requested by the Engineer.

N17.4. QUALIFICATION TESTING

N17.4.1. GENERAL

These tests consist of all component, subsystem, and vehicle tests to be performed at a Supplier's, Contractor's, or MDT's facility to demonstrate compliance with the requirements of the Contract Documents.

Components, subsystems, and vehicle tests failing to meet specified design or performance requirements shall be adjusted, modified, or redesigned and shall be retested at the Contractor's expense until all qualification tests are passed to the Engineer's satisfaction. These tests shall be conducted once, if passed, and must be witnessed by the Engineer to be considered valid and approved.

A complete report shall be submitted for each qualification test that is conducted, detailing all analyses of results and any corrective action that was necessary to certify conformance with the requirements of these Contract Documents (CDRL N1705). Test report submittals shall be listed initially in the Contractor's Test Plan as individual elements of CDRL N1705 (for example N1705.1, N1705.2, etc.)

A complete and Engineer-approved test report or analysis is required prior to the FAI acceptance of any component or subsystem.

N17.4.2. COMPONENT QUALIFICATION TESTING

Component qualification tests shall stress the equipment under environmental conditions as severe as those described in TPN2. While stressed in this way, it shall be demonstrated that the component performs its intended functions without failure.

N17.4.3. SUBSYSTEM QUALIFICATION TESTING

All subsystems shall be tested to verify compliance with the requirements of the Contract Documents. Related subsystems may be integrated and tested together, if approved by the Engineer, to verify compliance of the individual subsystems and to verify the design of the interface between them.

The interfaces between subsystems are viewed as crucial aspects of the system design. To verify these interfaces, it is preferred that subsystem tests be designed to include as many subsystem interfaces as is possible.

N17.4.4. VEHICLE QUALIFICATION TESTING

The Contractor shall, after successful completion of component and subsystem qualification testing, conduct vehicle qualification tests, using three (3) Pre-Production Married Pairs, as defined in this section, to verify the performance of vehicles, subsystems, and the interfaces between them.

In order to minimize the amount of time MDT facilities and rail system are required for vehicle qualification testing, tests that can be conducted at the Contractor's facility shall be performed there.

Testing that requires vehicle operation on MDT's Metrorail System shall be conducted with MDT personnel controlling the vehicle. Authorization

for testing at MDT's facilities or on MDT's property shall be requested, in writing, at least 15 working days prior to the requested access date.

Vehicle level dynamic testing shall be conducted on a test track at the Contractor's facility, or equivalent (i.e., Pueblo, CO), as approved by the Engineer.

N17.4.5. SPECIFIC TESTS

The following vehicle qualification tests shall be included in the test program plan:

a. Track/Station Clearance: Perform track, station, yard, and shop tests verifying the results of the system clearance margin report (TPN2).

b. Coupler, Truck, and Cable Clearance: Verify the ability of a four-car consist (2 married pairs) to negotiate a minimum-radius curve as defined in TPN2. Verify coupler function in accordance with TPN4.

c. Ambient Temperature: Determine the maximum temperature rise in enclosed equipment lockers, equipment boxes, and undercar areas near heat-producing equipment to verify that temperatures do not exceed design limits for components. The test shall comprise at least four hours of simulated-revenue service operation.

d. Noise and Vibration: The Contractor performs a vehicle qualification test to verify the acoustic noise and vibration requirements of TPN2.

e. Carbody Equalization: Perform a test to verify that the following conditions are met:

(1) With the secondary suspension system totally deflated and the car at AW0 loading resting on level, tangent track, the jack(s) shall be placed under the wheels on one side of one truck.

(2) Then, raise the wheels at the jacking location until they are lifted 2 inches above the Top of Rail (TOR).

(3) While the required lift is held, the amount of wheel lift above the TOR shall be measured and recorded at all wheels.

(4) The two wheels diagonally opposite the jacking position on the adjacent truck(s) shall not lift.

(5) Half the sum of the lifts measured for the four wheels on the other diagonal(s) shall be less than one half of a new wheel flange depth.

(6) This test shall be conducted at all four locations on each vehicle of a married pair.

f. Door System: A complete door assembly shall be tested to operate under all conditions that may compromise door function during normal operations, including mounting in a way that represents worst-case vehicle deflection and environmental conditions.

(1) The door system controls, including both relay components and microprocessor VMS interface components shall be qualification tested to demonstrate all functional requirements of TPN6, and TPN20. The door control system test shall also demonstrate proper function of the ADA visual and audio indications.

(2) The full range of adjustable parameters shall demonstrate compliance with specification requirements.

(3) The functionality of all release mechanisms and the overall system shall be demonstrated during qualification testing even if they are also verified by acceptance testing.

g. Air Comfort Subsystem Cooling: The HVAC system shall be tested in an approved climate chamber with the capability of providing ½ carset of all latent and sensible heat loads to the evaporator section, and static pressure simulated to the blower unit with all evaporator interfaces simulated.

The condenser test section shall be similarly configured to simulate vehicle interfaces, including airflow, and be maintained at a temperature of 105°F.

The HVAC contractor shall demonstrate the maximum available cooling capacity of the system.

Testing shall begin after the vehicle has been exposed to temperature of 95°F for at least 8 hours and with the interior temperature of the vehicle at 95°F. The length of time required to stabilize temperatures, after air conditioning equipment is energized shall be measured.

Testing shall include passenger and solar load simulation and a functional check of all apparatuses, including thermostats and controls, an air balance test, a pressurization test, and a temperature and relative humidity check to demonstrate compliance with the specified cooling requirements.

(1) The speed, supply voltage, and current demand of the equipment shall be electronically measured and continuously recorded for all of the test conditions. The recording devices shall be arranged so that the individual current demands and supply voltages of refrigerant compressors, evaporator blower

motors, heating units, and condenser fan motors can be measured and recorded. Tests shall be made with the apparatus running at both 900 VDC and 600 VDC third rail power supply.

(2) At the beginning of the test and upon the test's completion, a sample of refrigerant oil shall be taken and analyzed for contaminants. Comparison shall be made to determine acceptability.

h. Propulsion Subsystem: Perform tests to demonstrate compliance with the requirements of TPN2 and TPN10, including testing to IEC 61287-1 and IEC 61377. These tests shall be performed at all car-weights (AW0 through AW3).

i. Brake Resistor Grid: The Contractor shall perform testing to determine worst case dynamic brake grid temperature.

j. Combined Systems Test: The Contractor shall perform lab simulated testing to an Engineer approved test specification that demonstrates a successful integration between Propulsion, Brake, and Train Control systems. The Combined Systems Test shall be part of the Vehicle Qualification Test Program and shall be conducted once to the satisfaction of the Engineer. However the Contractor shall maintain all of the test equipment, including: propulsion, brake, and train control equipment available and ready to perform additional integrated combined testing if verification and validation of the systems integration design is needed. The test equipment availability shall be maintained until acceptance of the 33rd Married Pair.

k. Truck Assemblies: The Contractor shall perform tests to demonstrate compliance with the requirements of TPN11.

l. Friction Brake Disc Temperature: Perform approved tests to verify compliance with thermal capacity requirements of TPN12. These tests shall be performed at all car-weights (AW0 through AW3).

m. Friction Brake Subsystem Test: The Contractor shall perform tests to demonstrate compliance with the requirements of TPN2 and TPN12 on the friction brake system.

n. Spin/Slide Test: The Contractor shall perform tests to demonstrate compliance with the spin/slide system requirements of TPN2, TPN10, and TPN12.

o. Electromagnetic Interference (EMI): The Contractor shall perform a test to verify the EMI control requirements of TPN2.

p. Weight Distribution: Verify compliance with weight distribution as specified in TPN2.

q. Lighting: The Contractor shall perform a test to verify that the lighting system is in accordance with ADA requirements and TPN8.

r. Battery/Emergency Power: The Contractor shall perform a test to verify that the battery system is in accordance with the load requirements of TPN9.

s. Ride Quality: The Contractor shall perform a ride quality test jointly with the Engineer as specified in the final test procedure. The ride quality shall be evaluated according to ISO 2631-1.

t. Traction Motors: Perform test to verify design requirements of traction motors as specified in TPN10.

u. Auxiliary Inverter: Perform tests to verify proper design and operation of inverter as specified in TPN9, including IEC 61287-1 and IEC 61133 tests. Additionally, the tested unit shall successfully pass the following tests:

(1) Start into an open circuit three times in succession.

(2) Start into a short circuit three times in succession.

(3) Run without damage while connected to rated load with supply voltage being interrupted and reapplied (cycled) rapidly.

v. Gear Unit: Perform gear unit type test to verify design requirements specified in TPN10.

w. Third Rail Gaps: Conditions that lead to repetitive erratic and random interruptions of primary power shall be simulated by this test. Tests shall be conducted to demonstrate the ability of the propulsion control and auxiliary power systems to function without damage under such conditions.

x. Communication Systems: The Contractor shall perform testing to verify that the communications system is in accordance with the requirements of TPN13.

y. Auxiliary Motors: One of each type of auxiliary motor shall be tested, according to IEEE 112 type testing, to verify capabilities and power rating.

z. A complete functional test shall be performed on the ATS, and ATP subsystem to verify compliance with the requirements detailed in TPN14.

aa. The Contractor shall consider ground-borne vibration in the testing of the new vehicles. The Contractor shall demonstrate to the Engineer's satisfaction that the ground-borne vibration, induced by the new vehicles, is no greater than that experienced with the existing vehicles.

bb. Consist-Level Testing: The Contractor shall perform system-wide qualification testing in all modes to verify that four married pairs (pre-production and/or production married pairs) can be coupled and operated as a consist with all subsystems fully operational. The Contractor shall demonstrate that all trainline functions perform

satisfactorily from control cabs at each end of each married pair of cars when F- ends of cars are coupled together in A car to A car, B car to B car, and A car to B car configurations.

N17.5. PRE-SHIPMENT AND POST-SHIPMENT TESTS

N17.5.1. PRE-SHIPMENT TESTS

Before each completed vehicle may be shipped from the Contractor's facility, tests shall be conducted to demonstrate compliance of the vehicle with the specification requirements and to verify all aspects of vehicle manufacturing and performance that can be tested at that location. All qualification testing and production acceptance testing shall be completed to the Engineer's satisfaction prior to the start of pre-shipment testing.

At a minimum, pre-shipment tests for each vehicle/married pair shall include the following.

- Trainline test.
- Wiring continuity check.
- Insulation resistance test.
- High potential test.
- Carbody water tightness test.
- Functional operation of subsystems.
- Operation of static inverter and all auxiliaries.
- Operation of Pneumatic Compressor.
- Test that the turning moment of the truck installation is below 8,000 ft-lbs.
- Successful completion of Departure Test.
- Any additional tests requested by the Engineer.

Completion of pre-shipment testing to the Engineer's satisfaction is required in order to ship a new vehicle to MDT.

N17.5.2. POST-SHIPMENT TESTS

The Contractor shall perform tests on all vehicles after each vehicle has been shipped to MDT to verify functionality and to demonstrate compliance with the specification requirements.

At a minimum, the post-shipment tests for each vehicle shall include:

- Successful completion of the Departure Test.
- Low-speed running test for acceleration and braking rate adjustment.
- Train control test.
- Any additional tests requested by the Engineer.

All post-shipment tests for each vehicle shall be completed to the Engineer's satisfaction prior to Acceptance Testing.

N17.6. ACCEPTANCE TESTING

N17.6.1. PRODUCTION ACCEPTANCE TESTS

Acceptance tests approved by the Engineer shall be performed on all components, subsystems, and the completed vehicle. Information based on experience gained from previous testing or vehicle operation can be utilized to expand the testing requirements with the Engineer's review and approval. Test procedures shall be expanded to focus on areas of concern.

Complete records shall be maintained of all tests that are performed. Any failures and subsequent corrective actions shall be noted. The corrective action records shall be provided to the Engineer.

As an integral part of their Quality Assurance Program, the Contractor and Subcontractors shall perform these acceptance tests on each set of equipment that is produced.

Tests shall be conducted at the point of manufacture. The tests shall ensure that each unit is produced to at least the same quality level as the unit presented for the First Article Inspection.

N17.6.1.1. WATER TIGHTNESS TEST

Water tightness of the car shall be conducted to confirm carbody water tightness. The water tightness of the door seals and functional operation of the drains shall be verified as part of this test.

N17.6.1.2. DOOR SYSTEM

A vehicle-level door system acceptance test procedure shall be performed. This test shall verify that all door system parameters are set within specified ranges.

N17.6.1.3. HVAC SYSTEM

Each HVAC system shall be tested during production to verify proper wiring, control, and operating abilities.

N17.6.1.4. HIGH AND LOW VOLTAGE SYSTEMS

Current collectors shall be tested on each vehicle to verify adequate insulation and current-carrying capacities.

The auxiliary voltage supply of each vehicle shall be tested to verify proper operation.

The low-voltage apparatus of each vehicle shall be tested to verify proper operation.

N17.6.1.5. TRUCKS

The Contractor shall test each truck assembly to verify production conformance.

N17.6.1.6. TRACTION MOTORS

Acceptance testing shall be performed on each traction motor. In addition, production conformance testing, including load test, shall be performed on one traction motor during each month of production, regardless of the number of traction motors produced each month. The motor shall be selected at random by the Engineer.

Traction motors and gear units shall be secured as applicable prior to shipment of the vehicle to avoid damage.

N17.6.1.7. UNDERFLOOR EQUIPMENT WATERTIGHTNESS

The watertightness of underfloor equipment boxes shall be tested by spraying the boxes for 10 minutes to simulate exposure that would normally result from car washing, rain, or wheel splash. Nozzles spaced no greater than 3 ft. from underfloor boxes shall be used to deliver at least 0.625 gal of water per minute per nozzle with a velocity of at least 150 f/s. After 10 minutes of spraying, equipment boxes shall be checked

for water tightness. There shall be no water inside the enclosure when opened.

N17.6.2. VEHICLE ACCEPTANCE TESTS

After the completion of design qualification testing, production acceptance testing, pre-shipment testing, and post-shipment testing, tests and inspections shall be conducted on each completed vehicle on MDT's property to demonstrate compliance of the vehicle with the Specification requirements. In addition to any other tests or inspections proposed by the Contractor, the following shall be performed:

a. Inspection of vehicle upon delivery to MDT (receiving inspection).

b. Successful verification of ATP system.

c. Vehicle performance tests in AW0 and at all speeds up to the maximum as specified in TPN2. Vehicles shall be instrumented, and recordings shall be made to evaluate the operation of propulsion and braking subsystems during these tests. Married pairs shall comply with the requirements of TPN10 and TPN12.

d. The function of trainlined door controls shall be tested.

e. A communications system test shall be performed.

The Contractor shall present the completely tested, inspected, and documented vehicle to Miami-Dade Transit for acceptance after it has passed all tests, the test reports completed, and the car history books updated.

Miami-Dade Transit reserves the right to Conditionally Accept vehicles that are ready-to-run in revenue service except for minor defects that require corrective action but will not materially affect revenue service operation. Miami-Dade Transit will issue a Certificate of Conditional Acceptance with an attached list of open items. The Contractor shall submit a corrective action plan and schedule for each Conditionally Accepted vehicle.

Any Conditional Acceptance for revenue service does not relieve the Contractor of the liability to correct defects as required by the Contract.

Miami-Dade Transit will issue a Certificate of Conditional Acceptance to the Contractor for each vehicle when, Miami-Dade Transit's sole opinion, the vehicle meets the conditions specified in this section.

Miami-Dade Transit will issue a Certificate of Acceptance of Final Inspection to the Contractor for each vehicle when, in Miami-Dade Transit's sole opinion:

a. The car has been completed in full accordance to the Technical Specification, approved engineering submittals, and Change Orders.

b. The car has had all items of corrective actions identified at the Conditionally Accepted stage completed.

c. All required documentation for the car has been received and approved by Miami-Dade Transit.

N17.7. INSPECTION PROGRAM

N17.7.1. GENERAL

The Contractor shall plan, conduct, and maintain an inspection program in accordance with the requirements of an Engineer-approved plan and GP6. The inspections shall verify conformance of all items and activities to acceptance criteria of the procedures, instructions, and drawings. In general, all requirements of the Contract Documents shall be subject to verification by inspection. Inspections shall be conducted in accordance with approved, written checklists by persons other than those who performed the work.

N17.7.2. INSPECTION PLAN

The Contractor shall submit to the Engineer for review and approval an inspection plan, defining inspection milestones on a schedule indicating planned dates for their occurrence (CDRL N1706).

The inspection plan shall be properly coordinated with other system assurance plans and activities, including design, procurement, manufacturing, and testing. The inspection plan may be used by the Engineer as an aid to scheduling personnel for inspections at Subcontractors' and Suppliers' locations as well as on-site at the Contractor's facility.

N17.7.3. INSPECTION PROCEDURES AND REPORTS

All inspections shall be conducted using approved procedures and criterion that shall be generated and maintained by the Contractor. Procedures for all inspections shall be submitted to the Engineer for review and approval (CDRL N1707).

Inspection report format and content shall be approved by the Engineer and shall be submitted within 14 days after the completion of an inspection (CDRL N1708).

As a minimum, inspection reports shall include:

- The inspector's name(s).
- The witness' name(s).
- The inspection date and location.
- The equipment name, part, calibration due date, inspection procedure, and serial numbers.
- Any reference document numbers.
- The quantity and a description of all deficiencies.
- The nature of corrective actions.
- The quantities of equipment approved or rejected.

N17.7.3.1. TRACKING SYSTEM

The Contractor shall maintain a system to track inspections of all components, materials, and vehicles. The tracking system shall accurately indicate the following test status of any item:

- Whether it has been inspected.
- If it has been inspected in terms of its disposition.
- Whether it was accepted or rejected.

The system shall identify the inspection status of any vehicle.

N17.7.4. INSPECTIONS

N17.7.4.1. GENERAL

The Contractor's Suppliers and Subcontractors shall extend to the Engineer full cooperation and all reasonable facilities to permit the convenient inspection of the Work, including clean, accessible, adequate office space, utilities, and facilities at the Contractor's Suppliers' and Subcontractors' plant, at no cost to MDT. Office space shall include high speed internet, telephone, printer, fax and telecopy access for each resident MDT representative. Provisions shall be made for services of a full-time interpreter if plant personnel do not speak English. Copies (in

English) of all drawings, diagrams, and data shall be supplied, as needed, to inspect and check the design, construction, assembly, installation, workmanship, clearance, tolerance, and functional testing of all vehicle parts and apparatuses.

Components and subsystems shall be removed from storage, and made fully available and accessible for inspection such that the Engineer has full access to all areas of the component or subsystem.

The Contractor shall notify the Engineer at least 21 days prior to performing any inspections or tests during manufacture in order to allow the Engineer to witness the activity.

N17.7.5. INSPECTED COMPONENT DISPOSITION

N17.7.5.1. STATUS

The Contractor shall maintain a system capable of tracking the inspection status of all materials, components, subsystems, and vehicles by lot, serial, component, or vehicle number. Inspection status shall be reviewed on a weekly basis with the Engineer.

N17.7.5.2. DISCREPANT MATERIAL AND COMPONENT DISPOSITION

The Contractor shall label and segregate all material and components determined to be non-compliant with the Contract Documents. Materials and components non-compliant with the requirements of the Contract Documents, or which have been otherwise rejected, shall not be used on vehicles without receiving prior written authorization from the Engineer. Requests for authorization to use non-conforming materials or components shall be submitted for review and approval and shall be supported by documentation that details what is non-conforming about the material and explains why the non-conforming material should be allowed.

N17.7.5.3. FIRST ARTICLE INSPECTION

A First Article Inspection (FAI) shall take place at the point of assembly, whether at the Supplier's or Contractor's facility, after completion of factory acceptance tests on the first production unit of every component and subsystem to verify proper configuration, materials, operation, and production methods.

Major components and systems for which an FAI is required are listed below (the Engineer reserves the right to add to this list):

- Carshell.
- Vehicle interior.
- Seating.
- Lighting components.
- Door system.
- Coupler and Draft Gear.
- HVAC system.
- Auxiliary Electric components and system.
- Propulsion components and system.
- Truck frames.
- Completed Truck assemblies.
- Wheel and Axle Assemblies
- Friction Braking components and system, including friction disc.
- Communications/VMS components and system.
- Train Control components and system.

The Engineer shall be notified in writing of the proposed FAI date. The FAI shall be scheduled for a date that is mutually acceptable to both the Contractor and the Engineer.

Components and subsystems shall be made fully available and accessible for FAI such that the Engineer has full access to all areas of the component or subsystem.

The FAI shall verify that production hardware complies with design configuration and drawings as agreed upon during the FDR. The factory acceptance test procedures and results shall be available for review at the FAI. The Engineer may request the Contractor to repeat the factory acceptance test or parts of it at the FAI.

The Contractor shall submit to the Engineer for review and approval the latest approved drawings, test procedures, specifications, quality documentation, and a list of drawings required for adequate evaluation of

the equipment under inspection (CDRL N1709). The list of drawings shall be identified by revision and shall be complete to the line replaceable unit.

The FAI report shall be submitted to the Engineer for review and approval after the performance of any FAI (CDRL N1710). The FAI shall remain open until all FAI items are closed and the Contractor submits a final Engineer-approved FAI report.

N17.7.5.4. CONTRACTOR SOURCE/INCOMING MATERIALS INSPECTION

The Contractor shall provide for the inspection of all materials. The inspections may take place either at the Supplier's or at the Contractor's facilities. The Contractor shall propose to the Engineer for review and approval a materials inspection program as part of the Inspection Plan. A method of increasing the standards shall be included with any sampling plans if non-conforming products have passed the receiving inspection.

The Contractor shall include as part of the incoming inspection:

- Checklists for materials and components.
- Any acceptance test records.
- Supplier's submitted certifications or test results required by the specification or Purchase Order.

N17.7.5.5. MANUFACTURING/IN-PROCESS INSPECTION

The Engineer will have personnel on-site at the Contractor's manufacturing facility to audit the progress of the Work. The Contractor shall give the on-site personnel 21 days written notification of scheduled inspections. The Engineer, at its own discretion, may opt to:

- Audit the Contractor's inspection after it has been completed.
- Perform a joint inspection with the Contractor.
- Perform its own inspection after the Contractor's inspection has been completed.

N17.7.5.6. PRE-SHIPMENT INSPECTION

Every vehicle shall be inspected by the Contractor with the Engineer, prior to releasing any vehicle for shipment to MDT. A pre-shipment (outgoing) inspection shall verify the completeness of the testing at the Contractor's facilities and completeness of the documentation package of

each vehicle. A part of this inspection shall be a final physical inspection of the vehicle as prepared for shipping to MDT.

N17.7.6. INCOMING INSPECTION

Upon delivery of materials, components, assemblies, subsystems, or vehicles at MDT's facilities, the Engineer will perform incoming inspections.

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TABLE OF CONTENTS

N18. SYSTEM ASSURANCE 18-1
N18.1. GENERAL 18-1
N18.1.1. CITED REFERENCES 18-1
N18.1.2. SUBMITTALS – CDRLS 18-1
N18.2. CONTRACTOR QUALITY ASSURANCE PROGRAM 18-2
N18.2.1. GENERAL 18-2
N18.2.2. QUALITY ASSURANCE PLAN 18-3
N18.2.3. QUALITY ASSURANCE PLAN REQUIREMENTS 18-3
N18.2.4. QUALITY ASSURANCE PLAN ELEMENTS 18-4
N18.2.5. ENGINEER AUDITS 18-12
N18.3. SYSTEM SAFETY PROGRAM 18-14
N18.3.1. GENERAL 18-14
N18.3.2. SYSTEM SAFETY PROGRAM PLAN 18-14
N18.3.3. HAZARD CATEGORIES 18-15
N18.3.4. SYSTEM SAFETY CRITERIA 18-16
N18.3.5. SYSTEM SAFETY ANALYSES 18-17
N18.3.6. SYSTEM SECURITY PLAN 18-18
N18.4. RELIABILITY PROGRAM 18-19
N18.4.1. GENERAL 18-19
N18.4.2. RELIABILITY PROGRAM PLAN 18-19
N18.4.3. RELIABILITY DEFINITIONS 18-19
N18.4.4. RELIABILITY REQUIREMENTS 18-21
N18.4.5. RELIABILITY ANALYSES 18-21
N18.4.6. RELIABILITY TESTING 18-21
N18.5. MAINTAINABILITY PROGRAM 18-24
N18.5.1. GENERAL 18-24
N18.5.2. MAINTAINABILITY PROGRAM PLAN 18-24
N18.5.3. MAINTAINABILITY DEFINITIONS 18-25
N18.5.4. MAINTAINABILITY REQUIREMENTS 18-26
N18.5.5. MAINTAINABILITY DESIGN CRITERIA 18-27
N18.5.6. MAINTENANCE CONCEPT 18-28
N18.5.7. MAINTAINABILITY ANALYSES 18-29
N18.5.8. MAINTAINABILITY DEMONSTRATION TEST 18-30

N18. SYSTEM ASSURANCE

N18.1. GENERAL

This section defines the required quality assurance, quality control, safety, reliability, and maintainability activities that the Contractor shall perform under this Contract.

The Contractor shall submit the following system assurance plans and documents to the Engineer for approval. The requirements of the plans listed below are detailed in this section:

- Quality Assurance plan.
- Quality assurance manual.
- System safety program plan.
- Reliability program plan.
- Maintainability program plan.

These may be submitted by the Contractor as individual documents or compiled into a comprehensive plan. In either case, each element shall be fully integrated and consistent with each other.

N18.1.1. CITED REFERENCES

Source/Section	Title
FTA-IT-90-5001-02.1	FTA Publication – "Quality Assurance and Quality Control Guidelines"
ISO 9000	International Standards Organization, Quality Management and Quality Assurance Standards
MIL-HDBK-470A	Designing and Developing Maintainable Products and Systems

N18.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No.	Title	TP Reference
N1801	Contractor's Quality Assurance Manual	TPN18.2.1.

CDRL No.	Title	TP Reference
N1802	Quality Assurance Plan	TPN18.2.2.1.
N1803	Quality Assurance Plans (of other Suppliers)	TPN18.2.3.
N1804	Quality Assurance Records/Procedures	TPN18.2.4.13.
N1805	System Safety Program Plan	TPN18.3.2.
N1806	System Safety Analyses	TPN18.3.5.
N1807	System Security Plan	TPN18.3.6.
N1808	Reliability Program Plan	TPN18.4.2.
N1809	Reliability Analyses	TPN18.4.5.
N1810	Reliability Test Plan	TPN18.4.6.2.
N1811	Reliability Test Reports	TPN18.4.6.5.
N1812	Maintainability Program Plan	TPN18.5.2.
N1813	Subsystem Corrective Maintenance Allocations	TPN18.5.4.2.
N1814	Maintenance Concept Document	TPN18.5.6.
N1815	Inspection and Maintenance Analysis	TPN18.5.7.1.
N1816	Fault Isolation Troubleshooting Plan	TPN18.5.7.2.
N1817	Maintenance Engineering Analysis	TPN18.5.7.3.
N1818	Maintainability Demonstration Test Plan	TPN18.5.8.1.
N1819	Maintainability Demonstration Test Report	TPN18.5.8.1.

N18.2. CONTRACTOR QUALITY ASSURANCE PROGRAM

N18.2.1. GENERAL

The Contractor shall utilize an Engineer-approved quality assurance program to oversee the Work of the Contract and to ensure that the product and manufacturing process meet all the requirements of the Contract Documents. This program shall be maintained through the duration of the Contract and all warranty periods.

The quality assurance activities and responsibilities required by this specification include establishing and maintaining a quality assurance program, satisfying all requirements identified in the program, and conducting timely quality assurance audits of the program.

The provisions of the Contractor's quality assurance program shall be imposed on the Contractor's entire organization and on all Subcontractors and Suppliers. The Contractor shall assure conformance with the quality

assurance requirements of all such entities. The Contractor shall make available for the Engineer's review and inspection all required procedures, plans, manuals, and any other documentation to be used to ensure conformance.

The Contractor shall be certified to the appropriate ISO 9001 standard (as revised). The Contractor's ISO certification shall be maintained active and current throughout the life of the Project.

A copy of the certificate shall be submitted with the proposal.

The Contractor shall submit the Quality Assurance Manual (QAM) with the Proposal. The QAM shall describe the Contractor's Quality Management System (QMS) and shall list the Contractor's policies for planning, implementing, and maintaining quality (CDRL N1801).

N18.2.2. QUALITY ASSURANCE PLAN

N18.2.2.1. GENERAL

The Contractor shall submit a proposed Quality Assurance Plan with the Proposal, revising it for Engineer approval, following award of the Contract (CDRL N1802). The plan shall include a schedule of milestones, including submittals, and shall be updated as events occur that change any schedule dates.

The Engineer may use the quality assurance plan as a basis for planning the auditing and witnessing of production procedures and inspections, as well as any testing or other activities for which the Engineer determines monitoring is warranted.

N18.2.3. QUALITY ASSURANCE PLAN REQUIREMENTS

The quality assurance plan shall ensure that all activities are performed correctly by competent personnel. These activities shall include, but are not limited to, managing, designing, purchasing, fabricating, installing, cleaning, inspecting, testing, handling, storing, and shipping. The quality assurance plan shall identify the person responsible for all quality assurance activities affecting the planning and execution of the Work. The quality assurance plan shall identify the methods to verify the coordination of all relevant activities, including, but not limited to, manufacturing, testing, inspection, safety, reliability, and maintainability.

The quality assurance plan shall include all procedures and forms that the Contractor shall use to ensure that materials, processes, personnel, and product comply with the requirements of the Contract Documents. The Contractor shall impose its own Engineer-approved quality assurance plan requirements on all Subcontractors and Suppliers for this Project. The Contractor shall maintain a surveillance program to monitor all Subcontractors and Suppliers.

For all software in any carborne equipment, the Contractor and all Subcontractors shall provide a software quality assurance plan in accordance with the requirements of TPN22 and TPN19.

The Contractor shall submit to the Engineer the quality assurance plans of Suppliers providing major elements of this Project with the Management Plan (CDRL N1803). This shall include the Suppliers for the carshell, propulsion system, braking system, door system, trucks, VMS, and communication system. The Engineer may request the quality assurance plans of other Suppliers as well.

N18.2.4. QUALITY ASSURANCE PLAN ELEMENTS

The Contractor's quality assurance plan shall, at a minimum, adhere to and contain elements corresponding to the 15 quality elements described in the FTA's "Quality Assurance and Quality Control Guidelines, FTA-IT-90-5001-02.1," or adhere to ISO 9000 series standards as applicable. The 15 quality elements are as follows:

a. Management responsibility.

b. Documented quality system.

c. Design control.

d. Document control.

e. Purchasing.

f. Product identification and traceability.

g. Process control.

h. Inspection and testing.

i. Inspection, measuring, and test equipment.

j. Inspection and test status.

k. Non-conformance.

l. Corrective/Preventive action.

m. Quality records.

n. Quality audits.

o. Training.

N18.2.4.1. MANAGEMENT RESPONSIBILITY (ELEMENT 1)

The Contractor shall clearly establish and implement a quality management structure for the Contract. All personnel related to the quality elements of the project shall be identified in an organization chart and their responsibilities clearly documented. Responsibility for quality shall rest with the highest level within the organization and shall be independent from other functional areas.

A quality policy shall be established and implementation of the policy shall be the responsibility of one designated person with whom the Engineer may address matters pertaining to quality. That person shall be independent of the project and project manager and shall have direct access to Contractor senior management. The roles and responsibilities of that person shall be clearly identified in the Contractors' Quality Assurance Plan.

N18.2.4.2. DOCUMENTED QUALITY SYSTEM (ELEMENT 2)

The Contractor shall establish and implement a quality management system directly applicable to the Contract. The system shall clearly identify quality objectives for the Contractor and these objectives shall extend to all subcontractors and suppliers, as applicable. Documented quality procedures and instructions shall be developed for all phases of the project, including design, manufacturing, testing, and warranty. The procedures shall be readily available to all Contractor personnel and the Engineer and shall be maintained in a current state.

N18.2.4.3. DESIGN CONTROL (ELEMENT 3)

The Contractor shall establish and implement measures to ensure that engineering procedures are well defined and designs are controlled, prepared, verified, issued, and revised in accordance with the requirements of the approved quality system. Applicable regulatory requirements, industry codes and standards, and acceptance criteria shall be identified, used, and documented.

Original designs and changes to approved designs shall be subject to change control measures, and both shall be approved only in accordance with the requirements of the Quality Assurance Plan.

N18.2.4.4. DOCUMENT CONTROL (ELEMENT 4)

The Contractor shall develop and implement a system for the control of all documents related to the project including, but not limited to:

- Contract Documents (e.g., General and Technical Provisions).
- Correspondence.
- CDRLs.
- Design Documents.
- Quality Documents.
- Drawings.
- Plans, Procedures, and Reports.
- Manuals, Parts Catalogs and Training Materials.
- Test Specifications.

A revision tracking system shall be implemented on all documents, as applicable and a formal log of all Contract material shall be established and maintained. Formal approval and sign-off shall accompany all Contract documents.

N18.2.4.5. PURCHASING (ELEMENT 5)

The Contractor shall establish and implement measures to ensure that all purchased components and services conform to the requirements of the Contract Documents. These measures shall provide for incoming inspection, source inspection, inspection of production facilities, audits of documentation, and the review of Subcontractor quality assurance plans and procedures.

The Contractor shall conduct meetings with Subcontractors or provide other means to clarify provisions of the Contractor's procurement documents for materials and components supplied for this Contract. Procurement documents shall incorporate adequate technical and quality provisions. These requirements shall be identified by reference to specific drawings, specifications, codes, standards, regulations, procedures, instructions, and acceptance criteria. The Engineer shall be permitted to review Contractor-issued purchase orders to confirm that these requirements are forwarded to all Subcontractors.

N18.2.4.6. PRODUCT IDENTIFICATION AND TRACEABILITY (ELEMENT 6)

The Contractor shall establish and maintain effective material identification and traceability controls to prevent the use of incorrect or defective items and to ensure that only correct and acceptable items are used or installed.

Identification shall be maintained either on the items or in documents traceable to the items throughout all production phases from the receipt, storage, fabrication, repair, and shipping. Markings shall be transferred to each part of an identified item when subdivided and shall not be obliterated or hidden by surface treatments. The status of inspections, tests, and other activities shall be maintained with indicators, such as tags, stamps, shop travelers, or other Engineer-approved means.

Item identification methods and procedures shall be implemented to ensure that product traceability is established and maintained in a manner that allows critical components, subsystems and final assemblies to be traced to a particular project, specific warranty, test report, supplier, purchase order, batch number, point in time, applicable drawings, specification, or other document during all stages of production, delivery, and installation or end use.

The Contractor shall establish and implement measures to ensure that all items are handled, stored, and shipped in accordance with the quality assurance plan. These measures shall be consistent with the

configuration management and car history book requirements of TPN16. These measures shall include, but not be limited to, instructions and procedures for:

- Marking parts in accordance with the bar coding requirements of TPN15.
- Identifying and selecting parts used in the manufacture and assembly of systems and subsystems in accordance with approved design requirements and documentation, such that no improper or incorrect parts are utilized.
- Marking non-conforming parts in accordance with the requirements of Element 11 in TPN18.2.4.11.
- Identifying and providing cautionary markings (e.g., "fragile").
- Providing any special protective environments.
- Providing protective coatings (e.g., against weathering and corrosion).
- Providing drying agents.
- Providing moisture barriers.
- Disposing of materials based on shelf life.
- Providing locking mechanisms to control movement of rotating parts.

Identification and traceability shall be maintained either on the items or in documents traceable to the items throughout the receipt, storage, fabrication, repair, and shipping. Markings shall be transferred to each part of an identified item when subdivided and shall not be obliterated or hidden by surface treatments. The status of inspections, tests, and other activities shall be maintained with indicators, such as tags, stamps, shop travelers, or other Engineer-approved means.

N18.2.4.7. PROCESS CONTROL (ELEMENT 7)

Control of manufacturing and production processes shall be properly monitored and reviewed by the Contractor. Procedures defining the methods of monitoring, reviewing, and revising production and manufacturing processes and procedures shall be properly documented.

All manufacturing personnel shall abide by "hold" and "examination" points and shall not obscure work to be reviewed. If the Engineer cannot properly view any area for inspection, the Contractor shall, at its own expense, make modifications such that the Work can be adequately inspected.

N18.2.4.8. INSPECTION AND TESTING (ELEMENT 8)

The Contractor shall plan and conduct inspections in accordance with the quality assurance plan. Inspections shall be conducted in accordance with an Engineer-approved, written checklists by persons other than those who performed the Work. Inspection personnel shall prepare accurate records of all inspections. Inspection records shall indicate:

- Inspector's name.
- Date.
- Equipment type description.
- Model and serial number.
- Nature and number of observations made.
- Number and type of deficiencies found.
- Quantities approved and rejected.
- The nature of corrective action taken.
- Applicable reference documentation.

The Contractor shall strictly maintain inspection procedures. The procedures shall be applied to:

- Contractor acceptance inspections.
- Source inspections.
- Incoming inspections.
- In-process inspections.
- Production inspections.
- Hold-point inspections.
- Final inspections.
- First article inspections.
- Pre-shipment inspections.

The Contractor shall provide for the inspection of all incoming materials. The inspections may take place at the Suppliers' facilities, Subcontractors' facilities, or at the Contractor's facilities. The Contractor shall specify, subject to the Engineer's approval, the type of inspection employed for each item, either sampling, statistical, or 100 percent. When the Contractor employs sampling or statistical inspection, the details shall be provided in their quality assurance plan. A method of increasing the standards shall be included with any sampling program if non-conforming product has passed the receiving inspection. The Contractor shall include as part of the receiving (incoming) inspection:

- Checklists for materials and components.

- Acceptance test records.
- Certifications or test results required by the specification or purchase order.

The Contractor shall notify the Engineer in advance of all inspections and tests during the manufacture of items and shall allow adequate time for the Engineer to attend, prior to performing the inspection or test.

The Contractor shall establish and implement measures to ensure that all items will perform satisfactorily in service in accordance with the requirements of the Contract Documents. Functional testing, operational testing, and acceptance testing shall be performed under controlled conditions in accordance with the quality assurance plan and the requirements of TPN17.

The Contractor shall have provisions in place to ensure that any previously inspected area of the Work shall be re-inspected after rework, modifications, or retrofits.

N18.2.4.9. INSPECTION, MEASURING, AND TEST EQUIPMENT (ELEMENT 9)

The Contractor shall establish and implement Engineer-approved control measures to ensure that tools, gauges, instruments, and other measuring and test equipment used for the Work on this Contract are calibrated in accordance with the quality assurance plan. These measures shall also ensure that all such items are of proper type, range, accuracy, and tolerance for their specified use.

Measuring and test equipment shall be calibrated, adjusted, and maintained at prescribed intervals against certified equipment to adhere to nationally recognized standards. The calibration status shall be labeled or otherwise recorded to ensure adherence to calibration schedules. Evidence of compliance shall be readily available for Engineer inspection and shall identify the date of the last calibration, the individual who performed the calibration, and when the next calibration is due.

N18.2.4.10. INSPECTION AND TEST STATUS (ELEMENT 10)

The Contractor shall maintain a system to track the inspection and test status of all components, materials, and vehicles during manufacturing, installation, testing and warranty. The system shall identify the status of any such inspected item to indicate acceptance, rejection, disposition, or a pending inspection. The system shall be capable of identifying the present inspection status of any vehicle.

The Contractor shall provide a verification of readiness in the form of completed and signed inspection check sheets before any vehicle is shipped to MDT. The inspection check sheets shall be included in the vehicle Car History Book.

N18.2.4.11. NON-CONFORMANCE (ELEMENTS 11)

The Contractor shall establish and implement measures to ensure that items that do not conform to specified requirements are controlled to prevent inadvertent installation. The control measures shall contain procedures for identifying, documenting, segregating, and disposing non-conforming items, as well as procedures for notifying the affected organizations (e.g., the Subcontractor or Engineer). Defective items shall be red-tagged or otherwise marked and segregated in a designated holding area, pending disposition instructions.

The Contractor shall establish a Material Review Board (MRB) to review and dispose of non-conforming materials. The MRB shall include, at a minimum, representatives from the Contractor's Materials, Engineering, Production, Procurement, and Quality departments. The MRB shall suggest for the Engineer's approval whether a non-conforming product shall be scrapped, repaired, returned to Supplier, or reworked in-house.

The Engineer will be present at MRB meetings to assist in the evaluation of non-conforming materials and to approve the MRB's determination. The MRB shall promptly identify the causes of defects, recommend corrective actions to prevent recurrence of the defects, and take follow-up action to verify the completion of corrective actions.

Any material that the MRB identifies as "repaired" must be approved by the Engineer prior to being used on a vehicle.

