This document is a draft Scope of Services for a future solicitation and is subject to change without notice. This is not an advertisement.

Miami-Dade County, Florida

Dockside Container Handling Gantry Cranes

SCOPE OF SERVICES

Base Cranes and Options

1. Base Cranes
The selected Proposer shall furnish and make fully operational three (3) Cranes, four (4) Spreaders, two (2) Overheight Adaptors and Spare Parts, in accordance with this Scope of Work and Technical Specifications (attached to this Section 2 as Attachment A), to be installed at Gantry Crane Wharf on the South side of Lummus Island, Port Miami, Miami, Florida USA. The Work to be performed by the selected Proposer includes, but is not limited to providing all labor, materials and services for the design, fabrication, erection, assembly, painting, commissioning, testing, transportation, installation, re-commissioning, testing and certification of three (3) 65 Long Ton capacity, Super Post-panamax, “H” Frame, Dockside, Rail-mounted Gantry Container Handling Cranes as completed structures including a warranty of same. No additional work shall be performed by the selected Proposer at Port Miami except as approved by the County, and to re-assemble, re-erect, re-install cranes and components as a result of transportation, touch-up painting (as required), commissioning, testing, and certification of the Cranes. The design criteria, characteristics and features of the Cranes are delineated in the Technical Specifications (Attachment A) attached hereto.

The selected Proposer shall be responsible to provide and pay for all items, labor, facilities and services necessary for proper execution and completion of the Work, temporary or permanent, in accordance with the conditions of any contract issued as a result of this RFP, except as expressly provided otherwise.

2. Option A - Higher Stowed Wind Conditions Supplement:
As an optional supplement to the Base Cranes – provide the Cranes designed and fabricated for the Higher Stowed Wind conditions as described in Section 3.32 of the Technical Specifications (Attachment A).

3. Option for up to Five (5) Additional Cranes
The County, at its sole discretion, may elect to acquire up to five additional cranes, as stated in Section A 1, above, and potentially with “Higher Stowed Wind Conditions Supplement option as stated in Section 2.2 A2 above.

4. Optional Crane Components and Services
The County, at its sole discretion, may require the selected Proposer to furnish and make fully operational additional optional crane components and services as requested in the Price Proposal Form and in accordance with the Technical Specifications here attached with any agreement issued as a result of this RFP, which Cranes are to be installed on the Gantry Crane Wharf on the South side of Lummus Island, Port of Miami, Miami, Florida USA and services to be rendered.

B. Delivery and Completion Work
The selected Proposer shall install fully operational Cranes at the Port of Miami within 596 calendar days from the date of Notice to Proceed with Contract Work from the County in accordance with the Technical Specifications. Should the County award any or all of Optional Items simultaneously or within one hundred twenty (120) Calendar days of the initial NTP, no additional time will be authorized for the completion of the Work associated with the Optional Items and said items shall be delivered to the Port of Miami within the above 596 days from the Notice to Proceed.
C. Legal Restrictions, Permits and Traffic Provisions
The County will waive all fees and charges normally required for the dockage and storage area facilities on the Port of Miami. A Delivery Site shall be provided at the Port to unload the Cranes and perform all work to make the Cranes operational for commercial service. The use of the Delivery Site is strictly limited to Work as specified herein the Technical Specifications and for the specific time required to perform this said work as enumerated herein. The dockage is limited to the unloading operation of the Cranes as approved by the Port of Miami Berthing Office and the United States Coast Guard.

The selected Proposer shall be responsible for obtaining local contractor services as required to include stevedores, to unload and make the Cranes operational. The selected Proposer shall be responsible to secure and pay for all US work VISA(s), permits, fees and licenses necessary for the proper execution and completion of the design, fabrication, assembly, erection, installation, painting, commissioning, testing, transportation, delivery, unloading, commissioning, testing and certification of the Cranes and any worked related to the successful completion of the Project.

D. Contract Administration
The Port Engineer, or designee, shall be the authorized administrator for the County of any contract issued as a result of this RFP. The Port Engineer may elect to assign Seaport Capital Development staff and contracted personnel to represent the County as necessary to assist in the administration of any contract issued as a result of this RFP.

The County may also contract for consulting crane engineering services as needed to assist the County in its review of the selected Proposer's performance. The County may request that such Consulting Engineer perform certain other services on this Project on the County's behalf. In addition to these consulting crane engineering services, the County may also contract with inspection and testing laboratories for any work required in the performance of the Work. If the County does acquire consulting engineering and/or other services as described herein, it will advise the selected Proposer. The selected Proposer shall cooperate with the County's Consulting Engineer as it pertains to providing access for inspections, reporting and related matters. The County may also request that the selected Proposer provide copies of certain documentation resulting from work hereunder to the County's Consulting Engineer.

All assigned County, Consulting Engineer and Representatives staff will be acting as representatives and agents for the County and shall have free access to all documents, materials, Work sites and work related to the Services provided to the County by the selected Proposer at all times for measuring and observing the same. The selected Proposer shall afford this said assigned staff, Consultants and Representatives all the necessary facilities and assistance for so doing.

The Port Engineer may elect to provide additional Consulting Engineers to assist in the carrying out their responsibilities. The authority of such engineers shall be as set forth and defined by the Port Engineer.