N18.2.4.12. CORRECTIVE/PREVENTIVE ACTION (ELEMENT 12)

Corrective action procedures shall be established, documented, and maintained by the Contractor. These include procedures for investigation of the cause of nonconforming work and the corrective action needed to prevent recurrence, and procedures for analysis to detect and eliminate potential causes of nonconforming work. This element also includes implementing and recording changes in procedures resulting from corrective action.

Corrective action procedures shall be established for:

- Investigating the cause of nonconforming product and taking the corrective actions needed to prevent recurrence.
- Analyzing processes to detect and eliminate potential causes of nonconforming product(s).
- Initiating preventative actions to deal with problems to a level corresponding to the risks encountered.
- Ensuring that corrective actions are taken and that they are effective.
- Implementing and recording changes in procedures resulting from corrective action.

The Contractor shall establish and maintain preventive action procedures to identify and eliminate the causes of potential nonconformities in order to prevent their occurrence. The preventive action procedure shall be established to define requirements for:

- Determining potential nonconformities and their causes.
- Evaluating the need for action to prevent occurrence of nonconformities.
- Determining and implementing actions taken.
- Maintaining records of results of action taken.

N18.2.4.13. QUALITY RECORDS (ELEMENT 13)

The Contractor shall ensure that all quality assurance records and procedures are prepared and maintained in accordance with the quality assurance plan. These records and procedures shall be submitted to the Engineer for review and approval (CDRL N1804). They shall be legible, identifiable, readily retrievable, and protected against damage, deterioration, and loss. The records shall include, but not be limited to:

- Process control reports.
- Welder qualification certificates.
- Inspection and test reports.
- Inspection check sheets.
- Calibration reports.
- Non-conformance reports.
- Corrective action reports.
- Audit reports.
- Other pertinent data.

N18.2.4.14. QUALITY AUDITS (ELEMENT 14)

The quality assurance plan shall describe the form, schedule, and checklists to be used for audits that shall be used to verify Contractor compliance with all aspects of the quality elements of the project and its effectiveness. Audit plans shall be developed and shall identify the scope, schedule, personnel, and the procedure for the notification of organizations to be audited.

Audits shall be performed in accordance with the checklists by personnel who have not been assigned responsibility for performing the portion of the Work being audited. These personnel shall have the authority to conduct independent audits, recommend actions to correct and prevent recurrence of deficiencies, and take follow-up actions to verify completion of corrective actions.

N18.2.4.15. TRAINING (ELEMENT 15)

All personnel required to perform quality functions shall receive training in accordance with the quality assurance plan. Training shall be directly applicable to the task or function being performed and refresher training shall be administered when changes to the function or process dictate. All training shall be documented and readily available for inspection by the Engineer.

N18.2.5. ENGINEER AUDITS

N18.2.5.1. GENERAL

The Engineer may audit the Contractor, or any Subcontractor, at anytime during the term of the Contract.

The Engineer may perform quality assurance functions, including audits, inspections, test witnessing, etc., during the life of the Contract. These functions may be performed independently and in addition to the Contractor's activities. These activities will help to ensure that the Contractor is performing the quality assurance functions as defined and agreed to by the Engineer and verify that all services and products delivered to MDT conform to the requirements of the Contract Documents. The quality assurance activities of the Engineer shall in no way lessen, negate, or replace the quality assurance responsibilities of the Contractor.

N18.2.5.2. BUY AMERICA AUDITS

The Contractor shall be subject to audits at anytime during the performance of this Contract to ensure compliance with the "Buy America" requirements as set forth in GP2.

N18.2.5.3. RIGHT OF ACCESS

The Contractor shall provide the Engineer with free access to the Contractor's shops, offices, and facilities in order to audit, inspect, examine, and test components/systems prior to and during component/system manufacture. Quality surveillance shall include, as appropriate, the selective review, observation, and evaluation of processes, records, reports, manufacturing operations, quality control systems, and programs to verify compliance with contractual quality requirements. This right of access includes the properties of all entities engaged in supplying any goods or services to the Contractor as a part of this Contract.

N18.2.5.4. NON-CONFORMANCES

If the Engineer ascertains instances of non-conformance to the specifications, whether in the Contractor's plant or in a plant at another

location where work is being performed, the Contractor shall correct the non-conformance to the Engineer's satisfaction. Any work accomplished when the quality program is in a state of non-approval or non-conformance shall be done at the risk of the Contractor.

The Engineer has the right to have production at any non-conforming site stopped until the non-conformity is resolved to the Engineer's satisfaction and approval. Any delay of work caused by any non-conformances of the Contractor or by any entity performing work for the Contractor, shall be at the Contractor's expense and shall not serve as a basis for an extension of time for program or delivery schedules.

N18.2.5.5. CONTRACTOR AUDITS OF MANUFACTURERS/SUPPLIERS

The Contractor shall maintain a surveillance program to monitor all Subcontractors and Suppliers. As part of the surveillance program, the Contractor shall perform onsite quality audits on all Subcontractors or Suppliers that provide the following:

- Major Components and Systems for which an FAI is required.
- Components and Systems with purchase order totals in excess of $1,000,000.
- Manufacturing Services to Components and Systems identified in the first two bullets above.
- Other Services affecting Quality.

The Contractor's surveillance program shall monitor all Subcontractors and Suppliers that provide other components and systems, or services to such components and systems, which are not subject to onsite quality audits. In addition, the Contactor's surveillance program shall include continual evaluation of all Subcontractors and Suppliers performance levels and action plans to address poor performance.

The Contractor shall maintain surveillance of Subcontractors or Suppliers until all its Contract requirements have been met. The Contractor shall keep records of all Contractor audits and surveillances of Subcontractors and Suppliers and these records shall be made available to the Engineer upon request.

N18.2.5.6. AUDIT REPORTS

The Engineer will issue audit reports following the completion of the audit. The report shall describe the scope of the audit, procedures followed, and any deficiencies found. The report will also indicate whether the audit was conducted due to non-conforming product or services and the corrective action required for each non-conformance. The Contractor shall inform the Subcontractors and Suppliers of the Engineer's findings and requested responses.

The Contractor shall prepare responses to the Engineer in a format consistent with the Engineer's audit reports. The Contractor shall describe any corrective actions that the Supplier and/or Subcontractor must undertake, as a result of a noncompliance discovered during an audit, and shall determine the date upon which these corrective actions must be initiated in order to achieve compliance. The Engineer will decide if the corrective actions specified by the Contractor are sufficient.

N18.3. SYSTEM SAFETY PROGRAM

N18.3.1. GENERAL

The Contractor shall develop and implement a safety program to identify potential and actual hazards and shall initiate the actions necessary to eliminate or control them. The safety requirements shall stress fault-tolerant and fail-safe concepts. The system safety program shall ensure:

a. Safety, consistent with system operating requirements, is designed into the system in a timely, cost-effective manner.

b. Hazards are identified, evaluated, and eliminated; or the associated risk is reduced to a level acceptable to MDT throughout the entire life cycle of the system.

c. Historical safety data, including lessons learned from other systems, are considered and used.

d. Minimum risk is sought in accepting and using new designs, materials, and production and test techniques.

e. Actions taken to eliminate hazards or reduce risk to a level acceptable to MDT are documented.

f. Retrofit actions are minimized.

g. Changes in design, configuration, or mission requirements are accomplished in a manner that maintains a risk level acceptable to MDT.

h. Consideration is given to safety and ease of disposal of any hazardous materials associated with the system.

i. Hazards identified after production are minimized consistent with program restraints.

N18.3.2. SYSTEM SAFETY PROGRAM PLAN

The Contractor shall submit to the Engineer for review and approval a System Safety Program Plan (SSPP) (CDRL N1805). The program shall provide for the safety of:

a. Patrons and MDT personnel boarding, alighting, and being transported by the vehicle.

b. Personnel who are operating, maintaining, or testing the vehicle or its associated wayside equipment and supporting facilities.

c. The vehicle itself and its associated equipment and support facilities.

The SSPP shall contain the following information, at a minimum:

a. Specific information showing how the Contractor shall verify the attainment of system safety requirements during the design, manufacturing, installation, and test phases of the Contract.

b. Organizational relationships and personnel responsible for system safety. The Contractor's system safety engineer/manager shall report to or have direct access to the Contractor's program manager.

c. Detailed listing, description, and schedule of specific system safety tasks, including special system safety studies, types of analyses, in-plant and on-site testing, and integrated testing.

d. Procedures for identifying, reporting, recording, and resolving hazards identified during design, manufacturing, installation and testing.

e. Schedule indicating key milestones to ensure that system safety activities are performed in a timely manner.

f. Procedures by which system safety personnel shall review and approve designs, design changes and top-level drawings.

g. Methods to ensure that the Subcontractors' system safety efforts are consistent with the overall system requirements and that progress reports and analyses are included in program reviews.

h. Procedures to control records, including accident-hazard reports, analyses, and tracking data.

i. A Safety Certification Plan, which includes the methodology, procedures, and activities, by which the Contractor will certify that each vehicle meets all safety related requirements of the Contract Documents and satisfies the requirements of the Miami-Dade Transit Safety Certification Program Plan, Revision 4, dated October 1996.

N18.3.3. HAZARD CATEGORIES

The following hazard categories shall be used to identify hazard levels and assess hazard impacts on the system:

a. Category I, Catastrophic: Operating conditions under which personnel error, environment, design deficiencies, subsystem or component failure, or procedural deficiencies can cause death or system loss.

b. Category II, Critical: Operating conditions under which personnel error, environment, design deficiencies, subsystem or component failure, or procedural deficiencies can cause severe personal injury, severe occupational illness, or major system damage requiring immediate corrective action.

c. Category III, Marginal: Operating conditions under which personnel error, environment, design deficiencies, subsystem or component failure, or procedural deficiencies that can be counteracted or controlled with only minor personal injury, minor occupational illness, or minor system damage. Included are those conditions that could require reverting to slightly degraded performance in a safe, backup mode.

d. Category IV, Negligible: Safe operating conditions under which personnel error, environment, design deficiencies, subsystem or component failure, or procedural deficiencies could result in less than personal injury, occupational illness, or system damage.

N18.3.4. SYSTEM SAFETY CRITERIA

Criteria for system design and subsequent operational procedures shall ensure that the system safety objectives are implemented throughout design development, testing, delivery, operations, and maintenance of the vehicles. The system safety criteria shall provide, at a minimum, for the following:

a. Potential or actual hazards that have been identified through analyses shall be eliminated in the following order of precedence:

(1) Design for minimum hazard.

(2) Use of safety devices.

(3) Use of warning devices and labels.

(4) Use of special maintenance and operating procedures.

b. No subsystem or component single point failure shall result in a Category I or Category II hazard with a probability of more than 5 x $10e^{-7}$. If reasonably possible, subsystems or components whose failures impact train operation (i.e., safety critical systems) shall be backed up by simpler subsystems that shall enable safe operation in the event of such failure. Whether a backup subsystem is "reasonably possible" shall be determined and/or approved by the Engineer. All single point component failures in safety-critical systems shall be detectable.

c. Where failures could result in personal injury, major damage, or inadvertent unsafe operation of equipment, the design shall incorporate redundancy, fault-tolerant, or fail-safe principles.

d. Personnel operating, maintaining, or repairing equipment shall not be exposed to Categories I or II hazards and shall be able to control Category III hazards.

e. The vehicle design shall include component interlocks wherever an out-of-sequence operation can cause a hazard.

f. Emergency equipment for public use shall be clearly identified and accessible.

g. Interlocks, cutouts, fittings, and similar items shall be accessible through access panels that shall be secured to prevent tampering and vandalism.

N18.3.5. SYSTEM SAFETY ANALYSES

The Contractor shall perform the following analyses. Each of these analyses, including hazard reduction resolutions, shall be submitted to the Engineer for review and approval and shall be updated as required to reflect design changes (CDRL N1806).

N18.3.5.1. PRELIMINARY HAZARD LIST (PHL)

The Contractor shall develop and submit a Preliminary Hazards List. The list shall identify hazards or areas of concern related equipment, facilities, personnel, or processes. The list shall be developed using the technical specification requirements, the Contractor's experience on similar projects, prior lessons learned, previous analyses, and MDT experience gained through personnel interviews. The PHL shall provided data for various safety analyses.

N18.3.5.2. PRELIMINARY HAZARD ANALYSIS (PHA)

The Preliminary Hazard Analysis shall identify, evaluate, and document all hazards associated with systems, subsystems, equipment, operations, human interfaces, and their related environment. It shall include recommendations to eliminate, control, or accept the identified hazards. All identified hazards shall be logged and tracked throughout the project.

N18.3.5.3. SUBSYSTEM HAZARD ANALYSES

These analyses shall verify subsystem compliance with safety requirements and shall include consideration of environmental conditions, human and equipment interfaces, and impact of associated failures on the safety of vehicle subsystems and associated equipment and facilities.

N18.3.5.4. OPERATING AND SUPPORT HAZARD ANALYSIS

These analyses shall:

a. Identify and evaluate safety considerations associated with the environment, personnel, procedures, and equipment involved throughout the operation of the vehicles.

b. Include activities, such as testing, installation, maintenance, support, transportation, storage, operations, and training.

c. Be used as basis for the following:

(1) Design changes, when feasible, to eliminate hazards or provide safety devices and safeguards.

(2) Special procedures for servicing, training, handling, storage, and transportation.

(3) Publication of warning and caution notices and special inspection and emergency procedures in operating and maintenance instructions, including emergency action to minimize personal injury.

(4) Identification of time span of hazards and actions required to preclude occurrence of undesired events.

(5) Catastrophic occurrences are not acceptable.

N18.3.5.5. SAFETY-CRITICAL ITEMS LIST

The Contractor shall develop and maintain a Safety-Critical Items List. Safety-critical items are items required to resolve hazards that can result in critical or catastrophic occurrences. The Safety-Critical Items List shall include areas in which human errors can cause hazardous conditions. The Safety-Critical Items List shall document resolution of all Category I and Category II hazards.

N18.3.6. SYSTEM SECURITY PLAN

The Contractor shall submit or make available for a review at the Contractor's facility, a system security plan detailing how MDT vehicles while in the Contractor's possession shall be protected from intentional harm. In addition, MDT personnel shall be protected while on the Contractor's property performing their required duties. The plan shall be a formal document that describes the planned security tasks required to meet system security requirements. It shall outline organizational responsibilities, levels of commitment, methods of accomplishments, depth of effort and integration with other design and management activities (CDRL N1807).

N18.4. RELIABILITY PROGRAM

N18.4.1. GENERAL

The Contractor shall establish a reliability program to ensure that the Vehicles exhibit reliability in accordance with the requirements of the Contract Documents. Reliability shall be measured as Mean Distance Between Service Failures (MDBSF). The MDBSF requirements for vehicles and equipment subsystems will be defined in accordance with the specifications as described herein.

N18.4.2. RELIABILITY PROGRAM PLAN

The Contractor shall submit a reliability program plan with the Proposal, revising it as required for Engineer approval, following the award of the Contract (CDRL N1808). At a minimum, the plan shall address the following:

a. Reliability program objectives.

b. A schedule of reliability program activities that identifies specific tasks, their start and completion dates, and how they are coordinated and integrated with major program milestones for the design, and test phases.

c. The Contractor's methodology to predict compliance with the specified reliability requirements, including descriptions of design and analysis techniques.

d. The organization and personnel responsible for managing the reliability program.

e. Controls for equipment Subcontractors and how compliance shall be assured.

f. Reliability status reporting, including failure summary reports, fault reports, analyses, and tracking failure data. All vehicle subsystem and component failures shall be reported.

g. Definition of interfaces between the reliability program and other closely related programs, such as maintainability, system safety and manuals development.

h. Demonstration testing for verification of compliance with the specified reliability requirements.

N18.4.3. RELIABILITY DEFINITIONS

The following reliability definitions shall be used in execution of this Contract:

N18.4.3.1. MEAN DISTANCE BETWEEN SERVICE FAILURE (MDBSF)

Mean Distance Between Service Failure (MDBSF) is the total operating distance (S) accumulated by the vehicles divided by the total number of service failures (F_s) occurring during accumulation of that distance. This is expressed quantitatively by the following equation:

$$MDBSF = \frac{S}{F_s}$$

N18.4.3.2. RELEVANT FAILURE

A relevant failure is any failure that requires repair or replacement of any vehicle system, subsystem, or component that is not an approved consumable item or that is an approved consumable, but has not achieved its design service life, and which failure has not been due to:

a. A failure occurrence in another system or subsystem.

b. A failure of MDT to perform the recommended and approved preventative or service maintenance actions.

c. Vandalism or physical mistreatment at a human interface.

d. Operating or weather conditions of unusual aspect or severity beyond those specified in TPN2.

e. An accident.

f. Failure caused by human error.

The term "unusual aspect or severity" shall be understood to mean a condition that does not occur on MDT's vehicle System more often than once in 10 years. The time, place, or type of service operated by the vehicle at the time of a failure shall not be of any consequence.

N18.4.3.3. SERVICE FAILURE

A service failure is any relevant failure that results in a train delay in excess of 3 minutes or causes a train to be removed from revenue service or any relevant failure that prevents a Married Pair or Train from being placed into service.

N18.4.3.4. PATTERN FAILURES

A failure shall be classified as a pattern failure when a failure occurs in 5% of the total contract quantity of identical components, used for the same function, in the same assembly, subsystem, or system; or identical failures occur that affect 5% of the vehicles procured under this Contract. Pattern failures shall be considered reliability defects and the Contractor shall take Engineer-approved corrective action to eliminate the pattern failure (reliability defect) in accordance with GP5.3.

N18.4.4. RELIABILITY REQUIREMENTS

The Contractor shall meet the overall MDBSF and subsystem MDBSF requirements identified in Exhibit N18-1. Exhibit N18-2 only identifies the major equipment included within each subsystem with reliability MDBSF requirements. The Contractor shall expand this list to include all of the equipment, parts, etc. that may result in a failure.

N18.4.5. RELIABILITY ANALYSES

Reliability analyses shall be provided in written and electronic format to the Engineer for review and approval at the preliminary design review and shall be maintained and updated through final design (CDRL N1809). All analyses shall be submitted under the same CDRL number, but need not be submitted at the same time. These analyses shall serve as a basis for predicting that the vehicles will meet the reliability requirements. Documented verification of product history that demonstrates compliance with the reliability requirements may be acceptable in lieu of analyses upon the Engineer's approval. The following analyses, performed to the Engineer-approved Line Replaceable Unit (LRU) level, and supporting documentation shall be provided and updated as required to reflect design changes:

- Functional descriptions, reliability models, and reliability block diagrams.
- Reliability allocations to the Engineer-approved LLRU level.
- Reliability predictions at the system, subsystem, and component levels.
- Failure Mode, Effects, and Criticality Analysis (FMECA).

N18.4.6. RELIABILITY TESTING

N18.4.6.1. GENERAL

The Contractor shall perform reliability testing approved by the Engineer to demonstrate compliance with system MDBSF and subsystem MDBSF requirements. Reliability testing shall be performed utilizing all vehicles delivered under this Contract and the reliability test program shall begin when the first married pair has been accepted by MDT and has accumulated 10,000 miles of revenue running. All failures shall be reported, but only service failures shall be counted in computing MDBSF values.

N18.4.6.2. RELIABILITY TEST PLAN

The Contractor shall develop and submit to the Engineer for approval a reliability test plan that shall define the requirements and test procedures

for a reliability demonstration test as described herein. This test plan (CDRL N1810) shall include, at a minimum, the following items:

a. A test schedule that includes vehicle delivery, failure-free testing, and anticipated reliability testing dates for each vehicle.

b. The success-failure criteria for measuring vehicle and subsystem MDBSF values.

c. Analysis methods to be used to identify cause and need for corrective action.

d. Means of verifying achievement of MDBSF requirements.

e. Change control procedures for implementing design changes during the test program.

f. The format and location of test records, test logs, and data records.

g. Reliability test procedures.

h. Methodology to be used during the test to classify failures, such as relevant, non-relevant, pattern, or non-pattern failures.

N18.4.6.3. RELIABILITY DEMONSTRATION TEST

The purpose of this test is for the Contractor to demonstrate that the vehicles satisfy the reliability requirements. The test shall start when the first married pair has been accepted and has accumulated 10,000 miles of revenue running.

The Contractor shall gather failure data on the population of vehicles in the reliability demonstration test and provide a monthly report as specified herein. These reports shall be used for the reliability assessment and acceptability of the vehicles. The Contractor shall use a reliability tracking system to track data during the test.

Each vehicle shall be included in the reliability test. Each married pair shall be entered into test when it has been accepted and has accumulated 10,000 miles of revenue running. Each married pair shall be in test for 12 consecutive months. Once a married pair has been in test for 12 consecutive months it shall be removed from the test, unless it has exhibited a pattern failure. The test shall conclude only after:

- All systems have been in their final configuration for at least 12 months,
- Each married pair has been in test for 12 consecutive months, and
- All subsystems have met their corresponding reliability requirements during the last six months of the test period.

Subsystems that are not meeting their reliability requirements at the end of the test may be required to remain in test until they have meet their

requirements for six consecutive months, solely at the discretion of the Engineer.

The MDBSF of the vehicles and the MDBSF for each subsystem shall be tracked throughout the reliability test program. At the end of six months of testing, the MDBSF for each subsystem shall be calculated. If any subsystem does not meet its corresponding requirement, the Contractor shall perform an analysis, which shall be presented to the Engineer for review and approval. The analysis shall include at a minimum: all applicable data, cause(s) for failure(s), and recommended corrective action. The Engineer, as necessary, may require the Contractor to take corrective action, up to and including complete system redesign, to ensure that the subsystem is compliant with its requirement. The MDBSF for each subsystem shall be calculated and evaluated each successive month using a six-month moving average.

Whenever any subsystem falls below its MDBSF requirement and requires corrective action, the Engineer may remove that subsystem from the test. If a subsystem is removed from testing, the test for that subsystem shall not restart until approved corrective action has been taken. Failure data collection and failure analysis shall continue, regardless of test status. Once corrective action has been taken, the test for that subsystem shall continue as defined above.

Before a subsystem can be returned to testing, a proposed plan for corrective action shall be developed and forwarded to the Engineer for approval. The plan shall include proposed restart procedures, proposed changes, and appropriate supporting data. The proposed plan shall clearly identify if failures are random or patterned and a specific method of verifying the effectiveness of change(s). The specified performance and required characteristics of the equipment shall not be changed to achieve reliability requirements, unless approved by the Engineer.

Preventive maintenance procedures specified for the equipment during normal operation will be performed by MDT in cooperation with the Contractor during the reliability test.

Failure records shall be maintained on the Contractor's reliability tracking system for all vehicle subsystems and available for the Engineer's review. Individual equipment failures shall be reported in accordance with failure reporting procedures and failure report forms.

N18.4.6.4. FAILURE REVIEW BOARD

The Contractor shall participate on a failure review board established by the Engineer to monitor the status of the reliability test program. The board shall be chaired by the Engineer and shall consist of MDT, the Engineer, and Contractor personnel. The board shall meet at least monthly to evaluate failures and assign relevancy for MDBSF calculation purposes. The contractor shall record mileage on a per vehicle basis and

MDT will provide to the Contractor any available failure information from its event logs. The Contractor shall be responsible for analyzing and tracking all failures, identifying trends and pattern failures, and for entering data into the reliability tracking system. The Contractor shall identify and perform corrective action when subsystems fail to meet their MDBSF requirement.

N18.4.6.5. RELIABILITY TEST REPORTS

The Contractor shall submit test reports in written and electronic format for the Engineer's review and approval resulting from the monthly failure review board meetings beginning one month after the start of reliability testing program until all subsystems pass the test and a final test report is issued. These test reports will be used to track the progress of the reliability test program.

At the conclusion of the test program, a final report that includes achieved Vehicle and subsystem MDBSF and all test records that the Contractor has maintained to document MDBSF values shall be submitted in written and electronic format (CDRL N1811).

N18.5. MAINTAINABILITY PROGRAM

N18.5.1. GENERAL

Procedures, policies, and practices for performing maintenance shall be based on and be compatible with those currently in use by MDT. The physical design of systems, subsystems, and components shall follow the maintainability design criteria identified herein.

The objective of the maintainability program shall be to minimize maintenance labor and materials costs, vehicle downtime, and the need for specially trained and highly skilled repair and maintenance personnel. The Contractor shall implement a maintainability program to ensure that these objectives are met.

N18.5.2. MAINTAINABILITY PROGRAM PLAN

The Contractor shall submit a maintainability program plan with the Proposal, revising it as required for the Engineer's approval, following the award of the Contract (CDRL N1812). The maintainability program plan shall be based on the requirements of this section. The Contractor shall use MIL-HDBK-470A as a guide in developing the plan. The purpose of the maintainability program plan is to ensure that the system shall be designed to meet the specified maintainability requirements in a cost-effective manner. At a minimum, the plan shall contain the following:

a. Maintainability program objectives.

b. A schedule of maintainability program activities that identifies specific tasks, their start and completion dates, and how they are coordinated and integrated with major program milestones for the design and test phases.

c. The methodology the Contractor shall use to predict compliance with the maintainability requirements as specified, including descriptions of design and analysis techniques.

d. The organization and personnel responsible for managing the maintainability program.

e. Controls for equipment Subcontractors and how compliance will be assured.

f. Maintainability program status reporting.

g. Definition of interfaces between the maintainability program and other closely related programs, such as reliability and system safety.

N18.5.3. MAINTAINABILITY DEFINITIONS

N18.5.3.1. MEAN TIME TO REPAIR

Mean Time to Repair (MTTR) is the ratio of the total active corrective maintenance time, T_{cm}, expended during a given time interval, T, for the total population of identical items divided by the total number of relevant failures, F, requiring corrective maintenance that occurs within the population of items during the same time interval. It is expressed quantitatively as:

$$MTTR = \frac{T_{cm}}{F}$$

N18.5.3.2. CORRECTIVE MAINTENANCE

Corrective Maintenance (CM) is all maintenance tasks associated with the restoration of a vehicle, subsystem, or item of equipment to operational status when the need for correction is due to a relevant failure.

N18.5.3.3. PREVENTIVE MAINTENANCE

Preventive Maintenance (PM) is all maintenance tasks associated with the performance of scheduled activities to vehicles, subsystems, or equipment. This activity may consist of servicing and inspection, component rehabilitation, or functional checks of operating systems.

N18.5.4. MAINTAINABILITY REQUIREMENTS

N18.5.4.1. SYSTEM CORRECTIVE MAINTENANCE REQUIREMENTS

The Contractor shall meet the following system corrective maintenance requirements for the vehicle:

- Mean time to repair = 1.5 hours.
- Maximum maintenance time to repair (M_{max}) of 3.5 hours for at least 90% of all actions.

The system corrective maintenance requirements shall be analyzed in the maintenance engineering analysis identified in this section and verified by test in accordance with the requirements herein.

N18.5.4.2. SUBSYSTEM CORRECTIVE MAINTENANCE ALLOCATIONS

The Contractor shall allocate MTTR requirements to the various subsystems identified in Exhibit N18-2. The allocations shall be submitted to the Engineer for review and approval (CDRL N1813). The allocations shall take into account the reliability of each subsystem such that the overall MTTR requirements of this section are met.

The subsystem corrective maintenance allocations shall be analyzed in the maintenance engineering analysis identified herein.

N18.5.4.3. PREVENTIVE MAINTENANCE REQUIREMENTS

The total preventive maintenance man-hours required by each vehicle shall not exceed 8.0 man-hours per 5,000 miles. The preventive maintenance shall include all servicing, inspections, or any task required on a scheduled basis, exclusive of vehicle cleaning activities, daily safety inspections, and major overhauls. The frequency and elapsed time to perform these tasks shall be defined in the maintenance and servicing manuals.

The preventive maintenance requirements shall be analyzed by subsystem in the inspection and maintenance analysis identified herein.

N18.5.4.4. SERVICING REQUIREMENTS

Servicing shall be restricted to the replenishment of consumables and shall not be required more often than every 60 days, exclusive of replenishment of windshield washer fluid and HVAC filters. The frequency and elapsed time to perform these tasks shall be defined in the maintenance and servicing manuals.

The servicing requirements shall be analyzed in the inspection and maintenance analysis identified herein.

Specific requirements for truck maintenance are presented in TPN11.

N18.5.5. MAINTAINABILITY DESIGN CRITERIA

The vehicles and all of their subsystems and components shall incorporate the following design features:

a. Accessibility: All subsystems and components requiring preventive maintenance shall be readily accessible for service and inspection. Accessibility of components shall be proportional to frequency of maintenance and repair of the components; that is, the more the need to access a component, the easier the access shall be. No active electrical or mechanical components that require maintenance shall be structurally embedded to preclude convenient access for repair or replacement.

b. Modular Design: Modular design principles shall be employed to the greatest extent practical. Components shall be packaged together in replaceable subassemblies, according to the logical function that they perform. Components or subassemblies requiring occasional removal shall preferably be plug-in units.

c. Interchangeability: Assemblies or components that are functionally interchangeable shall be physically interchangeable. Assemblies or components that are not functionally interchangeable shall not be physically interchangeable.

d. Adjustments: The need for adjustments shall be avoided. When adjustment points cannot be avoided, they shall be readily accessible, adequately identified, and self-locking to prevent inadvertent adjustment or drift.

e. Skills and Training: The maintenance requirements of the vehicle and its subsystems and components shall be in accordance with the skills and training of MDT maintenance personnel.

f. Special Tools: The number of special tools required for maintenance and repair shall be minimized. However, if they are required, they shall be defined and furnished in accordance with TPN15.

g. Panels and Openings: Panels and openings shall be of sufficient quantity, size, and placement to permit ready access from normal work areas and positions. Adjustment controls, fittings, safety valves, and such shall be directly accessible through panels and openings. Self-retaining fasteners shall be used whenever possible.

Special access opening tools shall not be used, unless considered necessary to prevent vandalism.

h. Cable Connections: Cable connectors shall be spaced far enough apart so that they can be grasped firmly for connecting and disconnecting. Connectors shall be properly labeled and keyed so that they cannot be interchanged or improperly installed. Signal and power pins shall not be adjacent to one another.

i. Lifting Assists: Handles, lifting lugs, or approved functional equivalents shall be provided on components of 40 lbs (18 kg) or more.

j. Visual Inspection: Visual inspection of equipment shall be unobstructed.

k. Structural Elements: Access to structural components shall be provided to the greatest extent practicable to allow inspection for cracks, corrosion, and structural integrity.

l. Test Points: Built-in test points shall be provided and marked. Major components having test panels or test points shall be located for easy accessibility and shall permit external monitoring of critical functions. Test points shall be protected against environmental damage and human error.

m. Fault Isolation: Failure indicators shall be provided and identified. Systematic fault isolation procedures shall be developed and included in the maintenance manuals.

n. Labeling: All test points, fault indicators, modules, wire junctions, pipes, tubes, wires, etc., shall be identified by name plates, color coding, number coding, or other means to assist maintenance personnel.

o. Hardware: Standard, commercially available industrial components and hardware shall be used whenever possible.

N18.5.6. MAINTENANCE CONCEPT

The Contractor shall develop a maintenance concept document and submit it in written and electronic format to the Engineer for review and approval at the preliminary design review and updated as required (CDRL N1814). The document shall address:

- Maintenance categories.

- Maintenance manning and skill levels.
- Maintenance equipment and facilities.
- Special test equipment.
- Maintenance support equipment.
- Special tools.
- Fault isolation methods and procedures.

N18.5.7. MAINTAINABILITY ANALYSES

The following maintainability analyses shall be performed by the Contractor and updated as required to reflect design changes.

All analyses shall be submitted to the Engineer for review and approval in written and electronic format.

N18.5.7.1. INSPECTION AND MAINTENANCE ANALYSIS

The Contractor shall perform an inspection and maintenance analysis to show compliance with the preventive maintenance and servicing requirements herein. The analysis shall be submitted to the Engineer for review and approval at the preliminary design review and updated as required (CDRL N1815).

N18.5.7.2. FAULT ISOLATION/TROUBLSHOOTING PLAN

The Contractor shall develop a fault isolation/troubleshooting plan to show how failures will be isolated on the vehicle once they occur. The plan shall be submitted to the Engineer for review and approval at the preliminary design review and updated as required (CDRL N1816). At a minimum, the plan shall include the Contractor's approach to fault isolation/troubleshooting and a table showing:

- Fault symptoms.
- Probable fault causes.
- Fault isolation procedures.

N18.5.7.3. MAINTENANCE ENGINEERING ANALYSIS

The Contractor shall perform a Maintenance Engineering Analysis (MEA) to ensure that the requirements of the maintainability program are met. The analysis shall consider the reliability of each subsystem such that the overall Mean Time to Repair requirements of this section are verified. The maintainability requirements shall be compared to those being predicted and then achieved by the Contractor. The Contractor shall identify and define the prediction techniques that have been used. The analysis shall

be submitted to the Engineer for approval at the preliminary design review and updated as required (CDRL N1817).

The Contractor shall correct those subsystems that exceed 10 percent of any allocation at the discretion of the Engineer. The MEA shall address:

- System corrective maintenance requirements of this section.
- Subsystem corrective maintenance allocations of this section.

The analysis of the various components shall include specific maintenance actions and shall be categorized as follows.

a. On-Vehicle Activities and Time To Perform:

   (1) Troubleshoot and Fault Isolate.

   (2) Remove and Replace or Repair.

   (3) Functional Checkout.

b. Off-Vehicle Activities and Time To Perform.

N18.5.8. MAINTAINABILITY DEMONSTRATION TEST

The Contractor shall conduct a formal maintainability demonstration test to prove compliance with system corrective maintenance requirements. The test shall be developed using MIL-HDBK-470A as a guide. The test shall be conducted using MDT maintenance personnel to perform the demonstration test tasks.

N18.5.8.1. MAINTAINABILITY DEMONSTRATION TEST PLAN

The Contractor shall submit a maintainability demonstration test plan to the Engineer for review and approval (CDRL N1818). The test plan shall be developed using MIL-HDBK-470A as a guide and shall include:

a. A test schedule of maintainability testing dates.

b. Method of verifying achievement of MTTR requirements.

c. The success-failure criteria for measuring MTTR and M_{max} values.

d. Maintainability demonstration test procedures.

e. Analysis methods to identify the cause and need for corrective action.

f. The format and location of test records, test logs, and data records.

A final maintainability demonstration test report showing the results of the test shall be submitted for review and approval after completion of the test (CDRL N1819).

EXHIBIT N18-1

SYSTEM RELIABILITY REQUIREMENTS

Overall System MDBSF Requirement = 250,000 Miles		
TP Section	Subsystem	MDBSF* (Miles)
3	Carbody	1,500,000
4	Couplers and Draft Gear	7,000,000
5	Operator's Cab	Included in Carbody
6	Doors	2,500,000
7	HVAC System	8,500,000
8	Lighting	15,000,000
9	Auxiliary Electrical Equipment	2,500,000
10	Propulsion	3,500,000
11	Trucks and Suspension	10,000,000
12	Friction Brakes	2,000,000
13	Communications	1,200,000
14	Train Control	3,500,000
20	Vehicle Monitoring System	5,000,000

* Average vehicle speed = 32 mph.

* Assume Train Length = 2 Married Pairs for all calculations.

EXHIBIT N18-2

SYSTEM EQUIPMENT IDENTIFICATION

TP Section	Subsystem	Equipment Identification Major Elements including, but Not Limited to
3	Carbody	Structures, Accessories, Misc. Non-operating vehicle Accessories (Windows, Seats, Signs, Panels), Door Assemblies
4	Couplers and Draft Gear	Mechanical Coupler, Electrical Heads, Coupler Controls, Drawbar
5	Operator's Cab	Operator's Console, , Master Controller Operator's Seat, Cab Accessories, Front End Controls, TODs
6	Doors	Door Operators and Linkage, Door Controls
7	HVAC System	Evaporator Assemblies, Compressor/Condenser Assemblies, HVAC Controls,
8	Lighting	Interior and Exterior Lights, Head and Taillights
9	Auxiliary Electrical Equipment	Auxiliary Inverter, LVPS, Battery, Distribution Circuitry, Annunciators, Circuit Breakers, Bypass Switches, Current Collector Assemblies
10	Propulsion	Traction Motors, High Speed Circuit Breaker, Knife Switch, Inverter, Control Logics, Gear Units
11	Trucks and Suspension	Truck and Components from Rail to Body Bolster, Suspension, Wheels and Axles, Journal Bearings
12	Friction Brakes	Compressor, Electro/Pneumatic Controls, Brake Pneumatic Components, Piping and Fittings, Brake Actuators, Spin/Slide Apparatus, Logic
13	Communications	Public Address, Passenger Information Signs and Intercom Equipment, CCU, Radio, CCTV Cameras, DVRs, Vehicle Media Controller and Wireless Interface Equipment and Smoke Detectors
14	Train Control	ATP, ATO and TWC Equipment
20	Vehicle Monitoring System	VMS Units, Data/Event Recorders, TMS Hardware and Software

TABLE OF CONTENTS

19. MATERIALS AND WORKMANSHIP 19-1
19.1. GENERAL 19-1
19.1.1. CITED REFERENCES 19-2
19.1.2. SUBMITTALS – CDRLS 19-7
19.2. METALS 19-8
19.2.1. STEEL 19-9
19.2.2. ALUMINUM 19-10
19.3. NON-METALS 19-10
19.3.1. ELASTOMERS 19-10
19.3.2. GLASS 19-12
19.3.3. PLASTICS AND POLYMERS 19-13
19.3.4. PLYWOOD 19-16
19.3.5. SANDWICH PANELS 19-17
19.3.6. NEOPRENE FOAM 19-18
19.3.7. SILICONE FOAM 19-18
19.3.8. FLOOR COVERING 19-19
19.3.9. MARKING FILM 19-19
19.3.10. CAULKING AND SEALING 19-20
19.3.11. ADHESIVES 19-21
19.4. JOINING AND FASTENING 19-22
19.4.1. FASTENING TO STRUCTURAL MEMBERS 19-22
19.4.2. THREADED FASTENERS 19-22
19.4.3. RIVETS AND RIVETING 19-24
19.5. PROTECTION OF METALS 19-24
19.5.1. DISSIMILAR METAL TREATMENT 19-25
19.5.2. PAINT AND PRIMER 19-25
19.6. WELDING, BRAZING, AND SOLDERING 19-27
19.6.1. WELDING 19-27
19.6.2. BRAZING 19-29
19.6.3. SOLDERING 19-29
19.7. PIPING, TUBING, HIGH PRESSURE HOSES, AND PRESSURE VESSELS 19-30
19.7.1. PIPING AND TUBING REQUIREMENTS 19-30
19.7.2. HIGH PRESSURE HOSES 19-31

19.7.3. PRESSURE VESSELS 19-31
19.8. BEARINGS AND LUBRICATION 19-31
19.8.1. ANTI-FRICTION BEARINGS 19-31
19.8.2. SLEEVE BEARINGS AND BUSHINGS 19-31
19.8.3. LUBRICANTS 19-32
19.9. THERMAL AND ACOUSTIC INSULATION 19-32
19.9.1. GENERAL 19-32
19.9.2. THERMAL INSULATION 19-32
19.9.3. ACOUSTIC INSULATION 19-32
19.10. WIRING AND ELECTRICAL DEVICES 19-33
19.10.1. ELECTRICAL AND ELECTRONIC PARTS REQUIREMENTS 19-33
19.10.2. CONDUCTORS 19-33
19.10.3. ELECTRICAL EQUIPMENT AND DEVICES 19-43
19.10.4. ELECTRONIC COMPONENTS 19-46
19.11. FLAMMABILITY AND SMOKE EMISSION 19-48
19.11.1. FLAMMABILITY AND SMOKE GENERATION LIMITATIONS 19-49

N19. MATERIALS AND WORKMANSHIP

N19.1. GENERAL

This section defines the requirements for the materials and workmanship to be utilized in the construction of the new Miami Metrorail Vehicles. All materials shall be new and shall satisfactorily and safely perform within their operating environment and in accordance with their intended functions.

All materials shall be approved by the MDT Fire Life Safety Committee. Workmanship shall conform to the best manufacturing practices. Material that is defective or repaired may not be used. These materials shall also be in accordance with the stated specifications and cited standards.

The Contractor shall review, approve, and submit to the Engineer samples as required by the Contract Documents.

The Contractor shall maintain records tracing all materials to their manufacturer and verifying compliance with quality standards identified in this section.

Whenever commercial material is not addressed by a specification or standard, the material shall be identified by the commercial trademark, name, and address of the Contractor. A description of the material composition shall be submitted to the Engineer for review and approval (CDRL N1901).

Substitutes for approved materials or single source materials shall not be used, unless reviewed and approved by the Engineer. Usage shall be determined on a case-by-case basis.