The Port Engineer will review and approve, for conformance with the design concept of the Work and with the requirements established in this RFP, or take other appropriate actions upon selected Proposer's Submittals such as designs, progress payments, shop drawings, product data and samples. The County's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

The Consulting and/or Crane Engineer will not be responsible for notifying the selected Proposer when to begin, cease or resume work on individual operations, for giving early notice of the rejection of faulty work, for supervising
the work, or for serving as an arbiter in establishing subcontract limits between any parts of the work, unless otherwise directed to do so by the Port Engineer.

E. Project Schedule
The selected Proposer shall submit the final proposed Project Schedule to the Port Engineer for review and approval within fifteen (15) days after Notice-to-Proceed issued as a result of this RFP. The Project Schedule is to include but not be limited to the planning, design, submittals, fabrication, erection, installation, commissioning, testing, transportation, delivery, re-commissioning, final testing, certification and hand-over of the Cranes for commercial operation as required herein. All schedule issues shall be addressed and resolved prior to the Pre-design Conference (Kick-off Meeting) that shall be held at the Port's Capital Development offices no later than twenty-five (25) days after Notice-to-Proceed is issued.

The selected Proposer, Port Engineer and the County's Representative may schedule telephone and/or on-site conferences at the selected Proposer's or the Port's offices as necessary to expedite the planning, design, fabrication and the Work to be performed. All Project Schedule milestones may not be changed, except upon the written approval of the Port Engineer.

The selected Proposer shall assist the Port Engineer and Representatives in reviewing and analyzing said schedule.

The Project Schedule shall delineate all milestones, details and interface of activities necessary for the successful completion of the Work within the time specified herein. Unless otherwise directed by the County in writing, the selected Proposer shall perform the Work in strict conformance with the approved Project Schedule and the Specifications.

The Project Schedule shall detail principal activities at the site(s) of the Work as well as off-site activities including, but not limited to, design, design drawing submittals, approvals, procurement, fabrication, erection, assembly, transport of goods to work sites, installation, painting, commissioning, testing, transportation of the Cranes to the Port of Miami, delivery, installation, re-commissioning, final testing, certification and hand-over of Cranes for commercial operation in accordance with all requirements herein and with the Technical Specifications. The Project Schedule shall show with sufficient detail and sequence all activities, their descriptions, duration, start and finish dates and dependencies, including the work of subcontractors, subconsultants and suppliers both on and off the site(s), all as necessary to complete the work.

The selected Proposer shall promptly advise the Port Engineer in writing of any milestone or occurrence requiring substantial revision of or deviation from the schedule and shall furnish a revised schedule within five (5) calendar days of such (prior to) occurrence for approval. Review, approval or disapproval of a scheduled milestone shall in no way waive any of the requirements for Contract completion time, or relieve the selected Proposer of any of his obligations under any Contract issued as a result of this RFP.

F. On Site Inspections at Manufacturing Facility
The Port Engineer shall conduct inspections of materials, equipment and any Work in progress, make comments and approve of Work during each phase of the Work including the design, fabrication, erection, (assembly, commissioning, testing) at the different fabrication and assembly sites where the Work is being performed, at loading and at delivery of the Cranes to the Port specified in the Technical Specifications (Attachment A). Additionally, prior approval at any fabrication, manufacturing, assembly and erection site of any Work herein, shall not relieve the selected Proposer from complying with the Technical Specifications and repairing any defects or deficiencies found throughout the execution of the Work.
G. **Testing**
The selected Proposer shall provide the necessary material certifications and perform all testing in accordance with all applicable codes, industry standards and the herein Technical Specifications. Certificates of inspection of testing shall indicate if that portion of the work inspected and/or tested meets the minimum requirements of the standard of regulation(s) specified. Certificates shall include the name of selected Proposer, project name, description of inspection and/or test performed, time period in which said activity(ies) was performed, detailed results, printed name and signature of qualifier, and location and date of inspection or test.

The County reserves the right to retain the services, at the County's expense, of a professional material testing and inspection firm(s) to carry out inspections and tests on materials, Crane components, assemblies and fabrication processes before and after incorporation into the Crane works.

If any test(s), whether performed by representatives of the selected Proposer or the County, show that any part of the works, materials or components that have been assembled, or any materials or components to be incorporated therein, do not meet the standards as set forth in this RFP, the County shall have the option to reject all the materials and works associated with the components. Rejected materials, works and components shall be removed and replaced with materials, works and components in accordance with the Technical Specifications of this RFP and as approved by the Port Engineer. Rejected or non-conforming items will not be paid for by the County until the non-conformance is removed and its replacement has been assembled, installed as required by this RFP and approved by the Port Engineer.

The selected Proposer shall provide access to the County and its Representatives to all works and to any plant fabricating and/or assembling of the Cranes or Crane components and parts for the purpose of carrying out inspections, sampling, testing, certifications, etc. A quality assurance (QC/QA) plan approved by the County shall be followed by the selected Proposer as specified in the Technical Specifications herein. Any non-conformance with the quality assurance plan will be cause for rejection of the materials, parts components and/or of Work in question unless a solution is offered to the County, which is acceptable to the Port Engineer.