Foreign matter, such as shavings, chips, etc., shall be completely removed from all assemblies, subassemblies, parts, and components.

Surfaces exposed to passengers, crew, or repairmen shall be smooth and free of burrs, fins, sharp edges, and dangerous protrusions.

The Contractor shall dispose of any materials used in the Work that are not deliverable to Miami-Dade in accordance with the Contract Documents.

The following materials shall not be used in the construction of the vehicles:

- Polyvinyl chloride (PVC).
- Asbestos.
- Lead in brake shoes or paint.

- Urethane foam.
- Polychlorinated Biphenyl.
- Kapton insulated wire.

Threaded aluminum fasteners shall not be used. Threaded aluminum holes may only be used with a helicoil or other equivalent component.

The Contractor shall maintain a list of all materials used in the vehicle and shall submit this list along with material certifications and material property test reports to the Engineer for review and approval (CDRL N1902).

The Contractor shall keep all Material Safety Data Sheets (MSDS) on file for all chemical materials used in the manufacture of the vehicle. A copy of each MSDS shall be submitted to the Engineer for review and approval (CDRL N1903). Material Safety Data Sheets will be reviewed by the MDT Fire Life Safety Committee.

N19.1.1. CITED REFERENCES

The following section lists the documents referenced in this specification.

Effective date of documents:

- Applicable documents shall be of the issue in effect on the date of the issue of contract.

Substitute documents:

- The use of later revision or use of a comparable document, in place of a specific document shall require approval by the Engineer.

Source/Section	Title
49CFR 238.103	Passenger Equipment Safety Standards – Fire Safety
AA Publication	Aluminum Standards and Data
AA 6053-T61	Aluminum Alloy
AA 6061-T6	Aluminum Alloy
AAR	Association of American Railroads
AAR M-201	Steel Castings
AAR M-618	High Pressure Hoses
AAR RP-585	Wiring and Cable Specification
AAR RP-587	Wire and Cable Insulating Material – Silicone Rubber Insulated

Source/Section	Title
AAR, Signal Manual, Vol. 2, Section 6	As Applicable
ADA	Americans with Disabilities Act
AISI	American Iron and Steel Institute
APTA	American Public Transportation Association
APTA RP-E-004-98	Recommended Practice for Gap and Creepage Distance
APTA RP-E-009-98	Recommended Practice for Wire Used on Passenger Equipment
APTA SS-E-001-98	Standard for Insulation Integrity
APTA SS-E-005-98	Standards for Grounding and Bonding
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B31.1	Code for Power Piping
ANSI Z26.1	Safety Codes for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways
ASME, Section VIII	Boiler and Pressure Vessels Code
ASME, Section IX	Welding and Brazing Qualifications
ASTM	American Society for Testing and Materials
ASTM A27	Steel Castings, Carbon, for General Application
ASTM A31	Steel Rivets and Bars for Rivets, Pressure Vessels
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A242	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105,000 psi Minimum Tensile Strength
ASTM A354	Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A488	Standard Practice for Steel Castings, Welding, and Qualifications of Procedures and Personnel

Source/Section	Title
ASTM A490	Heat-Treated Steel Structural Bolts, 150,000 psi Minimum Tensile Strength
ASTM A502	Steel Structural Rivets
ASTM A588	Specification for High Strength-Low Alloy Structural Steel with 50,000 psi Minimum Yield
ASTM A606	Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance
ASTM A666	Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar
ASTM A668/A668M-04	Forgings, Carbon and Alloy Steel, for Railway Use
ASTM B33	Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B174	Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C177	Standard Test Method for Steady State Heat Flow
ASTM C273	Plywood, Metal-Faced
ASTM C1166	Elastomers
ASTM D256	Tests for Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D523	Test for Specular Gloss
ASTM D573	Rubber-Deterioration in an Air Oven
ASTM D618	Conditioning Plastics and Electrical Insulating Materials for Testing
ASTM D624	Test for Rubber Property – Tear Resistance
ASTM D638	Test for Tensile Properties of Plastics
ASTM D695	Test for Compressive Properties of Rigid Plastics
ASTM D785	Test for Rockwell Hardness of Plastics and Electrical Insulating Materials
ASTM D790	Test for Flexural Properties of Plastics and Electrical Insulating Materials

Source/Section	Title
ASTM D792	Test for Specific Gravity and Density of Plastics by Displacement
ASTM D1055	Flexible Cellular Materials - Latex Foam
ASTM D1360	Test for Fire Retardancy of Paints (Cabinet Method)
ASTM D2583	Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D3359	Standard Method for Measuring Adhesion by Tape Test
ASTM D3675	Surface Flammability of Flexible Cellular Materials Using a Radiant Heat Source
ASTM E162	Test for Surface Flammability for Materials Using a Radiant Heat Energy Source
ASTM E648	Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E662	Test for Specific Optical Density of Smoke Generated by Solid Materials
ASTM E1333	Large Chamber Test Method
ASTM G24.30	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM G38.6	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
AWS B2.2	Standard for brazing procedure and performance qualification
AWS C7.2	Recommended Practices for Laser Beam Welding, Cutting, and Drilling
AWS D1.1	Structural Welding Code, Steel
AWS D1.2	Structural Welding Code, Aluminum
AWS D1.3	Structural Welding Code, Sheet Steel
AWS D1.6	Structural Welding Code, Stainless Steel
AWS Handbook	Brazing and Welding Handbook
FMVSS 302	Standard for Vehicle Materials
FRA	Federal Railroad Administration
IEEE 11	Rotating and Electrical Machinery for Rail and Road Vehicles
IEEE 383	Class 1E Electric Cables, Field Splices

Source/Section	Title
IEEE 1478	Standard for Environmental Conditions for Transit Rail Car Electronic Equipment
IPC 2221	Printed Wiring for Electronic Equipment
JEDEC	JEDEC Solid State Technology Association
MIL	MIL Standard
MIL-C-5015	Connector, Electrical, Circular Threaded, AN Type, General Specification for Materials
MIL-C-7438	Core Material, Aluminum, for Sandwich Construction
MIL-HDBK-454	General Standard Requirements for Electronic Equipment
MIL-IPC 2221	Standard for PC Board Design
MIL-M-43719	Marking Film Decals
MIL-P-21035	Paint, High Zinc Dust Content, Galvanizing Repair
MIL-R-5757	Relays, Electromagnetic
MIL-R-6106	Relays, Electromagnetic, including Established Reliability Types
MIL-STD-104 Class 1	Limit for Electrical Insulation Color
MIL-STD-889	Dissimilar Materials
MIL-STD-35340	Washer-Lock, Helical Spring, Extra Duty (extra-heavy) Series
MIL-W-6858	Welding, Resistance: Spot and Seam
MIL-W-81044	Wire, Electric, Cross linked, Polyalkene, Cross linked
NATO VG 95 234	Connector, Electrical, Circular Threaded, AN Type, General Specification for Materials
NATO VG 96 454, Part 3	Connector, Electrical, Circular Threaded, AN Type, General Specification for Materials
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEMA AB3	Molded Case Circuit Breakers and their Application
NEMA LD3	High Pressure Decorative Laminates
NEMA LI1	industrial Laminated Thermosetting Product
NEMA MG1-2003	Motors and Generators

Source/Section	Title
NFPA 130	Standard for Fixed Guideway Transit Systems
NFPA 130 Table 8.4	Test Procedures and Performance Criteria for the Flammability and Smoke Emission Characteristics of Materials Used in Fixed Guideway Vehicles and Passenger Rail Cars
NIST Voluntary Product Standard PS 1-07	Construction and Industrial Plywood
SAE AS22759/6	Wire, PTFE, ETFE Insulated, Copper or Copper Alloy Conductor
SAE Grade 5	Society of Automotive Engineers Steel Specification
SAE Grade 8	Society of Automotive Engineers Steel Specification
SAE J403	Chemical Compositions of SAE Carbon Steels
SS-T-312	Tile, Floor; Asphalt, Rubber Vinyl, Vinyl-Asbestos

N19.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No	Title	TP Reference
N1901	Material Composition Description	TPN19.1.
N1902	Material Lists and Test Reports/Certification	TPN19.1.
N1903	Chemical Material Safety Data Sheets (including paints, adhesives, sealants, compounds, solvents, and lubricants)	TPN19.1.
N1904	Certification of Compliance for Elastomeric Materials	TPN19.3.1.2.
N1905	Body Fill Material Smoke and Flame Test Results	TPN19.3.3.4.
N1906	Plymetal Sealant	TPN19.3.5.2.
N1907	Neoprene Foam Physical and Performance Characteristics	TPN19.3.6.
N1908	Silicone Foam	TPN19.3.7.
N1909	Floor Covering Samples	TPN19.3.8.

CDRL No.	Title	TP Reference
N1910	List and Properties of Adhesives	TPN19.3.11.
N1911	Proposed Threaded Inserts or Special Fasteners	TPN19.4.2.1.
N1912	Proposed Blind Rivets	TPN19.4.3.1.
N1913	Corrosion Control Plan	TPN19.5.
N1914	Sealant Method for Ferrous Metal	TPN19.5.1.2.
N1915	Paint Procedures	TPN19.5.2.1.
N1916	Paint and Primer Data	TPN19.5.2.1.
N1917	Underfloor Piping, Conduits and Wireways Paint System	TPN19.5.2.2.
N1918	Accessory Exterior Coatings	TPN19.5.2.4.
N1919	Paint Underfloor	TPN19.5.2.6.
N1920	Welding Operations Documentation	TPN19.6.1.1.
N1921	Welder Qualifications of Personnel	TPN19.6.1.2.
N1922	Stress Relief Procedure	TPN19.6.1.3.
N1923	Resistance Weld Procedures	TPN19.6.1.3.
N1924	Piping Cleaning Methods	TPN19.7.1.1.
N1925	Proposed Lubricants for Bearings and Bushings	TPN19.8.3.
N1926	Thermal and Acoustical Insulation Data and Application Process	TPN19.9.1.
N1927	Design Loads for 600V and 2000V Cables	TPN19.10.2.
N1928	Proof of Design for Proposed Underfloor Connector	TPN19.10.2.4.
N1929	Integrated Circuits Screening Method	TPN19.10.4.4.1.
N1930	Flame Propagation and Smoke Density Test Results/Certification	TPN19.11.1.1.
N1931	Matrix of Flammable Materials Giving Weight, Heat Values, Flame Spread Index, and Ignition-Points	TPN19.11.1.1.

Certificates of Compliance shall be retained for all material tests, including flammability and smoke emission. Test results and certificates of compliance shall be submitted to the Engineer.

N19.2. METALS

N19.2.1. STEEL

N19.2.1.1. LOW-ALLOY HIGH TENSILE STRENGTH, STRUCTURAL STEEL

Low-Alloy High Tensile (LAHT) steel for the carbody shall conform to the requirements of ASTM A242.

LAHT structural parts exceeding 0.5 inch in thickness shall conform to the requirements of ASTM A588.

LAHT hot-rolled and cold-rolled steel sheet and steel strip, with improved atmospheric corrosion resistance, shall conform to the requirements of ASTM A606.

Other low alloy steels may be used with the approval of the Engineer.

N19.2.1.2. STAINLESS STEEL

Corrosion resistant, austenitic, stainless steel sheet, strip, plate, and flat bar shall conform to the requirements of ASTM A666. Stainless steel shall be AISI type 201, 204, 301, 302, 304, 316, or 347 in accordance with the intended function. Other types of stainless steels, i.e., ferritic, martinsitic, or duplex, may be used with the approval of the Engineer.

For welded applications, L or LN varieties of those steels shall be used. For laser type welding applications, other varieties of stainless steels for welding may be used with the approval of the Engineer.

The Contractor shall prepare and submit for approval a test and inspection plan for the acceptance of all stainless steels to be used prior to the purchase of any such material.

A passivation process shall be utilized subsequent to cutting operations of exposed interior and exterior stainless steel components.

All stainless steel used in this procurement shall be cast, rolled, and finished in the United States.

N19.2.1.3. STEEL CASTINGS

N19.2.1.3.1. General Requirements

Steel castings shall be selected for the composition characteristics, heat treatment, and design best suited for the intended service. Weld repairs of castings shall be allowed, provided that repairs are performed by welders qualified according to ASTM A488 and the repairs are performed in accordance with a written procedure approved by the Engineer.

N19.2.1.3.2. High Strength Castings

High strength castings shall be tested, inspected, and accepted in accordance with the procedures described in AAR M-201.

N19.2.1.3.3. **General Purpose Castings**

General purpose steel castings shall conform to ASTM A27, either Grade 65-35 or Grade 70-36, or as otherwise approved by the Engineer.

N19.2.1.3.4. **Low Alloy Nickel Castings**

Any low alloy nickel castings shall conform to AAR M-201.

N19.2.1.4. STEEL FORGINGS

Alloy steel forgings shall meet the requirements of ASTM A668/A668M-04.

N19.2.2. ALUMINUM

Aluminum alloy mill products shall be identified by designations prescribed by the Aluminum Association (AA) and shall conform to specifications contained in the AA Publication, "Aluminum Standards and Data."

Aluminum alloy surfaces shall not make direct metal-to-metal contact with the surfaces of copper, brass, bronze, silver, nickel, nickel-plated parts, or alloys of any of these materials, lead, tin, or ferrous materials, except for electrical connections where appropriate joint compounds shall be used. This exception is subject to the Engineer's review and approval.

N19.3. NON-METALS

This section describes the standards for non-metallic materials used for the vehicles.

N19.3.1. ELASTOMERS

N19.3.1.1. GENERAL

Elastomeric parts may include door and window seals, glazing strips, truck bumpers and snubbers, structural and compressible gaskets, and mounting pads. All parts shall be composed from suitable elastomers compounded and cured to perform satisfactorily under the environmental conditions in which the vehicle may be operated. Elastomers subject to exposure to ultra-violet light shall be formulated to be resistant to the effects of same. Elastomers subject to exposure to oils and other potential solvents, including car wash fluids, shall be selected accordingly.

N19.3.1.2. COMPLIANCE

Elastomeric materials shall be tested to verify compliance with the following performance requirements, unless specific design applications dictate otherwise. Certificates shall be provided stating compliance with the requirements of the standards (CDRL N1904). In addition to the indicated tests, elastomers must pass the smoke/flame performance criteria tests as specified in NFPA 130, test method ASTM C1166 and ASTM E662, with the exception of truck suspension elastomers.

Physical Property	ASTM Test Method	Test Value
Hardness, Durometer A	D2240	45 to 75
Tensile strength	D412	1500 psi (min.)
Ultimate Elongation	D412	300% (min.)
Ozone Resistance	D1149	No cracks
Oil Aging Resistance	D471	+80% change in volume (max.)
Permanent-Set Resistance	D395, Method B	25% comp. set (max.)
Brittleness Temperature	D746	-40°F
Tear Resistance	D624	200 lb/inch (min.)
Resistance to Heat Aging	D573	96 hrs. 160°F
Smoke Emission	E662	D_s <100 @ 90sec D_s < 200 @ 240sec
Flammability	C1166	No flame dripping
Max Change in Elongation		-40%
Max Change in tensile strength		-15%
Max Change in Hardness, Durometer A		-5 to +15

The tensile strength shall not be reduced by more than 25% when subjected to accelerated aging by the methods specified in ASTM D573 for a period of 96 hours in an air oven at 160°F.

N19.3.1.3. FINISH

Elastomeric materials shall be smooth, and have a natural finish. Interior decorative trim shall be colored to harmonize with adjacent surfaces. All colors and gloss shall be as approved by the Engineer.

N19.3.1.4. METAL PARTS

Metal parts to which elastomeric materials are cured shall be made in accordance with SAE J403 and consist of 1020 or 1045 hot-rolled steel or equivalent, suitably cleaned for bonding.

N19.3.2. GLASS

Laminated safety glass shall be used and shall conform to the following general manufacturing and finish requirements:

N19.3.2.1. SAFETY GLASS

Safety glass shall meet the requirements under Item 1, Table 1 of the latest revision of ANSI Z26.1, "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Code."

Laminated safety glass used in the F-end of the car, including that in the end door, shall be certified as having been tested and having met the FRA 49CFR223 Type I requirements. Side window and non F-end glazing shall meet FRA 49CFR223 Type II requirements.

To prevent particles of glass from striking the Operator, the window in front of the Operator shall incorporate a spall shield as its interior surface. Alternatively, a clear plastic sheet, with an approved abrasion-resistant coating may be installed behind the window and extend from the top of the Operator's console to the top of the window. This plastic sheet shall be hinged or otherwise arranged for easy removal to permit cleaning its forward surface and the interior surface of the window.

N19.3.2.2. TYPE

All safety glass shall be of the laminated sheet type and shall consist of two sheets of glass bonded with an approved interlayer of plasticized polyvinyl butyral resin in the form of a membrane approximately 0.045-inch thick, and resistant to degradation from ultraviolet or visible light and heat.

N19.3.2.3. FLATNESS

When an individual piece of glass is laid on a truly flat surface, such as a surface plate, the glass shall not indicate a bow of more than 0.030-inch per linear foot.

N19.3.2.4. DIMENSIONAL TOLERANCE

The overall dimensions of individual pieces as supplied shall be held within 0.060-inch of the dimensions specified.

N19.3.2.5. OVERLAP TOLERANCE

The overlap of one laminate of the piece with respect to the other, at an edge, shall not exceed 1/32-inch. Corners and burrs shall be ground smooth and all edges shall be treated in accordance with ANSI Z26.1, Section 6.

N19.3.2.6. COLOR

The color of the glass shall be as required by Section 3. When new, there shall be no more than ± 4% variation in the color of individual pieces of laminated sheet glass when examined over a white background.

N19.3.2.7. HAZE

All the laminates of the safety glass shall be so nearly free from haze that the glass shall have approximately the same clarity as a piece of the same nominal thickness of plate glass when viewed against a north light.

N19.3.2.8. SPECS AND SCRATCHES

Occasional specks of foreign material and scratches are permissible, provided such specks do not exceed 0.020-inch in greatest dimension and scratches do not exceed a total of 3 inches in length and neither are within the central three-quarters area of the light.

N19.3.2.9. BOND SEPARATION

The bond between two sheets of glass and the membrane shall be of such quality that when the glass is broken by twisting or by direct impact, there will be no separation between the glass sheets. Lights that contain unbonded areas shall not be used.

N19.3.2.10. MARKING

All safety glass shall be marked with proper identification in accordance with ANSI Z26.1, Section 7, and appropriate FRA-Type designation. The window light shall be installed so that the identification marking can be read from the inside lower right hand corner.

N19.3.3. PLASTICS AND POLYMERS

N19.3.3.1. MELAMINE LAMINATES

Melamine laminates shall be two-ply laminated and consist of a hard plastic film facing that is permanently bonded to a base sheet.

The melamine sheet shall be directly molded to the base sheet at a temperature of no less than 270o F and pressure of at least 1000 psi. The melamine sheet shall be at least 0.013 inch thick; the base sheet shall be

at least 0.025 inch thick. The use of contact adhesives to bond the melamine to the base sheet is not acceptable.

The final laminate assembly must conform to NEMA LD3 and be tested to ASTM E162 and ASTM E662 to meet the performance criteria set forth in NFPA 130.

N19.3.3.2. FIBERGLASS REINFORCED PLASTIC

The numerous processing methods are grouped under two headings:

a. Matched die molding.

b. Open die molding.

   (1) Hand lay up.

   (2) Spray lay up.

   (3) Vacuum bag or pressure bag.

The following requirements shall apply to fiberglass reinforced plastic:

a. Fiberglass Reinforced Plastic (FRP) shall be a polymeric-reinforced, laminated material, composed of a gel-coated surface, fiberglass reinforcement, and a polyester, epoxy, phenolic, or approved equivalent resin. FRP shall be able to withstand, without any physical degradation or deformation, the stresses encountered in the environment where it is to be used. FRP shall be resistant to acids, mild alkalis, and cleaning solutions used by MDT. All open die molded parts shall be gel coated.

b. In addition to the test requirements listed in this section, FRP products shall meet the flame/smoke requirements herein.

c. Resins used shall be of good commercial grade, thermosetting materials selected to meet physical and molding-process requirements. Resins and catalysts shall have life information available.

d. Fiberglass reinforcement shall be mat, fabric, woven roving, continuous roving, chopped spun roving, or swirl mat as required to meet physical and process requirements. Glass content by weight shall be 25% minimum.

e. Gel-coated finishes shall be resistant to scuffing, fire, weather, ultra violet light, perspiration, and cleaning agents, be pigmented to match the vehicle colors as approved by the Engineer, and have a minimum thickness of 0.015 inch.

f. Sandable or primer gel-coat shall be provided on panels that require painting.

g. Gel-coat additives, fillers, monomers, catalysts, activators, inhibitors, pigments, and flame proofing materials shall be added to

resin mixes to obtain finished products with required characteristics. Mineral filler shall not exceed 28% of finished weight for preformed matched die molding process.

h. Production techniques shall ensure that glass fiber reinforcement is distributed throughout final product in such manner as to avoid resin-rich or resin-starved sections. Voids, air pockets, or exposed sharp edges of the final product shall not be acceptable. FRP panels shall have greater thickness at attachment points and edges.

i. FRP panels that are to be painted shall be sanded and filled before the prime and finish coats are applied. In addition, surfaces shall be uniform, smooth, and free of porosity and crazing.

j. Certificates shall be provided stating that reinforced plastic materials comply with the requirements of specified standards. Pre-test conditioning of test specimens shall conform to ASTM D618.

k. Fiberglass parts shall be fastened by bolting through metal joints or strips. Washers or similar inserts shall be bonded between fiberglass panels when joined.

Fiberglass-reinforced plastic materials shall comply with the following minimum requirements:

Mechanical Property	ASTM Test Method	Open Molding	Matched Die Molding Preform
Tensile Strength	D638	10,000 psi	18,000 psi
Compressive Strength	D695	20,000 psi	24,000 psi
Flexural Strength	D790	19,000 psi	32,000 psi
IZOD impact	D256	10 foot-pounds per inch of notch	13 foot-pounds per inch of notch
Hardness	D2583	45 Barcol	45 Barcol
Heat	None	175°F Continuous	N/A
Thickness	None	1/8 inch min.	1/8 inch min.

N19.3.3.3. THERMOPLASTIC MATERIALS

Thermoplastic materials shall be resistant to ultra-violet light, and comply with the following requirements.

Physical Property	ASTM Test Method	Performance Requirement Value
Specific Gravity	D792	1.20 to 1.36
Hardness (Rockwell)	D785	90 to 100
Tensile Strength	D638	5,500 psi minimum at 73°F
Smoke Emission	E662	D_s (1,5) ≤ 100 D_s (4,0) ≤ 200
Flame Resistance	E162	I_s ≤ 25
Flexural Modulus	D790	320,000 psi minimum Elasticity at 73°F
Flexural Strength	D790	10,000 psi minimum at 73°F
Impact Strength (at 73°F, notched IZOD)	D256	0.36 N-m per mm (6.6 foot pounds per inch) of notch minimum
Heat Shrinkage	None	15% maximum 10 minutes at 380° F
Thickness	None	3/32 inch minimum

NOTE: Values as per NFPA 130 Table 8.4 Test Procedures and Performance Criteria for the Flammability and Smoke Emission Characteristics of Material Used in Fixed Guideway Vehicles and Passenger Rail Cars.

N19.3.3.4. PLASTIC/COMPOSITE BODY FILLER MATERIAL

All body filling material shall be selected to effectively discourage flame propagation, smoke generation, cracking, and checking. In all cases, the manufacturer's instructions shall be followed during application of body filler material. The Contractor shall submit to the Engineer for approval all material specifications, including flame and smoke test results, of all proposed body fill material for the vehicle (CDRL N1905).

N19.3.4. PLYWOOD

All plywood shall conform with the requirements of Grade "Structural I" of the NIST Voluntary Product Standard PS 1-07. Plywood used in flooring shall be marine grade. All plywood shall be stored under cover, protected from precipitation, wind, and sun. Each plywood panel shall be formed from one piece; jointed panels shall not be allowed. Plywood panels shall be sealed on all edges and cutouts as soon as possible after fabrication

with two coats of an approved paint/sealant to prevent moisture intrusion. All exposed edges of plywood, joints between plywood, fastener heads, and any openings or cutouts within the plywood shall be waterproofed and sealed with an approved coating prior to installation in the vehicle.

N19.3.5. SANDWICH PANELS

N19.3.5.1. GENERAL

Sandwich panels include, but are not be limited to, plymetal, honeycomb, or lumber-core panels, with metal or other approved facing material.

N19.3.5.2. PLYMETAL

The term "plymetal," as used in this Specification, refers to metal-faced plywood and shall conform to ASTM C273, unless otherwise specified. Plymetal panels for floor construction shall be faced on both sides with 0.016 inch minimum thickness stainless steel. Plymetal panels shall be sealed on all edges and cutouts as soon as possible after fabrication with two coats of an approved paint/sealant to prevent moisture intrusion with the metal seams properly bonded together. No delamination areas of stainless steel skin from the plywood core is allowable. In addition to these requirements, plymetal panels shall also meet the following test criteria:

Minimum Metal to Wood Conditions	Average Shear Value Test (or 80 % Wood Failure)
Dry Shear	250 psi
Boil shear, 3 hr. boil (tested wet at room temperature)	150 psi
Soak Shear, 48 hr. soak wet at room temperature	150 psi
Creep or cold flow, under static load for 48 hrs. at room temperature	250 psi

All exposed edges of the panels, joints between panels, fastener heads, openings, or cutouts within the panels shall be water-proofed and sealed with an Engineer-approved coating prior to installation in the vehicle. The sealant shall be submitted to the Engineer for approval (CDRL N1906).

N19.3.5.3. HONEYCOMB PANELS

The term "honeycomb panels," as used in this Specification, refers to honeycomb material bonded to melamine or to metal. Honeycomb-core panels shall be commercial grade and conform to applicable requirements of MIL-C-7438, unless otherwise specified. Bonding between the base material and the cover shall be sufficient to develop the full strength of the honeycomb material. There shall be no delamination allowed between the honeycomb core and the bonded material. Other composite materials may be proposed for the approval of the Engineer.

N19.3.5.4. COMPOSITE PANELS

The term "composite panels," as used in this Specification, refers to flat formed sheet materials not listed herein that may be utilized for structural flooring or other flat structural applications. Composite panels shall be formulated of materials with a proven service of transit application, and be resistant to water, oils, mold, and mildew. Bonding materials utilized as part of the composite shall be sufficient to develop the full strength of the composite panel. Composite panels shall be addressed in the vehicle structural analysis with worst case application loading not exceeding the yield strength of the material when analyzed in accordance with the structural analysis in TPN3. Panels shall be designed to accommodate movement due to expansion without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subjected to temperature and humidity ranges as specified in TPN2. Materials utilized in the formulation of composite panels shall yield formaldehyde emissions less than 0.20 ppm using the Large Chamber Test Method of ASTM E1333.

N19.3.6. NEOPRENE FOAM

Neoprene foam shall be high-resiliency foam latex. Base elastomer of latex shall be polymerized chloroprene (polychloroprene) and shall contain no reclaimed rubber.

The structure of foam shall consist of a network of closed cells of uniform character. Material shall have a high resistance to flexing, tearing, wetting, and burning as specified in this section.

Physical and performance characteristics shall be submitted for review and approval (CDRL N1907). Dimensions of elastomers shall conform to the requirements of ASTM D1055.

N19.3.7. SILICONE FOAM

Silicone foam shall be low-density and flame retardant.

Material shall be non-corrosive for use with metals and in hostile environments and exhibit low compression set.

Physical and performance characteristics shall be submitted for review and approval (CDRL N1908).

N19.3.8. FLOOR COVERING

Floor covering shall be a rubber sheet or an approved equivalent. The flooring shall be non-staining, non-discoloring, and non-oil extended. Rubber floor covering shall nominally contain 20% butadiene styrene rubber by weight. At room temperature, floor covering shall bend around a 0.75 inch diameter mandrel without breaking, cracking, crazing, or showing any change in color. Only high quality hard clay shall be used as a filler. No limestone shall be used in the compound. The rubber flooring shall be fully homogeneous throughout and shall be submitted to the Engineer for review and approval. The rubber flooring material shall meet the requirements of Federal Specification SS-T-312 and the flame and smoke test requirements herein. The selected floor covering material shall be slip-resistant in accordance with ADA.

Color and material samples shall be submitted to the Engineer for review and approval (CDRL N1909).

N19.3.8.1. FLOOR COVERING INSTALLATION

Prior to the installation of floor covering, the sub-floor shall have all depressions, voids, and cracks filled with an approved leveling compound and shall be leveled and smoothed to within 0.19 inch over 40 inch in any horizontal direction.

Floor covering shall be permanently secured to the plymetal sub-floor using adhesive recommended by the flooring manufacturer and approved by the Engineer. The floor covering and adhesive shall be resistant to solutions and solvents.

The bottom side of the flooring shall be sanded before laying and then securely bonded to the sub-floor panels, using a process recommended by the flooring manufacturer for high traffic applications. Flooring seams shall be sealed to prevent dirt accumulation and water intrusion.

N19.3.9. MARKING FILM

N19.3.9.1. GENERAL

Marking film decals and adhesives shall conform to the requirements of MIL-M-43719. Application techniques shall be in accordance with the manufacturer's recommendations.

N19.3.9.2. PHYSICAL PROPERTIES

The following physical properties shall apply to the marking film:

a. Lettering film shall be sufficiently opaque so that, when applied, films shall completely hide any contrasting background and shall be legible.

b. There shall be an initial 60° gloss value of 40 when tested in accordance with ASTM D523.

c. Films shall retain adhesive properties after one week of continuous exposure to a temperature of 150oF.

d. Films shall conform to the contours and surface finishes of the vehicle's interior and exterior surfaces at locations where decals are to be applied.

e. Overall thickness of processed film shall be between 0.0015 and 0.0045 inch.

f. Films shall withstand immersion in either distilled water or SAE No. 20 motor oil for 24 hours at temperatures ranging from 70oF to 90oF without any appreciable degradation in adhesion, color, or general appearance.

g. Marking films shall withstand the effects of detergents and brushes used in washing procedures for removal of graffiti.

h. Marking film shall be formulated to be resistant to ultra-violet light.

N19.3.10. CAULKING AND SEALING

N19.3.10.1. GENERAL

The use of caulking and sealing compounds shall be minimized.

Corrosive caulking and sealing compounds shall not be used.

Caulking and sealing compounds shall be applied in accordance with the manufacturer's instructions and recommendations, be non-staining, and supplied in colors closely matching those of adjacent materials and surfaces.

If butyl-type caulking is used, it shall be extruded polyisobutylene sealer compound of 100% solids.

Caulking primers shall be quick-drying, colorless, non-staining sealers, and of a type and consistency recommended by manufacturers of caulking materials for the particular surface involved.

Packing (backstop) shall be a non-staining, resilient material, such as fiberglass roving, neoprene, butyl, closed-cell foams, or other compressible materials compatible with the caulking compound used.

Caulking compound application shall be compatible with any following paint application.

N19.3.10.2. APPLICATION AND WORKMANSHIP

Joints, spaces, and junctures shall be packed and caulked or sealed. Dirt, dust, oil, and other foreign materials that would adversely affect caulking work shall be removed.

Surfaces shall be thoroughly dry before applying caulking compounds.

When so stipulated by the sealant manufacturer, paint and other protective coatings shall be removed from surfaces to be caulked prior to priming and application of sealants.

Surfaces that will have polysulfide liquid polymer or silicone compounds applied directly to them shall be prepared in accordance with the manufacturer's recommendations.

Compounds shall be applied with pneumatic guns with properly sized nozzles that exert sufficient pressure to completely fill voids and joints.

Unless otherwise indicated, the entire perimeter of each opening shall be caulked.

When the use of a caulking gun is impracticable, suitable hand tools shall be used with attention to achieving a smooth, continuous application.

The finish of caulking joints on flush surfaces and internal corners shall be neatly pointed; excess material shall be removed and caulking, where exposed, shall be free of wrinkles and uniformly smooth.

Application of polysulfide compounds shall be in accordance with the manufacturer's instructions and recommendations.

Compounds shall not be used when they become too gelled to be discharged in a continuous flow and shall not be modified by addition of liquids, solids, or powders.

When two-part compounds are being used, only the amount of caulking that can be installed within 4 hours shall be mixed.

Adjoining surfaces, finishes, and fixtures shall be carefully protected throughout caulking operations; stains, marks, or damage thereto, as a result of caulking and sealing work, shall be removed.

N19.3.11. ADHESIVES

The adhesives to be used for the installation of floor covering, panels, insulation, and vibration isolation materials shall have a satisfactory history in a rail transit environment. A list of all proposed adhesives, including the physical, chemical, and fire safety properties of each, shall

be submitted to the Engineer for review and approval (CDRL N1910). Adhesives shall have the shelf life identified on the container.

This requirement does not apply to adhesives used in extremely small quantities, such as application of nameplates or markers.

N19.4. JOINING AND FASTENING

N19.4.1. FASTENING TO STRUCTURAL MEMBERS

The Contractor shall ensure that any fastening or joining to structural members does not result in the possibility of moisture accumulation within any structural member.

N19.4.2. THREADED FASTENERS

N19.4.2.1. GENERAL

The number of different sizes and styles of fasteners used shall be minimized. Within common vehicle areas, fasteners shall be coordinated to limit the number of tools required for maintenance. Fastener applications shall be reviewed with and approved by the Engineer during the vehicle design review, and during manufacture. Fasteners shall contain unified inch screw threads conforming to ANSI B1.1 standards, unless otherwise specified or approved by the Engineer. All fasteners shall be stainless steel or zinc trivalent chromate finished steel (ASTM B633), depending on specific application. Zinc plating shall confirm to the latest revision of ASTM B633 type II SC3 or SC4.

All component mounting points shall be joined using SAE hardware. Metric fasteners may be used inside assemblies with the approval of the Engineer.

No protruding screws, mounting bolts, or similar items shall be permitted on the exterior of the vehicle. All fasteners used on the interior shall be stainless steel, dichromate or zinc-plated steel. For the vehicle interior, all exposed screws and fasteners shall be stainless steel with flat, oval or pan head, tamper resistant, and of the same type. All exposed bolts and nuts shall be stainless steel, unless approved by the Engineer. Exposed screws shall be of approved tamperproof type. Self-tapping screws shall not be used. Use of threaded inserts or special fasteners shall require the Engineer's review and approval (CDRL N1911).

At least 1.5 threads shall be visible beyond all nuts. Bolts smaller than 0.25 inch shall not project more than 1.5 threads plus 0.25 inch. Bolts 0.25 inch or larger shall not project by more than 8 threads.

N19.4.2.1.1. **Locking Requirements**

All threaded fasteners shall be self-locking or provided with locking devices. Locking devices shall be either; lockwire, lockwashers, or locknuts, as appropriate, for the desired application or service. Lockwire shall be stainless steel as specified herein. Lockwashers smaller than 0.75 inch shall be commercial standard, and those 0.75 inch and larger shall conform to MIL-STD-35340. Locknuts shall be of the nylon collar insert type. Nylon and interference lock nuts shall not be reused. The bolts shall have chamfered ends and at least 1.5 threads shall project through the nylon collar or outer interference thread. Bolts used with nylon locknuts shall not be used in areas of high temperature, heated or drilled for cotter pins. All locknuts shall comply with the Industrial Fasteners Institute requirements regarding locking ability.

N19.4.2.1.2. **Torque Marking/Indexing**

The Contractor shall ensure the proper application of all threaded fasteners. Torque marks extending from the threaded fastener to the surface that is being secured shall be applied to all safety-related hardware, including, but not limited to, truck, door, and brake equipment bolts.

The Engineer may require non-safety-related hardware to have a tightening indication present that is not required to extend onto surrounding surfaces.

N19.4.2.2. NUTS AND BOLTS

All fasteners with a thread diameter of ¼ inch or greater and all related hardware shall be manufactured in the United States and lot controlled with source steel traceable to U.S. manufacturer. All fasteners shall require the submittal of Certifications of Compliance (C of C), including material, with each shipment of hardware to the end user.

Carbon steel bolts shall conform to the requirements of ASTM A325; alloy steel bolts shall conform to ASTM A354 Grade BD or ASTM A490 as applicable. Nuts shall meet the requirements of ASTM A194, G38.6 or G24.30 as applicable. All screws, nuts, and bolts shall be stainless steel or zinc plated dichromate coated steel. Stainless steel nuts and bolts shall be used for stainless-to-stainless joints. Stainless steel bolts shall not be used in tapped holes or with tapping pads.

SAE Grade 8 hardware shall be used for mounting the traction motors to the trucks and for all truck-mounted apparatuses, unless specifically allowed otherwise by the Engineer.

All structural bolts for the undercar equipment shall be a minimum of SAE Grade 5 and the bolt diameter shall be no less than 3/8 inch diameter, regardless of design load.

N19.4.2.3. ELECTRICAL AND HIGH TEMPERATURE CONNECTIONS

Stainless steel screws, bolts, nuts, flat washers, and lock-washers, with both steel and plating suitable for high temperature without degradation of the strength of the hardware or its corrosion resistance, shall be used in mounting and in making connections to resistors and other heat-producing apparatus. Flat washers shall be used on both sides of all electrical connections (i.e., under bolt head and under nut). The Contractor shall apply anti-galling protection on stainless steel screw threads.

N19.4.3. RIVETS AND RIVETING

N19.4.3.1. GENERAL

Rivet holes shall be accurately located and aligned, and, when necessary during assembly, holes shall be reamed round to the specified size in position. Hand-driven steel rivets shall be driven hot and shall completely fill the holes. Mechanically driven rivets may be driven cold. Heads shall be concentric with the shank of the rivet. Exposed heads shall be free from rings, fins, pits, and burrs. Any rivet that is removed shall be replaced with the next larger size rivet after the hole is reamed to the appropriate size.

Rivets and lock pins exposed to passengers shall be stainless steel or aluminum as appropriate to the materials being joined.

The use of blind rivets for the fastening of vehicle exterior panels is prohibited. The use of blind rivets for other vehicle applications shall require the Engineer's review and approval (CDRL N1912).

N19.4.3.2. ALUMINUM

Aluminum alloy rivets shall be composed of AA 6061-T6 or AA 6053-T61 aluminum, or 2024 series aluminum, compatible with the associated parent metal.

N19.4.3.3. STEEL

Steel rivets shall conform to ASTM A502 or ASTM A31 or approved equivalent.

N19.5. PROTECTION OF METALS

The Contractor shall prepare a corrosion control plan that shall locate all areas of dissimilar metal or other material joining that could result in galvanic corrosion and material deterioration and materials that require treatment to prevent corrosion due to atmospheric exposure. This plan shall document the methods used to preclude failure due to corrosion for

any of the described conditions. The Contractor shall update this document as materials and treatments change. The corrosion control plan shall be submitted to the Engineer for review and approval (CDRL N1913).

N19.5.1. DISSIMILAR METAL TREATMENT

N19.5.1.1. GENERAL

All metals used in the fabrication process shall be surface-treated prior to assembly with corrosion-resistant materials; the severity of exposure to which the surface shall be subjected must be considered. The joining of incompatible metals and materials shall be minimized as much as possible. When such metals must be joined, provision shall be made in accordance with MIL-STD-889 to prevent chemical and/or electrical reactions between the metals.

Areas exposed to corrosive fluids or cleaning solutions shall be protected with coatings resistant to those fluids. It is the Contractor's responsibility to verify this to the Engineer's satisfaction.

Except as otherwise indicated, all exposed aluminum in the finished work within the carbody's interior shall have a protective anodized coating.

N19.5.1.2. STEEL SURFACES

All ferrous metal surfaces, other than stainless steel, unless otherwise specified, shall be protected by methods described herein. Steel surfaces not requiring protection shall be galvanized by the methods and requirements described in ASTM A123. Minor damage to galvanized coatings shall be repaired in accordance with MIL-P-21035. All reservoir interiors shall be protected from corrosion using an approved sealant method (CDRL N1914).

N19.5.2. PAINT AND PRIMER

N19.5.2.1. GENERAL

Data on all paints proposed to be used for this contract shall be submitted to the Engineer for review and approval (CDRL N1915).

The Contractor shall prepare a document containing procedures (CDRL N1916) for the following:

a. Surface cleaning.

b. The repair of surface imperfections such as; dents, roughness, gouges, and other visible defects.

c. Primer application.

d. Topcoat finish.

All surfaces to be painted shall be prepared as recommended by the paint system manufacturer.

Application of paint shall be uniformly applied to the thickness recommended by the paint manufacturer for application and thickness.

N19.5.2.2. UNDERFLOOR

Exposed underfloor steel surfaces, after installation of welded-on bracketry, shall receive a sufficient coat of primer and Munsell N6.0/30%R topcoat, which shall be Engineer approved and meet the recommendations of the paint system manufacturer for application and thickness (CDRL N1917).

N19.5.2.3. EQUIPMENT ENCLOSURES

The exterior of all equipment enclosures shall be coated with an Engineer-approved primer and coating with color of the paint to be Munsell 6.0/30%R. The interior of all equipment enclosures shall be coated with a primer and an Engineer-approved white insulating coating.

N19.5.2.4. CARBODY EXTERIOR

The carbody exterior shall be bright stainless steel, and will not be painted.

Any accessory exterior coating applications shall comply with the Manufacturer's recommendations and Engineer approval (CDRL 1918).

N19.5.2.5. ROOF

The roof shall have the same requirement as the carbody exterior. Each vehicle shall have a car number decal on the roof. The life of the decal, numeral application, size, position, and font shall be approved by the Engineer.

N19.5.2.6. UNDERFLOOR PIPING, CONDUITS, AND WIREWAYS

The Contractor shall ensure that wireways, supporting bracketry, conduits, and piping shall be finished with a paint system of approved color, which shall be Engineer approved and meet the recommendations of the paint manufacturer for application and thickness (CDRL N1919).

N19.5.2.7. ADHESION CRITERIA

Paint adhesion to metal or plastic surfaces shall rate a minimum of 3A when measured using ASTM D3359, test method A.

Film thickness shall be as recommended by the paint manufacturer or as specified in the Engineer-approved process specification of the Contractor or Subcontractor performing the Work. The allowable paint thickness shall not be less than that recommended by the paint manufacturer.

N19.5.2.8. CORROSION PREVENTION

Metals, particularly underframe equipment and structure, shall be treated in a manner considering the saline and moisture environment of Miami, Florida. Finish systems shall be reviewed with the Engineer during the design review phase of the project for approval.

N19.6. WELDING, BRAZING, AND SOLDERING

N19.6.1. WELDING

N19.6.1.1. GENERAL

The Contractor shall be responsible for the quality of all welding and brazing. Prior to welding, all surfaces shall be thoroughly cleaned to remove corrosion, rust, scale, slag, grease, oil, water, paint, and other foreign materials.

Parts that are joined by welding shall be supported and held in position by tables, or fixtures to prevent warping. Each weld shall be uniform in width and size throughout its entire length. Each welding pass shall be cleaned and free of slag before the next layer of weld material is deposited. Each layer of welding shall be smooth, free of cracks, pinholes, and undercuts and shall be completely fused to the adjacent weld beads and base metal. Chipping or grinding of welds shall be performed in a manner that will not gouge, groove, or reduce the adjacent base metal thickness.

All surface marks resulting from welding shall be treated in order to eliminate any visible defects in the finished surface.

Complete documentation for all welding operations shall be submitted to the Engineer for review and approval (CDRL N1920). Welding operations shall comply with the requirements herein.

N19.6.1.2. WELDER QUALIFICATION

Welders shall be tested to verify their proficiency for producing sound welds. Welder qualification tests shall be performed in accordance with the applicable requirements of AWS standards, ASME, Section IX: Welding and Brazing Qualifications, or other approved specifications. Records of welder qualifications shall be submitted to the Engineer for review and approval (CDRL N1921). The Engineer will have the right to

request that test welds be made by any operator, whether under direct control of the Contractor or a Subcontractor, to ascertain his/her competence and to determine the suitability of the welding procedure.

N19.6.1.3. WELDING PROCEDURES

All welding practices, not specifically addressed in other sections, shall be in accordance with requirements of AWS C7.2, AWS D1.1, AWS D1.2, AWS D1.3, or AWS D1.6. The appropriate AWS Handbook requirements for dynamically loaded structures shall be applied. Resistance welding shall be in accordance with MIL-W-6858. The Engineer will have the right to require test welds from any approved operator at any location or any Contractor or Subcontractor that is responsible for producing welded assemblies under this Contract.

The method used in depositing weld metal shall be one that reduces warping and residual stresses. To achieve this, tack welding, offset welding, skip welding, and other devices and sequences well-known to the craft shall be used when appropriate. A stress-relieving process suitable for the type of material shall be employed to remove any residual stresses (CDRL N1922).

The weld method shall penetrate into the bottoms of angles and vees and ensure complete fusion at these points. Fillet welds shall be extended around the ends of members wherever practicable. Manual welds having a thickness greater than ¼ inch shall be made with at least 2 passes. Machine welds of any thickness may be made with one or more passes as approved by the Engineer. In any welding operation, the scale shall be completely removed from the underlying bead and surrounding metal before the next bead is applied. The direction or grinding performance of welds shall be determined by an approved Certified Welding Inspector. All welding shall enable complete and adequate fusion with the base material throughout the weld.

Resistance welding operations shall be undertaken using only equipment fitted with meters or readouts and adjustments for time, current, and pressure. Accurate control of cleanliness, time, current, pressure, and electrode size and shape to produce welds of specified strength shall be maintained. The Contractor shall determine, experimentally or otherwise, the proper setting of the controls and shall provide against unauthorized changes. Similarly, the shape, size, and surface conditions of electrodes required to give satisfactory welding and acceptable finish shall be determined. A complete record shall be made and retained. The processes shall be subject to the Engineer's approval based on sample welds tested by either the shear-strength or the tear-test method. The complete records of the test results shall be maintained by the Contractor.

Resistance weld procedures shall be submitted to the Engineer for approval (CDRL N1923).

N19.6.1.4. WELDING ELECTRODES

The choice of welding rod or wire filler metal shall be made with adequate consideration of the make, type, size, composition, and suitability to the application and shall be in accordance with the AWS Welding Handbook. Welding electrodes for steel or manual shielded metal-arc welding shall conform to applicable AWS standards or be otherwise approved by the Engineer. Bare electrodes and granular flux used in the submerged arc or gas metal arc process shall conform to the provisions of AWS D1.1, Section 1.17.3, Clause 5.3.3. Welding electrodes will be stored in a dry, closed environment to prevent contamination.

N19.6.1.5. WELD REPAIRS

Weld repairs shall be performed in accordance with Engineer-approved procedures that conform to the requirements of AWS D1.1, Clause 5.26

N19.6.1.6. WELDING INSPECTION AND EXAMINATION

Welds shall be inspected to verify compliance with specifications. Welding inspection procedures and welding inspector qualification tests shall be performed in accordance with the applicable requirements of AWS.

Non-destructive examination and testing of welds and welder qualification tests shall be performed in accordance with the applicable requirements of AWS.

N19.6.1.7. HEAT TREATMENT

When required by specifications or drawings, welded assemblies shall be stress-relieved by heat treating in accordance with the requirements of AWS D1.1, Chapter 4, Part A, Clause 5.8.

N19.6.2. BRAZING

The Contractor shall maintain a brazing program similar to that of the welding program specified herein. All brazing, qualification of brazers, and repair of brazing defects shall be in accordance with the requirements and recommendations specified in the AWS B2.2.

N19.6.3. SOLDERING

Soldering of electronic equipment shall comply with the requirements of MIL-HDBK-454.

N19.7. PIPING, TUBING, HIGH PRESSURE HOSES, AND PRESSURE VESSELS

N19.7.1. PIPING AND TUBING REQUIREMENTS

All piping shall be seamless copper, stainless steel, or precision formed steel as determined by the application. All air brake piping shall be seamless stainless steel pipe. Copper tubes or piping shall not contact aluminum parts. Pipes and tubing shall be adequately supported, at least every 2 ft using shock mounting clamps throughout its length and at connections, and must not interfere with the removal of or access to other components. A minimum clearance of 0.13 inch shall be maintained on all piping and tubing used in the vehicle. Carbody air lines must have suitable capacity and must be seamless stainless steel, or copper. Stainless steel fittings shall be used with stainless steel piping and tubing.

All piping, valves, fittings, installation, and testing methods shall be in accordance with the Code for Power Piping, ANSI B31.1. Joints in a straight run of pipe that serve the sole purpose of connecting pipe lengths shall not be used; unavoidable joints in piping shall be made in an approved manner. All inaccessible runs of tubing or piping shall be without joints.

All piping shall be installed in such a manner as to provide thorough drainage. All piping shall be securely fastened with zinc-chromate-impregnated core tape, or an approved equivalent, between the pipe and clamp to prevent chafing and vibration. Piping and tubing clamps shall be secured at both sides of the clamp. Clamps securing copper tubing shall include isolation to prevent wear and abrasion.

All bending and framing of tubing and piping shall be performed using approved tools and procedures. Reduction of interior piping area, whether caused by bending or any other means of greater than 10% is unacceptable. All bends shall not be less than the minimum bend radius of the material being used.

N19.7.1.1. CLEANING

Air piping shall be deburred and blown out after cutting and thoroughly cleaned and capped after installation. The Engineer reserves the right to verify piping cleanliness at anytime during the production process.

After installation of the piping and before connection or installation of air system components, all piping shall be cleaned by methods reviewed and approved by the Engineer (CDRL N1924). The piping systems shall be cleaned a second time, following the completion of component installation, using Engineer-approved procedures. Following the installation, all piping systems shall be pressure tested in accordance with

ANSI B31.1, or other Engineer-approved method. All leaks that appear during pressure testing shall be repaired and retested in accordance with Engineer-approved procedures.

N19.7.2. HIGH PRESSURE HOSES

All hoses used in the pressurized air system shall comply with AAR M-618. All hose fittings shall be of a reusable type as approved by the Engineer. Every hose assembly will have a unique part number. Hoses shall be provided with swivel fittings for ready maintenance.

N19.7.3. PRESSURE VESSELS

Unfired pressure vessels shall conform to ASME, Section VIII. Test reports shall be furnished with each pressure vessel received by the Contractor; a copy of each test report shall be included in the Car History Book of the appropriate vehicle. Each pressure vessel shall be stamped by the testing facility, whether it is the manufacturer or a third party, as verification of unit testing. All pneumatic pressure vessels shall have the interior protected from corrosion.

N19.8. BEARINGS AND LUBRICATION

Operations and Maintenance manuals shall include a comprehensive lubrication schedule listing all lubrication points, lubricant used, and frequency of application. This lubrication schedule shall be in the form of a single table, listing all car equipment.

N19.8.1. ANTI-FRICTION BEARINGS

Anti-friction bearings shall be used for rotary shaft support. Bearings subject to atmospheric or liquid contamination shall be sealed by labyrinth, lip, or face seals. Bearings that are not splash-lubricated or bath-lubricated shall be provided with standard grease fittings and drain plugs or pressure-release devices for re-lubrication. Subject to the Engineer's approval, ball-bearings that are factory "lubricated-for-life", may be used. Bearings shall be installed and removed without major disassembly of related components, and in no case shall thrust be carried across the rolling elements in pressing a bearing into its seat. Bearings and lubricants shall perform satisfactorily within their operating environment.

N19.8.2. SLEEVE BEARINGS AND BUSHINGS

Sleeve bearings shall be used for shafts with rotary motion of less than one full revolution. Sleeve bearings shall be adequately lubricated. Sleeve

bearings supporting ferrous shafts shall be composed of bronze, brass, or aluminum alloys as approved by the Engineer.

Sleeve bearings shall be used to support rotary shafts if space limitations preclude the use of anti-friction bearings.

Self-lubricated bushings (sintered metal) shall be used in accordance with the manufacturer's recommendations and may not be used for shafts with speeds greater than 500 rpm.

N19.8.3. LUBRICANTS

Lubricants shall be selected as readily commercially available products, applied in accordance with the device or component manufacturer's instructions. Lubricants shall be identified on component drawings, assembly drawings, maintenance manuals, and on overall vehicle lubrication schedule. This schedule, which shall be submitted for approval to the Engineer, shall list all lubricants, the application of each, the quantity used, and the lubrication interval (CDRL N1925).

N19.9. THERMAL AND ACOUSTIC INSULATION

N19.9.1. GENERAL

All thermal and acoustical insulation data and application shall be submitted to the Engineer for review and approval (CDRL N1926).

N19.9.2. THERMAL INSULATION

Thermal insulation materials shall be of the rigid, non-rigid, or spray-on type. Insulating materials shall be fire-retardant, non-hygroscopic, resistant to fungus, and provided with a vapor barrier to prevent the entry of moisture, oil, gases, and dust. Insulating materials shall be formaldehyde free and unaffected by moisture or oil. The materials shall not absorb fluids and gases and shall possess the required properties to meet the noise, vibration, and heat loss limits recommended. Insulation materials shall be installed in accordance with the Contractor's recommendations. Thermal insulation material shall have a thermal conductivity of not greater than 0.25 Btu/hr-ft^2-°F/inch when tested in accordance with ASTM C177.

N19.9.3. ACOUSTIC INSULATION

Sound damping material used in fabrication of the vehicle shall be resistant to diluted acids, greases, gasoline, aliphatic oils, and vermin. It must be resistant to fungus and must not support combustion. It shall not be effected by sunlight and ozone and shall not become brittle with age.

Application shall be in accordance with the Contractor's recommendations.

N19.10. WIRING AND ELECTRICAL DEVICES

This section specifies the requirements for all wire and cable used in the vehicle and vehicle systems. All electrical wire and cable used in the vehicle shall be approved by the Engineer.

Wire sizes, insulation requirements, materials, shielding methods, and identification of wire and cable used for primary, auxiliary, control, and communications applications shall be based on the current-carrying capacity, voltage drop, mechanical strength, temperature, and flexibility requirements in accordance with applicable AAR, APTA, ASTM, MIL, NEC, and NEMA standards.

The Contractor shall keep the number of wire types and sizes used in the vehicle to a minimum.

N19.10.1. ELECTRICAL AND ELECTRONIC PARTS REQUIREMENTS

Each electrical, electronic, and electromechanical part shall be selected and controlled on the basis of manufacturers data sheets, catalog cuts, or control drawings that identify the parts physical, environmental, and performance requirements as well as quality and reliability requirements, including inspections and tests for qualification and acceptance, and lot sampling where required. Documentation used in selection process shall be available for review during design reviews and FACI.

Part Qualification: Parts shall be qualified at part level to requirements of applicable specifications.

Part Deviations and Substitutions: System to monitor and control use of de-rated and substituted equipment parts shall be established and maintained.

N19.10.2. CONDUCTORS

The wiring for the Metrorail vehicles shall meet the requirements of AAR RP-585. As recommended in AAR RP-585, the wire insulation system used in this contract shall be at a minimum rated for 230°F.

Current capacities shall conform to APTA RP-E-009-98, ampacity and derating tables. Table 1 "Ampacities of Copper Conductors (104°F Ambient)" gives the ampacity for 230°F rated wire for three conductors in a raceway and for a single conductor in free air. When more than three conductors are routed in a raceway or cable duct, the ampacities in Table 1 shall be derated as detailed by Tables 2 through 5. The Contractor shall submit design loads for each 600V and 2000V cable showing that the requirements of APTA RP-E-009-98 are met (CDRL 1927).

Low-voltage control power circuits shall use minimum 600V cable. Primary and auxiliary power circuits shall use minimum 2,000V cable. The smallest conductor wire size to be pulled through conduits or wireways shall be 14 AWG. 16 AWG wire may be used in circuits where the current is low and physical strength is not required or when laid in wireways. The minimum sized conductor allowed for wire in control compartments shall be 18 AWG. The minimum sized conductor allowed to be used for wire on electronic units, cards, and card racks shall be 28 AWG. Conductors smaller than specified herein are subject to approval by the Engineer for control compartments and twisted/shielded multiple conductors for improved flexibility.

Multi-conductor cables with a minimum conductor size of 18 AWG may be used in all applications providing the proper ampacity and derating charts and procedures described above are applied.

N19.10.2.1. WIRE CONDUCTORS

Conductor material shall be a soft, annealed, tinned copper conforming to ASTM B33. As a minimum stranding shall be Class K, per ASTM B174 for all wire AWG 6 through 350 MCM.

N19.10.2.2. INSULATION

Each conductor shall be separately covered with insulation. Wires not within enclosed equipment or suitably protected locations shall comply with the requirements of AAR RP-585 for mechanical strength, temperature, and flexibility, or as otherwise approved by the Engineer. Wires within enclosed equipment or suitably protected locations shall comply with the requirements of MIL-W-81044, or as otherwise approved by the Engineer.

Unless otherwise stated, electrical wire installation shall be designed with gap and creepage distance between voltage potentials and carbody ground in accordance with the requirements of APTA RP-E-004-98.

For general-purpose wire and cable, the insulation shall be made of heat- and moisture-proof material suitable for use at conductor temperatures of 230°F minimum in dry and wet locations. For high-temperature applications, such as connecting to heaters and resistors, the insulation shall be suitable for a maximum conductor temperature of 302°F.

Motor leads and all exterior cables shall use Exane insulation or an Engineer-approved equal.

Asbestos-based, urethane-based, and polyvinylchloride-based insulations or jacket materials shall not be used.

The outer jacket material of multi-conductor cable shall be the same as that used to insulate individual conductors, unless physical considerations

indicate that a different material with superior characteristics is required. Multi-conductor cables shall be provided with at least 10% spare wires of each wire type and size and at least one spare wire of each wire type and size.

Shielding shall be used over multi-conductor cable for safety-critical circuits. Shielding material shall be woven wire providing at least 60% coverage and shall be soft, annealed, and tinned copper of area equal to or greater than the largest conductor.

Non-conducting separators may be applied between conductor and insulation on conductor sizes greater than No. 5 AWG.

Leakage between primary wiring and the vehicle body shall be measured (insulation resistance tested) in accordance with APTA SS-E-001-98. The resistance shall be at least 10 MΩ.

Hi-pot (dielectric) test shall be performed on all vehicle wiring using a frequency of 50/60 Hz for one minute, per APTA SS-E-001-98.

600V wire insulation shall be used for low voltage control, signal, communications, and alternating current auxiliary power circuits. Wire insulation used on primary power circuits shall be rated for 2,000V direct current as a minimum.

Cabling: In multi-conductor cables, component wires shall be cabled with left-hand lay and with a lay length 8-16 times the diameter of the cabled wires.

Color: Insulation and jacket colors shall be in accordance with MIL-STD-104, Class 1. White is the preferred color for general car and signal wires unless otherwise specified. Power cable jacket shall be black.

Removability of insulation: Primary wire insulation shall be readily removable by conventional wire stripping devices without bunching of the insulation or breaking of strands.

Workmanship: All wire and cable shall be constructed free of mechanical and electrical flaws, inclusions, and significant cosmetic blemishes.

N19.10.2.3. GROUND CABLES AND SHUNTS

Ground cables and shunts shall be extra-flexible, tinned, non-insulated, stranded copper, and shall be terminated by approved, crimped ring terminals on both ends.

Ground cables and shunts shall be sized to withstand the maximum failure current that could be anticipated with complete failure of the return wiring. In no case shall the size of a ground cable or shunt be less than 10 AWG.

Grounding materials and methods shall comply with APTA SS-E-005-98 titled Standard for Grounding and Bonding.

N19.10.2.4. CABLE CONNECTORS

Connectors shall be used where any wire, multi-conductor cable, or cable (other than traction power cable) connects to an assembly that can be removed from the carbody structure, or inside subassemblies that contain LRUs.

Connectors shall be circular bayonet coupling connectors in accordance with NATO Standard VG 95 234. They shall be quick disconnect, three point positive lock, bayonet type with metal housings that are water tight when connected and have gold plated, resilient mounted, crimp type contact pins rated for 500 insertions. Additionally, for all undercar cables and cables in the cab that can be exposed to rain from open cab windows Shrinkable connector back shells according to NATO standard VG 96 454, Part 3. Connectors on printed circuit cards not utilizing edge type connectors shall be quick disconnect, three point positive lock, bayonet type, and have gold plated, solder type contact pins insertions. Alternate type connectors may be used with the approval of the Engineer.

Commercial connectors are limited for use on non-vital interior car applications such as lighting and speaker disconnects.

Extension bodies shall be used, if necessary, to ensure that there is sufficient room to terminate the cable wires within the connector body. The cable jacket shall extend within the body, shall be held by a clamp, and shall have a gasket seal at the entrance. Unused connector pin positions shall be sealed with connector contacts. Adjacent connectors shall either use different inserts or different insert orientations to prevent erroneous connections.

Box mounted connectors shall be mounted to the interior surface of the box, with an environmentally watertight design.

The mating portion of box mounted connectors shall utilize watertight backshell boots or an integrated backshell and flexible conduit system. The properties of the connectors shall be within the envelope and scope of MIL-C-5015. The Contractor shall submit proof of acceptable performance (environmental, chemical resistance, MIL-C-5015 requirements) of any proposed underfloor connector system to the Engineer for review and approval (CDRL N1928).

N19.10.2.5. TERMINALS

Terminations and connections throughout the vehicle shall be of the compression (crimp) type and be provided with an insulated collar where practical. Only insulated ring tongue terminals may be used on terminal blocks with stud or screw terminals. The use of modular terminal blocks mounted on DIN rail(s) is permissible inside electronic equipment enclosures. Individual terminal blocks shall be cross-connectable by shunting straps, have facility for affixing markers for identification, and

have metal parts recessed below the surface of insulating material. Wire wrap terminations shall be permitted only for specific applications and only if approved on a per case basis by the Engineer. Quick-disconnect (fast-on) terminals with locking features may be used to connect relays. The use of fast-on type terminals elsewhere in vehicle is prohibited. Terminals shall not utilize PVC insulation. Terminals shall be attached to wiring with the crimping tools and dies recommended by the connector manufacturer. The terminal used shall be of the type that securely grips and holds the insulation of No. 10 AWG wire or smaller. The crimp terminal shall be rated to match the wire conductor diameter and the insulation diameter. Conductors that will be subjected to motion relative to the terminal shall be protected to prevent breakage of the conductor at or near the terminal.

Spare terminals shall be provided for each terminal assembly in an amount equal to at least 10% of all terminals with at least one spare terminal provided for each size terminal.

Traction motor terminals shall be high-current, high-voltage, single-contact, watertight connectors conforming to the requirements of MIL-C-5015, except that they shall be of the bayonet-lock, quick-disconnect type. As an alternative, bolted lug connections inside protective enclosures may be used if approved by the Engineer.

When multiple ring terminals are stacked on a common terminal board stud, the largest wire cage terminals shall be positioned at the bottom of the stack.

When multiple ring terminals are stacked on a common terminal board stud, adjacent ring terminals shall be oriented back to back to eliminate bending of the ring terminal collar.

Ring terminals shall not be bent to facilitate termination.

N19.10.2.6. HIGH-TEMPERATURE WIRE AND CABLE

Insulation for all wires in high-temperature applications, such as those connecting with heaters and power resistors, shall conform to the following standards, unless deviations are submitted and approved by the Engineer and proof of equivalency is provided.

a. For wire sizes No. 16 AWG and larger, the insulation shall be silicone rubber in accordance with AAR RP-587, 230°F irradiated cross-linked polyolefin or abrasion-resistant extruded teflon polytetrafluoroethylene (PTFE), per SAE AS22579/6.

b. For wire sizes No. 18 AWG and smaller, the insulation shall be abrasion-resistant extruded PTFE Teflon, per SAE AS22579/6.

This type of wire and cable shall not be bundled together or run with any other type of cable.

N19.10.2.7. COMMUNICATIONS WIRE AND CABLE

Communications wire and cable shall consist of twisted pairs of not less than No. 16 AWG, soft annealed, and tinned copper. Each twisted pair shall have a woven wire shield providing 85% or greater coverage. Shield wire shall be soft annealed, tinned copper. Stranding shall be at least 26 strands. Insulation and shielding for communications wire and cable shall have an effective capacitance between two conductors of a twisted pair of not greater than 30 pF/ft. The jacket shall be waterproof and abrasion-resistant and shall provide insulation resistance greater than 1 MΩ/ft between shield and water. All communications wire and cable shall be installed in conduits or as otherwise approved by the Engineer.

N19.10.2.8. APPLICATION

All wiring shall be performed and directed by experienced personnel using appropriate tools for stripping insulation, cutting, soldering, and attaching mechanical crimp-type terminals with correct dies.

All vehicle subsystem wiring connected to a given piece of electrical apparatus shall be insulated for the highest voltage supplied to that apparatus. Wires operating with potential differences of 50 volts or more shall not be cabled or routed together.

Wires connected to transient-generating apparatuses, such as unsuppressed contactor coils, shall not create electrical interference in other circuits.

All crimping pliers shall be calibrated and of a design that will lock the jaws of the pliers until the jaws have advanced sufficiently to fully crimp the connector associated with the die in use.

Wiring for any communication and cab signal shall conform to the requirements established by the Contractor of such equipment.

All circuits shall be adequately protected and insulated from ground. All circuits and branches must be separable to isolate their grounds when troubleshooting is required.

As practicable, all wiring shall be fabricated into standard harnesses and installed in prefabricated groupings and standardized locations in the vehicle. An additional 10% of spares for each wire size and at least one spare of every wire size in any harness shall be included.

The electric apparatus shall be housed in sealed enclosures to remain clean and dry. The external terminal posts shall be well-protected by tight-fitting boots.

Wiring and cabling applied to moving apparatus and equipment shall be routed between fixed points and protected in a manner to eliminate any and all wear and chafing. Such routing shall be reviewed at production of the first Vehicle for approval by the Engineer.

N19.10.2.9. WIRE HARNESSING

The harnessing requirements include the materials and performance for cable jackets; connector adapters; and heat-shrinkable tubing, markers, molded boot adapters, transitions, controlled soldering devices, environmentally sealed crimp splices, terminals and disconnects.

a. Harnessing sealing: All connectors shall be sealed to prevent ingress of moisture. All connectors shall have a boot adaptor to allow for the use of a heat-shrinkable boot to seal the interface between the connector/adaptor to harness. The use of strain-relief/saddle-clamp or other mechanical style adapters shall not be allowed.

b. Construction techniques: Harnesses shall be constructed in such a manner that repair or maintenance is readily possible. Connector potting or molding-in-place is not permitted. Where possible, connector repair shall be achievable without complete de-pinning.

Where point-to-point cable design and/or where wire break outs are within 2 feet of a cable end, the use of a manufactured cable with an extruded cable jacket that meets the requirements of this and other associated specifications is preferred. All cable break out legs and other harnesses shall be fabricated from the same wire type as cables and covered with heat-shrinkable tubing. Strain relief at all connections shall be accomplished with a heat-recoverable boot, except single conductors where heat-recoverable tubing may be used. All break outs (transitions) shall be made using appropriate heat-recoverable molded parts.

At wall/floor locations where cables must pass through, the design of these bulkhead penetrations shall be such that the cables/harness shall have only one cable per feed-through. The feed-through shall be (length/thickness dependent) either of stuffing tube or adaptor/ heat-shrinkable boot design. When stuffing tubes are used, i.e. cables that are routed along the underside of the vehicle and pass through the floor and terminated near the topside of the floor, the underside end of the stuffing tube shall have provisions for an adaptor/boot to seal/strain relieve the cable and be removable. The cable jacket shall be in place for a minimum of 4 inches above/beyond the upper end of the stuffing tube.

a. Wire/cable interconnect: All wire and cable interconnections including shield termination, wire splicing, coaxial cable termination and primary wire end terminations shall use heat-shrinkable, environmentally sealed controlled soldering or crimp termination devices.

b. Wire runs: Underframe wires shall be run in covered raceways with removable covers. Truck wiring and wiring in areas of free movement or within interior lockers or wall or roof cavities shall be adequately clamped, supported and protected from abrasion. Wire

runs shall be continuous and unbroken lengths between connection points.

Conductors of different circuit voltages shall be run separately. Circuit conductors carrying alternating current shall be grouped in the same raceway to prevent heating of adjacent metal surfaces by induction. Conductors within raceway enclosure shall be insulated for maximum voltage of any conductor within same raceway enclosure.

Watertight bushings and drip loops shall be provided on exposed cables to prevent fluid runoff into connected equipment. Slack shall be provided in cables at equipment terminals to allow for shock and vibration movements and equipment shifting for alignment, cover removal, and component replacement.

a. Wire supports: All cable/harnesses shall be clamped at regular intervals to reduce vibration. Exposed wiring shall be supported at not greater than 2-foot spacings. Cables shall be cleated where they pass through bulkheads and structural members.

b. Sufficient slack shall be provided to prevent mechanical strain where movements might exist between any wire and terminal. Cleats and cable supports shall have inserts that prevent chafing and cutting of cable.

c. Cable fittings: Watertight strain relief bushings or watertight quick disconnects shall be used where cable enters or leaves junction boxes or equipment enclosures. Fittings shall prevent chafing and damage to conductor jacket and insulation where cable passes through any structural member or bulk head.

N19.10.2.10. UNDERCAR WIRING INSTALLATION

All undercar wiring of No. 8 AWG or smaller shall be run in insulated metal raceways and polycarbonate wire ducts with securely fastened and easily removable metal covers. Wire and cable shall be securely anchored in an approved manner in the ducts to prevent chafing from relative motion. All wire ducts and conduits shall be of waterproof construction. Watertight strain-relief bushing with insulated throat liners shall be provided at the duct entrance and exit points.

When physical strength is required, No. 6 AWG or larger wires may be used and supported in place without any type of enclosure by using molded rubber cable support blocks. This method is also acceptable in protected areas subject to damage or vandalism with Engineer approval.

Wires or cables shall not pass over or through the battery compartment or, if in conduit or ducts, over the main motor resistors. Floor wiring shall be run in conduits or ducts and may be run through partitions, but only if suitable bushings are provided at such points of passage.

In no case shall wires or cables, carrying primary line voltage, be tied to or directly supported by conductive members at ground potential. The wires or cables shall be securely anchored in an approved manner and shall be covered at the point or points of contact with an approved insulating material.

Sufficient slack and wire length shall be provided to prevent breaking or separation from bushings or terminals and to allow for a serviceability loop for two re-terminations. Drip loops shall be provided. Wire radius shall not be less than wire manufacturer's recommendations.

N19.10.2.11. POWER CABLE INSTALLATION

Wiring of No. 6 or larger that operates at 700V power, with the exception of cables passing through or above the floor, shall be cleated in place. The cleats, described in this section, shall be positioned at intervals no greater than 18 inch with a minimum clearance of 1.97 inch between the cable and any structural member, component, or other cable. If mechanical protection is required, short lengths of conduit, complying with the requirements specified this section, may be employed, one conduit per wire, subject to approval by the Engineer. The Contractor shall not run high-voltage cabling through the carbody interior, except for heater circuits. Wire routing and securing shall be approved by the Engineer in all wires subjected to motion during operations, e.g., underframe and carbody.

N19.10.2.12. CONDUIT AND RACEWAY REQUIREMENTS

All vehicle wiring shall be routed in metal raceways or conduits. Open or closed metal raceways and conduits and their elbows, couplings, nipples, bushings, lock nuts, universal joints, and other conduit fittings shall be so designed that the sections can be mechanically and electrically coupled while the wires are protected from abrasion. All metal raceways, conduit and fittings of ferrous metal shall be hot-dip galvanized after fabrication. Galvanize coating shall not interfere with the function of the fittings. All conduits shall be arranged to prevent moisture traps, shall drain toward control boxes, and shall be supported to the carbody at least every two feet.

High-voltage wiring (i.e., wiring in excess of 120V) shall not be run in the same cable ducts, conduits, or raceways as low-voltage wiring. High voltage wiring shall be separated from low voltage/control wiring by a minimum of 2 inches. 700V wiring shall run in its own cable ducts, conduits, and raceways.

Wires in conduits, ducts, and raceways shall be free of kinks, insulation abrasions, and insulation skinning. All exit points of wiring from conduits, ducts, and raceways shall be protected to eliminate wire chaffing.

Conduits that may contain three or more conductors shall be sized such that the sum of the cross-sectional area of the wires and cables does not exceed 40% of the cross-sectional area of the conduit. For two conductors, a limit of 30% shall be used; for a single conductor, a limit of 53% shall be permitted. When conduit nipples with a length not exceeding 24 inches and without bends of more than 15 degrees are used between enclosures, a maximum fill of 60% shall be permitted.

N19.10.2.13. CLEATING

All cable and wiring not installed in conduits, ducts, or raceways shall be cleated by split, block cleats of molded neoprene rubber (or an approved equivalent), and nonflammable, insulating material with a durometer reading of 50 to 60. The holes in the cleats shall be sized to securely hold, without damaging, the individual wires and cables. Alternatively, holes in cleats can all be the largest hole required and color coded bushings used to adjust the holes for smaller cables. Cleats and cable supports shall be designed to prevent chafing and cutting of the cables. Each cleat shall have a stiffener on the side away from the mounting bracket that will act to spread the bolt clamping force over the entire length of the cleat. Bolts shall have approved locking hardware. Cable and wiring using cleats shall be supported to the carbody at least every 2 ft.

N19.10.2.14. JUNCTION BOXES AND FITTINGS

Pull-boxes, outlets, and junction boxes shall be provided specifically for application with the conduit and cable systems with which they are to be used. Fittings of ferrous metal shall be galvanized inside and outside after fabrication. The galvanized coatings shall not interfere with the function of the applied fittings. Screws and other hardware shall be made of stainless steel.

All undercar junction boxes shall be waterproofed, vented, and shall protect enclosed equipment and connected conduits from water seepage. Interiors of all junction boxes shall be protected with an insulating light color paint using an approved painting procedure. Boxes shall be sufficiently large to provide free space for attached conductors. Junction boxes shall be appropriately marked as approved by the Engineer.

N19.10.2.15. SPLICING AND TAPING

Splicing is prohibited. Taping is prohibited.

N19.10.2.16. WIRE AND TERMINAL MARKING

All wires and cables shall be marked with a wire number within 6 inches of the end of the wire and every 6 inches along the entire length of each conductor. The wire identification markings shall be permanent and shall

be of a scheme approved by the Engineer. The Engineer will approve the marking method and final product for permanence, legibility, and readability. Wire markers shall retain their readability for the life of the vehicle and equipment.

All conductors on the vehicle shall have permanent wire marker designations applied at the ends of each conductor. All wire markers shall be of the heat-shrink tubing type and shall meet the flame and smoke testing requirements herein; wrap-around markers are not allowed.

Wire marker designations shall be assigned and applied to all electrical conductors. The marker designations shall be approved by Engineer.

The color scheme of the wire markers shall be permanent black printing on yellow background for primary power circuits and permanent black printing on white background for control and low-voltage circuits. The Engineer will approve the marking method and final product for permanence, legibility, and readability.

N19.10.3. ELECTRICAL EQUIPMENT AND DEVICES

N19.10.3.1. MOTORS

Traction motor requirements are set forth in TPN10. Motors other than as specified in TPN10 shall meet the applicable requirements of IEEE 11.

Motor data: For each motor dimensional prints and following information shall be provided:

a. Manufacturer and type.

b. Horsepower output, insulation, and high-pot test requirements.

c. Rotational velocity (RPM) at full load.

d. Full-load torque.

e. Efficiency at 100 and 75% loads.

f. Weight.

g. Locked rotor current.

h. Full-load current.

i. Lubrication data.

Alternating current motors shall be squirrel cage induction type, rated for ambient temperature encountered in installed location. Motors shall be designed, constructed, and tested in accordance with NEMA MG1-2003. Motors shall be designed for full-voltage starting. Motors weighing more than 40 pounds shall incorporate lifting provisions and be complete with suitable handling devices.

N19.10.3.2. MOTOR STARTERS

Auxiliary motors shall be equipped with individual starters as required by design.

a. Starters shall be rated for continuous duty at the service indicated.

b. Starters shall be equipped with sufficient auxiliary contacts to comply with requirements for annunciator circuits as indicated.

c. Thermal overload protection shall be provided.

d. Reduced-voltage starters shall be equipped with adjustable reset circuits that shall provide quick release and restart down to 20% below nominal voltage.

N19.10.3.3. CIRCUIT PROTECTION

Circuit protection shall meet the following requirements:

a. Circuit breakers shall be molded-case type, single-pole, or multi-pole, with a frame size suitable for continuous current and interrupting duty.

(1) Handles shall indicate "ON", "OFF"," and "TRIPPED" positions. Each pole shall be equipped with trip mechanism, consisting of an inverse time element for overload protection and instantaneous magnetic element for short circuit protection. Each pole shall be equipped with an adequate means of arc extinction to prevent flashover.

(2) Multi-pole breakers shall operate contacts simultaneously. Breaker current rating shall be clearly visible after installation and comply with requirements of NEMA AB3.

(3) Electrically controlled breakers shall be equipped for operation from LVPS. Circuit breakers shall be properly coordinated with protective devices.

(4) Other than High Speed Circuit Breakers (HSCB) used for 700 VDC circuits that shall be designed to contain any resulting arc completely within its enclosure, circuit breakers shall not be used for protection on 700 VDC circuits.

b. Fuses shall be provided, as indicated for 700 VDC circuits that are suitable for continuous current and interrupting duty. Fuses shall be properly coordinated with transient suppressers. Fuses shall not be used for AC and low-voltage applications. Indicator-type fuses shall be used in all locations unless approved by the Engineer.

c. A properly marked spare fuse-holder equipped with a spare fuse shall be provided in all locations where fuses are utilized, except for the main fuse. This includes all carborne equipment.

N19.10.3.4. RELAYS AND CONTACTORS

The requirements for relays and contactors are as follows:

a. Low-current relays (less than 10 amps per pole) shall have silver-alloy contacts. Very low-current relays (one amp and less) shall have gold-plated, silver-alloy contacts. Low-current and very low-current relays that have not been proven in rail service shall comply with requirements of, but not need to be qualified to, MIL-R-5757. Higher-current relays shall comply with requirements of, but not need to be qualified to, MIL-R-6106.

b. Relays shall be capable of at least one million electrical operations at rated contact capacity. Plug-in relays shall be secured in their sockets by mechanical restraint.

c. Relay and contactor coils shall be suppressed to mitigate transient voltage spikes, with the suppressing network mounted as close to the coil as possible. Relays and contactors, except low-power miniature relays mounted on printed-circuit boards, shall incorporate means of visually determining whether contacts are picked up or dropped out.

d. Relays used in safety-critical circuits shall comply with requirements of the AAR Signal Manual, Volume 2, Section 6, unless otherwise approved.

e. Contactors used to interrupt 700 VDC circuits shall be equipped with blowout coils or other means of arc suppression.

N19.10.3.5. PUSH-BUTTON SWITCHES AND INDICATORS

The requirements for push-button switches and indicators are as follows:

a. Switches shall be heavy-duty with electrical characteristics, ratings, and accessories as required for circuit application.

b. Push-button (including illuminated) switches shall have silver plated terminals.

c. Indicators and push-button switches shall have insulation resistance of at least 1000 MΩ to case at 500 VDC. Indicators shall be two-color LED type with one-color projection. Relamping of indicators shall be from the front.

d. Contacts shall have maximum resistance of 0.10 Ω at 3 VDC and 10 mA loads. Minimum open contact resistance shall be 50 MΩ.

e. Contact shall be rated for inductive loads. The contacts shall normally operate at not more than 20% of the manufacturer's inductive rating for 2,000,000 cycles of operation at 77°F. The electrical-contact material shall normally be a break-before-make type. The push-button contacts shall be silver or silver with gold plate.

N19.10.3.6. INDUCTORS

Power inductors shall have vacuum-impregnated windings and be rated to withstand at least twice the maximum peak-to-peak voltage expected in normal operation. Inductors shall not emit audible noise in excess of 65 db at a distance of 24 inches while operating at rated voltage and load.

N19.10.3.7. TRANSFORMERS

Transformers shall have vacuum-impregnated windings and have a minimum inter-winding breakdown voltage of 1,500 VDC. Transformers shall not emit audible noise in excess of 65 dB referred to 20 μPa at a distance of 24 inches while operating at rated voltage and load.

N19.10.3.8. RESISTORS

Resistors, other than power/braking resistors, shall be derated 50% at a minimum. Carbon resistors are not permitted on printed circuit boards.

N19.10.3.9. CAPACITORS

Capacitors shall be rated for transients of at least twice the maximum peak voltage expected in normal operation and shall be applied at continuous voltages not greater than 80% of rated working voltages.

N19.10.4. ELECTRONIC COMPONENTS

N19.10.4.1. GENERAL

Electronic components shall comply with the following requirements:

a. Components shall be clearly and permanently labeled with values or type identification.

b. Components, as applied in their circuits, shall be derated at a minimum of 25% from manufacturer's ratings, and resistors 50%.

c. For power semiconductors, derating of current shall be such that the manufacturer's maximum junction temperature is not exceeded 230°F with a 25% increase in semiconductor current above that required for performance.

d. Semiconductor devices shall be available from more than one qualified manufacturer.

e. Carbon resistors shall not be used on printed circuit boards.

f. All printed circuit board ground planes shall be electrically isolated from the enclosure housing the printed circuit board.