H. **Responsibility for Deviations**
The County's review of design drawings, material or equipment shall not relieve the selected Proposer of its responsibility for any deviation from the requirements of this RFP, unless the selected Proposer has specifically informed the County in writing of such deviation at the time of submission and the County has given written approval for the specific deviation. Additionally, the selected Proposer shall not be relieved from its responsibility for errors or omissions in the design calculations, design shop drawings, materials, fabrication, components, assemblies, quality control, erection, painting, commissioning, testing, certifications, equipment failures and/or the Cranes' operational requirements by the County's review thereof.

I. **Schedule of Values**
The selected Proposer shall submit, for approval by the County, a schedule of values to be used as a basis for making monthly progress evaluations of the Work. The schedule of values breakdown shall show the amount allocated for material, equipment, labor, engineering and identify those items of Work that will be performed by subcontractors for each phase of the Work. The sum of these amounts shall equal the total as stated in the Contract Price Schedule. The selected Proposer shall submit such additional information as requested by the County which in its opinion is required to verify the selected Proposer's schedule of values.

J. **Method and Times of Payment**
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Miami-Dade County, Florida

All monetary transactions shall only be performed in United States Dollars (USD) without exceptions.

Payment Milestones
The County desires the following schedule for the payment of Cranes:

1. Ten percent (10%) of the Contract Price will be paid at Notice to Proceed.

2. Ten percent (10%) of the Contract Price will be paid within thirty (30) days from the Port Engineer's acceptance of the Final Design Drawings prior to commencement of fabrication.

3. Fifty percent (50%) of the Contract Price allocable to each crane will be paid upon loading and securing a fully erected, pre-commissioned and tested Crane in accordance with the Specifications, on the crane delivery vessel and the presentation of the shipping documents associated therewith. If the loading and securing is beyond the latest shipping date shown on the approved Project Schedule, $15,000 USD (fifteen thousand United States Dollars) per crane times the number of days late will be deducted from the payment as a reserve against liquidated damages.

4. Twenty percent (20%) of the Contract Price shall be paid upon successful completion of the Delivery, Re-Commissioning, Final Testing and Certification against the presentation of "Substantial Completion with Contract Work" of each crane plus any deductions for reserve from the payment item No. 3 above and less $15,000 USD (fifteen thousand United States Dollars) per crane times the number of calendar days to the date of the "Substantial Completion with Contract Work" is beyond the Approved Project Schedule date.

5. The payment in item No. 4 above will be subject to a ten (10) calendar days berth usage restriction for the delivery ship at the Port of Miami Lummus Island gantry berth for a delivery and unloading of two (2) Cranes on to the Delivery Site, plus an additional ten (10) day dock usage restriction for the ship if three (3) or more cranes are delivered to the Port. The payment in item No. 4 above shall be reduced $15,000 USD (fifteen thousand United States Dollars) per crane times the number of calendar days beyond the ten (10) calendar days berth usage restriction for delivery of two (2) Cranes or twenty (20) calendar days for delivery of three (3) or more cranes, the Contractor occupies the gantry berth. The payment in item No. 4 above shall be reduced by the prevailing tariff times the number of calendar days, beyond the ten (10) or twenty (20) days indicated above if applicable; the ship occupies the gantry berth.

In any case, the Port reserves the right to re-assign the berth of the ship, keep the same berth, or order the delivery ship out to anchor.

6. Ten percent (10%), the remaining balance, of the contract price allocated to each Crane will be paid for each crane against the presentation of the "Final Acceptance Certificate" thereof.

If during the progress of the Work it appears that the selected Proposer's bills for materials and labor are not being paid, the County shall have the right to withhold from the selected Proposer's payment in sufficient sums to protect it against all losses from possible liens, and to apply the said sums to the payment of such debts. Milestone payments made by the County to the selected Proposer are not an admission by the County that the Work is done or that its quantity or quality is satisfactory. The selected Proposer has 30 days after completion and acceptance of the Work to file any claims.
Miami-Dade County, Florida

The County will make the final payment only after the selected Proposer presents to the County Finance Director satisfactory evidence that all liens, claims and demands of both the Contractor as well as its subcontractors employed in the construction of the Work are fully satisfied, and that the project is fully released from any and all such liens, claims, and demands. The County does not assume any responsibility or liability to any person other than the prime Contractor.

K. Liquidated Damages
If the selected Proposer fails to complete the Work within the time stipulated in this RFP (plus any granted extensions by the County), the selected Proposer shall pay to the County the sum of fifteen thousand dollars ($15,000.00) per day per Crane that the selected Proposer requires to complete the Contract, not as a penalty or forfeiture, but as liquidated damages to the County.

M. Selected Proposer Submittals
The selected Proposer shall submit documentation in accordance with the Project Schedule for review by Port Engineer for all Work as required herein to include but not be limited to the Technical Specifications. Upon completion of the Work, as-built drawings and manuals shall be submitted as required by the same.

1. Design and Fabrication Submittals
The selected Proposer shall provide the Port Engineer Submittals in accordance with the Project Schedule and Technical Specifications for review. Should the selected Proposer proceed with procurement of materials, parts, components and fabrication prior to notification by the County that submittal review is complete; the selected Proposer shall do so at its own risk. County review of design drawings will include the general scheme and character of the details, but not the checking of dimensions, nor will such review relieve the selected Proposer from the responsibility of executing its Work in accordance with the Contract drawings and Specifications.

The selected Proposer shall provide the following:

a. Design drawings, with calculations, showing the logical development of loads and forces for each load combination for a given component(s) or assembly.

b. Design drawings of the component(s) or assembly with calculations of the stresses, the material used, the allowable stress for the load combination considered, when applicable, with manufacturer's published catalog descriptions, dimensions and rating information.

c. Assembly and erection drawings.

d. Design drawings shall include, but shall not be limited to detail drawings of parts, structural, mechanical, electrical and hydraulic drawings, fabrication drawings, field layout drawings and all similar types of drawings. As the Cranes shall be shipped to the Port of Miami fully erected and operational, design drawings shall include drawings, calculations and procedures for loading and off-loading of the Cranes and drawings showing the Cranes preparation for ocean shipment. This includes preparation being provided for protection against salt water on Crane parts. Design drawings shall contain all required details and information in reasonable scale and enough views to clearly show the work to be done or the item to be furnished as approved by the Port Engineer.

2. As-built Drawings and Manuals
The selected Proposer shall furnish as-built drawings, calculations, test results and maintenance and operations manuals as specified in the Technical Specifications. The final record drawings used in the construction of the Cranes, including details of all parts and components, shall be furnished to the Port of Miami for use only in maintaining the structure, machinery, hydraulic, and electrical equipment. Subject to Florida's Public Records Laws, these copies of drawings shall be maintained as private information to the Port of Miami and its employees, for the sole purpose of making repairs and replacements to the equipment. They shall not be used in any way, by the Port of Miami to infringe on any copyrights or patents. The drawings and manuals for the Cranes shall also be made available to the County in an electronic format as required by the Technical Specifications.

N. Calculations
Calculations for the design of the Cranes will be provided as required herein and in accordance with the Technical Specifications.

O. Field Office
The County shall provide the selected Proposer with suitable field office space for its use as well as for the County's Project Representative(s) near or at the Crane Staging Area of the Cranes. Additionally, the selected Proposer shall be provided with a Delivery Site on a predetermined wharf to make the Cranes operational.

P. Training
The selected Proposer shall provide training as required herein and in accordance with the Technical Specifications.

Q. Seaport Security
The selected Proposer shall comply with all Seaport security requirements, including such requirements as to inspection of vehicles entering and leaving the secured area(s) of the Port and personnel identification badge as required by Chapter 28-A of the Miami-Dade County code. (See Exhibit D - Form of Agreement).

R. Traffic Control
The selected Proposer shall be responsible for traffic control and maintenance of safety devices surrounding the installation Work Site which are necessary to adequately warn port users, other contractors and County personnel working at or near the site that work is in progress and caution is to be exercised. The selected Proposer shall follow FDOT (Florida Department of Transportation) MOT (Maintenance of Traffic) requirements as approved by the Port Engineer at the Delivery Site. The selected Proposer shall manage the barricades and safety tape(s) required. All work related with Traffic Control and management shall be directly coordinated with the Port's Chief of Operations.

S. Safety
The selected Proposer shall comply with requirements herein including the Technical Specifications. A Safety Officer shall be assigned to the Project for its duration. At a minimum, the Safety Officer shall be physically present at Port of Miami for the complete time period from the Crane(s) delivery date through commissioning, testing, certifications and placement into operation of each Crane delivered to the Port. The selected Proposer shall be responsible for initiating, maintaining and supervising all safety precautions, the Delivery Site and programs in connection with said Work. The selected Proposer shall submit its final Safety Plan for on-site Port re-commissioning to the Port Engineer sixty (60) days prior to shipment of Cranes.

T. Punch List
The Port Engineer or his representative(s) shall perform a final complete inspection and test the Crane(s) as specified in but not limited to the Technical Specifications for compliance with any Contract issued as a result of this RFP. All Crane deficiencies and items not in compliance with the Contract shall be noted in a Punch List. Upon
completion of Punch List, the selected Proposer will be provided with said list. Final acceptance shall not be authorized until all Punch List items have been addressed and resolved to be in compliance with these specifications and to the satisfaction of the County.

U. Delivery Site, Staging, Re-erection and Clean Up

The selected Proposer shall be provided a Delivery Site on a the gantry wharf located on the South side of Lummus Island Container Terminal for unloading, installation, final re-commissioning, testing and making operational on the gantry rails the Cranes as required by the enclosed Specifications. The area shall consist of approximately 95 meters (312 feet) long x 42 meters (138 feet from the waterside face of the concrete sea wall/bulkhead to the landside of the landside gantry rails). The County will provide an adjacent or nearby Staging Area for equipment and crane components staging, re-erection of the Cranes, assembly, final commissioning, testing and certification of the Cranes as required prior to final installation on the gantry wharf crane rails.

The Contractor shall be responsible for all Work and management of and within the Delivery Site for as long as the Contractor is afforded the Delivery Site. The upkeep and control of the Cranes and all other equipment and materials within this site is the responsibility of the Contractor. All Work performed within the site shall be directly coordinated with the County’s Representatives.