N19.10.4.2. PRINTED CIRCUIT BOARDS

Printed circuit boards shall be of glass epoxy construction, comply with requirements of NEMA LI1, Grade FR-4, and have minimum nominal thickness of 0.063 inch, with the exception of Mezzanine boards which do not exceed 25% area of the board on which it is mounted, for which a thickness of 0.04 inch is permitted. Conductor materials shall be determined on the basis of current-carrying capacity and in accordance with IPC-2221. Minimum conductor thickness shall be 0.002 inch.

a. Edge connectors and boards shall be keyed to prevent insertion of any board in a wrong position and mounted for ease of board removal and replacement.

b. Component labeling on the printed circuit boards shall be provided.

c. All bare printed circuit boards shall be silk screened, showing both location and key pin locations.

d. Jumpers are prohibited unless approved by the Engineer. Any jumpers such approved shall be installed in accordance with MIL-IPC 2221.

e. All printed circuit boards shall be coated with a clear insulating, protective coating. This coating shall cover the entire board and components, except for contact areas and those components that would be adversely affected.

N19.10.4.3. SEMICONDUCTOR/INTEGRATED CIRCUITS REQUIREMENTS

The Contractor shall be responsible for ensuring that all electrical and electronic circuitry (whether of its own design and manufacture or those of its manufacturers and Contractors) meets or exceeds the semiconductor and/or integrated circuit criteria listed herein.

a. All semiconductor junction temperatures shall be limited to 230°F.

b. Transistors and other solid-state power devices operated from nominal battery supply shall be protected by a transzorb suppression device. These transistors and solid-state devices shall have voltage ratings higher than the maximum voltage rating for full conduction of the selected transzorb.

c. All semiconductors shall be JEDEC (Joint Electronic Device Engineering Council) registered and numbered and shall be available from at least two different manufacturers, unless otherwise approved by the Engineer. However, non-JEDEC registered devices that carry more than 100 amps may be used with the Engineer's approval. The Contractor shall submit to the Engineer for review and approval complete procurement specifications, defining each such device, and evidence of availability from two or more manufacturers based on those specifications.

d. All semiconductor/integrated circuits shall be rated to properly perform at temperature extremes, ranging from -40°F to +185°F.

N19.10.4.4. MICROPROCESSOR-BASED SYSTEM REQUIREMENTS

Any carborne equipment using microprocessors shall conform to the hardware and software requirements herein.

N19.10.4.4.1. General

Microprocessor-based components, assemblies, and power supplies shall be provided with voltage/current regulation and protection to ensure proper operation. All interfacing wiring shall be protected against interference from other carborne or wayside electrical radiation.

Microprocessor based systems must adhere to IEEE 1478 Standard for Environmental Conditions for Transit Rail Car Electronic Equipment.

Memory components shall be of the "flash" type and shall be permanently mounted (soldered in place) on the printed circuit board.

The microprocessor shall be suitable for the rugged environmental conditions encountered in transit applications and shall be supported by software development language and diagnostic programs that are acceptable to the Engineer.

The microprocessor assembly shall be housed in an enclosure that shields the microprocessor assembly and the surrounding circuits from EMI radiation and interference.

All integrated circuits shall be screened for defects. Methods based on a burn-in for the completed assembly shall be submitted to the Engineer for review and approval (CDRL N1929). The burn-in shall be performed when the equipment is operational with all input signals and loads (output signals) connected to simulate non-quiescent operating and power dissipating conditions within the devices and system.

The microprocessor shall have external buffers provided and shall be protected from external voltage and current transients and EMI.

N19.10.4.4.2. Software Requirements

All software provided as a part of this Contract shall be compliant to the requirements set forth in GP5 and TPN22. All software shall be verified by testing to be compliant as set forth in GP5 and TPN22.

N19.11. FLAMMABILITY AND SMOKE EMISSION

All combustible materials used in the construction of the vehicle shall satisfy the flammability, smoke emission, and zero halogen requirements cited in this section.

Materials used in the vehicle shall be "zero halogen" whenever possible in addition to the requirements of the smoke emission and flammability.

The Contractor shall furnish a matrix showing the total weight of materials, where used, flammability and smoke emission test identity, test facility, test requirements, test results and the material and quantity of test samples.

As a minimum, all combustible materials in the construction of the vehicle shall meet the requirements as set forth by the following table as published in the latest edition of the NFPA 130 Standard for fixed Guideway Transit Systems. This table identifies the test procedure and performance criteria for the flammability and smoke emissions characteristics of those materials.

N19.11.1. FLAMMABILITY AND SMOKE GENERATION LIMITATIONS

N19.11.1.1. GENERAL

All materials shall have a maximum flame propagation index I_s of 35, when tested, in accordance with ASTM E162, Radiant Panel Test, except as indicated otherwise. Flame Propagation and Smoke Density test results shall be submitted to the Engineer (CDRL N1930).

All materials shall have a D_s (1.5) < 100, D_s (4.0) < 200, and maximum D_m of 300 when tested in accordance with ASTM E662 in flaming and non-flaming modes. All materials shall have a maximum D_m of when tested in accordance with ASTM E662.

A Matrix of Flammable Materials, giving weight, heat values, flame spread index and ignition temperatures shall be submitted to the Engineer (CDRL N1931).

The following materials shall meet the flame and smoke characteristic requirements:

- Seating Components: Frames, shrouds and armrests.
- Panels, including wall, ceiling, partition, and windscreen.
- Equipment Boxes and shrouds/covers.
- Battery cases.
- Other materials not specified elsewhere.

N19.11.1.2. INSULATION

Thermal and acoustical insulation shall have a flame propagation index (I_s) of 25 or less with no flaming, running, or dripping when tested in accordance with ASTM E162, and a D_s of 100 or less at 4 minutes when tested in accordance with ASTM E662.

N19.11.1.3. SEAT CUSHIONS

Seat cushions shall comply with NFPA 130 with a maximum I_s of 25 when tested in accordance with ASTM D3675 and maximum D_s of 100 at 90 seconds and 175 at 4 minutes when tested in accordance with ASTM E662. Alternatively seat cushion assembly construction employing a fire barrier cover over FMVSS 302 foam shall comply with the testing criteria defined in 49 CFR 238.103, Appendix B note 3.

N19.11.1.4. FABRICS AND UPHOLSTERY

Seat upholstery shall comply with NFPA 130.

N19.11.1.5. FLOOR COVERING

Floor covering shall be rubber sheet and shall have a critical radiant flux of not less than 0.5 W/cm² or CRF ≥ 5KW/m² when tested in accordance with ASTM E648.

Floor covering shall have a D_s of no greater than 100 at 90 seconds and 200 at 240 seconds when tested in accordance with ASTM E662.

N19.11.1.6. WINDOWS AND DIFFUSERS

Windows and lighting diffusers shall have a flame propagation index (I_s) of 100 or less when tested in accordance with ASTM E162, and a D_s of 100 or less at 90 seconds and 200 or less at 4 minutes when tested in accordance with ASTM E662.

N19.11.1.7. HVAC DUCTING

In accordance with NFPA 130, any ducting or ducting elements used for HVAC shall have an I_s of no greater than 25 when tested in accordance with ASTM E162 and a D_s of no greater than 100 at 4 minutes when tested in accordance with ASTM E662.

N19.11.1.8. ELECTRIC WIRE INSULATION

Electrical insulation on wire and cables shall meet the flammability requirements of IEEE 383, modified to use a 210,000 Btu/hour flame, positioned 13.5 inches from test cables, with cable tray positioned 1 ft from corner panel.

Electrical insulation shall have D_s not greater than 50 within 4 minutes when tested in accordance with ASTM E662.

N19.11.1.9. PAINT AND COATINGS

All paint and coatings shall conform to the fire-retardation requirements of ASTM D1360 for all paint and coatings with a thickness greater than 0.002 inch.

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TABLE OF CONTENTS

N20. VEHICLE MONITORING SYSTEM 20-1
N20.1. GENERAL 20-1
N20.1.1. CITED REFERENCES 20-1
N20.1.2. SUBMITTALS – CDRLS 20-1
N20.2. MATERIAL REQUIREMENTS 20-2
N20.3. POWER REQUIREMENTS AND TERMINATIONS 20-2
N20.4. SYSTEM DESCRIPTION 20-2
N20.5. REQUIREMENTS FOR WAYSIDE INTERFACES 20-4
N20.6. DESCRIPTION AND FUNCTIONS 20-4
N20.6.1. GENERAL 20-4
N20.6.2. DESIGN REQUIREMENTS 20-4
N20.6.3. FEATURES & FUNCTIONS 20-7
N20.7. CONFIGURATION DOCUMENTATION 20-15
N20.8. SYSTEM REDUNDANCY 20-15
N20.9. INTERFACE, TRAINLINE AND COMMUNICATION PROTOCOLS 20-16
N20.10. ENVIRONMENTAL REQUIREMENTS 20-16
N20.11. FACTORY TESTING 20-16
N20.12. SAFETY ANALYSIS 20-16

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N20. VEHICLE MONITORING SYSTEM

N20.1. GENERAL

The Vehicle Monitoring System (VMS) shall be designed to provide vehicle monitoring onboard vehicles.

N20.1.1. CITED REFERENCES

Source/Section	Title
EN 50121-3	Electromagnetic Compatibility. Rolling Stock. Train and Complete Vehicle
EN 50128	Railway Applications. Communications, Signaling and Processing Systems. Software for Railway Control and Protection Systems
EN 50155	Electronic Equipment on Rail Vehicles
EN/IEC 61373	Railway Applications. Rolling Stock Equipment. Shock and Vibration Tests.
IEC 61375	Electric Railway Equipment – Train Communication Network.
NFPA 70	National Electric Code (NEC)

N20.1.2. SUBMITTALS – CDRLS

CDRL No.	Title	TP Reference
N2001	Electrical and Mechanical Details, Drawings, and all Proposed Wire Tag Designations	TPN20.3.
N2002	Manufacturer's product literature and specifications of onboard VMS	TPN20.6.1.
N2003	VMS design, Configuration, and Database	TPN20.6.2.
N2004	VMS Integrated Communications Network Configuration Diagram	TPN20.6.2.
N2005	Key Indicators Degraded Performance of Principal Car System	TPN20.6.2.

CDRL No.	Title	TP Reference
N2006	Display Screen Configuration and Options	TPN20.6.2.
N2007	VMS System Interface Plan	TPN20.6.2.
N2008	Redundant Data, VMS Redundancy, Center and Local Units, Data Recorder	TPN20.8.

N20.2. MATERIAL REQUIREMENTS

Electrical materials and installation methods to be used in the fabrication of VMS equipment, including wire, cable, printed circuit boards, and circuit protective devices, shall conform to the requirements specified in TPN19.

N20.3. POWER REQUIREMENTS AND TERMINATIONS

The VMS will receive low voltage power from its own circuit breaker. All systems shall derive power from the batteries in the event of LVPS failure.

All systems shall operate within the voltage ranges as specified in TPN2. All wiring shall meet the requirements of NFPA 70. The Contractor shall submit all electrical and mechanical details, drawings, and all proposed wire tag designations to the Engineer for approval in accordance with the design review requirements of TPN16 and the drawings requirements of TPN15 (CDRL N2001).

N20.4. SYSTEM DESCRIPTION

The VMS shall provide a centralized function onboard to monitor the major onboard systems and devices. The operation, fault status, fault data logging, incident investigation and reporting of the onboard systems shall be controlled as an integrated system of distributed intelligence.

The major onboard systems and devices shall include but shall not be limited to:

- Propulsion.
- Friction brakes.
- HVAC.

- Low Voltage AC (Auxiliary Inverter) and/or DC Power Supply (LVPS) as well as traction power supply.
- Door Control.
- ATC (ATP, ATO and TWC).
- Train radio.
- Ethernet and Wireless interfacing equipment.
- Communication Control Unit and Vehicle Media Controller.
- Public address and Intercom Systems.
- Passenger Information System.
- CCTV/Security System.

Additionally, the VMS shall perform the following:

- Built-in daily departure test.
- Portable Test Unit (PTU) interface to allow communication access to the VMS and also PTU communication access to for all other intelligent subsystems.
- Data logging of parameter values collected from the major onboard (sub) systems as listed above and as approved by the Engineer. This shall be referred to as the VMS data logger.
- Interface with all onboard subsystem sensing equipment to perform the intended functions.
- Data retrieval, recording and processing from onboard equipment shall transmit to MDT Facilities via wireless to the backend MDT servers.
- The Contractor shall be responsible for the installation of breakers, wiring to breakers and cutout switches, conduit, supports, and all other apparatus required for the installation of antennas and electronic equipment.
- The Contractor shall be responsible for testing all VMS wiring installed on the vehicles and for the proper termination of any wiring installed or designated for "future use".
- The Contractor shall be responsible for verifying and testing any modifications installed to ensure that there is no interference with the operation and functioning of the system. This testing shall be conducted on the vehicles.

N20.5. REQUIREMENTS FOR WAYSIDE INTERFACES

The Contractor shall supply MDT with vehicles that will interface properly with the MDT wireless system. The new vehicles do not need to be trainline compatible with the existing MDT vehicles.

N20.6. DESCRIPTION AND FUNCTIONS

N20.6.1. GENERAL

The Contractor shall design, using the basic requirements defined herein, manufacture, assemble, test, furnish, install, interface, and commission the VMS equipment to perform as specified. Manufacturer/Suppliers' Product literatures and specifications for VMS shall be submitted for the review and approval of the Engineer (CDRL N2002).

The VMS shall be a state-of-the-art design with the ability to interface with the MDT Ethernet or wireless networks to offer real-time data retrieval. The TODs shall be coordinated with the cab layout design and included in the man-machine-interface analysis. The VMS shall have built-in functions to monitor all faults and store data.

The Contractor shall ensure that the VMS is reliable and completely tested and demonstrated for all the built-in features.

It is the Contractor's responsibility to assure coordination among the VMS supplier, the suppliers of various subsystems for the sensing devices and protocols, and the Contractor's System Integrator.

N20.6.2. DESIGN REQUIREMENTS

The Contractor shall, using the basic requirements defined herein, design, configure, assemble, furnish, install and test onboard equipment to allow safe and convenient operation.

Two (2) Train Operator Displays (TOD) unit shall be mounted on the train Operator's console for alarm monitoring and data entry.

The VMS shall perform data acquisition, data processing, data communication and data presentation functions. The Contractor shall submit complete details, configuration, and logic diagrams for the VMS for the Engineer's review and approval (CDRL N2003).

Interfacing capability shall be provided with ten percent (10%) spare unallocated car system I/O capacity for future expansion and when

utilized it shall not produce any adverse performance impact on data throughput performance.

The Contractor shall provide a complete VMS integrated communications network configuration diagram, which shall be submitted for review by the Engineer that details all transmission modes and media (CDRL N2004).

The transmission mode and protocol of the VMS shall maintain reliable operation and be immune to interference or performance degradation in the environment influenced by EMI and harmonics generated from the traction power VVVF inverters and auxiliary static inverters.

A single point failure of any individual part shall not cause any adverse performance impact or cause loss of data.

The VMS shall log fault occurrence, log data, determine the health of the car systems, and present alarm and condition status onboard to the train Operator.

Fault algorithms, data acquisition routines, and data storage logic shall be programmed and presented using a graphical interface approved by the Engineer. The Contractor shall coordinate with subsystem subcontractors to ensure that following features are provided:

- Completely coordinated subsystem sensors and/or Ethernet connection as required to process all possible fault and health monitoring points not limited to the extent defined herein.
- Software and database integration such that for all health monitoring and/or fault conditions, The VMS shall identify on the TODs of the controlling cab any failed subsystem in the consist. Faults logged by the failed subsystem shall be viewable on the TODs.
- The System shall be programmable to return to its defaulted normal operating conditions, if desired.
- The System shall have event recording, data logging, storage, and retrieval features for future reference and analysis.
- Software shall have self-checking and diagnosing features for its own performance.
- File transmission to the wayside shall be in the XML format and possible through the FTP protocol as well as TCP/IP (streaming). In case of TCP/IP streaming to the wayside, the Contractor shall provide the wayside software to interpret the data in a workable format.

- The PTU shall be capable of connecting to the wayside central database to analyze, query and interpret the data for troubleshooting and maintenance purposes.
- In the event a file transmission gets interrupted the system will continue the data transmission from the point it got interrupted as opposed to retransmitting the entire data file.

On-board fault occurrence logging and degraded performance condition monitoring logging shall be provided as an integral part of the VMS. Each subsystem shall report faults and degrade performance to the VMS on a real time basis. The Contractor shall identify the key indicators of degraded performance of all subsystems for review by the Engineer (CDRL N2005).

The Contractor shall develop and debug the initial VMS operating and troubleshooting database. The database used shall be of an open standard such as XML and shall be approved by the Engineer.

Data of the fault log events and summary alert alarms for degraded performance shall be transmitted wirelessly or via the data radio. The TODs shall use backlit Color LCD technology and be software driven by the VMS and CCU as defined in TPN13. Commands shall be entered by the train operator or a maintainer using either soft keys or via touch screen. A minimum of two TOD displays shall be provided in each cab.

The TODs shall provide the train Operator with information regarding the operating status of the consist, car/system health. The display shall include the ability to input vehicle operations information (e.g., staff number, train run number). The VMS shall be able to automatically identify and update train consist configuration. The VMS shall be able to display the status of any subsystem components critical to the safety of the consist.

The TODs shall always display a warning message on a per car per subsystem basis of any vehicle subsystem detected with an active fault alarm condition. Selectable screen page listings of active fault alarms for the total consist shall be provided.

The VMS shall display the time continuously. This shall be in 24-hour clock format (HH:MM:SS) to the nearest second. The VMS shall synchronize its clock with the system clock via data radio upon power up of the VMS. The VMS shall synchronize the subsystem clocks.

Display screen configurations and options shall be submitted for the Engineer's review and approval (CDRL N2006). The VMS design shall offer sufficient options to program the desired display on the TODs.

VMS programming shall allow for user friendly, easy data entry, changes, additions and deletions in functions, priorities and categories of alarms changing, and upgrading throughout the life of the system.

The VMS shall be configured to transmit and retrieve data in real-time and to download at the end of each run.

The Contractor shall furnish and integrate all design documentation and interfaces between its equipment and equipment furnished by other subcontractors in an Interface Plan provided at the design reviews for Engineer's approval in accordance with TPN16 (CDRL 2007).

N20.6.3. FEATURES & FUNCTIONS

The VMS shall provide a centralized function to monitor all major onboard systems and devices. The operation, fault status, fault data logging, incident investigation and reporting of onboard systems shall be controlled as an integrated system of distributed intelligence.

The VMS shall provide operating support to the crew, improve service to passengers and facilitate maintenance and inspection of the equipment.

It is not essential for the basic operation of the consist.

Detailed monitoring functions will be finalized during various design reviews, However, in general, VMS functions shall include but shall not be limited to those listed below.

N20.6.3.1. VMS FUNCTIONS FOR THE TRAIN OPERATOR

- Monitoring.
- Failure indication.
- Door opening by-pass indication.
- Displays and Key input functions.

N20.6.3.2. VMS FUNCTIONS FOR MAINTENANCE

- Up-loading to the train radio or Vehicle Media Controller.
- Failure Recording.
- Data Logging.
- Data Upload/Download.

- Onboard Test for major equipment.

N20.6.3.3. VMS SELF-DIAGNOSTIC

- Service equipment check.
- Measurement functions for running distance and energy consumption recording.

N20.6.3.4. TIME ADJUSTMENT AND OTHER FUNCTIONS

- VMS initialization.

N20.6.3.5. UPLOADING OF INFORMATION

There shall be three levels of information from the VMS to be uploaded through the MDT data links. Regardless of the level of information to be uploaded, voice communications shall always have priority over the VMS information. The three priority levels of information to be uploaded are:

N20.6.3.5.1. **Priority Level 1:**

Information related to critical alarms such as incidents or faults on the train that have significant impact on operations and services, and require immediate attention for passenger and system safety.

An audible alarm shall sound and the message shall be in a coded format containing the train run number, car number within the consist and the event code. The list of event codes to be included in this level shall be proposed by the Contractor and submitted to the Engineer for review and approval. The length of the message for the radio shall not exceed 25 bytes. Information shall be transmitted immediately and automatically as the event occurs, and shall be re-transmitted if an acknowledgement signal is not received from the Lehman Center Maintenance Facility or Operation Control Center through the vehicle media controller within a time period to be defined. Priority Level 1 alarms will be sent to both Central Control via the data radio to the CAD AVL, and over the wireless system.

The table below is a preliminary list of Priority Level 1 alarms.

SUBSYSTEM	PRIORITY LEVEL 1 ALARMS
ATC	Loss of signals
Doors	Door fails to open

SUBSYSTEM	PRIORITY LEVEL 1 ALARMS
Doors	Door fails to close
Coupler	Parted train
Coupler	Improper coupling
Communications	Loss of vehicle radio
Communications	Loss of public address
Communications	Loss of passenger intercom
Auxiliary Power	APU failure
Propulsion	Propulsion failure
Brakes	Low main reservoir pressure
Brakes	Low brake pipe pressure
Brakes	Failure of brakes to release
Brakes	Parking brake failure
Brakes	Electric brake failure
Alarms	Fire or smoke alarm
HVAC	Hot Car
HVAC	Cold Car
General	Derailed train
Lighting	Headlight failure

N20.6.3.5.2. **Priority Level 2:**

Information related to non-critical alarms such as incidents or faults, which have less significance, or no impact on operations and services that may require attention before trains return to the Lehman Center Maintenance Facility. Priority Level 2 faults are also faults that add information related to a Priority Level 1 fault.

The message shall be in a coded format containing the train run number, car number, system code and event code. The list of event codes to be included in this level shall be proposed by the Contractor and submitted for review and approval by the Engineer.

The length of the message for the radio shall not exceed 25 bytes.

The frequency of uploading shall be 30 minutes.

Information shall be transmitted automatically when there is a shutdown or power applied to the train. The VMS shall have the capability to sort

and not to re-transmit the messages that have been sent as Level 1 information. The information shall be transmitted again if an acknowledgement signal is not received from the Lehman Center Maintenance Facility or Central Control within an adjustable time period. Priority Level 2 alarms will be transmitted over the wireless system.

The table below is a preliminary list of Priority Level 2 alarms.

SUBSYSTEM	PRIORITY LEVEL 2 ALARMS
ATC	Poor station stop accuracy
ATC	Train overspeed
ATC	Improperly high acceleration
ATC	Violation of ATP controlled conditions
ATC	Unauthorized train motion
ATC	No train berthing signal - left
ATC	No train berthing signal - right
ATC	ATP berthing signal and program stop antenna side disagree on platform side determination
ATC	ATP logic failure
ATC	ATO logic failure
ATC	TWC logic failure
ATC	Tachometer failure
Doors	Door opening by-passed
Doors	Short door travel
Doors	Unscheduled train door opening or unlocking including end doors
Doors	Door cut-out
Doors	Doors closed and locked indication failure
Doors	Door dynamic brake function inoperative
Doors	Obstructed door
Doors	Sensitive edge failure
Doors	Door too slow to close
Doors	Door closing too fast or slow
Doors	Door opening too fast or slow
Doors	No zero speed signal from ATP

SUBSYSTEM	PRIORITY LEVEL 2 ALARMS
Doors	Failed door closed limit switch
Doors	Failed door locked limit switch
Doors	Illegal door open command
Doors	Illegal door close command
Coupler	Brake pipe pressure not trainlining
Coupler	Head end relay not activated with car keyed up
Coupler	Trailing end relay not activated with car keyed up
Communications	CCTV DVR not recording
Communications	CCTV camera not functioning properly
Communications	PIS failure
Communications	CCU failed
Communications	VMS failed
Communications	TOD failure
Auxiliary Power	Auxiliary inverter lockout
Auxiliary Power	Low voltage power supply lockout
Auxiliary Power	Loss of ground return
Auxiliary Power	HSCB trip
Auxiliary Power	HSCB failure
Auxiliary Power	Low battery voltage
Auxiliary Power	Input power circuit breaker tripped
Auxiliary Power	Auxiliary inverter logic failure
Auxiliary Power	LVPS logic failure
Auxiliary Power	Contactor failure
Auxiliary Power	Filter capacitor failure
Auxiliary Power	LVPS output voltage out of tolerance
Auxiliary Power	Auxiliary inverter output frequency out of tolerance
Auxiliary Power	Auxiliary inverter output voltage out of tolerance
Auxiliary Power	IGBT failure
Propulsion	Propulsion lockout
Propulsion	Inverter over-temperature
Propulsion	Ground fault detection
Propulsion	Motor over-temperature

SUBSYSTEM	PRIORITY LEVEL 2 ALARMS
Propulsion	Dynamic brake resistor over-temperature
Propulsion	Filter capacitor failure
Propulsion	Motor over-speed
Propulsion	Improper trainline combination detected
Propulsion	IGBT overcurrent
Propulsion	IGBT switching failure
Propulsion	Inverter fault current
Propulsion	Contactor feedback failure
Propulsion	Open dynamic brake resistor grid
Propulsion	Failed tachometer
Propulsion	Propulsion shutdown and automatic restart
Propulsion	Motor phase unbalance
Propulsion	Excessive wheel diameter difference
Propulsion	Inverter phase unbalance
Power Collection	Loss of third rail power
Brakes	Emergency brake application
Brakes	Failure to recover form slide
Brakes	Air compressor failure
Brakes	Brakes cut-out
Brakes	Parking brake on with train in motion
Brakes	Emergency brake T/L cur-out
Brakes	Improper trainline combination detected
Brakes	Air bag pressure out of tolerance
Brakes	Brake logic failure
Brakes	Service brake pressure too high
Brakes	Service brake pressure too low
Brakes	Emergency brake pressure too high
Brakes	Emergency brake pressure too low
Brakes	Tachometer failure
Pneumatics	Loss of air bag pressure
Alarms	Silent alarm
Radio	Data radio failure

SUBSYSTEM	PRIORITY LEVEL 2 ALARMS
HVAC	Evaporator motor failure
HVAC	Condenser motor failure
HVAC	No three phase AC input voltage
HVAC	Condenser CB tripped
HVAC	Condenser pressure too high
HVAC	Condenser pressure too low
HVAC	Evaporator pressure too high
HVAC	Evaporator pressure too low
HVAC	Heaters too hot
HVAC	Restricted filter
HVAC	Clogged evaporator valve
General	Passenger weight exceeds AW3
General	Train stopped with valid non-zero speed code
General	Train stuck at station with door closed, locked and brake released
General	Vehicle odometer failure

N20.6.3.5.3. **Priority Level 3:**

Information regarding alarms, that may not require attention, such as fault log and data logger data, condition-based monitoring data for maintenance scheduling, fault finding reasons, and confirmation of the daily train testing in the maintenance facility.

This level of information shall be an extension of the Level 1 and 2 information and shall assist the maintenance personnel to identify the nature of failure or potential failure so as to plan maintenance activities, to decide whether the train will be berthed and who shall be assigned to address the failure. The level 3 information shall include parameter values vs. time for relevant parameters associated with each level 1 or level 2 fault. The parameter values vs. time associated with a particular level 1 or level 2 fault will begin 3 seconds prior to the fault and end 3 seconds after the fault. This information will be stored by the VMS data logger which contains a continuous 72 hour data base for all the parameters associated with all the level 1 and level 2 faults. A request for level 3 information for a particular fault will show a plot of the associated

parameters over the 6 second time period beginning 3 seconds before the fault to 3 seconds after the fault.

The message shall be in a coded format containing the train run number, car number, system code, event code, and incident time. The list of event codes to be included in this level shall be proposed by the Contractor and submitted for review and approval by the Engineer. The list shall include daily train diagnosis data and confirmation of successful completion of daily automatic and manual triggered tests required to be undertaken during train preparation for service.

The length of the level 3 message shall not exceed 1 Kbyte.

The VMS data logger shall have a minimum storage capacity of 72 hours, with the data being overwritten on a FIFO basis. It shall also be possible to download to the VMS PTU or the wayside, the information contained in the data logger for any selected time period within the 72 hours of collected data.

Priority Level 3 data will be transmitted over the wireless system following all Priority Level 1 and Priority Level 2 alarms.

The three levels of information shall be changeable by the application software. The initial settings shall be proposed by the Contractor and submitted for review and approval by the Engineer.

All three levels of information shall be able to be downloaded directly from the VMS via a Laptop PTU.

The Contractor shall propose the details of functional design and operations logic for the Engineer's review and approval. The details shall include but shall not be limited to the following parameters and components:

a. Functions for the Operator: Monitoring, failure indication, display and key input functions.

b. Functions for Maintenance: Message information, message length and uploading timing for the priority 1, 2 and 3 alarms.

c. Failure Recording Functions: Failure recording items, recording capacity, recording data and failure trace recording.

d. Data Recording Functions: Recording items, sampling intervals, recording capacity and storage method.

e. Data upload/download Functions: Bi-directional data transfer between the laptop and the central unit on the train.

f. Onboard Test: Test of major equipment, VMS self-diagnostic functions and service equipment check.

g. Measurement Functions: Running distance and energy consumption recording and Time adjustment function.

h. Other Functions: Power and brake tractive effort request, ATO operating mode, VMS initialization to include at a minimum, train identification and consist information.

N20.7. CONFIGURATION DOCUMENTATION

The Contractor shall provide the drawings and details for the VMS configuration for the review and approval in accordance with TPN15 and TPN16. The configuration documentation shall address the following:

a. VMS Unit: Central unit for the lead car, local unit on each car, data recorder with flash memory that records train status at a minimum of every 500ms (at least twice a second).

b. Data Link: Train data link connecting central unit, local unit and event recorder (See TPN15) in the ring topology and utilization of nodes in a store and forward method. Local data link connecting VMS and each equipment on the car.

c. Initial Setting: In order to input the current information to VMS, manual settings such as car number, number of cars in the train etc.

N20.8. SYSTEM REDUNDANCY

The Contractor shall provide design information illustrating VMS system redundancy for the Engineer's review and approval (CDRL N2008). It shall include:

a. Central and Local Units: Failure of either the Lehman Center Maintenance Facility, Central Control or the local unit shall not interfere with VMS communication.

b. Event Recorder: Two data recorders shall be provided with identical functions in each married pair (See TPN15).

c. Train Operator Display: The TODs shall be redundant as per TPN13.

N20.9. INTERFACE, TRAINLINE AND COMMUNICATION PROTOCOLS

See TPN13, Communications.

N20.10. ENVIRONMENTAL REQUIREMENTS

The VMS onboard equipment provided by Contractor shall be capable of being operated at specified performance levels, stored and maintained, without impairment resulting from the effect of the environment, throughout the range of worst case values specified in TPN2. This shall include the ambient temperature ranges, relative humidity, maximum rainfall, wind speed and other potential tropical conditions.

N20.11. FACTORY TESTING

The Contractor shall ensure that VMS components are pre-tested by the manufacturer. The Contractor shall develop a vehicle test plan and vehicle test procedures to verify the performance and interfaces with other subsystems as specified in TPN17.

N20.12. SAFETY ANALYSIS

The Contractor shall provide safety analyses of the onboard VMS equipment as installed and functioning in the Vehicle in accordance with TPN18.

TABLE OF CONTENTS

N21. EXISTING FLEET AND WAYSIDE COMPATIBILITY 21-1
N21.1. GENERAL 21-1
N21.1.1. CITED REFERENCES 21-1
N21.1.2. SUBMITTALS – CDRLS 21-1
N21.2. AUTOMATIC TRAIN CONTROL, COMMUNICATIONS AND VEHICLE MONITORING AND CONTROL SYSTEM 21-1
N21.3. MAINTENANCE 21-2

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N21. FLEET AND WAYSIDE COMPATIBILITY

N21.1. GENERAL

The new Miami-Dade Metrorail vehicles will be operated over the entire existing and future Miami-Dade Metrorail System and mechanically couple with the existing Metrorail Fleet for towing purposes. For this aspect coupler adapters shall be provided. Trainline interaction between the existing fleet and the new fleet is not required.

Full functional compatibility with performance, trainline, and all other vehicle aspects shall be completely compatible between the base fleet and any and all option vehicles.

N21.1.1. CITED REFERENCES

Source/Section	Title
None	

N21.1.2. SUBMITTALS – CDRLS

The following items shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No	Title	TP Reference
N2101	Compatibility Analysis Report	TPN21.2.

N21.2. AUTOMATIC TRAIN CONTROL, COMMUNICATIONS AND VEHICLE MONITORING AND CONTROL SYSTEM

The Contractor shall ensure that the ATC and Communication Systems are compatible with the MDT wayside equipment as specified in TPN13 and TPN14. Also the Contractor shall comply with the requirements of compatibility for VMS as per TPN20. The Contractor shall submit a complete system compatibility analysis with all scenarios of operation for the Engineer's review and approval (CDRL N2101).

N21.3. MAINTENANCE

The new vehicles shall, to the maximum extent possible, be able to be maintained in and by Miami-Dade's present shop facilities using the existing shop equipment.

The Contractor shall supply any special tooling that is required for the maintenance of any system or subsystem that is not presently in Miami-Dade's possession in accordance with the requirements set forth in TPN15.

TABLE OF CONTENTS

N22. SOFTWARE SYSTEMS 22-1
N22.1. GENERAL 22-1
N22.1.1. CITED REFERENCES 22-1
N22.1.2. SUBMITTALS – CDRLS 22-2
N22.1.3. STANDARDS 22-3
N22.2. CONTRACTOR AND SUPPLIER QUALIFICATIONS 22-3
N22.3. SOFTWARE DOCUMENTATION 22-4
N22.3.1. REQUIRED DOCUMENTS - CONTRACTOR 22-5
N22.3.2. SOFTWARE PROJECT MANAGEMENT PLAN 22-5
N22.3.3. REQUIRED DOCUMENTS - SUPPLIERS 22-6
N22.3.4. DOCUMENT DELIVERY SCHEDULE 22-7
N22.4. COMMERCIALLY AVAILABLE SOFTWARE 22-8
N22.4.1. CONFIGURATION CONTROL 22-9
N22.4.2. PORTABLE TEST UNIT SOFTWARE 22-9
N22.4.3. BENCH TEST UNIT SOFTWARE 22-9
N22.5. VITAL SYSTEM REQUIREMENTS 22-10

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N22. SOFTWARE SYSTEMS

N22.1. GENERAL

This section defines software requirements and systems requirements applicable across the car systems. These requirements apply to all systems that include processors or other programmable components such as Programmable Logic Devices (PLDs). The application requirements for the vehicle systems are detailed in other portions of the Specification.

The Contractor and Suppliers must establish a rigorous software quality assurance (SQA) process to ensure system safety and software quality. The Contractor and Suppliers shall assure that standards and procedures are established and followed throughout all phases of software lifecycle. MDT requires that a realistic set of software plans be provided from each supplier early in the project. Progress reports are then required to demonstrate progress to plan and to assure adequate steps are taken to recover from schedule slips or technical problems. Using process monitoring, product evaluation, and audits, the compliance to the agreed upon standards shall be monitored. MDT may audit any aspect of the development including management, process, requirements, design, or test.

Selected related hardware and system requirements are included in TPN19 and GP5.

All computer hardware and software for this contract is subject to the same requirements, except as granted within this specification. Vital or Safety Critical systems have additional requirements; see section N22.5, (Vital System Requirements). The Contractor shall analyze the overall requirements and design to determine which systems are Safety Critical.

If the Contractor will supply software for this project then they shall also be considered a Supplier and shall also be subject to the requirements of this section pertaining to Suppliers.

All computer hardware and software, including firmware, shall be service proven as described within the Contract Documents.

N22.1.1. CITED REFERENCES

Source/Section	Title
BS 7799-2	Information Technology - Code of Practice for Information Security Management

Source/Section	Title
IEEE 730	Standard for Software Quality Assurance Plans
IEEE 828	Software Configuration Management Plan
IEEE 830	Standard for Software Test Documentation
IEEE 1012	Standard for Software Verification and Validation Plans
IEEE 1016	Recommended Practices for Software Design Descriptions
IEEE 1233	Guide for Developing System Requirements Specifications
IEEE 1558	Standard for Software Documentation for Rail Equipment and Systems
IEEE 14764 (Previous IEEE 1219)	Standard for Software Engineering Software Life Cycle Process Maintenance
ISO/IEC 27002 (BS ISO/IEC 17799)	Information Technology - Security Techniques - Code of Practice for Information Security Management
ISO/IEC 90003	Software Engineering, Guidelines for the Application of ISO 9001 to Computer Software
SEI	Software Engineering Institute

N22.1.2. SUBMITTALS – CDRLS

CDRL No.	Title	TP Reference
N2201	Software Project Test Plan	N22.3.1.
N2202	Software Quality Assurance Plan	N22.3.1.
N2203	Software Project Management Plan	N22.3.1.
N2204	Software Configuration Management Plan	N22.3.1.
N2205	Software Verification and Validation Plan	N22.3.1.
N2206	Software Verification and Validation Report	N22.3.1.
N2207	User Documentation	N22.3.1.
N2208	Software Requirements Specification (SRS)	N22.3.3.

CDRL No.	Title	TP Reference
N2209	Software Requirements Traceability Matrix	N22.3.3.
N2210	System Functional Description (SFD)	N22.3.3.
N2211	Software Configuration Control Plan (SCCP)	N22.4.1.
N2212	Vital Software Validation Report	N22.5.

N22.1.3. STANDARDS

All software supplied by the Contractor shall comply with the following requirements where applicable:

- ISO/IEC 90003 – Software Engineering, Guidelines for the application of ISO 9001 to computer software.
- Guidelines for the Information Security Management Systems according to the security standard of ISO/IEC 27702 and BS 7799-2.
- The software documentation generated under this contract shall comply with IEEE 1558, Standard for Software Documentation for Rail Equipment and Systems, and its associated IEEE software standards.
- All software shall be designed in accordance with IEEE 730. The code shall be written in a high level programming language. The Contractor and/or Contractor providing any microprocessor-based equipment shall submit a software quality program plan, prepared in accordance with IEEE 730, to the Engineer for review and approval as required by TPN18. For reference, IEEE 730 has the following minimum software documentation requirements:
  - Software requirements specification (IEEE 1233, IEEE 830).
  - Software design description (IEEE 1016).
  - Software verification and validation plan (IEEE 1012).
  - Software verification and verification report (IEEE 1012).
  - Software Quality Assurance Plan (IEEE 730).
  - Software Maintenance Requirements Specification (IEEE 14764).
- The requirements of TPN19 and GP5.

N22.2. CONTRACTOR AND SUPPLIER QUALIFICATIONS

The Contractor, as systems and software integrator, and Suppliers who are providing processor-based products shall have a mature software and systems development process. To confirm its capability, the Contractor shall submit an independent Software Capability Evaluation (SCE) for

themselves and for each supplier. The evaluation shall use the Capability Maturity Model Integrated for Systems Engineering and Software (CMMI-SE/SW) from the Software Engineering Institute (SEI).

Since the overall System Engineering, software design, integration, and subcontract management are critical to the success of the project, the Contractor's SCE is required regardless of whether or not they directly produce software. In each case, the SCE must cover the entire range of activities, by the Contractor or Supplier, relevant to the project. The specific details of how the evaluations will be conducted and any tailoring issues shall be presented to the Engineer for approval before the evaluations are performed.

The independent evaluations shall include the use of a lead evaluator who is certified by the Software Engineering Institute (SEI) and shall be conducted according to the methodologies established by the SEI. The lead evaluator shall not be affiliated with the Contractor or the Suppliers and shall not have been involved with their improvement activities. The Contractor's evaluation report must be provided to the Engineer for approval prior to the first Preliminary Design Review (PDR), and each Supplier's report must be submitted prior to the PDR for the relevant subsystem.

For the Contractor, if their CMMI level is below 2, and for each supplier with a CMMI level below 2, a course of action must be defined to mitigate the impact of the problem areas on the project and to improve the processes to at least CMMI level 2 by the time of Final Design Review (FDR). To this end an intensive effort is required.

The Supplier shall submit monthly progress reports identifying progress to plan for improving to CMMI level 2. The reports must demonstrate a concerted effort and tangible results. Reports shall continue up through the submittal of the final SCE report confirming a level 2 rating.

N22.3. SOFTWARE DOCUMENTATION

Since software is part of a total system design, it will be reviewed as part of each design review.

Software documentation shall be consistent with IEEE 1558, Standard for Software Documentation for Rail Equipment and Systems, using the type 5 requirements as defined in that standard, and with the requirements of TPN19 and GP5.

Thorough and accurate software documentation submittal and the Engineer's approval is required. MDT shall be provided with sufficient documentation to fully comprehend and analyze the operation of the equipment in which the software is to be installed.