The selected Proposer shall remove from the Port of Miami property all excess materials and debris resulting from the Work. No burning or disposal of materials will be allowed on the Delivery Site. All disposal functions must be in accordance with applicable codes and regulations.

The Work Site shall be kept clean during the progress of all Crane Work. The selected Proposer shall provide sufficient sanitary facilities and trash containers as needed. The selected Proposer shall take whatever measures are necessary to avoid causing paint over-spray during painting and the creation of undue dust on surrounding premises. The selected Proposer shall be responsible for any damage caused by all Work performed by the selected Proposer including paint over-spray or dust from its operations. The Port Engineer’s opinion will be the determining factor in reviewing these matters.

No materials or rubbish shall be allowed to go adrift or to be placed, spilled, dropped, thrown, or otherwise dumped into the surrounding bodies of water including Fisherman’s Channel. Any debris afloat or dumped in the surrounding bodies of water or Channel as a result of the selected Proposer’s Work and operations shall be immediately retrieved by the selected Proposer. Any oil, detergent or other deleterious substance which is spilled into the Fisherman’s Channel, Biscayne Bay or surrounding bodies of water as a result of the Work, shall be the responsibility of the selected Proposer to immediately clean and mitigate. The selected Proposer shall comply with all laws, regulations and rules governing working adjacent to such waters as well as with all applicable air pollution and environmental control rules, regulations ordinances and statutes and any materials or equipment that may fall into the water shall be retrieved at the selected Proposer’s expense.

Upon Completion of all Work at the Port of Miami, the selected Proposer’s shall hand over the Delivery Site to the Port in the same condition in which it was initially provided.
Dockside Container Handling Gantry Cranes
TECHNICAL SPECIFICATIONS
FOR
Dockside Container Handling STS Gantry Cranes
for Port Miami Gantry Wharves
Project No. 2015.029

Rope Towed Trolley Design

Gantry Container Handling Cranes for
Lummus Island Container Crane Wharf

Revision: December 22, 2016

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**RFP No.00317**  
Appendix A, Attachment A - Technical Specifications

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SECTION 1

INTRODUCTION
SECTION 1 - INTRODUCTION

1.1 SUMMARY

1.1.1 Port Miami is to procure three (3) 65 Long Ton capacity Super Post-Panamax Ship-to-shore (STS aka Quay), "H" Frame, Dockside, Rail-mounted Container Handling Cranes with four (4) Separating Twin-lift 65 LT Spreaders; one (1) for each Crane and a spare spreader; two (2) Overheight Adaptor and related spare equipment, parts and components. The Cranes shall be of similar design and geometrically the same as the existing Port Miami Gantry Cranes 13-16 when possible as approved by the County. All parts, components and systems shall be the same as the existing cranes with the exception of the controls and drives system, and other systems as specified herein and approved by the County.

1.1.2 The Cranes and all other equipment, parts and components shall be delivered to the Port fully erected or disassembled, commissioned and tested in accordance with the requirements of the Scope of Work and herein these Specifications. The Cranes, components and equipment shall be unloaded onto the Lummus Island Container Terminal Gantry Wharf on the south side of Port Miami and moved to the Crane Staging Area. No fabrication and installation work shall be performed by the Contractor at Port Miami, except for re-erection, re-assembled, re-installations touch-up painting (as required), re-commissioning, retesting and certification of the Cranes.

1.1.3 The Work to be performed by the Contractor includes, but is not limited to, providing all labor, materials and services for the planning, design, engineering, fabrication, manufacturing, erection, assembly, installation, painting, commissioning, testing, transportation, re-erection, re-assembled, installation, re-commissioning, retesting and certification of 65 Long Ton capacity, Super Post-Panamax, Gantry Cranes as completed structures including a warranty of same as required herein these Specifications and the Scope of Work.

1.1.4 The Contractor may select to transport and deliver the Cranes to Port Miami fully erected and fully commissioned, or, not fully erected but commissioned as approved by the County. The intent is to minimize the time the Cranes are stored on the gantry crane wharf’s rails, not operational, obstructing the container ship operations. As such, a Crane Staging Area is being provided to the Contractor for storage and staging of crane components, parts and materials, or/and, for re-erection and re-assembly of the pre-commissioned assembled Crane.

1.1.5 The Contractor shall submit to the County a Project Schedule including detail sequence of any disassembly and reassembly, and comply with the same as required herein these Specifications and the Scope of Work. The Project Schedule shall detail each of the crane’s individual fabrication, manufacturing, assembly, erection, commissioning and testing. As the Cranes can be shipped and delivered all three (3) at the same time OR individually, the Contractor shall specifically state the commercial service of each Crane.

1.1.6 The Contractor shall provide and pay for all items, facilities and services necessary for proper execution and completion of the Work, temporary or permanent, in accordance with any Contract issued as a result of the RFP.

1.1.7 These Technical Specifications serve as the principal documents regulating the Work to be performed under any contract with the County. The Work shall be performed in strict compliance with these Technical Specifications. If any deviation from these requirements is discovered, the Contractor shall take immediate corrective actions and shall correct the non-compliance and/or deficiencies. The County and its representatives shall not be held accountable and/or responsible for any of the Contractor’s non-compliance.

1.1.8 These Technical Specifications provide structural, mechanical and electrical details and criteria for the design, fabrication, erection, installation, painting, re-commissioning, testing, shipping, delivery, make operational the Cranes, final testing and commissioning. The requirements, criterion and details specified herein are the minimum acceptable for the execution of the Work.
1.1.9 The Contractor shall obtain, from the certifying agencies, certification of the Cranes for cargo handling use of the capacity under the spreader system and all other certifications required herein and as specified in these Specifications. The Contractor shall submit to the certifying agencies all necessary calculations, drawings and data necessary for such certification or approval. The County will cooperate with Contractor as necessary for this purpose.

1.1.10 The Cranes shall be designed for maximum simplicity, maintainability, and fail safe operation in the event of any one failure.

1.1.11 Safety and reliability of the Cranes is paramount, maintainability is critical and low energy consumption and durability of operation are essential. It is expected the Cranes will be used to load and discharge containers up to twenty four (24) hours a day during all but the most adverse weather conditions.

1.1.12 The Cranes shall:
   a) have adequate safety devices to protect personnel, the Crane runway, the Cranes, the vessel, rolling stock and containers from injury or damage during service;
   b) be highly reliable through use of conservative design factors;
   c) be economical for the purpose intended;
   d) be highly productive in continuous operation for an estimated useful life of twenty five (25) years. (The County recognizes periodic needs for repair or replacement of rotating equipment and periodic inspection and repairs of structures;
   e) require a minimum of maintenance, and;
   f) be able to withstand variations in the weather during operation without damage or deterioration (other than paint) of the Cranes.

1.1.13 All components, parts, materials and equipment used in the construction of these Cranes shall be new, unused, and free of defects. All these parts and components shall be manufactured for the marine environment of Tropical South Florida.

1.1.14 Spare and replacement parts shall be available for the Cranes for at least fifteen (15) years after the date of the Final Acceptance Certificate of the last Crane delivered to and accepted by the County in accordance with the provisions of this contract. The Contractor shall provide to the County a list of spare parts to support the Cranes as recommended by the original equipment manufacturer. The spare parts shall be identified on this list by the original manufacturer and part number. The County will have the right to replace any part of the Cranes directly from the Contractor or from any subcontractor or vendor of the County’s choosing. The Contractor agrees that it has not made nor will it make any agreement with any Subcontractor or Vendor which would nullify or restrict the County’s right to do so.

1.1.15 All communication, correspondence, training, instruction books, manuals, nameplates, and submittals including design calculations, catalog cuts, illustrations, printed specifications, weld qualifications, mill tests, inspection reports, literature, data, or other required data shall be in the English language.

1.1.16 Spare parts or suitable replacements shall be available in the US for 15 years, within 24 hours of written request. Spare parts whose delivery times exceed 24 hours shall be identified in a separate list that includes the predicted lead time together with the supplier’s recommended spare parts list for purchase by customer.

1.2 DESIGN RESPONSIBILITY

1.2.1 The Contractor shall be responsible for the design of Cranes. The County is not, and does not propose to be, the design agent.

1.2.2 The Contractor shall design and shop detail the Cranes which will comply with the space limitations, loading performance requirements, operating and stowed rail load allowables and design criteria called for in the Specifications.
1.2.3 The Contractor will prepare complete design calculations. All calculations will be made by a qualified Contractor’s Engineer, registered in the U.S.A., or country of manufacture, or country of the Fabrication Site and will be stamped with his registered engineer’s stamp, which will show the branch of engineering in which he is registered and his registration number, and will be signed and dated by him. All drawings, both assembly and detail, will be stamped, signed and dated by the Contractor’s Engineer showing that he has reviewed the drawing and they accurately reflect the conclusions of his design calculations.

1.2.4 The Contractor’s Engineer shall insure that shop work meets the quality that his design requires.

1.2.5 Deviations from the specified concepts, systems or components specified in the Specifications or accepted by the County from the Contractor’s proposal shall be individually brought to the County’s attention. The County reserves the right to refusal of each proposal based solely on its own overall best interest. In the event of such refusal, the Contractor will, without delay, diligently pursue alternate state-of-the-art designs. Where the Contractor can show evidence of benefit to the County, the County will not unduly delay acceptance of such concepts, systems, or components.

1.2.6 The Port Engineer and other County named Representatives shall be entitled during manufacture to inspect, examine and test on the Fabrication Site during working hours, the materials and workmanship and check the progress of manufacture of the Cranes, and if part of any Crane is being manufactured on other premises the Contractor shall obtain for the Port Engineer and other County named Representatives permission to inspect, examine and test as if the said Crane was being manufactured on the Contractor’s premises. Such inspection, examination of testing, if made, shall not release the Contractor from any obligation under this Agreement.

1.3 CONTRACTOR’S DOCUMENTATION

1.3.1 The Contractor shall submit for review and approval by the County copies of all design drawings, schematics, calculations, catalog information and assembly and arrangement drawings used by the Contractor to design, manufacture, and erect the Cranes. These calculations shall demonstrate conformance of the Contractor’s design with the Specifications.

1.3.2 The sole purpose of the review is to verify compliance of the design concept with the requirements of the Specifications. It is not to be construed as a check of the adequacy of the Contractor’s design and in no way relieves the Contractor of its responsibility to conform to all the requirements of the Specifications and to guarantee the adequacy of the equipment furnished for the intended purpose.