N22.3.1. REQUIRED DOCUMENTS - CONTRACTOR

The Contractor shall utilize a Software Project Management Plan (SPMP), a Software Quality Assurance Plan (SQAP), a Software Configuration Management Plan (SCMP), a Software Test Plan (STP) and a Software Verification and Validation Plan (SVVP) in accordance with IEEE Standard 1558 (CDRL N2201). The plans shall describe a mechanism for orderly software development using the required documents. These plans shall describe the Contractor's responsibilities for the overall requirements analysis and design, the partitioning of the requirements to the subsystems, the coordination of System designs, and the integration of the subsystems to provide the requirements for the entire system.

The Contractor shall develop and submit for approval the following documents.

a. A Software Quality Assurance Plan (SQAP). The scope of this document shall cover the entire software development for the project. It shall describe the responsibilities of the Contractor and of the Suppliers (CDRL N2202).

b. A Software Project Management Plan (SPMP). Details shall be provided describing monitoring of Supplier activities to assure development tasks are completed and delivery requirements are met for each development phase from concept development to warrantee support (CDRL N2203).

c. A Software Configuration Management Plan (SCMP) in accordance with IEEE 828, including definition of the Software Configuration Items (SCI) within each subsystem (CDRL N2204).

d. A Software Verification and Validation Plan (SVVP).This document shall describe the verification and validation plans related to integration of the subsystems that produce the desired behavior of the complete system. Verification and validation is to be done as early in the development cycle as possible. Whenever possible it shall be done within the subsystem development (CDRL N2205).

e. A Software Verification and Validation Report (SVVR) for each release of software (CDRL N2206).

f. User Documentation (CDRL N2207).

N22.3.2. SOFTWARE PROJECT MANAGEMENT PLAN

The Software Project Management Plan (SPMP) for both the Contractor and the Suppliers shall include a schedule showing the key tasks defined for the software development. A Gantt chart shall be used showing the timing and interrelationships between tasks. This schedule shall include the allocation of time and resources for realistically addressing issues raised by internal reviews, contractor reviews, or by MDT. The SPMP shall include detailed descriptions of the metrics to be used to monitor

and control the project. This shall include monitoring project progress on intermediate tasks and triggering management corrective actions with sufficient time to assure required deliveries are met.

N22.3.3. REQUIRED DOCUMENTS SUPPLIERS

Each supplier shall create and submit the full set of documents conforming to IEEE Standard 1558 Standard for Software Documentation for Rail Equipment and Systems for type 5 as defined in that standard.

The SQAP shall incorporate a procedure for making changes to approved software. The Contractor shall submit a Software Change Request to the Engineer for approval before making any changes to approved software. The Software Change Request shall describe why changes are required and what steps the Contractor plans to follow to ensure integrity of the software change. The Contractor shall describe the details of the validation process:

a. Bench testing of the specific change.

b. System functional bench testing.

c. On-site static and dynamic tests.

d. Two week revenue test.

The Software Change Request shall also describe what will be employed to validate the software.

The SQAP shall also describe what quality metrics will be produced and how they will be reported to MDT.

If a change to car software requires a change to PTU or BTU software as well then that software must be supplied to the PTU and BTU before the car software is applied to a revenue service car.

The supplier's Software Verification and Validation Plan (SVVP) shall require internal peer reviews of each version of the documents. Summary reports of these reviews shall be included in the Software Verification and Validation Report (SVVR) and shall state the version of the documents reviewed as well as the versions of all related documents used in the review. These include, for example, documents that the subject document was reviewed against such as a Software Requirements Specification (SRS) (CDRL N2208) or related interface specifications used in the review of a Software Design Description (SDD). The review reports shall list for each V&V task, the type of review, the participants, the date, the versions of all items used in the review, and all issues from the review. The SVVP shall also require reviews of each design or source code change prior to test and release. Summaries of these also are required in the SVVR.

All documentation shall use names and acronyms consistent with those in the Technical Specification and as defined in the General Provisions for the specific system.

The Contractor shall assure that the documentation produced provides for the straightforward traceability of requirements of the Technical Specification throughout the design documentation and including the final tests. The problem reporting and corrective action process shall provide reports allowing the easy tracing of problems found at each development stage back to changes in the requirements, design or implementation in source code.

Each software release shall be provided in a package including a consistent set of up to date and approved software documents, test reports, the updated SVVP, and a Software Version Description (SVD).

The Software Requirements Traceability Matrix (SRTM) (CDRL N2209) shall provide cross-referencing between the requirements of the SRS and the corresponding sections of the System Functional Description (SFD) (CDRL N2210), SDD, and the Software Verification Test Plans. It shall include one table for each SCI and within each table there shall be a row for each SRS requirement. The columns shall include the unique identifier for the individual requirements defined in the SRS, a short description of the requirement the reference to the corresponding SFD section, the reference to the SRS section, the reference to the SDD section or sections, and the reference or references to the Software Validation tests. Since the references are dependent on the version of the documents referenced, the specific versions of all referenced documents must be stated for each table.

All references to documents shall specify the location to a sufficiently specific section of text so the reader easily and unambiguously understands the intention.

N22.3.4. DOCUMENT DELIVERY SCHEDULE

The correspondence between design reviews and software submittals shall be as shown below:

Review Type	Software Related Documentation
Time of conceptual design drawings:	Software Quality Assurance Plan (SQAP) for Contractor
	Software Project Management Plan (SPMP) for Contractor
	Preliminary Overall System Functional Description (Overall SFD)
	Software Quality Assurance Plans (SQAP) for Suppliers
	Software Project Management Plan SPMP) for Suppliers
	Preliminary Software Configuration

Review Type	Software Related Documentation
	Management Plan (SCMP) for Contractor, and Suppliers
	Preliminary System Functional Description (SFD) for Contractor and Suppliers
	Preliminary Software Requirements Specifications (SRSs)
	Preliminary Software Design Descriptions (SDD) (Architecture level)
	Preliminary Software Verification and Validation Plan (SVVP) for Contractor and Suppliers
	Preliminary Software Requirements Traceability Matrix (SRTM) for each system
	Vital System Microprocessor Software/Firmware Specifications
In-Process Design Review:	Update of documents required for PDR
Final Design Review:	Complete versions of all required documents

After original approval, changes to the software shall be formally submitted to the Engineer for approval prior to implementation of the changes in the source code. New versions of software must be accompanied by revised, reviewed and released software documentation.

N22.4. COMMERCIALLY AVAILABLE SOFTWARE

Some software supplied under this procurement may be Commercially Available (CA) to a wide variety of users. Examples include operating systems supplied by chip manufacturers and data base software for wayside fault analysis. The Contractor shall submit a list of software which is commercially available to the general public. MDT shall determine which software will then be classified as CA.

For Commercially Available software, software documentation requirements are limited to: (1) a description in the SFD of the functions of the item and its interfaces; (2) the original data storage/transfer media (CD-ROM or diskette); (3) functional and usage details; and (4) all provider manuals and licenses required for MDT's site use. For all other software, as deemed by MDT, the documentation requirements of GP5 and TPN19 apply.

N22.4.1. CONFIGURATION CONTROL

The Contractor shall develop and maintain a Software Configuration Control Plan (SCCP) for tracking software changes relative to cars, Portable Test Units (PTUs), and Bench Test Units (BTUs) on MDT's property. This plan shall be submitted for approval by the Engineer. The Contractor shall include in the plan a database system capable of maintaining the history of all software and status changes making it possible to determine which versions currently resides in which equipment, on which cars, and also the dates for which versions were used in the past. The database system shall be capable of generating various reports showing the configuration of a typical vehicle system in terms of software history and status, and also a fleet configuration report capable of determining the exact software configuration of a particular operating unit on a car by car basis. The Contractor shall make these reports available to MDT starting at the delivery of the first car.

The Software Configuration Control Plan (SCCP) shall be submitted for approval by the Engineer (CDRL N2211).

The Contractor shall submit a final software configuration for each car at the time of acceptance, or conditional acceptance, in an electronic format as approved by the Engineer.

All software shall be identified by a name and a version number. The name shall identify the equipment into which the software is installed. Every change to software shall be reflected in an update version number.

N22.4.2. PORTABLE TEST UNIT SOFTWARE

Portable test unit (PTU) software is subject to the same requirements as other software as detailed in the preceding sections. Design of the PTU shall include consideration of future ease of upgrade and ease of migration to newer replacement computers during the life of the cars. This includes possible use of open systems and tools. At time of first car delivery the operating systems used shall be current market versions readily available at the time. Two levels of passwords shall be provided: one allowing access to data for analysis and troubleshooting and the other allowing modification or reloading of software.

N22.4.3. BENCH TEST UNIT SOFTWARE

Bench Test Unit (BTU) software is subject to the same requirements as other software as detailed in the preceding sections. Design of the BTU shall include consideration of future ease of upgrade and ease of migration to newer replacement computers during the life of the cars. This includes possible use of open systems and tools. At time of first BTU delivery the operating systems used shall be current market versions readily available at the time. Two levels of passwords shall be provided:

One allowing access to data for analysis and troubleshooting, and the other allowing modification or reloading of software.

N22.5. VITAL SYSTEM REQUIREMENTS

Microprocessor systems employed in safety critical systems or subsystems shall be considered vital. The requirement of this section must be complied with by those systems.

Each vital system shall monitor on a continuous basis that is capable of executing its instruction set correctly, that the executive software and the application logic have not changed since installation of the system, and that databases are valid and not corrupted. Systems that revert to a more restrictive state in the event of corruption are acceptable.

The system shall ensure that inputs are correctly recognized and not stuck in a less restrictive state, and that they are responsive to changes in the external input circuits.

The system shall ensure that inputs and intervals variables are current and not "stale" data from previous operations.

The system shall ensure that output devices are driven correctly and are responsive to changes in output status of the microprocessor-based equipment. No de-energized output shall be spuriously energized.

Data exchanged between microprocessors shall be current and valid.

Failure of the system to meet any or all of the above requirements shall result in a shut down of the microprocessor and reversion to a restrictive state of all outputs.

The microprocessor-based ATP system shall be equipped with its own regulated power supply. The power supply shall be used solely for the excitement of the system itself and not for the energizing of other systems or associated equipment such as input or output relays or circuits.

The equipment shall be protected against and shall not malfunction or cause an unsafe condition due to power fluctuations or the carborne low voltage supplies, including but not limited to power dips and spikes, electrical noise, and radiation of externally generated electromagnetic energy.

In the event of a power interruption, the system shall automatically reset to its normal operating mode upon restoration of input power.

A Vital Software Validation Report shall be added to the standard package of Software Quality Assurance Documentation, which shall be provided by the Contractor according to the requirements herein (CDRL N2212).

Vital software validation shall be based upon a series of tests proving a fail-safe feature of software design.

TABLE OF CONTENTS

N23. CONTRACT DATA REQUIREMENTS LIST 23-1
N23.1. GENERAL 23-1
N23.1.1. CITED REFERENCES 23-1
N23.1.2. SUBMITTALS – CDRLS 23-1
N23.2. COLUMN DEFINITIONS 23-2
N23.3. SCHEDULED SUBMITTAL DATE DEFINITIONS 23-2

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N23. CONTRACT DATA REQUIREMENTS LIST

N23.1. GENERAL

The Contractor shall comply with the submission requirements for schedules, reports, certificates, and other data listed in these Technical Provisions.

This section contains a listing of deliverable items included in sections TPN1 through TPN23 of the Technical Provisions. Deliverables described solely in the Contract General Provisions are not included.

The Contractor is responsible for furnishing all deliverables included in these Technical Provisions and the Contract General Provisions in accordance with the required submittal dates, as modified by the approved, detailed Schedule of Values per GP9.2.3.

The Contractor may propose to combine multiple CDRLs into a single CDRL at any time. CDRLs may only be combined with Engineer approval.

All CDRLs shall include a revision log showing revision, date, and description of the changes, a Table of Contents, and identification of the specification section against which the CDRL has been submitted.

If a dispute arises concerning whether a CDRL is required, the Engineer's interpretation of the Specification shall be considered final.

N23.1.1. CITED REFERENCES

Source/Section	Title
None	

N23.1.2. SUBMITTALS – CDRLS

The following item shall be submitted to the Engineer for review and approval. The applicable section is given for reference.

CDRL No	Title	TP Reference
N2301	CDRL Delivery Plan	TPN23.2.

N23.2. COLUMN DEFINITIONS

The Contractor shall submit all deliverables listed as specified in Exhibit N23-1. The Contract data requirements in Exhibit N23-1 are organized into four columns that list the following types of information:

- CDRL No. – CDRL serial number.
- Title – CDRL item description.
- Reference Paragraph – Item's location in Technical Provisions.
- Scheduled Submittal Date – Time after NTP for initial submittal.

The Contractor shall submit to the Engineer for review and approval a plan and schedule for the submission of all CDRLs within 28 days after NTP. This schedule shall generally follow the Work as specified by TPN16 (CDRL N2301).

N23.3. SCHEDULED SUBMITTAL DATE DEFINITIONS

An attempt has been made to designate when a CDRL shall be submitted by the Contractor. For further clarification, the Contractor shall use the following definitions when determining the submittal date for a CDRL:

- XX days after NTP – The CDRL is due on or before XX days after the Notice to Proceed date.
- With delivery of the last HRV – The CDRL is due on the day the last HRV is delivered to MDT.
- As required – The CDRL is due in accordance with the Engineer's interpretation of the TP paragraph that defines the CDRL.
- XX days prior to ... – The CDRL is due XX calendar days prior to the noted activity or event.
- XX days after ... – The CDRL is due XX calendar days after the noted activity or event.
- With proposal (as required) – The CDRL shall be submitted with the Engineer's Proposal and shall be updated to reflect the Engineer's comments in accordance with an Engineer-approved schedule.
- Prior to Contract close-out – The CDRL shall be submitted prior to the date when all of the contractual requirements of the Specification have been satisfied.

If a dispute arises concerning these definitions or any CDRL submittal date, the Engineer's interpretation of when a CDRL is due for delivery shall be considered final.

EXHIBIT N23. CONTRACT DATA REQUIREMENTS LIST

TPN1 SYSTEM DESCRIPTION			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
	None		

TPN2 SYSTEM REQUIREMENTS			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N201	Vehicle Dynamic Clearance Envelope Outline Drawings	TPN2.1.7.	30 days prior to the IDR
N202	Analysis Results	TPN2.1.7.	30 days prior to the PDR
N203	Vehicle Center of Gravity	TPN2.1.8.1.	30 days prior to the FDR
N204	Power Consumption Report	TPN2.1.11.	30 days prior to the PDR
N205	Acceleration Requirements List	TPN2.2.1.3.	30 days prior to the IDR
N206	Acoustic Noise Plan	TPN2.4.	30 days prior to the PDR
N207	Interference in Rapid Transit Signaling Systems, Suggested Test Procedures Noise Analysis	TPN2.4.2.	30 days prior to the PDR
N208	Electromagnetic Compatibility (EMC) Control and Test Plan	TPN2.4.2. TPN2.4.2.9.	30 days prior to the PDR
N209	Electromagnetic Compatibility Detailed Test Procedure	TPN2.4.2.	30 days prior to the IDR
N210	Electromagnetic Compatibility Detailed Test Report	TPN2.4.2.	Within 14 days after test completion
N211	Shock and Vibration Test Plan	TPN2.5.	30 days prior to the PDR
N212	Ride Quality Test Procedure	TPN2.7.	30 days prior to the PDR
N213	Final Photographs on DVD	TPN2.10.	With the delivery of the first two new vehicles

TPN3 CARBODY			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
N300	Structural Analysis	TPN3.3.	30 days prior to the IDR
N301	End Accessibility Scheme	TPN3.3.13.	30 days prior to the PDR
N302	Water Test Procedure	TPN3.3.14.	30 days prior to the IDR
N303	Advertising and Notice Frame Design	TPN3.7.8.	30 days prior to the PDR
N304	Graphics and Decals Design	TPN3.7.9.	30 days prior to the FDR
N305	Lock Key Configuration	TPN3.7.10.	30 days prior to the IDR

TPN4 COUPLER AND DRAFT GEAR			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N401	Mechanical Coupler Head Documentation	TPN4.2.2	30 days prior to the PDR
N402	Mechanical Coupler Head Qualification Test Procedure and Report	TPN4.2.2.	30 days prior to the FDR
N403	Uncoupling System Documentation	TPN4.2.3.	30 days prior to the IDR
N404	Uncoupling Qualification Test Procedure and Report	TPN4.2.3.	30 days prior to the FDR
N405	Coupler Centering Spring Assembly Design Documentation	TPN4.2.6.	30 days prior to the IDR
N406	Coupler Electric Head System Design Documentation	TPN4.2.7.	30 days prior to the FDR
N407	Coupler Electric Head System Qualification Test Procedure and Report	TPN4.2.7.	30 days prior to the FDR
N408	Inter-Car Draw Bar Clearance Diagram	TPN4.2.8.	30 days prior to the IDR

TPN5 OPERATOR'S CAB			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N501	Human Engineering Analysis	TPN5.2.	30 days prior to the PDR
N502	Final Equipment Location and Cab Configuration	TPN5.2.	30 days prior to the IDR
N503	Operator Console Design	TPN5.3.	30 days prior to the PDR
N504	Fault Annunciation System Details	TPN5.3.3.	30 days prior to the PDR
N505	Warning Device Details	TPN5.3.4.	30 days prior to the IDR
N506	Proposed Operator's Storage Area Configuration	TPN5.4.5.	30 days prior to the PDR
N507	Silent Alarm Switch Location	TPN5.4.6.	30 days prior to the PDR
N508	Fire Extinguisher	TPN5.4.8.	30 days prior to the PDR
N509	Hostler Panel Design	TPN5.6.	30 days prior to the PDR
N510	Operator's Cab & Hostler Panel Mock-Up	TPN5.7.	30 days prior to the IDR

TPN6 DOORS			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N601	Qualification Testing and Factory Acceptance Testing Procedure	TPN6.1.3.	30 days prior to the FDR
N602	Door System Test Plan	TPN6.1.3.	30 days prior to the IDR
N603	Side Door Functional Operation Description	TPN6.3.	30 days prior to the PDR
N604	Door Controls Description	TPN6.4.	30 days prior to the IDR

TPN7 AIR COMFORT SYSTEM			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N701	Passenger Heat Loads Air Conditioning Analysis	TPN7.3.	30 days prior to the PDR
N702	Refrigeration Circuit Performance Analysis	TPN7.3.	30 days prior to the IDR
N703	HVAC System Test Specification	TPN7.3.	30 days prior to the FDR
N704	System Component Data	TPN7.3.	30 days prior to the FDR
N705	Air Flow Design Calculations	TPN7.3.	30 days prior to the PDR
N706	Stress Analysis	TPN7.3.	30 days prior to the FDR
N707	Qualification Test Procedure	TPN7.3.	30 days prior to the FDR
N708	Acceptance Test Procedure	TPN7.3.	30 days prior to the FDR
N709	Refrigerant Selection	TPN7.4.2.	30 days prior to the PDR
N710	Soldering Procedures for HVAC Piping	TPN7.4.3.	30 days prior to the PDR

TPN8 LIGHTING			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N801	Computer Analysis of Illumination	TPN8.2.1.	30 days prior to the FDR
N802	Data and Test Results of the Ballasts	TPN8.2.6.	30 days prior to the IDR
N803	Specifications and Data Sheets on all Exterior Lamps and Lights, including LEDs	TPN8.3.	30 days prior to the IDR
N804	Headlight Visibility Data	TPN8.3.1.	30 days prior to the IDR

TPN9 AUXILIARY ELECTRIC			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N901	Operating Characteristics and a Load Analysis for the Primary Power Supply	TPN9.1.4.1.	30 days prior to the IDR
N902	Operating Characteristics and a Load Analysis for the AC Voltage Power Supply	TPN9.1.4.2.	30 days prior to the IDR
N903	Operating Characteristics and a Load Analysis for the Low-Voltage Power Supply	TPN9.1.4.3.	30 days prior to the IDR
N904	Current Collector Design Details	TPN9.2.2.	30 days prior to the PDR
N905	Fuse Mounting Location and Details	TPN9.2.5.2.	30 days prior to the IDR
N906	Information to Show that Contactors Operate in Severe or Heavy Storm Conditions with Moisture Present	TPN9.2.5.4.	30 days prior to the IDR
N907	Spare Studs or Threaded Bolt Holes on Ground Plate for Connections	TPN9.2.5.5.	30 days prior to the IDR
N908	Coordination Analysis of Protection Devices	TPN9.2.6.	30 days prior to the IDR
N909	AC Power Distribution Assembly Load Sequencing	TPN9.4.1.	30 days prior to the IDR
N910	Breaker Identification and Labelling Plan	TPN9.4.1.	30 days prior to the IDR
N911	Feeder Breaker Location	TPN9.4.2.	30 days prior to the IDR
N912	Branch Circuit Breakers	TPN9.4.3.	30 days prior to the PDR
N913	Pneumatic Pump & Interlock Design	TPN9.4.5.	30 days prior to the PDR
N914	Utility Outlet Installation Procedure	TPN9.4.6.	30 days prior to the FDR
N915	Operating Characteristics, Load Analysis, and a Voltage Interruption Analysis for the Auxiliary Inverter	TPN9.6.1.	30 days prior to the PDR

TPN9 AUXILIARY ELECTRIC			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N916	Functional Description of Diagnostic Methods for Troubleshooting/Fault Isolation	TPN9.6.2.	30 days prior to the IDR
N917	Details of Diagnostic/Data Logging Capabilities, Storage Capacity, Self-Test, and Level of Fault Reporting	TPN9.6.3.	30 days prior to the IDR
N918	Self-Tests	TPN9.6.4.	30 days prior to the FDR
N919	Characteristics of Power Circuit Devices (including comparison of maximum capabilities vs. Design values)	TPN9.6.7.	30 days prior to the IDR
N920	Evidence of Cooling System Reliability	TPN9.6.7.	30 days prior to the IDR
N921	Analysis of Proposed Battery and Associated Circuits	TPN9.8.2.	30 days prior to the PDR
N922	Analysis of Emergency Load Requirements and Battery Capacity	TPN9.8.2.2.	30 days prior to the PDR
N923	Grounding Plan (including details and functional diagram)	TPN9.9.1.	30 days prior to the IDR
N924	Grounding Arrangement with Sufficient Redundancy for Safety and Operational Reliability	TPN9.9.3.	30 days prior to the IDR

TPN10 PROPULSION			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1001	Propulsion System Interface Description	TPN10.1.6.	30 days prior to the PDR
N1002	Flow Chart Describing the Intercommunication between Microprocessors Used to Control Subsystems Interfacing with the Propulsion System	TPN10.1.6.	30 days prior to the PDR
N1003	Main Component Technical and Functional Descriptions	TPN10.2.1.	30 days prior to the FDR
N1004	Curves of Vehicle Tractive Effort vs. Speed for Propulsion and Braking Modes	TPN10.2.1.	30 days prior to the FDR
N1005	Power Circuit Schematic Diagram, Control, Logic Functional, Schematic, and Wiring Diagrams	TPN10.2.1.	30 days prior to the IDR
N1006	Dynamic Brake Operation and Friction Brake Blending Design	TPN10.2.4.	30 days prior to the PDR
N1007	Propulsion System Duty Cycle Calculation	TPN10.2.6.	30 days prior to the FDR
N1008	Thermal Analysis and Motor Winding Temperature Rises for the Worst-Case Duty Cycle	TPN10.2.6.	30 days prior to the IDR
N1009	Voltage Interruption Analysis Describing the Start-up and Shutdown Control Circuits and their Algorithms	TPN10.2.7.	30 days prior to the IDR
N1010	Inverter Operating Characteristics and Analyses	TPN10.3.1.	30 days prior to the IDR
N1011	Layout and Configuration of the Power Semiconductor Assemblies	TPN10.3.2.	30 days prior to the PDR
N1012	Power Devices and Comparison of Maximum Capabilities vs. Design Values	TPN10.3.2.	30 days prior to the IDR
N1013	Propulsion System Fault Description Document	TPN10.4.1.	30 days prior to the FDR
N1014	Control Logic Hardware Fan Location	TPN10.4.2.	30 days prior to the IDR

TPN10 PROPULSION			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
N1015	Diagnostic, Data Logging, and Storage Capabilities	TPN10.4.3.	30 days prior to the IDR
N1016	Self-Test Details and Capabilities	TPN10.4.4.	30 days prior to the PDR
N1017	Details of the Load Weigh Panel and its Integration with the Propulsion and Brake Systems	TPN10.4.10.	30 days prior to the IDR
N1018	Function of Dynamic Brake IGBT and Crowbar Device with Associated Resistor in	TPN10.5.3.	30 days prior to the PDR
N1019	Line Filter Characteristics and Analysis of Interference with Signaling Track Circuits	TPN10.5.4.	30 days prior to the PDR
N1020	Filter Capacitor Warning Label Design and Location and the Maintenance Safety Procedure	TPN10.5.4.1.	30 days prior to the IDR
N1021	Traction Motor Electrical and Mechanical Characteristics	TPN10.6.1.	30 days prior to the IDR
N1022	Structural Analysis of Traction Motor Mounting	TPN10.6.2.	30 days prior to the PDR
N1023	Traction Motor Drawings and Suspension Data	TPN10.6.2.	30 days prior to the PDR
N1024	Traction Motor and Gearbox Coupling Details	TPN10.8.	30 days prior to the FDR
N1025	Equipment Box Location and Mounting Details	TPN10.9.1.	30 days prior to FDR
N1026	Component Qualification and Acceptance Test Specifications and Results	TPN10.11.1.	30 days prior to the FDR
N1027	Listing of Faults and Parameters to be Recorded by The Subsystem Fault Loggers and Details of the Fault Logger Memory, Capacity, and Data Reading Method	TPN10.11.3.	30 days prior to the FDR

TPN11 TRUCK ASSEMBLIES			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1101	Truck Conceptual Design Documentation	TPN11.1.3.	30 days prior to the PDR
N1102	Alternative Truck Configuration Analysis	TPN11.1.5.	With the Proposal
N1103	Truck Structural Analysis Program	TPN11.1.5.	30 days prior to the PDR
N1104	Axle Design Evaluation	TPN11.5.3.	30 days prior to the IDR
N1105	Wheel Design	TPN11.5.4.	30 days prior to the IDR
N1106	Journal Bearing Retention Method	TPN11.5.5.	30 days prior to the PDR
N1107	Proposed Bearing Specifications, Reliability Data, Service Requirements	TPN11.5.5.1.	30 days prior to the IDR
N1108	Journal Bearing Installation Procedure	TPN11.5.5.1.	30 days prior to the FDR
N1109	Procedure for Assembly and Inspection of Components Fitted on to each Wheel/Axle Assembly	TPN11.5.6.	30 days prior to the FDR
N1110	Procedures for Qualification Testing to be Performed on Assembled Axles with Wheels, Bearings, and Brake Equipment	TPN11.5.6.	30 days prior to the FDR
N1111	Design Data for the Primary Suspension Member	TPN11.5.9.1.	30 days prior to the IDR
N1112	Qualification Test to Verify the Spring Characteristics and the Resulting Graphs or Charts	TPN11.5.9.1.	30 days prior to the IDR
N1113	Evaluation the Vehicle Suspension Configuration	TPN11.5.9.2.	30 days prior to the IDR
N1114	Reports Containing the Technical Specifications of the Air Spring Secondary Suspension	TPN11.5.9.2.	30 days prior to the FDR
N1115	Design Data that Completely Defines the Tubing Configuration, Routing and Clamping Points	TPN11.5.9.4	30 days prior to the FDR

TPN11 TRUCK ASSEMBLIES			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1116	Analysis of the Proposed Lateral Stop to Carbody Interface Including Engineering Drawings, Test Reports and Measures Proposed to Minimize Lateral Displacement and Improve Ride Quality	TPN11.5.9.5.	30 days prior to the FDR
N1117	Documents Detailing the Method of Aligning the Bolster with the Carbody	TPN11.5.9.6.	30 days prior to the FDR
N1118	Inspection Procedure for Completed Truck Assemblies	TPN11.7.1.	30 days prior to the FDR
N1119	Qualification Test Procedure	TPN11.7.2.1.	30 days prior to the FDR
N1120	Acceptance Test	TPN11.7.2.2.	30 days prior to the FDR

TPN12 FRICTION BRAKING			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1201	Friction Brake System Plan	TPN12.1.3.	30 days prior to the PDR
N1202	Air Supply System Design Documentation	TPN12.2.1.	30 days prior to the IDR
N1203	Air Dryer System Design Documentation	TPN12.2.1.	30 days prior to the IDR
N1204	Air System Qualification Test Procedures and Report	TPN12.2.1.	Within 14 days after test completion
N1205	ECU Diagnostic Design, Data Logging Signal Monitoring Capability, and Storage Capacity	TPN12.3.1.1.	30 days prior to the FDR
N1206	Spin/Slide Control Design	TPN12.3.1.1.	30 days prior to the IDR
N1207	Brake System Component Acceptance Testing Procedure and Report	TPN12.4.	30 days prior to the FDR
N1208	Brake System Qualification Testing Procedure and Report	TPN12.4.	Within 14 days after test completion

TPN13 COMMUNICATIONS			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1301	System Interface Report & Recommendations	TPN13.1.	30 days prior to the IDR
N1302	System Integration Documentation	TPN13.2.1.	30 days prior to the IDR
N1303	Communication link between Stations. Communication Room and the Platform	TPN13.2.1.	30 days prior to the IDR
N1304	Proposed Operator Interface Equipment Layout	TPN13.3.3.1.	30 days prior to the IDR
N1305	CCU Designer Qualifications	TPN13.3.3.1.1.	30 days prior to the IDR
N1306	Communication Port for PTU	TPN13.3.3.1.1.	30 days prior to the PDR
N1307	Proposed CCU System Block Diagram	TPN13.3.3.1.1.	30 days prior to the PDR
N1308	CCU Location, Installation, and Replaceable Filter Requirements	TPN13.3.3.1.1.	30 days prior to the IDR
N1309	Design and Configuration for Vehicle Silent Alarm	TPN13.3.3.1.6.	30 days prior to the IDR
N1310	Onboard (shared) Trainline Design, including configuration and block diagram	TPN13.3.3.2.	30 days prior to the PDR
N1311	PA System Design and Specifications	TPN13.3.4.1.	30 days prior to the IDR
N1312	Door Chime Proposal and Schematic	TPN13.3.4.1.	30 days prior to the PDR
N1313	Proposed Messages, Audio Announcements, and Corresponding Textual Messages	TPN13.3.4.2.	30 days prior to the PDR
N1314	PA Microphone Station Design and Location	TPN13.3.4.3.2.	30 days prior to the PDR
N1315	Speaker Calculation and Mounting Details	TPN13.3.4.3.3.	30 days prior to the IDR
N1316	Passenger Information system design, Signs, mounting and programming details	TPN13.3.5.1.	30 days prior to the IDR
N1317	Proposed Interior Signs and Mounting Details	TPN13.3.5.3.3.	30 days prior to the IDR

TPN13 COMMUNICATIONS			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1318	Passenger's Display Signs Protocol and Interface to the Local Area Network	TPN13.3.5.3.4.	30 days prior to the IDR
N1319	All Display Interfaces, Application Software, and Software Protocols	TPN13.3.5.3.4.	30 days prior to the IDR
N1320	Noise Control Plan, location and Installation details for the IC System	TPN13.3.6.2.	30 days prior to the PDR
N1321	CCTV/security System design and Block Diagram	TPN13.3.7.2.	30 days prior to the PDR
N1322	DVR Placement details inside the vehicle	TPN13.3.7.3.1.	30 days prior to the IDR
N1323	Complete Radio System Block Diagram	TPN13.4.1.	30 days prior to the PDR
N1324	Radio equipment location, mounting & cable lengths	TPN13.4.1.	30 days prior to the IDR
N1325	Installation details and location for Emergency Transit Switch	TPN13.4.1.3.	30 days prior to the PDR
N1326	Radio System Interface Plan	TPN13.4.6.	30 days prior to the IDR
N1327	Radio Software Functionality Plan & Flow Charts	TPN13.4.6.	30 days prior to the IDR
N1328	Digital Radio Triggering Requirements	TPN13.4.6.	30 days prior to the IDR
N1329	List of Alarm Condition Messages	TPN13.4.6.	30 days prior to the PDR
N1330	Design and Block Diagrams for the General Information Video System	TPN13.5	30 days prior to the PDR
N1331	EMI Susceptibility Analysis	TPN13.7.	30 days prior to the IDR
N1332	Manufacturer's Test and Inspection Procedures	TPN13.7.1.	30 days prior to the IDR
N1333	Test and Inspection Plan of System Components	TPN13.7.1.	30 days prior to the IDR

TPN14 AUTOMATIC TRAIN CONTROL			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
N1401	Preliminary Design Description	TPN14.1.4.	30 days prior to the PDR
N1402	Intermediate Design Description	TPN14.1.4.	30 days prior to the IDR
N1403	Final Design Reports	TPN14.1.4.	30 days prior to the FDR
N1404	Electrical and Mechanical Details, Drawings and Proposed Wire Tag Designation	TPN14.1.8.	30 days prior to the IDR
N1405	Manufacturer's product literature and specifications of onboard ATC equipment	TPN14.3.2.	30 days prior to the PDR
N1406	Vehicle Modifications, Interface specifications and documentation as defined.	TPN14.3.2.	30 days prior to the FDR
N1407	Design Configuration details for ATP card file and PCBs.	TPN14.3.3.2.2.	30 days prior to the IDR
N1408	Drawings Showing all Proposed Installation Locations and Mounting Clearance of the onboard ATC equipment components including installation manuals and procedures	TPN14.3.5.2.1.	30 days prior to the IDR
N1409	Trainlines and Non-Trainlined Interfaces	TPN14.3.5.2.4.	30 days prior to the PDR
N1410	Details for ATO design features & operating parameters including manuals and test procedures	TPN14.3.6.	30 days prior to the IDR
N1411	Design, configuration, features and functions of TWC and Wayside Interfaces	TPN14.3.7.	30 days prior to the IDR
N1412	Operator's TWC Interface	TPN14.3.7.1.	30 days prior to the IDR
N1413	List and Definition of all Required Trainlines	TPN14.4.3.	30 days prior to the IDR

TPN15 SYSTEM SUPPORT			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1501	Technical Support Plan	TPN15.2.3.	30 days prior to the IDR
N1502	Electronic Documentation Support System	TPN15.3.2.	30 days prior to the FDR
N1503	Manuals Program Plan	TPN15.3.3.	30 days prior to the IDR
N1504	Manuals Style Guide (including an electronic version)	TPN15.3.7.	30 days prior to the FDR
N1505	Table of Contents and Manual Samples	TPN15.3.8.	30 days prior to the FDR
N1506	Manual and Parts Catalogue Submittals and Signed Review Sheets	TPN15.3.9. TPN15.3.15.	30 days prior to delivery of the first Married Pair.
N1507	Manual Updates	TPN15.3.10.	Every 180 days until issuance of the Acceptance Certificate
N1508	Final Revision of All Manuals	TPN15.3.10.	At the end of the warranty period
N1509	Manuals CD	TPN15.3.10.	With each manual and parts catalogue delivery
N1510	Manual Binder Covers	TPN15.3.11.2.	30 days prior to the IDR
N1511	In-Process Review Agenda and Meeting Minutes	TPN15.3.13.	30 days prior to the FDR
N1512	Audit Results	TPN15.3.14.	30 days prior to the FDR
N1513	Training Program Plan	TPN15.4.3.	180 days after NTP
N1514	Training Style Guide	TPN15.4.5.	150 days after NTP
N1515	Training Outlines	TPN15.4.6.	230 days after NTP
N1516	Training Materials	TPN15.4.8.	30 days prior to start of training
N1517	Training Aids	TPN15.4.8.3.	30 days prior to start of training
N1518	In-Process Review Agenda and Meeting Minutes for Training	TPN15.4.9.	As required

TPN15 SYSTEM SUPPORT			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
N1519	Event Recorder Details	TPN15.5.1.	30 days prior to the IDR
N1520	Event Recorder Signal and Parameter Listing	TPN15.5.2.	30 days prior to the PDR
N1521	Special Test Equipment Plan	TPN15.6.	30 days prior to the PDR
N1522	Door System PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1523	Air Comfort System PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1524	Auxiliary Power PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1525	Propulsion PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1526	Friction Brake PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1527	Communications PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1528	ATC PTU Characteristics	TPN15.6.4.1.	30 days prior to the IDR
N1529	Listing of all Diagnostic Test Equipment and Associated Design Details	TPN15.6.5.	30 days prior to the IDR
N1530	Details of Electro-Mechanical Tester	TPN15.6.6.2.	30 days prior to the IDR
N1531	Details of Printed Circuit Board Testers	TPN15.6.6.3.	30 days prior to the IDR
N1532	Details of Test Carts	TPN15.6.6.4.	30 days prior to the IDR
N1533	Special Tooling List	TPN15.7.	30 days prior to the IDR
N1534	Recommended Spare Parts List/Revisions	TPN15.8.1.	30 days prior to the IDR
N1535	Final Spare Parts List	TPN15.8.2.	30 days after the spares provisioning conference
N1536	Bar Coding CD with Database	TPN15.9.	With delivery of the last vehicle
N1537	Electronic Drafting Support System	TPN15.10.1.1.	300 days after NTP
N1538	Drawing Submittals	TPN15.10.1.2.	30 days prior to the PDR/IDR/FDR as required

TPN15 SYSTEM SUPPORT			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1539	Drawings and BOM on CD	TPN15.10.1.3.	Prior to the contract closeout
N1540	All ECNs (as well as documentation and cost information)	TPN15.10.2.2.	As required
N1541	List of Drawings and Diagrams	TPN15.10.3.2.	30 days prior to the PDR
N1542	Final Complete List, in Both Paper and Electronic Format of all Drawings and Files Submitted	TPN15.10.4.	With acceptance of the last vehicle
N1543	Cab Simulator Details	TPN15.4.10.	30 days prior to the FDR

TPN16 MANAGEMENT SUPPORT			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
N1601	Management Plan	TPN16.2.1.	60 days after NTP
N1602	Manufacturing Plan	TPN16.2.1.	60 days after NTP
N1603	Project Schedule	TPN16.2.2.	60 days after NTP
N1604	Monthly Progress Reports	TPN16.2.3.	Monthly starting 30 days after NTP
N1605	Deliverables Schedule (other than vehicles)	TPN16.2.4.	30 days after NTP
N1606	Monthly Progress Status Updates	TPN16.2.4.1.	Monthly starting 30 days after NTP
N1607	Sample Materials and Paint Chips	TPN16.4.1.	30 days prior to the FDR
N1608	Preliminary Design Review Agenda and Data	TPN16.4.2.1.	30 days prior to each PDR
N1609	Final Preliminary Design Review Report	TPN16.4.2.1.	14 days after each PDR
N1610	Intermediate Design Review Agenda and Data	TPN16.4.2.2.	30 days prior to the IDR
N1611	Final Intermediate Design Review Report	TPN16.4.2.2.	14 days after each IDR
N1612	Final Design Review Agenda and Data	TPN16.4.2.3.	30 days prior to each FDR
N1613	Final Design Review Reports	TPN16.4.2.3.	14 days after each FDR
N1614	Final FDR Results Report	TPN16.4.2.3.	14 days after each FDR
N1615	Operator's Cab Mock-Up Review Report	TPN16.4.2.4.	14 days after each FDR
N1616	Underfloor Mock-Up Review Report	TPN16.4.2.5.	21 days after the review
N1617	Design Baseline Submittal	TPN16.4.3.	14 days after the last FDR
N1618	Modified Baseline Designs	TPN16.4.3.	As required
N1619	Weight Control Program Plan	TPN16.5.	30 days prior to the PDR
N1620	Weight Control Program Results	TPN16.5.	Prior to the delivery of the first vehicle
N1621	Strength Program Plan	TPN16.6.	30 days prior to the PDR

TPN16 MANAGEMENT SUPPORT			
CDRL NO.	TITLE	TPN REFERENCE	SCHEDULED SUBMITTAL DATE
N1622	Strength Program Results	TPN16.6.	30 days prior to the PDR
N1623	Car History Books	TPN16.7.	With the delivery of each vehicle
N1624	Proposed Car History Book Format	TPN16.7.	30 days prior to the FDR
N1625	Computer Database of Components Mounted on each HRV at the Time of Delivery	TPN16.9.3.	With the delivery of each vehicle
N1626	Decommissioning Plan	TPN16.10.	60 days after NTP
N1627	Pilot Car Personnel Transition Plan (PCPTP)	TPN16.11	30 days prior to the FDR