1.3.3 The review of the calculations and drawings by the County does not relieve the Contractor of its responsibilities and requirements for compliance with the Contract and these specifications. If the Contractor believes that any of the requirements of these Specifications are not stringent enough, it shall advise the County accordingly and shall use the more stringent criteria at no additional cost to the County.

1.3.4 Submittals, drawings and calculations will be in the English language and dimensioning throughout will be in the either the Imperial or metric system.

1.3.5 All such information will be clearly presented and will be full and complete and sufficient to properly identify and describe all aspects of the Work required to be performed by the Contractor so the County may check all details for conformance with the Specifications. Submittals, drawings and calculations will be submitted in a logical order so they may be checked as they are received against previous information submitted. Within thirty (30) days after Notice to Proceed, the Contractor shall submit a schedule of Submittals as described in Section 6.3, together with the anticipated dates upon which they will be submitted.

1.3.6 The sequence of submission of the Submittals shall follow the County approved Submittal Schedule. Submittals shall be presented such that all information is available for reviewing
each in detail. Each submission of Submittals by the Contractor must be accompanied by a letter/email of transmittal containing a list of Submittal giving titles and numbers. Decisions on these Submittals will be given by the County in writing within thirty (30) calendar days after receipt. Every revision made during the life of the Contract shall be shown by number, date, the reviewing person and subject, in a revision block and notation shall be made in the Submittals/drawing margin to permit rapid location of the revision. The time consumed by the Contractor in submitting and obtaining review action on Submittal shall be included in the time allowed for completion of the Contract. If revisions are made after a Submittal has been submitted and reviewed, the Contractor shall furnish corrected Submittals with description of required corrections in the same form require herein.

1.3.7 The Contractor shall permit the County’s Engineers and Representatives to review the detail shop drawings at the Fabrication Site(s) to ensure compliance with design concepts. Drawings shall indicate the method of weld inspection and the Contractor’s weld inspection procedure shall be submitted as part of the drawing submittals. Drawings and calculations submitted for review will be thoroughly checked, signed, dated, and stamped by the Contractor’s responsible engineer prior to submittal. Structural drawings will have been checked, signed, dated, and stamped by the Contractor’s Structural Engineer. Revisions to previously reviewed drawings will be initialed by the Contractor’s responsible Engineer to attest to his review and approval of the revision, and will be resubmitted.

1.3.8 All of the applicable requirements of this Section with reference to drawing submittals shall apply equally to design calculations, catalog cuts, illustrations, printed specifications, weld qualifications, mill tests, or other required data. All correspondence, drawings, calculations, literature instruction books, data, training, and nameplates shall be in the English language.

1.3.9 The County will consider Contractor’s requests to substitute alternate parts for those specified by proprietary name in the Specifications, but it will grant approval for those substitutions only when in its best overall interest to do so considering all factors including durability, reliability, availability, existing spare parts inventory, cost, and standardization.

1.3.10 Deviations from the specified concepts, systems or components specified in the Specifications or accepted by the County from the Contractor’s proposal shall be individually brought to the County’s attention. No deviations will be considered in the County’s review unless called to the attention of the County in writing.

1.3.11 Upon request at any future time, the Contractor shall provide at no cost to the County specific design drawings, calculations, catalogue information and shop detail drawings required the County for internal operation, maintenance or upgrading activities. The Contractor grants the County unlimited rights to use all calculations and drawings for maintaining, troubleshooting, operating, modifying and repairing the Cranes; however, the County will use reasonable endeavors to protect the Contractor’s proprietary rights and information if the above necessitates disclosure to third parties.

1.4 DEFINITIONS

The following words and expressions used in this Technical Specifications shall be construed as follows, except when it is clear from the context that another meaning is intended:

1.4.1 The words “Approved Equal” to mean approval of or by the County or its designee.

1.4.2 The words "Boom Stowed Position" to mean when the Crane’s boom is in the up/raised position and is secured and latched in the waterside apex boom latches.

1.4.3 The word “Consultant” or “Consulting Engineer” to mean any person, firm, entity or organization other than the employees of the County or the Contractor and who contracts with the County to furnish engineering services in connection with the Work.

1.4.4 The word “Contractor” to mean the selected Proposer that receives any award of a contract from the County as a result of this Solicitation, also to be known as “the prime Contractor”.

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1.4.5 The word "County" to mean Miami-Dade County, a political subdivision of the State of Florida, USA.

1.4.6 The word "Crane" or "Cranes" to mean the equipment being purchased to include spreaders and an overheight adaptor as a result of the Work for the purpose of loading and unloading shipping containers from seagoing vessels.

1.4.7 The word "Crane Engineer" to mean Port of Miami Crane Management, Inc., (PMCM, aka Crane Management) which is the Port Director's designee that shall direct, manage and oversee the execution of this Work at the discretion of the Port Engineer and the Port Director.

1.4.8 The words "Crane Staging Area" to mean a secured work area in the terminal/container yard of Port Miami where the Crane(s)'s disassembled components and materials are stored when off-loaded from the transportation vessel which area may also be used to re-erect, reassemble and commission the Crane(s).