TPN17 INSPECTION AND TESTING			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1701	Test Plan	TPN17.2.6.	30 days prior to the PDR
N1702	Contractor and Subcontractor Test Procedures	TPN17.3.1.	30 days prior to the FDR
N1703	Test Procedure Summary Sheets	TPN17.3.1.	30 days prior to the FDR
N1704	Test Report	TPN17.3.2.	Within 14 days after test completion
N1705	Design Qualification Acceptance Test Reports	TPN17.4.1.	Within 14 days after test completion
N1706	Inspection Plan	TPN17.7.2.	30 days prior to the PDR
N1707	Inspection Procedures	TPN17.7.3.	30 days prior to the FDR
N1708	Inspection Reports	TPN17.7.3.	Within 14 days after inspection completion
N1709	FAI Documentation Packages	TPN17.7.5.3.	Within 30 days prior to FAI
N1710	FAI Final Report	TPN17.7.5.3.	Within 30 days after FAI

TPN18 SYSTEMS ASSURANCE			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1801	Contractor's Quality Assurance Manual	TPN18.2.1.	With the proposal
N1802	Quality Assurance Plan	TPN18.2.2.1.	With the proposal
N1803	Quality Assurance Plans (of other Suppliers)	TPN18.2.3.	60 days after the NTP with the Management Plan
N1804	Quality Assurance Records/Procedures	TPN18.2.4.13.	30 prior to the PDR/IDR/FDR as required
N1805	System Safety Program Plan	TPN18.3.2.	With the proposal/as required
N1806	System Safety Analyses	TPN18.3.5.	30 days prior to the FDR/as required
N1807	System Security Plan	TPN18.3.6.	60 days after NTP
N1808	Reliability Program Plan	TPN18.4.2.	With the proposal/as required
N1809	Reliability Analyses	TPN18.4.5.	30 days prior to the PDR/as required
N1810	Reliability Test Plan	TPN18.4.6.2.	30 days prior to the PDR
N1811	Reliability Test Reports	TPN18.4.6.5.	Monthly, after reliability testing begins
N1812	Maintainability Program Plan	TPN18.5.2.	With the proposal/as required
N1813	Subsystem Corrective Maintenance Allocations	TPN18.5.4.2.	30 days prior to the IDR/as required
N1814	Maintenance Concept Document	TPN18.5.6.	30 days prior to the PDR/as required
N1815	Inspection and Maintenance Analysis	TPN18.5.7.1.	30 days prior to the FDR/as required
N1816	Fault Isolation Troubleshooting Plan	TPN18.5.7.2.	30 days prior to the FDR/as required
N1817	Maintenance Engineering Analysis	TPN18.5.7.3.	30 days prior to the FDR/as required
N1818	Maintainability Demonstration Test Plan	TPN18.5.8.1.	30 days prior to the IDR
N1819	Maintainability Demonstration Test Report	TPN18.5.8.1.	30 days after completion of the test

TPN19 MATERIALS AND WORKMANSHIP			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1901	Material Composition Description	TPN19.1.	30 days prior to the PDR
N1902	Material Lists and Test Reports/Certification	TPN19.1.	30 days prior to the IDR
N1903	Chemical Material Safety Data Sheets (including paints, adhesives, sealants, compounds, solvents, and lubricants)	TPN19.1.	30 days prior to the FDR
N1904	Certification of Compliance for Elastomeric Materials	TPN19.3.1.2.	30 days prior to the FDR
N1905	Body Fill Material Smoke and Flame Test Results	TPN19.3.3.4.	30 days prior to the IDR
N1906	Plymetal Sealant	TPN19.3.5.2.	30 days prior to the FDR
N1907	Neoprene Foam Physical and Performance Characteristics	TPN19.3.6.	30 days prior to the IDR
N1908	Silicone Foam	TPN19.3.7.	30 days prior to the IDR
N1909	Floor Covering Samples	TPN19.3.8.	30 days prior to the IDR
N1910	List and Properties of Adhesives	TPN19.3.11.	30 days prior to the IDR
N1911	Proposed Threaded Inserts or Special Fasteners	TPN19.4.2.1.	30 days prior to the IDR
N1912	Proposed Blind Rivets	TPN19.4.3.1.	30 days prior to the IDR
N1913	Corrosion Control Plan	TPN19.5.	30 days prior to the PDR
N1914	Sealant Method for Ferrous Metal	TPN19.5.1.2.	30 days prior to the IDR
N1915	Paint Procedures	TPN19.5.2.1.	30 days prior to the IDR
N1916	Paint and Primer Data	TPN19.5.2.1.	30 days prior to the IDR
N1917	Underfloor Piping, Conduits and Wireways Paint System	TPN19.5.2.2.	30 days prior to the PDR
N1918	Accessory Exterior Coatings	TPN19.5.2.4.	30 days prior to the IDR

TPN19 MATERIALS AND WORKMANSHIP			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N1919	Paint Underfloor	TPN19.5.2.6.	30 days prior to the IDR
N1920	Welding Operations Documentation	TPN19.6.1.1.	30 days prior to the IDR
N1921	Welder Qualifications of Personnel	TPN19.6.1.2.	30 days prior to the IDR
N1922	Stress Relief Procedure	TPN19.6.1.3.	30 days prior to the IDR
N1923	Resistance Weld Procedures	TPN19.6.1.3	30 days prior to the IDR
N1924	Piping Cleaning Methods	TPN19.7.1.1.	30 days prior to the IDR
N1925	Proposed Lubricants for Bearings and Bushings	TPN19.8.3.	30 days prior to the IDR
N1926	Thermal and Acoustical Insulation Data and Application Process	TPN19.9.1.	30 days prior to the IDR
N1927	Design Loads for 600V and 2000V Cables	TPN19.10.2.	30 days prior to the IDR
N1928	Proof of Design for Proposed Underfloor Connector	TPN19.10.2.4.	30 days prior to the IDR
N1929	Integrated Circuits Screening Method	TPN19.10.4.4.1.	30 days prior to the IDR
N1930	Flame Propagation and Smoke Density Test Results/Certification	TPN19.11.1.1.	Within 14 days after test completion
N1931	Matrix of Flammable Materials Giving Weight, Heat Values, Flame Spread Index, and Ignition-Points	TPN19.11.1.1.	30 days prior to the IDR

TPN20 VEHICLE MONITORING AND CONTROL SYSTEM			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N2001	Electrical and Mechanical Details, Drawings, and all Proposed Wire Tag Designations	TP20.3.	30 days prior to the PDR
N2002	Manufacturer's product literature and specifications of onboard VMCS	TP20.6.1.	30 days prior to the IDR
N2003	Train Management System design, Configuration, Database and menu-driven debugging software	TP20.6.2.	30 days prior to the IDR
N2004	VMS Integrated Communications Network Configuration Diagram	TP20.6.2.	30 days prior to the IDR
N2005	Key Indicators Degraded Performance of Principal Car System	TP20.6.2.	30 days prior to the IDR
N2006	Display Screen Configuration and Options	TP20.6.2.	30 days prior to the IDR
N2007	VMS System Interface Plan	TP20.6.2.	30 days prior to the IDR
N2008	Redundant Data, VMS Redundancy, Center and Local Units, Data Recorder	TP20.8.	30 days prior to the IDR

TPN21 FLEET COMPATIBILITY			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N2101	Compatibility Analysis Report	TPN21.2.	30 days prior to the PDR

TPN22 SOFTWARE SYSTEMS			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N2201	Software Project Test Plan	N22.3.1.	30 days prior to the PDR
N2202	Software Quality Assurance Plan	N22.3.1.	30 days prior to the PDR
N2203	Software Project Management Plan	N22.3.1.	30 days prior to the PDR
N2204	Software Configuration Management Plan	N22.3.1.	30 days prior to the PDR
N2205	Software Verification and Validation Plan	N22.3.1.	30 days prior to the PDR
N2206	Software Verification and Validation Report	N22.3.1.	Within 14 days after completion
N2207	User Documentation	N22.3.1.	30 days prior to the FDR
N2208	Software Requirements Specification (SRS)	N22.3.3.	30 days prior to the PDR
N2209	Software Requirements Traceability Matrix	N22.3.3.	30 days prior to the IDR
N2210	System Functional Description (SFD)	N22.3.3.	30 days prior to the IDR
N2211	Software Configuration Control Plan (SCCP)	N22.4.1.	30 days prior to the PDR
N2212	Vital Software Validation Report	N22.5.	Within 14 days after completion

TPN23 CONTRACT DATA REQUIREMENTS LIST			
CDRL NO.	**TITLE**	**TPN REFERENCE**	**SCHEDULED SUBMITTAL DATE**
N2301	CDRL Delivery Plan	TPN23.2.	30 days after NTP

INDEX

AAR.....8,225,235,297,464,465,471,472,493,495,496,499,507

AATCC.....8

ABRASION.....474,492,499,500,501,503

ABS.....20,21,49,54,55,71,75,82,89,97,99,108,112,120,143,152,236,300,301,317,339,416,494

ABSORBERS.....143,236

ABSORBING.....20,89,97

ACCELERATION.....11,12,22,31,34,42,44,46,47,50,57,58,59,63,110,116,189,206,312,351,417,526,554

ACCEPTABILITY.....252,414,450

ACCEPTANCE.....5,20,24,25,29,42,44,102,128,129,138,139,151,159,187,189,206,226,228,240,246,252,331,332,337,338,348,372,376,381,397,398,401,403,406,411,413,414,416,417,418,419,420,422,423,424,433,434,436,437,471,495,547,558,559,564,566,567,571,573,576

ACCESS.....15,18,28,59,72,79,82,83,84,86,88,89,91,93,105,106,120,122,123,127,133,138,142,143,144,145,149,164,166,167,172,173,178,180,181,185,191,192,194,196,199,203,204,205,207,231,241,242,249,256,257,260,264,270,271,273,275,278,280,282,288,289,290,298,301,356,358,383,393,394,405,412,421,422,423,433,440,443,445,455,456,460,470,488,492,507,519,547,548,555,579

ACCESSIBILITY.....18,28,59,72,127,164,256,288,383,455,456,555

ACCESSIBLE.....28,84,93,133,138,142,144,145,166,167,172,173,178,192,194,196,203,204,207,241,242,275,280,282,421,422,423,445,455,492

ACCIDENT.....21,180,289,385,443,448

ACCIDENTAL.....180,289

ACCOUNTS.....20

ACIDS.....48,476,494

ACOUSTIC.....34,49,81,92,281,412,462,470,494,511,554,580

ACQUISITION.....15,54,361,520,521

ACTIVATORS.....476

ACTUATORS.....245,460

ADA.....8,15,18,33,35,40,57,72,82,89,108,127,170,172,173,203,237,256,260,264,266,275,276,277,279,338,339,340,383,393,413,414,465,474,476,481,482,486,501,505,521,535

ADHESION.....19,26,46,92,225,240,467,482,488

ADU.....8,274,314,316,319,320,321

ADVERTISING.....70,72,87,264,555

AERODYNAMIC.....92

AESTHETIC.....71,81,82,85,87,89,153

AESTHETICALLY.....71,89

AFBMA.....8,185,202,203,225,235

AGING.....76,141,155,184,192,205,249,314,349,361,431,447,453,473,504

AGMA.....8,185,203

AIRBORNE.....48,149

AIRFLOW.....121,194,266,413

AISI.....8,72,73,465,471

ALARM.....103,105,113,120,121,130,142,256,258,259,263,268,269,270,282,284,285,289,292,305,312,320,321,325,353,520,521,522,523,524,525,526,527,528,529,530,557,568,569

ALARMS.....522,523,524,525,526,527,528,529,530

ALGORITHM.....187,188,189,191,194,292,521,563

ALIGNMENT.....21,26,39,59,76,204,238,239,241,283,284,502

ALLOY.....12,73,74,159,278,464,465,466,467,469,471,472,485,486,494,507

ALLOYS.....472,494

ALTERNATE.....113,116,152,272,303,304,335,363,364,498

ALUMINUM.....8,39,90,91,151,278,316,461,464,467,468,472,486,487,492,494

AMBIENT.....31,48,121,190,196,272,286,312,317,412,495,505,532

AMENDMENTS.....26

AMPACITIES.....495

AMPACITY.....186,495,496

AMPERE.....12,167

AMPERE-.....177

AMPERE.....177,179

AMPERE-.....179

AMPHENOL.....313

AMPLIFIER.....255,256,266,273,275,281

ANNOUNCEMENT.....9,10,112,127,256,258,263,265,266,267,269,272,273,274,275,276,288,289,291,292,568

ANNUNCIATOR.....103,121,134,145,177,369,460,506

ANTENNA.....36,54,260,263,271,288,289,298,307,308,309,310,323,519,526

ANTICLIMBER.....76,77,97

APPARATUS.....23,25,53,55,83,105,144,249,298,368,397,413,414,418,422,460,485,486,500,519

APTA.....9,33,51,72,73,75,90,98,102,137,141,149,152,155,156,159,161,166,181,225,234,235,245,246,248,249,266,465,495,496,497

ARCHITECTURE.....262,266,269,283,546

AREMA.....9,34,38,105,119,297,299

ASCE.....9,34,39,72,90,440,490

ASHRAE.....9,137,142

ASHRE.....170

ASME.....9,137,143,245,248,465,489,493

ASSESSMENT.....229,450

ASTM.....9,72,91,137,144,159,181,225,240,465,466,467,471,472,473,476,477,478,479,480,482,484,485,486,487,488,494,495,496,511,512,513

ATC.....7,8,9,27,28,76,79,83,86,88,91,93,99,110,112,168,179,180,201,202,205,227,237,256,279,284,287,288,291,295,297,298,299,300,301,302,308,309,310,311,322,323,325,330,348,351,352,358,359,370,373,434,475,476,477,482,499,519,524,526,535,570,572

ATMOSPHERIC.....471,486,493

ATOM.....9

ATP.....9,106,112,115,117,118,155,208,295,297,298,300,302,304,305,306,307,308,309,310,311,312,313,315,316,317,318,319,320,321,322,324,351,352,373,379,415,419,460,486,519,526,548,570

ATS.....9,71,85,88,89,90,121,140,192,206,238,309,373,376,413,415,460,477,479,501,502,503,504

AUDIBLE.....51,58,121,151,260,272,279,325,508,524

AUDIO.....8,54,107,255,258,260,263,264,265,266,268,269,270,271,273,276,282,283,284,285,291,292,293,302,349,353,413,568

AUTOCAD.....334,364,365,366,377

AVAS.....9

AWG.....9,496,497,499,500,502

AXLE.....26,36,48,57,60,163,180,181,191,197,203,223,225,226,227,228,233,234,235,236,241,269,316,324,397,423,460,565

BACKPLANE.....314,359

BACKSHELL.....498

BACKSIDE.....291

BACKUP.....113,199,360,444

BAFFLE.....49,141,204,281

BALLAST.....49,50,51,150,560

BANDWIDTH.....52,287,361

BARRIER.....69,81,82,435,494,512

BARRIERS.....69,82,435

BASED.....9,27,28,29,43,44,47,49,54,56,57,73,81,127,130,139,145,169,174,185,190,201,202,207,229,249,263,265,269,270,274,278,285,298,308,313,334,336,343,344,355,364,408,409,417,435,452,490,495,496,509,510,529,541,548

BASELINE.....36,43,299,374,381,384,393,394,395,574

BATTERIES.....159,175,177,179,180,302,518

BATTERY.....7,79,119,134,152,155,156,158,160,161,162,166,168,173,175,176,177,178,179,180,198,207,273,285,313,316,319,354,356,369,415,460,502,509,511,527,562

BAYONET.....155,498,499

BEAM.....76,78,113,153,154,467

BEARING.....8,26,58,108,170,175,180,181,184,185,202,203,204,223,225,226,227,228,235,236,241,242,397,460,462,470,493,494,565,580

BEARINGS.....8,26,170,175,180,181,184,185,202,203,204,225,226,228,235,236,241,242,397,460,462,470,493,494,565,580

BECU.....9

BERTHING.....118,133,300,304,305,306,309,311,526

BEZEL.....147,149,151,152

BEZELS.....147,151,152

BICYCLES.....89

BLUETOOTH.....357

BOLSTER.....71,75,76,77,122,181,223,225,226,227,228,230,234,238,239,240,460,566

BOLSTERS.....71,75,122,223,225,228,234,239,240

BOM.....9,331,366,367,374,573

BONDING.....159,201,465,474,480,497

BOOT.....498,500,501

BRAKE.....9,11,14,18,20,22,25,26,31,43,44,45,46,47,50,59,62,75,88,106,107,108,109,110,111,112,113,114,115,116,117,118,133,134,155,183,186,187,188,189,190,196,197,198,199,200,207,208,223,226,227,228,229,236,238,241,242,245,246,248,249,250,251,252,304,305,306,307,308,310,312,313,314,315,316,317,318,321,322,325,330,351,358,359,368,370,373,391,392,393,414,459,460,463,485,492,518,525,526,527,528,529,531,563,564,565,567,572

BRAKES.....18,22,25,45,46,59,75,108,115,116,117,118,155,196,207,228,229,236,242,248,249,252,316,370,459,460,518,525,528

BRAKING.....3,14,18,19,20,21,22,24,26,42,43,44,45,46,47,50,58,109,110,111,112,118,178,183,186,189,190,192,193,200,227,229,243,245,247,248,250,251,252,302,306,311,313,321,371,392,393,417,419,423,432,508,563,567

BRAZING.....137,144,461,465,467,489,491

BREAKER.....12,106,122,152,154,155,157,159,160,163,164,165,166,167,168,169,178,182,189,191,194,197,198,266,298,301,355,371,460,468,506,518,519,527,561

BTE.....9

BTU.....9,139,323,494,512,544,547

BUILT.....37,41,74,174,228,229,260,272,283,288,298,345,346,360,377,456,519,520

BULB.....122

BULKHEAD.....501,502

BUTTON.....46,101,107,108,109,112,113,115,116,117,118,119,145,173,279,280,281,289,306,312,317,318,360,507

BUTYL.....482

BYPASS.....107,115,117,118,305,312,325,460

CABLES.....28,41,52,54,75,97,101,102,161,165,166,168,200,205,206,227,239,241,271,286,288,289,290,467,470,496,497,498,501,502,503,504,512,580

CAD.....9,15,78,116,159,162,177,260,264,266,288,334,335,364,365,366,377,524

CALIBRATION.....28,233,284,298,342,355,359,360,362,408,421,437,439

CAMERA.....255,282,283,284,285,286,287,460,527

CAMERAS.....255,282,283,284,285,286,287,460

CANNED.....272

CANTILEVERED.....75

CARBODY.....3,57,58,60,69,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,97,158,164,168,180,181,182,196,200,202,226,228,238,241,248,391,392,393,412,416,417,459,460,471,487,488,492,496,498,503,504,555,566

CARRIER.....54,257,304,305,311,312,385

CARRIERS.....385

CARSHELL.....35,73,74,238,423,432

CARSHELLS.....73

CAT5.....268

CAULKING.....461,482,483

CBTC.....9

CCH.....10,255,260,264,266,267,273,279,280

CCHS.....267

CCTV.....10,178,255,258,259,262,263,265,266,267,269,276,277,282,283,284,286,287,370,460,519,527,569

CEILING.....80,87,90,121,142,144,152,274,277,287,289,511

CELLULAR.....56,269,467

CENTERLINE.....24,36,38,39,50,75,92,99

CERTIFICATE.....29,331,337,338,376,397,398,408,419,420,431,439,470,473,477,551,571

CERTIFICATES.....397,439,470,473,477,551

CERTIFIED.....56,234,248,431,437,474,490,542

CFM.....10

CFR.....10,18,33,35,72,127,131,149,154,155,245,256,383,393,464,474,512

CHB.....10,396,397,398

CHECKING.....478,521

CHEMICAL.....48,88,464,469,483,487,498,579

CIRCUIT.....10,12,14,26,52,53,54,55,97,98,100,101,106,108,119,122,129,131,132,133,134,137,138,139,141,145,152,154,155,157,158,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,178,182,183,184,185,186,187,188,189,190,191,192,193,194,196,197,198,199,200,205,206,240,249,253,255,259,261,266,267,272,275,281,282,285,290,299,300,301,302,303,304,305,306,307,310,311,313,314,316,317,320,322,324,331,336,342,355,359,360,361,363,367,368,371,372,373,377,392,393,415,460,468,470,496,497,498,500,502,503,505,506,507,508,509,510,518,527,548,559,561,562,563,564,572,580

CIS.....10,241,301,303,347,348,359,388,403,492

CLASSIFICATIONS.....363

CLASSIFIED.....375,448,546

CLEARANCE.....21,31,34,36,40,59,74,78,79,84,88,90,91,98,102,164,179,188,233,240,298,316,320,393,394,412,422,492,503,554,556,570

CLEATS.....206,238,502,503,504

CLIMBER.....35,36,76,77,97

CMMI.....10,542

COAST.....9,19,47,50,58,109,110

COAX.....289,501

COAXIAL.....501

COIL.....55,141,143,144,178,198,201,302,304,310,313,315,316,320,321,322,324,370,371,464,500,507

COLLAR.....289,485,498,499

COMBO.....356

COMBUSTIBLE.....390,510,511

COMFORT.....58,59,85,89,106,121,330,389,413,559,572

COMFORTABLE.....58,89,106

COMMISSIONING.....262,381,384,399,575

COMPARTMENT.....21,48,75,84,87,90,93,106,116,170,260,282,290,361,496,502

COMPATIBILITY.....3,11,19,33,35,51,52,55,56,57,169,199,206,517,533,535,536,554,582

COMPATIBLE.....19,27,73,79,109,172,231,234,252,255,278,286,288,290,292,297,301,308,333,345,348,357,362,364,365,366,367,386,452,482,483,486,487,520,535

COMPLIANCE.....18,35,59,78,81,82,90,106,131,188,229,246,256,276,288,385,386,390,391,397,406,409,410,411,413,414,415,416,419,437,439,440,442,445,447,449,453,457,458,463,469,470,473,485,491,539,579

COMPLYING.....49,130,133,238,503

COMPRESSOR.....7,18,51,118,137,138,139,142,143,146,166,167,173,179,240,243,245,246,247,248,281,413,416,460,528

COMPUTER.....9,14,150,193,231,249,266,270,273,288,319,352,353,356,384,391,398,539,540,541,547,560,575

CONDENSATION.....143,144,290,340

CONDENSER.....137,138,139,142,143,146,413,414,460,529

CONDUCTOR.....39,53,161,171,172,180,181,187,192,206,249,310,462,466,469,495,496,497,498,499,500,501,502,504,505,508,509,510,563

CONFIDENTIAL.....347

CONFIGURATION.....15,21,33,35,59,73,77,78,79,83,87,88,92,105,106,120,127,183,187,188,192,206,223,225,226,227,228,229,232,237,238,258,260,268,269,270,284,286,295,297,298,299,314,318,322,328,352,356,357,374,381,385,389,394,395,397,416,422,423,435,442,450,515,517,518,520,521,522,523,531,537,540,541,543,545,547,555,557,563,565,568,570,581,583

CONFIGURATIONS.....77,127,183,188,227,374,395,416,523

CONFIGURED.....73,106,232,245,261,266,275,286,298,324,362,372,413,523

CONSIST.....7,19,22,25,26,27,36,42,43,44,45,50,57,71,75,76,78,80,97,98,101,102,107,108,109,113,114,115,116,117,118,127,128,142,145,150,152,153,154,155,171,175,179,189,195,240,246,247,248,255,261,263,272,273,275,277,279,280,281,282,283,286,287,300,302,310,315,323,344,346,348,354,364,384,386,391,392,394,410,412,415,429,434,442,443,451,453,474,475,480,482,500,506,521,522,523,524,531,542,544,545

CONSOLE.....14,19,71,84,88,103,105,106,107,108,109,112,113,116,118,121,129,145,154,171,172,173,178,195,260,263,265,267,277,304,305,306,307,312,317,318,321,322,323,351,352,353,354,460,474,520,557

CONTAINED.....19,27,75,140,152,286,342,343,344,360,361,407,409,472,530

CONTRACT.....3,8,9,10,18,19,20,21,22,23,25,26,27,28,35,36,37,40,41,43,44,45,48,49,51,52,53,54,55,56,59,60,73,75,76,80,82,83,85,87,88,99,100,101,102,106,107,108,109,110,123,128,129,131,134,139,142,146,150,153,159,161,162,164,166,167,169,170,171,172,174,175,176,177,178,179,180,188,189,190,191,192,193,195,196,197,198,199,201,202,204,206,208,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,246,247,250,252,255,256,259,261,262,263,264,265,266,268,269,271,274,275,276,277,278,279,282,284,287,288,289,290,291,292,293,294,297,298,299,301,302,303,308,309,310,313,314,316,320,321,322,323,324,325,328,329,331,332,333,334,335,336,337,338,340,342,343,344,345,346,347,348,349,350,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,371,372,373,374,375,376,377,381,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,403,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,427,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,445,446,447,448,449,450,451,452,453,454,456,457,458,463,464,471,478,484,485,486,487,488,489,490,491,493,494,495,498,500,503,509,510,511,518,519,520,521,522,523,524,525,530,531,532,535,536,537,539,541,542,543,544,545,546,547,548,549,551,552,553,573,576,577,584

CONTROLLER.....12,15,17,22,24,103,107,108,109,110,111,112,113,115,130,131,146,152,154,155,175,188,193,262,265,269,271,314,346,352,372,378,379,460,519,523,524

COOLING.....18,113,135,137,139,140,141,142,144,145,146,158,160,166,170,172,173,175,192,194,204,247,266,290,310,391,413,562

COPPER.....137,143,144,159,251,268,466,469,472,492,495,496,497,500

CORROSION.....71,73,101,107,141,151,200,236,237,391,435,456,466,470,471,486,487,489,493,579

CORRUGATED.....80,143,144

COUPLER.....3,20,21,35,36,40,75,76,77,93,95,97,98,99,100,101,102,118,178,182,360,362,369,391,412,423,459,460,525,527,535,556

COUPLING.....20,26,75,82,95,97,98,99,100,101,102,113,184,187,200,204,241,242,303,352,498,503,525,556,564

COVING.....70,87

CPM.....10,386

CPU.....10,269,307,308,315,318,319

CRACKS.....456,473,481,489

CRASHWORTHINESS.....69,75,78

CREEPAGE.....188,465,496

CRF.....512

CRITICAL.....10,11,20,24,29,56,108,133,193,229,230,250,368,386,434,444,446,449,456,467,497,507,512,522,524,525,539,542,548

CWR.....10

DADE.....1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,183,184,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248,249,250,251,252,253,254,255,256,257,258,259,260,261,262,263,264,265,266,267,268,269,270,271,272,273,274,275,276,277,278,279,280,281,282,283,284,285,286,287,288,289,290,291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,311,312,313,314,315,316,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335,336,337,338,339,340,341,342,343,344,345,346,347,348,349,350,351,352,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,369,370,371,372,373,374,375,376,377,378,379,380,381,382,383,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,428,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,444,445,446,447,448,449,450,451,452,453,454,455,456,457,458,459,460,461,462,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,515,516,517,518,519,520,521,522,523,524,525,526,527,528,529,530,531,532,533,534,535,536,537,538,539,540,541,542,543,544,545,546,547,548,549,550,551,552,553,554,555,556,557,558,559,560,561,562,563,564,565,566,567,568,569,570,571,572,573,574,575,576,577,578,579,580,581,582,583,584

DATABASE.....14,262,269,270,331,335,352,353,357,358,364,381,384,398,399,517,521,522,547,548,572,575,581

DCU.....10

DEADMAN.....20,109,110

DECELERATE.....44,129

DECELERATION.....18,22,31,42,44,45,46,63,83,116,189,206,305,312,315

DECELEROMETER.....304,313,314,315

DECIBELS.....10,49

DEFECTIVE.....20,117,434,438,463

DEFECTS.....26,332,397,419,438,448,487,489,491,510

DEFOGGER.....114

DESTINATION.....87,116,147,153,155,263,265,270,272,275,276,277,278,289,352,370,372

DETENT.....110

DIAGNOSTIC.....10,125,134,145,146,157,160,169,170,174,182,183,187,193,194,195,208,246,249,250,265,266,270,271,286,295,300,308,314,316,318,328,330,345,346,349,352,355,356,358,359,378,510,524,531,562,564,567,572

DIAGNOSTICS.....125,134,146,157,169,170,174,183,194,250,266,286,295,300,316,318,345,346,358

DIAGRAM.....14,16,20,44,46,47,98,102,161,180,186,189,230,246,258,259,261,266,269,284,288,293,299,309,329,331,336,339,340,345,355,356,366,367,369,372,373,376,386,391,392,393,406,422,449,517,520,521,556,562,563,568,569,573,581

DIGITAL.....10,14,117,256,259,263,265,266,268,271,272,273,275,276,282,283,284,286,290,292,299,320,361,569

DIODE.....13

DISCONNECT.....28,113,163,166,174,181,200,201,202,208,241,286,302,313,359,456,498,499,501,502

DISPLAY.....8,13,16,17,106,115,134,150,182,197,208,230,255,258,260,264,266,267,269,270,273,276,277,278,284,287,291,292,313,314,315,316,318,320,321,323,328,339,340,357,358,359,518,520,522,523,530,531,569,581

DOCUMENTATION.....8,35,98,101,128,164,225,245,250,258,297,309,327,328,330,331,333,361,363,364,373,374,375,381,384,389,392,393,395,396,397,408,420,422,423,424,431,434,435,436,449,470,489,495,515,523,531,537,540,541,542,543,544,545,546,548,556,565,567,568,570,571,573,576,580,583

DOORS.....49,50,51,59,60,69,73,74,79,81,82,83,84,86,88,89,90,106,108,115,117,122,127,129,130,131,132,133,134,140,205,273,305,309,311,312,352,358,359,361,370,459,460,524,525,526,527,558

DOT.....10,11,291,329,365

DOWNLOAD.....170,171,195,271,284,285,286,293,314,523,530

DOWNSTREAM.....141

DRAFT.....3,20,76,77,95,97,98,99,100,101,102,331,337,339,343,365,366,367,423,459,460,556,572

DRAWBAR.....22,23,77,95,97,102,460

DRAWING.....8,19,20,34,40,41,76,87,99,100,101,128,139,187,188,202,226,228,230,231,234,235,238,246,261,269,278,297,298,299,302,309,320,322,328,329,331,335,338,340,341,342,345,349,359,363,364,365,366,367,368,369,370,374,375,376,377,385,386,388,390,391,392,393,394,395,405,420,422,423,424,433,434,443,491,494,495,517,518,531,545,554,564,566,570,572,573,581

DRIER.....143

DRILLING.....227,467

DRYER.....142,143,245,246,247,567

DRYERS.....142,246,247

DST.....10,171,313

DTE.....10,359,363

DUCTS.....141,142,164,198,262,424,429,440,465,472,476,477,494,502,503,504,541

DUPLEX.....119,166,167,256,259,263,279,282,289,471

DURABILITY.....87

DVA.....10,14,27,98,361,389,391,437,500

DVD.....10,35,60,333,365,398,554

DVR.....10,178,256,259,283,284,285,286,288,460,527,569

DYNAMIC.....18,20,31,34,40,44,45,47,57,59,64,73,92,118,182,183,186,187,189,190,192,193,198,199,200,203,205,207,208,228,233,234,235,245,248,351,412,414,490,526,528,544,554,563,564

EAM.....10,11,23,50,76,78,113,137,140,141,144,153,154,242,246,261,262,264,270,301,388,467,468,479,481,486,492,521

EAMS.....11,78,262,264,479,481

ECN.....11,331,374,573

ECP.....375

ECU.....9,14,18,47,78,79,81,86,88,89,105,106,149,246,249,250,253,258,259,262,263,264,266,269,271,280,282,283,284,286,287,313,315,319,341,365,386,387,394,395,418,427,430,431,438,439,445,446,447,450,451,466,481,485,492,499,502,503,504,507,519,539,540,541,548,567,569,577

EIA.....11,256,257,274,275,290

EIS.....11,279

ELASTOMERIC.....84,85,141,225,227,469,472,473,474,579

ELECTRIC.....3,7,12,14,18,20,24,26,28,31,34,36,41,44,45,46,50,51,52,53,57,72,75,78,88,95,97,98,99,100,101,102,107,109,114,115,118,119,127,128,129,130,131,133,138,140,149,157,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,185,186,187,189,190,196,200,202,206,223,229,238,239,241,248,277,282,285,297,300,301,302,309,310,314,317,324,329,360,361,366,367,368,369,371,372,373,391,392,393,404,405,423,455,459,460,462,466,467,468,472,486,487,495,496,497,500,503,505,506,507,508,509,510,512,517,518,525,548,556,561,562,564,570,581

ELECTROMAGNETIC.....11,33,34,35,51,52,55,56,57,101,164,172,199,206,293,310,374,414,468,517,548,554

ELECTRONIC.....9,11,12,60,88,114,127,145,157,169,170,172,174,182,185,189,194,195,197,199,208,231,249,257,264,266,279,288,298,300,307,315,327,329,330,331,333,336,338,342,346,347,348,349,360,362,364,36

5,366,367,368,370,371,377,378,379,391,392,393,413,449,452,456,457,462,468,491,495,496,498,508,509,
510,517,519,547,571,572,573

ELECTRONICS.....12,169,174,182,185,189,195,208,249,266,288,315,329,346,367,368,378

ELECTROSTATIC.....11,34,52,56

EMC.....11,35,53,54,55,56,293,554

EMERGENCY.....11,14,20,21,43,46,47,62,83,91,97,103,109,110,111,112,119,120,127,128,129,133,134,147,1
49,150,152,155,156,161,168,175,177,178,179,207,245,248,249,250,252,255,259,263,268,272,279,280,281
,284,287,289,305,313,315,321,341,415,445,446,528,562,569

EMI.....8,11,13,22,48,51,52,53,54,55,56,82,88,97,101,109,129,150,154,171,172,187,192,206,249,259,272,2
93,376,394,396,414,462,464,469,470,473,478,480,483,487,497,498,508,509,510,511,521,563,569,579

ENCLOSING.....25

ENDS.....7,27,71,74,75,76,77,78,119,127,227,228,237,274,278,314,334,406,416,452,485,490,492,497,504,5
05

ENERGIZED.....51,108,111,115,117,134,145,154,162,168,196,256,267,279,282,285,305,413,548

ENERGY.....20,22,74,75,89,97,99,120,231,275,299,467,524,531,548

ENVELOPE.....31,34,40,74,78,79,84,324,361,498,554

ENVIRONMENT.....8,23,29,31,33,48,49,56,58,73,79,80,83,85,99,106,121,142,165,174,180,188,192,196,205,2
25,234,237,247,249,250,257,267,271,276,282,293,317,338,350,352,353,357,361,388,403,411,413,435,443
,444,445,446,456,463,468,472,476,481,483,489,491,493,495,498,501,510,515,521,532

ENVIRONMENTAL.....23,29,31,33,48,79,80,83,85,142,180,188,247,249,250,257,403,411,413,445,456,468,472
,495,498,501,510,515,532

EPOXY.....476,509

EPROM.....11

EPTFE.....11

ESD.....11

ETHERNET.....101,195,256,261,263,265,268,269,273,284,286,287,319,356,357,519,520,521

EVALUATION.....15,34,85,174,226,234,287,337,347,404,423,438,440,441,539,541,542,565

EVAPORATOR.....137,138,139,140,141,143,144,146,413,460,529

EXCEPTIONS.....286,376

EXCLUSIVELY.....7

EXISTING.....21,23,27,35,37,40,43,52,60,73,76,79,87,92,108,112,227,236,239,241,242,255,261,264,282,288,
290,295,297,299,300,301,302,303,308,309,310,311,314,316,317,322,324,399,415,520,533,535,536

EXIT.....90,91,131,208,237,269,303,311,318,371,502,503

EXPANSION.....7,139,141,142,199,200,249,262,266,480,520

EXTINGUISHER.....103,105,121,557

FAA.....11

FABRICATED.....74,143,203,227,377,500,501

FABRICATING.....234,431

FABRICATION.....20,80,161,206,278,301,342,386,434,435,479,487,494,503,504,518

FACING.....22,24,38,60,89,107,146,186,261,263,269,272,283,284,287,303,309,310,313,475,479,510,519,520,563

FAILURE.....11,13,21,22,24,25,28,40,46,52,53,54,56,77,78,79,84,85,92,118,133,138,141,167,170,171,172,181,191,193,195,198,199,207,229,235,248,249,250,276,281,283,292,302,315,317,320,331,332,341,353,354,355,356,392,393,403,410,411,417,443,444,445,447,448,449,450,451,452,453,456,457,458,479,480,486,497,518,521,523,525,526,527,528,529,530,531,548

FAN.....113,114,121,138,143,146,170,172,187,194,266,414,563

FCC.....11,34,55,256,257

FDOT.....11,329,365

FDR.....366,372,384,390,392,393,394,423,542,564,574

FEA.....7,11,20,28,49,76,80,81,83,98,109,110,121,130,176,179,231,232,250,251,263,276,283,286,287,288,290,298,307,311,314,322,341,345,374,446,455,499,515,520,521,523,548,570

FEATURE.....20,28,49,76,80,81,83,98,109,110,121,130,176,179,250,251,263,276,283,286,287,288,290,298,307,311,314,322,341,345,455,499,515,520,521,523,548,570

FIBERGLASS.....71,81,476,477,482

FIFO.....11,285,530

FILM.....69,84,85,120,461,468,475,481,482,489

FILTER.....33,49,51,52,115,130,137,142,143,159,163,170,174,175,183,187,194,199,200,206,207,258,266,267,285,313,454,527,528,529,564,568

FINS.....141,143,144,192,463,486

FIRE-.....81,85,494,513

FIRMWARE.....270,271,539,546

FIXTURES.....29,51,80,122,147,149,150,151,152,153,483,489

FLAME.....177,469,470,473,476,478,480,481,505,511,512,579,580

FLAMMABILITY.....152,462,467,469,470,473,478,510,511,512

FLAMMABLE.....470,504,511,580

FLEET.....3,21,23,27,33,37,43,73,112,279,286,533,535,536,547,582

FLOODLIGHT.....114

FLOORS.....58,69,81

FLUID.....119,205,392,393,454,472,487,494,502

FLUORESCENT.....51,152

FMECA.....11,56,449

FMVSS.....11,467,512

FOAM.....89,122,144,461,464,467,469,480,482,512,579

FORCED.....11,71,80,82,84,85,172,175,192,338,339,476,477

FORDABILITY.....48

FORMALDEHYDE.....480,494

FPS.....11,283,284

FRA.....11,24,34,39,57,58,59,69,70,71,72,73,74,75,76,77,78,79,80,81,85,87,89,127,128,139,142,155,181,200,202,203,205,223,225,227,228,229,230,233,234,239,240,277,284,288,297,362,423,435,467,474,475,489,492,501,503,506,511,555

FREQUENCIES.....51,53,54,55,59,303,304,311,312,368

FREQUENCY.....8,11,14,15,17,28,51,52,54,55,57,58,59,99,169,172,173,174,183,188,191,199,202,233,274,275,280,281,289,302,303,304,311,337,341,342,391,454,455,493,497,525,527

FRICTION.....3,8,18,43,44,45,46,47,50,74,88,108,109,114,117,118,186,188,189,190,202,203,207,229,238,243,245,246,248,249,250,251,252,330,358,359,373,391,414,423,459,460,462,493,494,518,563,567,572

FRP.....11,278,476,477

FSK.....11

FTA.....11,34,52,53,429,432

FUNCTIONAL.....15,22,29,52,73,101,102,128,129,152,155,156,160,161,171,180,186,189,192,249,257,259,262,263,265,270,273,276,279,283,285,289,292,309,310,327,336,340,355,361,368,373,390,399,400,403,413,415,416,417,422,432,437,449,453,455,456,458,530,535,541,544,545,546,558,562,563,569,583

GANGWAY.....21,23,70,77,92,93

GATE.....12,18,80,111,143,144,169,171,188,192,236,249,283,286,388,422,438,440,507,542

GAUGE.....9,21,36,38,39,107,113,117,197,232,341,437

GEAR.....3,8,18,20,59,77,95,97,98,99,100,101,102,127,180,184,185,187,188,196,202,203,204,227,228,236,241,316,324,325,362,397,415,418,423,459,460,556,564

GENERATOR.....20,24,114,118,186,307,360,404,468

GENERATORS.....20,24,114,118,186,360,404

GHZ.....12,52,357

GIS.....11,509

GLAZING.....72,80,84,85,465,472,474

GOLD.....120,498,507

GRAFFITI.....48,84,86,88,89,278,482

HALOGEN.....510,511

HANDLE.....28,59,70,71,82,89,91,100,109,110,111,112,127,129,287,314,434,456,506

HANDRAIL.....71,90,91

HARNESS.....52,80,127,260,278,500,501,502

HAZARD.....56,75,93,108,141,197,257,399,427,442,443,444,445,446

HAZARDOUS.....56,141,197,399,442,446

HEADLIGHT.....79,113,115,117,147,150,153,154,156,353,525,560

HEADLIGHTS.....79,113,117,147,153,154,156,353

HEADWAY.....21,27,37,43

HEAT-.....72,169,198,338,412,466,501,505

HEATER.....103,121,138,140,141,144,146,496,499,503,529

HEATERS.....140,141,496,499,529

HEATING.....3,9,12,18,81,135,137,138,139,140,141,144,145,391,414,502

HORN.....109,114,179

HRV.....12,21,23,207,331,351,352,552,575

HSCB.....12,163,164,189,198,506,527

HUMIDITY.....31,48,139,140,312,413,480,532

HVAC.....12,50,84,103,108,118,121,122,135,137,138,139,140,141,142,143,144,145,146,157,166,167,179,358,359,370,391,413,418,423,454,459,460,512,518,525,529,559

HVDC.....12,23,206

HYDROGEN.....15

IDENTIFICATION.....12,15,32,60,160,179,240,250,263,337,339,340,342,354,362,368,371,385,388,409,432,434,435,446,460,475,495,498,504,508,531,551,561

IDR.....12,366,372,390,391,392,393

IEC.....12,34,56,57,81,87,102,159,177,185,186,188,199,200,201,202,206,233,234,343,355,404,414,415,474,475,478,500,517,540,541

IEEE.....12,186,201,202,206,257,264,265,268,269,270,271,278,325,329,333,353,354,357,365,367,383,392,404,415,467,468,505,510,512,540,541,542,543,544

IGBT.....12,169,171,187,188,192,198,527,528,564

ILLUMINATION.....108,150,171,195,560

INCANDESCENT.....363

INDICATOR.....28,29,87,103,106,107,108,114,117,118,142,143,147,153,154,155,164,173,174,178,179,267,279,281,287,310,314,317,319,320,341,352,354,360,434,435,456,506,507,517,522,581

INDUSTRIES.....11

INERT.....16,41,227

INFLICTS.....20

INJURY.....24,181,444,446

INOPERATIVE.....133,247,252,526

INSPECT.....3,11,21,28,29,54,99,172,180,181,192,203,204,223,224,226,228,233,236,239,241,242,259,293,294,329,337,341,342,343,345,346,348,376,386,390,394,395,397,398,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,430,431,432,434,435,436,437,439,440,446,453,454,455,456,457,471,490,491,495,523,565,566,569,576,577

INSPECTED.....28,54,402,419,421,422,424,435,437,471,491

INSPECTION.....3,11,21,28,29,99,172,180,181,192,203,204,223,224,226,228,233,236,239,242,259,293,294,329,337,341,342,343,345,346,348,376,386,390,394,395,397,398,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,430,431,432,434,435,436,437,439,440,446,453,454,455,456,457,471,491,495,523,565,566,569,576,577

INSULATE.....12,92,141,144,163,164,169,170,171,175,188,192,202,303,464,469,496,497,498,500,502

INSULATED.....12,92,141,144,163,164,169,170,171,175,188,192,202,303,464,469,497,498,500,502

INTEGRATE.....10,12,80,81,85,86,109,110,112,120,121,145,146,151,153,169,197,246,249,250,255,256,261,263,264,266,268,271,275,277,287,290,297,299,310,321,333,336,338,340,352,353,354,355,356,357,365,366,367,368,369,371,372,373,377,403,411,414,429,443,447,453,470,498,509,510,517,518,521,523,542,580,581

INTEGRATED.....10,12,80,81,85,86,109,112,120,121,145,146,151,153,169,246,249,250,256,261,263,264,266,271,275,287,290,297,299,310,333,336,338,340,352,353,354,355,356,357,365,366,367,368,369,371,372,373,377,403,411,414,429,443,447,453,470,498,509,510,517,518,521,523,542,580,581

INTEGRATOR.....19,246,253,261,262,264,265,298,299,520,541

INTER-.....70,92,95,97,98,102,261,264,508,556

INTERCHANGEABLE.....29,79,89,127,172,188,192,227,228,241,362,455

INTERCOM.....12,14,112,121,186,188,253,255,256,259,262,263,265,266,267,268,269,273,279,280,281,282,284,287,351,460,519,525,563

INTERIOR.....49,50,54,59,60,70,71,78,79,82,85,86,87,89,91,92,121,130,131,135,137,139,140,141,144,145,147,149,150,151,152,156,166,167,205,258,260,269,272,274,275,276,277,278,279,283,287,389,390,413,423,460,471,473,474,482,484,487,488,492,493,498,501,503,504,568

INTERLOCK.....22,107,111,113,115,119,125,129,133,134,153,154,157,160,166,167,178,180,188,196,289,300,303,370,445,561

INTERLOCKED.....107,111,113,129,133,153,180,196,289

INTERLOCKING.....133,154,188,300,303,370

INTEROPERABILITY.....255

INVERTER.....18,117,118,138,140,157,158,160,161,163,165,166,167,169,170,171,172,173,174,182,183,186,187,188,189,191,195,198,199,200,201,202,205,246,404,415,416,460,519,521,527,528,561,563

IPCEA.....12

ISO.....12,15,34,49,51,58,59,95,97,100,103,120,127,143,149,160,163,164,168,169,170,172,173,175,181,182,187,192,194,200,201,223,227,232,249,260,282,286,299,321,342,348,379,404,414,415,429,430,431,432,456,457,458,482,483,492,500,508,540,541,562,563,577

ISOLATION.....51,95,100,127,143,149,160,169,170,182,194,260,430,456,457,483,492,562,577

IVLSN.....12,333,368

IVR.....12

JACKET.....144,239,496,497,498,500,501,502

JEDEC.....468,509

JERK.....18,22,31,43,44,46,189,193,207,250

JOINTS.....71,74,76,81,83,85,144,203,228,239,303,477,479,483,485,492,503

KEY.....11,12,28,70,73,83,84,86,88,108,109,111,112,118,130,131,133,145,152,154,155,168,173,197,231,262,292,314,317,323,333,354,361,365,386,389,399,443,456,509,517,522,523,527,530,543,555,581

KEYED.....11,28,197,231,292,317,354,456,509,527

KNIFE.....163,184,200,201,460

LAHT.....12,73,471

LAMP.....51,74,93,103,106,108,115,116,144,149,150,151,153,226,227,238,267,305,363,492,498,501,502,504,507,560,565

LCD.....13,292,293,333,352,365,522

LEAF.....48,82,83,127,129,130,132,133,134,338,348

LEAFS.....83

LEAVES.....129,133,502

LIGHTING.....3,18,51,80,84,90,106,113,118,119,147,149,150,151,152,153,154,155,156,178,353,370,414,423,442,459,460,498,512,525,560

LIMITS.....41,42,50,51,52,53,54,55,56,59,92,140,168,169,173,177,193,225,233,248,252,300,305,337,341,391,393,412,494

LINER.....59,70,85,86,87,89,502

LINERS.....59,70,85,86,87,502

LLRU.....13,22,449

LOCKING.....28,79,84,111,122,133,152,154,180,188,196,300,303,339,370,396,435,455,485,499,504,526

LRU.....13,22,29,170,192,194,249,250,356,361,368,369,370,449,498

LUBRICATED.....170,175,235,493,494

LVDC.....13,178

LVPS.....13,159,162,169,170,175,176,177,178,354,355,460,506,518,519,527

MAINTAINABILITY.....15,22,78,177,185,205,223,227,234,235,240,249,299,333,334,344,374,389,427,429,430,431,447,452,453,454,455,457,458,577

MAINTENANCE.....7,8,9,13,14,15,20,21,22,25,27,28,29,34,48,54,59,73,76,79,86,88,99,100,101,105,106,123,131,134,138,142,143,144,145,146,150,151,152,165,170,172,173,174,177,179,187,192,194,196,200,201,203,223,227,228,233,237,240,241,246,247,251,256,260,264,267,269,271,275,286,290,297,301,308,329,331,332,333,335,337,338,341,342,343,344,345,346,348,350,355,356,359,360,361,362,363,373,377,378,379,388,427,430,444,446,448,451,452,453,454,455,456,457,458,484,493,494,501,522,523,524,525,526,529,530,531,533,536,540,541,564,577

MANUALS.....8,21,22,228,298,301,309,327,329,330,333,334,335,336,337,338,339,340,342,343,344,345,348,356,359,361,362,363,373,431,433,447,454,456,493,494,546,570,571

MANUFACTURER.....8,14,20,21,88,142,172,176,179,185,192,197,259,271,293,297,309,322,354,363,364,367,397,408,441,463,468,478,481,482,483,485,488,489,493,494,495,499,503,505,507,508,509,517,520,532,546,569,570,581

MARRIED.....7,8,18,19,22,23,24,25,27,41,42,44,45,71,82,92,93,97,98,100,101,108,113,117,118,138,153,165,167,175,177,178,189,191,246,247,263,264,265,266,267,271,275,277,279,282,283,301,302,317,323,331,337,340,341,348,353,354,361,364,376,395,396,398,399,411,412,414,415,416,419,448,449,450,459,531,571

MATERIALS.....3,9,19,23,26,75,80,81,85,86,87,91,92,122,141,161,185,198,199,201,203,206,230,234,278,288,301,327,330,333,334,341,342,344,345,347,348,350,356,366,375,377,383,389,390,399,403,421,422,424,425,431,433,434,435,436,437,438,442,452,461,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,518,571,574,579,580

MBPS.....13,262

MCL.....13,305,306,317,318

MCM.....496

MCS.....13,581

MCU.....13

MDBF.....192

MDBSF.....13,22,447,448,449,450,451,452,459

MEA.....8,13,15,18,20,21,22,23,25,26,27,29,33,37,41,43,46,47,49,50,51,52,53,54,56,57,92,109,111,119,130,139,141,150,171,176,179,180,188,194,198,204,207,209,225,226,236,238,239,247,252,255,257,263,274,287,292,313,315,321,329,333,347,349,359,360,371,384,391,406,408,409,412,413,414,432,433,434,435,437,438,447,448,450,453,454,456,457,458,467,488,492,497,506,507,524,531,566

MEMBERS.....71,74,78,80,83,204,230,461,484,490,502,503

METHODOLOGIES.....542

METHODOLOGY.....334,338,349,385,388,443,447,450,453

METRIC.....92,137,247,340,342,384,484,543,544

MHZ.....13,52,55,288,289,361

MICROPHONE.....253,258,268,273,274,279,280,281,282,291,568

MICROPROCESSOR.....127,130,131,145,169,171,185,186,188,193,194,195,207,249,263,265,269,290,298,308,313,319,336,343,356,372,393,413,510,541,546,548,563

MIL.....7,13,20,21,22,25,27,28,33,35,43,47,49,52,57,58,85,86,90,91,92,105,106,108,122,143,144,145,174,181,197,202,203,204,209,235,238,240,251,257,271,282,290,315,317,337,341,345,346,351,356,360,372,378,381,383,386,387,388,413,420,429,431,443,445,447,449,450,451,452,453,454,458,459,461,468,472,476,477,480,481,484,485,486,487,490,491,495,496,497,498,499,507,509

MMI.....10,11,12,13,14,34,86,129,153,171,196,250,257,258,262,266,286,308,381,384,399,446,463,464,520,523,541,542,568,575

MMIS.....11,12,13,34,257,262,308,381,384,399,520,542,575

MOCK-.....59,82,103,105,108,122,123,287,345,349,384,389,394,557,574

MOCKUP.....348,394

MODIFIED.....23,47,284,310,316,384,410,483,512,551,574

MOTION.....23,40,47,83,110,112,130,133,141,144,188,190,194,207,225,233,249,304,325,391,493,499,502,503,526,528

MOTOR.....11,13,18,20,24,25,31,46,49,54,58,59,72,116,125,127,132,138,143,144,145,161,166,167,169,170,175,181,184,185,186,187,188,189,190,191,193,196,197,198,201,202,203,204,206,227,228,229,233,241,242,317,324,362,373,404,414,415,418,460,465,468,474,482,485,496,499,502,505,506,527,528,529,563,564

MOUNTED.....29,36,46,54,57,58,74,76,77,79,80,101,106,107,109,111,112,115,119,120,121,122,137,141,143,144,152,162,171,174,177,178,181,182,192,196,197,202,205,227,233,235,238,240,241,249,268,269,274,275,276,278,280,281,286,288,291,309,315,316,324,352,354,360,364,384,393,398,400,485,498,507,509,510,520,575

MOV.....7,13,20,21,23,24,28,29,40,48,49,54,72,73,75,78,80,81,83,85,86,88,90,92,93,101,107,110,111,112,118,119,122,129,131,132,133,134,137,143,144,145,151,154,168,177,179,180,181,190,192,194,196,198,199,201,203,204,205,227,228,233,236,241,242,249,251,260,264,266,282,285,286,287,288,289,291,300,303,305,306,315,337,351,358,359,399,422,435,448,450,451,455,458,463,474,480,482,483,486,489,490,492,493,497,498,500,501,502,509

MRB.....13,397,438

MSDS.....464

MSS.....13,306,317,318

MTBF.....13,22

MTTR.....13,453,454,458

MVB.....14

NATO.....345,468,498

NDT.....14,386,397

NEMA.....14,72,89,468,476,495,505,506,509

NESC.....14

NFPA.....14,469,473,476,478,511,512,517,518

NIST.....11,14,98,440,467,469,478

NTFS.....357

NTP.....14,37,231,343,350,387,388,552,571,572,574,575,577,584

NTSC.....14,284

OCC.....14,18,19,22,24,26,47,54,57,58,77,81,98,108,132,167,171,173,175,189,190,195,199,241,242,248,279,292,300,301,302,303,304,305,311,316,319,324,347,364,403,420,431,439,444,446,448,453,455,457,475,521,522,524

OCU.....1,3,7,8,10,14,18,19,20,21,23,25,26,27,35,56,98,101,128,139,152,155,164,187,193,225,226,238,245,250,255,258,261,297,300,309,327,328,329,330,331,333,342,343,344,356,361,362,363,364,365,366,369,373,374,375,381,384,386,387,388,389,390,392,393,394,395,396,397,403,405,406,407,408,410,411,417,419,420,421,422,423,424,429,430,431,432,433,434,435,436,437,438,440,442,443,445,446,447,448,449,452,456,463,464,470,471,486,487,489,495,509,515,523,531,537,539,540,541,542,543,544,545,546,548,556,563,565,566,567,568,570,571,573,576,577,580,583

ODBC.....14,357,358,364

ODOMETER.....183,197,207,269,271,292,529

OPERATOR.....3,16,17,18,19,20,21,23,45,48,58,71,84,85,87,88,100,101,103,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,127,128,129,132,133,138,141,142,147,150,152,153,154,155,167,170,171,172,178,189,193,195,197,249,255,256,258,260,263,264,265,266,267,268,272,274,276,277,279,280,281,282,283,284,285,286,287,288,290,291,298,301,304,305,306,307,309,312,315,316,317,320,321,322,323,335,338,339,340,341,344,348,350,351,352,354,357,379,384,389,391,394,459,460,474,490,520,521,522,523,530,531,557,568,570,574

OSCILLATION.....232,275

OSHA.....14,98,100

OUTSIDE.....35,38,83,85,100,120,130,133,140,153,154,164,170,175,250,276,277,348,504

OVERSPEED.....115,121,207,300,304,305,306,307,308,310,312,318,321,526

OVERTEMPERATURE.....207

OVERVOLTAGE.....199,207

PAINT.....16,60,71,76,78,79,89,91,92,234,240,283,366,383,389,461,463,467,468,469,470,476,477,479,483,487,488,489,504,513,574,579,580

PANEL.....12,19,28,49,59,71,83,86,88,89,103,105,106,107,108,111,112,113,114,115,116,117,118,119,122,130,132,133,142,147,152,153,154,155,159,162,163,167,168,169,170,173,174,182,187,193,194,199,266,273,280,281,286,290,310,313,314,318,319,320,322,323,350,351,354,371,391,394,445,455,456,460,461,476,477,478,479,480,481,483,486,511,512,557,564

PARKING.....106,107,116,117,118,227,228,245,248,251,525,528

PASSENGER.....9,14,15,21,24,27,42,45,48,56,58,59,70,72,73,75,78,81,82,83,84,87,89,90,92,93,105,106,112,120,121,123,127,129,131,138,139,140,149,150,151,155,159,170,193,200,225,234,235,245,253,255,256,258,259,260,262,263,264,266,267,268,269,271,272,273,274,275,276,277,279,280,281,282,283,284,286,287,351,389,413,460,463,464,465,469,478,486,519,523,524,525,529,559,568,569

PASSWORD.....208,547

PATH.....10,14,20,76,181,182,198,373,386

PBS.....14

PCB.....14,297,313,314,316,570

PCBS.....297,313,314,570

PDA.....14,41,228,232,270,271,275,278,284,293,298,330,334,345,364,376,383,387,388,395,397,398,406,419,431,445,449,456,457,458,487,522,545,546,547,552,571,574

PDR.....14,228,366,372,390,391,392,542,546,577

PDS.....14

PECU.....14,466

PEDAL.....122

PEIC.....14,255,259,263,268,280,284,287

PIS.....14,15,255,256,259,262,265,269,272,275,276,277,527

PITCH.....144,277

PLD.....15,539

PLYMETAL.....81,469,479,481,579

PNEUMATIC.....20,26,97,99,100,118,122,127,157,160,166,167,236,237,238,240,241,247,248,249,250,251,360,361,366,367,368,371,372,373,392,393,416,460,483,493,528,561

POLYMER.....88,238,461,475,476,480,483

PRIMAVERA.....386

PRIMER.....461,470,476,482,487,488,579

PROBABILITY.....24,444

PROCESSOR.....127,130,131,145,169,171,185,186,188,193,194,195,197,207,249,263,265,266,269,290,298,308,313,315,316,319,333,336,343,356,357,365,372,393,413,510,539,541,546,548,563

PROCESSORS.....186,188,193,319,510,539,548,563

PROCUREMENT.....1,7,8,23,386,387,420,434,438,471,509,546

PROGRAMMABLE.....11,15,145,169,194,275,293,521,539

PROGRAMMED.....114,269,272,277,285,286,300,301,307,308,361,521

PROOF.....23,25,74,79,86,90,91,121,149,196,205,267,280,283,288,290,292,338,470,476,479,484,496,498,499,500,502,504,580

PROPERTIES.....95,98,192,230,231,365,440,466,470,482,483,494,498,579

PROPOSAL.....15,18,23,43,85,192,258,272,431,447,452,552,565,568,577

PROPULSION.....3,14,18,19,31,43,45,46,47,50,56,88,108,109,110,111,114,115,117,118,133,163,164,165,174,178,183,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,245,249,250,302,307,310,311,321,322,330,346,358,359,370,371,373,391,414,415,419,423,432,459,460,518,525,527,528,563,564,572

PROTOCOL.....15,16,255,257,258,261,264,278,279,283,298,325,515,520,521,532,569

PROVEN.....25,33,71,78,79,89,97,99,127,132,143,153,154,170,175,192,225,227,229,234,235,238,247,262,271,401,410,480,507,539

PTFE.....11,469,499

PTU.....15,75,106,134,146,170,171,182,193,194,195,207,208,225,250,258,266,275,283,284,285,286,293,318,319,328,330,353,355,356,357,358,359,361,390,519,522,530,544,545,547,565,568,572

PURCHASE.....363,385,424,434,437,441,471

PUSHBUTTON.....107,109,112,113,115,116,117,118,119,281,306,317,318

QUALIFICATION.....25,42,44,56,98,99,100,102,128,129,137,138,139,144,187,189,191,199,206,226,228,236,237,239,240,245,246,247,252,258,259,262,265,332,346,398,399,400,401,403,410,411,412,413,414,415,416,419,439,465,467,470,489,491,495,537,541,556,558,559,564,565,566,567,568,576,580

QUALIFIED.....144,283,331,334,374,386,407,471,495,507,508

RADIATED.....34,51,52,56,57,293,499

RADIUS.....38,39,209,217,238,239,412,492,503

RAIL.....1,7,8,9,10,11,12,18,19,20,21,22,23,24,25,26,27,33,34,35,36,37,38,39,40,43,44,48,49,50,52,53,54,55,58,70,71,72,73,76,83,84,87,90,91,92,105,113,118,122,128,144,149,152,154,156,157,162,163,165,170,174,175,183,185,186,189,190,191,192,200,201,207,210,225,227,228,229,233,235,236,237,241,245,248,257,262,263,271,276,280,282,297,299,300,301,302,303,304,309,316,329,346,378,379,381,398,404,411,412,414,415,460,463,464,466,467,468,469,478,483,495,498,507,510,517,525,527,528,535,540,541,542,544

RAINFALL.....48,532

RECYCLING.....132

REDUNDANCY.....23,161,181,251,444,515,518,531,562,581

REFRIGERANT.....137,138,139,142,143,144,413,414,559

REGULATION.....10,131,158,172,176,256,257,300,306,307,308,317,322,354,399,434,510

RELEASE.....20,22,46,83,97,106,107,110,111,116,118,122,125,128,129,132,133,196,241,248,251,287,321,325,374,386,387,393,413,493,506,525,529,543,544,545,546

RELIABILITY.....15,24,25,26,29,99,160,161,172,174,175,181,185,226,234,235,247,262,276,279,299,333,334,344,363,374,389,396,397,427,429,430,431,447,448,449,450,451,452,453,454,457,459,468,495,562,565,577

RELIEVE.....18,56,406,419,491,501

RENDERINGS.....85,389

RESETTING.....173

RESISTANT.....28,69,73,78,84,86,88,89,101,107,151,170,198,200,237,278,279,286,287,338,339,471,472,474,476,477,480,481,482,484,487,494,499,500

RETAINING.....455

RETROFIT.....338,374,437,442

REUSABLE.....493

REVISION.....327,330,331,334,336,337,338,339,340,343,358,362,369,374,376,385,386,388,390,391,392,393,394,397,407,408,409,424,434,443,464,474,484,551,571,572

ROLLED.....47,72,91,100,109,133,152,166,173,188,189,195,248,250,277,306,317,356,370,374,407,433,437,438,444,466,471,474,485,495,501,506,518,523,526

ROOF.....23,24,25,36,60,71,74,75,79,80,81,86,90,91,92,121,137,149,196,205,267,280,283,288,290,292,338,393,470,476,479,484,488,496,498,499,500,501,502,504,580

ROTARY.....79,100,108,111,113,493,494

RUGGEDIZED.....269,270,356

SAE.....15,469,474,482,484,485,499

SAFE.....11,14,15,21,24,26,28,46,56,72,74,78,79,83,85,87,90,91,92,97,98,106,130,133,137,141,142,149,158,161,163,165,168,169,179,180,181,187,188,190,193,197,200,202,204,205,209,210,228,230,235,245,247,249,250,251,264,290,299,300,304,306,308,313,315,324,336,340,341,374,389,427,429,430,431,442,443,444,445,446,447,453,454,455,463,464,465,469,474,475,483,485,497,507,515,520,522,524,532,539,548,562,564,577,579

SAFETY.....11,14,15,24,28,46,72,74,78,79,85,87,90,91,98,130,133,137,149,158,161,163,165,168,169,179,180,181,187,188,200,204,205,209,210,228,230,247,249,264,290,299,304,313,336,340,341,374,389,427,429,430,431,442,443,444,445,446,447,453,454,455,463,464,465,469,474,475,483,485,497,507,515,522,524,532,539,548,562,564,577,579

SAMPLING.....170,194,424,436,495,530

SCADA.....15

SCCP.....15,541,547,583

SCE.....9,15,34,39,51,55,56,72,90,116,152,198,223,238,259,293,320,340,351,353,363,370,440,490,510,535,541,542,569

SCHEMATIC.....12,20,99,100,101,128,186,189,258,272,309,333,336,338,341,349,350,355,366,367,368,369,370,371,372,373,377,392,393,563,568

SCMP.....15,543,546

SDD.....15,544,545,546

SEAT.....9,19,36,42,58,59,70,71,72,74,75,80,85,87,88,89,90,103,106,121,122,123,150,274,288,352,423,460,493,511,512

SEATED.....9,42,89,106,288

SEATS.....71,85,88,89,90,121,460

SECURED.....79,81,88,149,313,418,445,481,485,492,507

SEI.....15,540,542

SEMICONDUCTOR.....171,172,187,192,249,508,509,510,563

SENSOR.....130,134,145,172,196,197,241,246,261,298,304,307,310,312,313,314,315,316,317,319,320,324,354,360,363,521

SERIAL.....16,170,227,234,236,248,273,325,329,335,364,385,397,398,408,409,421,422,436,552

SHAFT.....204,493,494

SHEAR.....74,97,230,479,490

SHOCK.....31,35,57,58,74,75,77,78,97,99,181,196,204,205,229,236,238,247,257,284,286,316,317,492,502,517,554

SHUTDOWN.....56,145,166,173,175,176,178,187,191,194,286,525,528,563

SIGNAL.....16,21,25,26,28,31,34,45,46,47,51,52,53,54,56,62,107,110,112,114,118,120,127,129,130,131,133,173,187,188,190,199,246,249,250,260,261,265,266,272,273,275,285,287,299,300,301,302,303,304,305,306,307,308,309,311,312,314,315,316,317,318,321,324,325,329,330,336,351,352,353,354,359,360,367,370,372,373,392,393,456,465,497,500,507,510,517,524,526,554,564,567,572

SIGNALING.....34,52,54,56,187,199,304,309,329,351,353,517,554,564

SILICON.....144,461,464,469,480,483,499,579

SLIDE.....19,26,31,43,46,61,188,190,193,207,245,246,248,249,250,252,414,460,528,567

SMOKE.....10,142,460,462,467,469,470,473,476,478,481,505,510,511,525,579,580

SOAP.....15

SOLAR.....120,139,413

SOLDERING.....138,144,461,489,491,500,501,559

SOLENOID.....114,142

SONET.....15

SPARE.....24,25,100,102,115,116,118,150,160,165,166,167,168,242,249,309,310,323,328,329,331,332,342,348,349,362,363,375,399,405,497,499,500,506,520,561,572

SPARES.....25,118,362,375,500

SPEAKER.....51,253,256,258,268,272,273,274,275,279,280,281,282,288,291,292,293,333,353,365,498,568

SPEED.....12,18,22,24,26,31,39,40,42,44,45,46,48,49,50,52,53,54,58,59,63,75,82,92,99,112,113,115,117,119,121,129,133,163,183,186,188,189,191,196,197,198,202,203,206,207,209,214,215,216,227,232,237,241,249,250,252,268,271,300,301,302,303,304,305,306,307,308,310,311,312,313,314,315,316,317,318,319,320,321,322,324,325,351,413,417,419,421,459,460,494,506,526,528,529,532,563

SPEEDOMETER.....113,117,207,320

SPEEDS.....40,44,45,46,49,52,53,54,59,119,121,129,189,191,227,232,307,419,494

SPIN.....19,26,31,43,46,61,188,190,193,207,245,246,249,250,339,414,460,567

SPL.....8,13,15,16,17,23,49,58,84,99,106,115,134,150,182,197,208,226,230,238,255,258,260,264,266,267,269,270,273,276,277,278,284,287,291,292,313,314,315,316,318,320,321,323,328,339,340,357,358,359,418,467,493,501,504,518,520,522,523,530,531,566,569,581

SPLICING.....501,504

SQL.....364

SRS.....540,544,545,546,583

SRTM.....16,545,546

SSPC.....16

SSPP.....442,443

SST.....16

STABILITY.....257

STABILIZATION.....172

STABILIZE.....23,413

STAINLESS.....16,23,71,72,73,78,79,80,81,82,83,87,88,90,91,92,101,141,143,144,151,170,177,179,180,205,238,280,316,466,467,471,479,484,485,486,487,488,492,504

STATIONS.....7,36,40,43,209,258,273,274,279,280,281,282,287,300,307,309,568

STD.....16,105,106,257,290,468,485,487,497

STIFFNESS.....71,74,396

STOPS.....20,42,77,78,114,116,209,238,300,351

STRESS.....71,73,75,138,139,223,225,227,228,229,230,231,232,234,235,278,396,411,442,470,476,480,490,491,559,580

STRUCTURAL.....16,28,71,72,73,74,75,76,77,86,99,102,121,187,202,225,227,228,230,232,376,392,393,396,455,456,461,465,466,467,471,472,478,480,484,485,502,503,555,564,565

STRUCTURALLY.....28,102,121,455

SUBCONTRACTOR.....25,262,336,367,368,377,385,388,391,392,393,395,396,407,409,417,420,421,430,431,432,433,434,436,438,440,441,442,443,447,453,489,490,521,523,576

SUBSYSTEM.....18,19,22,24,25,26,33,36,50,51,56,108,109,111,127,128,137,145,169,170,171,186,187,188,195,207,208,227,233,239,246,248,249,260,261,262,263,265,267,298,299,303,307,313,321,322,336,337,338,340,341,351,355,356,357,358,359,360,361,362,363,366,367,373,374,385,390,391,392,393,395,397,400,401,403,405,406,407,408,410,411,413,414,415,416,417,419,422,423,425,430,434,435,443,444,445,447,448,449,450,451,452,453,454,455,457,458,459,460,500,519,520,521,522,524,525,526,527,528,529,532,536,542,543,548,563,564,577

SUNLIGHT.....108,276,494

SVD.....16,545

SVVP.....16,543,544,545,546

TAMPERPROOF.....86,121,280,283,484

TAPPING.....227,484,485

TCN.....16

TESTING.....3,5,9,14,20,23,25,29,42,52,56,57,82,95,99,100,102,128,129,137,141,151,156,159,171,172,174,184,186,192,195,206,223,226,228,236,237,239,240,243,246,247,248,252,253,259,261,262,275,282,293,294,295,298,300,331,332,337,344,347,348,349,355,359,360,361,386,396,397,398,399,400,401,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,431,432,433,436,437,443,444,446,447,449,450,451,452,458,465,466,491,492,493,505,510,512,515,519,529,532,544,558,565,567,576

TESTS.....26,59,85,102,139,159,160,171,182,193,195,200,206,208,229,239,240,299,354,356,360,374,397,400,401,403,405,406,407,410,411,412,414,415,416,417,419,422,434,435,437,466,470,473,489,491,495,517,530,544,545,548,562

TFT.....356

THD.....280

THERMAL.....43,81,92,132,139,185,186,190,198,201,235,414,462,470,494,506,511,563,580

THERMOPLASTIC.....477

THERMOSTATS.....140,413

THRESHOLD.....35,40,70,88,91,130,150,275,391

TIGHTNESS.....69,71,82,416,417,418,419

TOD.....16,106,109,255,260,264,266,267,268,272,277,284,287,318,323,352,460,520,521,522,523,527,531

TOPICAL.....387,389

TORQUE.....26,28,46,74,191,202,203,204,229,340,485,505

TOWING.....183,190,191,192,535

TRACK.....7,21,24,26,27,34,37,38,39,40,42,44,47,48,49,50,54,55,56,74,75,81,82,93,99,106,107,180,187,199,200,209,229,233,251,262,271,300,301,302,303,304,305,306,309,310,311,314,315,316,320,322,324,334,336,338,348,353,388,405,412,421,422,434,437,443,445,447,450,451,452,547,564

TRACKS.....38,251,353

TRACKSIDE.....251

TRAINER.....345,378

TRAINLINE.....26,47,62,95,97,98,100,101,102,108,109,110,111,113,116,119,125,127,129,130,131,133,152,168,171,173,175,182,193,195,196,207,248,249,255,258,261,264,265,266,268,269,276,279,287,290,292,295,298,302,321,325,354,360,367,369,370,391,415,416,419,515,520,528,532,535,568,570

TRAINLINED.....97,98,101,102,108,125,129,130,175,195,196,248,255,265,276,279,298,321,419,570

TRANSCEIVER.....56

TRANSDUCERS.....360,363

TRANSFER.....16,22,76,77,141,262,271,272,289,292,434,435,530,546

TRANSFORMER.....175,249,371,508

TRANSISTOR.....12,169,171,188,192,509

TRANSPORTATION.....7,9,10,11,18,72,127,256,274,329,379,383,446,465

TRUCK.....3,26,35,36,41,54,57,60,71,75,76,77,78,107,108,117,162,165,179,180,181,188,191,194,196,202,203,204,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,249,250,251,301,307,316,320,324,362,391,412,414,416,418,423,432,454,459,460,472,473,485,501,565,566

TRUCKS.....35,60,71,76,77,78,191,196,225,227,228,233,234,237,238,240,241,242,362,418,432,459,460,485

TTW.....16

TURNKEY.....262

TVS.....16

TWC.....16,26,55,106,295,298,309,310,322,323,324,460,519,526,570

UDP.....16,265,283

ULTRAVIOLET.....81,88,474

UNDERFLOOR.....36,41,78,79,83,251,384,390,394,418,470,488,498,574,579,580

UNFIRED.....137,143,248,493

UPHOLSTERY.....89,512

UPLOADED.....286,524

UPLOADING.....524,525,530

USB.....16,273,293,319,334,357,365

VAC.....12,17,50,84,103,108,118,119,121,122,135,137,138,139,140,141,142,143,144,145,146,157,162,165,166,167,169,179,201,246,280,358,359,360,370,391,413,418,423,454,459,460,476,508,512,518,525,529,559

VALVE.....28,55,99,100,139,142,143,145,227,228,233,237,240,241,247,248,251,315,363,392,393,455,492,529

VALVES.....28,55,99,100,142,143,145,228,237,240,241,248,251,363,392,393,455,492

VANDAL.....69,84,85,87,89,275,278,279,283,286,287,292,445,448,456,502

VANDALISM.....85,89,275,278,286,287,445,448,456,502

VDC.....12,13,17,23,37,41,152,161,162,169,172,173,175,177,178,185,189,190,200,201,206,264,285,288,414,506,507,508

VELOCITY.....17,22,24,26,45,58,75,79,141,142,150,304,305,306,418,505

VENDORS.....334

VENTILATED.....199,202

VENTILATION.....3,12,135,137,141,144,164,169,170,172,175,180,198,310

VIBRATION.....31,33,34,35,49,57,58,78,81,138,141,143,151,196,203,204,205,225,233,236,247,257,286,317,404,412,415,483,492,494,502,517,554

VIDEO.....10,253,255,256,259,260,264,265,266,268,270,271,276,283,284,285,286,287,292,293,333,345,349,357,365,569

VIOLET.....16,81,88,472,474,476,477,482

VISIBILITY.....83,85,150,152,277,560

VLU.....17,255,289

VMC.....17,269,270,271,581

VMS.....17,106,109,129,130,134,138,142,146,171,179,195,246,250,261,262,264,265,266,268,269,270,277,295,298,299,308,318,319,325,353,354,358,359,370,413,423,432,460,517,518,519,520,521,522,523,524,525,527,529,530,531,532,535,581

VOD.....17

VOLT.....12,13,17,21,23,34,37,41,44,51,52,53,54,72,75,106,108,118,119,130,131,132,138,141,150,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,179,181,182,183,187,188,189,190,191,194,199,200,202,205,206,207,241,249,266,275,293,301,302,309,313,367,368,369,371,372,373,391,413,415,418,495,496,497,499,500,502,503,505,506,507,508,509,510,518,519,527,529,548,561,563

VOLTAGE.....12,13,17,21,23,34,37,41,44,51,52,53,54,75,106,108,118,119,130,131,132,138,141,150,152,153,154,155,156,157,158,159,160,161,162,163,165,166,167,168,169,170,171,172,173,174,175,176,177,179,181,182,183,187,188,189,190,191,194,199,200,202,205,206,207,241,249,266,275,293,301,302,309,313,367,368,369,371,372,373,391,413,415,418,495,496,497,499,500,502,503,505,506,507,508,509,510,518,519,527,529,548,561,563

VOLTAGES.....37,41,44,52,53,54,172,175,189,194,368,372,413,502,508

VOLTS.....17,37,72,164,173,174,175,177,199,275,500

VOLUMETRIC.....247

VSWR.....17

VVVF.....17,183,188,191,521

WARRANTY.....26,228,250,309,331,332,334,337,338,340,362,363,366,381,385,396,397,398,430,433,434,437,571

WASH.....45,79,84,88,107,108,113,115,116,119,154,418,454,468,472,477,482,485,486

WASHER.....116,119,454,468,477,485,486

WASHING.....418,482

WATERPROOF.....79,196,479,500,502,504

WATERTIGHT.....25,74,154,277,418,498,499,502

WAYSIDE.....16,26,31,36,48,49,50,54,55,56,106,253,255,256,260,261,266,270,271,276,278,287,293,295,297,298,299,300,301,302,303,306,307,308,309,310,312,322,323,443,510,515,520,521,522,530,533,535,536,546,570

WEATHER.....71,83,84,101,153,154,205,290,435,448,476

WELDING.....9,71,74,80,164,225,227,234,248,386,461,465,467,468,470,471,489,490,491,580

WHEEL.....7,19,21,25,26,31,35,36,40,41,42,46,48,49,59,60,76,89,90,130,191,193,196,200,202,223,225,226,227,228,232,233,234,235,236,238,241,242,245,248,250,280,319,324,397,412,418,423,460,528,565

WHEELBASE.....36

WHEELCHAIR.....89,90,280

WHEELCHAIRS.....90

WHEELS.....21,25,26,35,36,42,49,59,60,191,202,223,225,226,228,233,234,235,236,241,248,397,412,460,565

WINDOWS.....69,71,74,81,82,84,85,88,106,107,113,115,122,150,155,276,334,357,366,460,498,512

WINDSCREEN.....70,83,85,86,87,131,511

WINDSHIELD.....22,24,69,85,103,106,116,119,120,150,277,454

WIPER.....103,116,119

WIRE.....9,29,80,102,149,159,161,165,168,180,189,204,205,206,256,257,260,261,262,263,264,265,266,269,270,271,272,273,275,278,283,284,287,293,297,301,302,309,310,318,321,322,329,357,366,367,371,392,393,456,460,464,465,466,468,469,470,485,488,491,495,496,497,498,499,500,501,502,503,504,505,512,517,518,519,520,522,524,526,530,570,579,581

WIRED.....204,269,272,283,322

WIRING.....20,48,56,80,97,119,127,158,165,167,168,180,184,186,189,196,205,227,241,260,261,263,264,265,271,278,285,288,298,301,302,309,310,313,317,320,321,353,354,366,367,368,371,372,373,376,416,418,462,464,468,495,497,499,500,501,502,503,504,510,518,519,563

WORKMANSHIP.....3,24,300,422,461,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,579,580

WRITTEN.....18,23,194,292,348,354,355,365,366,371,384,392,405,407,420,422,424,436,449,452,456,457,471,530,541

XML.....17,364,521,522

YARD.....27,38,99,111,113,117,134,256,301,304,306,310,312,318,323,341,412

ZERO.....17,18,22,26,38,44,46,99,110,112,133,176,188,196,197,247,249,304,305,306,312,510,511,526,529

Memorandum

To: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

From: Charles Scurr, Executive Director

Date: October 24, 2012

Re: **CITT AGENDA ITEM 5G:**
RESOLUTION BY THE CITIZENS' INDEPENDENT TRANSPORTATION TRUST (CITT) RECOMMENDING THAT THE BOARD OF COUNTY COMMISSIONERS (BCC), AUTHORIZE EXECUTION OF AN AGREEMENT IN THE AGGREGATE AMOUNT OF **$313,832,000.00** WITH ANSALDOBREDA S.P.A FOR NEW HEAVY RAIL VEHICLES; AUTHORIZING THE COUNTY MAYOR OR COUNTY MAYOR'S DESIGNEE TO EXECUTE THE CONTRACT FOR AND ON BEHALF OF MIAMI-DADE COUNTY AND TO EXERCISE ANY CANCELLATION AND RENEWAL PROVISIONS; TO EXERCISE ALL OTHER RIGHTS CONTAINED THEREIN; AND AUTHORIZING THE USE OF CHARTER COUNTY TRANSPORTATION SURTAX FUNDS **(MDT/ISD – BCC Legislative File No. 121816)**

On October 24, 2012, the CITT voted (10-0) to forward a favorable recommendation to the Board of County Commissioners (BCC) for the approval of the above referenced item, CITT Resolution No. 12-090. The vote was as follows:

Hon. Linda Zilber, Chairperson – Aye
Paul J. Schwiep, Esq., 1st Vice Chairperson – Aye
Hon. Anna E. Ward, Ph.D., 2nd Vice Chairperson – Aye

Christopher Benjamin, Esq. – Absent
Glenn J. Downing, CFP® – Aye
Alfred J. Holzman – Aye
Miles E. Moss, P.E. – Aye
Marilyn Smith – Absent

Joseph Curbelo – Aye
Peter L. Forrest – Aye
Prakash Kumar – Aye
Hon. James A. Reeder – Aye

cc: Alina Hudak, Deputy Mayor/County Manager
Bruce Libhaber, Assistant County Attorney
Alexander Bokor, Assistant County Attorney