1.4.9 The words "Crane Stowed Position" to mean a when the crane is secured at the stowed pin location and tied down. The Crane's boom may be in the up (Boom Stowed) position or in the lowered position (horizontal) for operations.

1.4.10 The word "Days" to mean Calendar Days.

1.4.11 The word "Department" to mean Seaport Department same as Port Miami.

1.4.12 The word "Deliverables" to mean all documentation and any items of any nature submitted by the Contractor to the County's Project Manager for review and approval pursuant to the terms of this Agreement.

1.4.13 The words "Delivery Site" to mean the wharf/quay work area at Port Miami where the erected and fully operational Crane(s) or the disassembled Crane(s) are off-loaded from the transportation vessel onto the gantry rails on the Port’s gantry wharf located on the South side of Lummus Island, Port Miami, FL USA.

1.4.14 The words "directed", "required", "permitted", "ordered", "designated", "selected", "prescribed" or words of like import to mean respectively, the direction, requirement, permission, order, designation, selection or prescription of the County's Project Manager; and similarly the words "approved", "acceptable", "satisfactory", "equal", "necessary", or words of like import to mean respectively, approved by, or acceptable or satisfactory to, equal or necessary in the opinion of the County's Project Manager.

1.4.15 The word "Gantry Wharf" to mean the wharves where the Port’s Quay Cranes are located to load and unload the container carrying ships calling Port Miami.

1.4.16 The words "High Winds" or "High Winds Shutdown" to mean wind conditions when winds are equal to or exceeds forty-two miles per hour (42 mph).

1.4.17 The word "Inspector" to mean the duly authorized representative of the County or Crane Engineer designated to inspect, reject and/or accept the Work as specified herein the Technical Specifications.

1.4.18 The word "Manufacturer" to mean the selected Proposer that receives any award of a contract from the County as a result of this Solicitation, also to be known as "the Contractor" and "the prime Contractor".

1.4.19 The word "Manufacturing" to mean the industrial production in which raw materials are transformed into finished goods such as equipment which in this particular case are the Cranes, appurtenances and everything associated with it for use of the customer (herein the County) using manual and scientific labor, machines, tools, chemical and biological processing, or formulation to include handicraft, trades and high tech.
1.4.20 The words "Manufacturing Facility", "Manufacturing Site" or "Contractor's Facility" to mean the Contractor's facility where the Cranes are fabricated, assembled, erected, fitted, components are installed, painted, commissioned, made operational, tested and loaded on to the transportation vessel/ship.

1.4.21 The word "Material" or "Materials" to mean all materials incorporated in the Work, or used or consumed in the performance of the Work.

1.4.22 The words “Miami-Dade County”, the County to mean the political sub-division of the State of Florida where Port Miami is physically located and to which Port Miami belongs to.

1.4.23 The word "Owner" to mean Miami-Dade County as assigned and represented herein to be the Port Director.

1.4.24 The word "Plans" to mean all of the official approved Plans, or exact reproductions thereof, which show the location, character, details, dimensions, and specifications of the Work to be done which are part of the Contract.

1.4.25 The word “Port” or “Seaport” to mean “Port Miami”, Miami-Dade County Seaport Department, Florida, USA.

1.4.26 The words “Port Director” to mean the Chief Executive of Port Miami, Miami-Dade County Seaport Department, Florida, USA. The Port Director’s designee is the Port Engineer.

1.4.27 The words “Port Engineer” to mean the Chief of Engineering in charge of the Port’s Engineering Program that is the Port Director’s designee which is the County’s Representative that shall be the authorized administrator of any Work performed as a result of any Contract.

1.4.28 The word "Project" to mean all work inclusive of and associated with this Contract which is Seaport RFP No 2015-029.

1.4.29 The words "Project Manager" or “PM” to mean the Port Engineer’s designee who shall be the duly authorized representative designated to direct and manage the Contract and the Work.

1.4.30 The words "Port Representative" or "PR" to mean the Port Engineer, who shall be assigned as the County’s representative to oversee the Project.

1.4.31 The word "Proposer", "Submitter" or "Respondent" to mean the person, firm, entity or organization, as stated on Form A-1, submitting a response to this Solicitation.

1.4.32 The word "Representative" to mean a person, organization and/or any crane consulting engineering firm, inspection firm or testing laboratory which is directly contracted by the County or the Crane Engineer and is assigned by the County or Port Engineer to oversee and/or perform any work on behalf of the County.

1.4.33 The words “Scope of Services” to mean Section 2.0 of the Solicitation, which details the work to be performed by the Contractor.

1.4.34 The word "Solicitation" to mean the Request for Proposals (RFP) document and all associated addenda and attachments which is the County’s RFP No. 00317.

1.4.35 The word "Specifications" to mean all directions, provisions, and requirements contained herein or attached hereto, together with all written agreements made or to be made, setting out or relating to the method and manner of performing the Work or to the quantities and qualities of materials and labor to be furnished under the Contract to include but not limited to the Technical Specifications.

1.4.36 The word "Subcontractor" or "Subconsultant" to mean any person, entity, firm or corporation, other than the employees of the Contractor, who contracts with the Contractor to furnishes labor and/or materials, in connection with the Work, whether directly or indirectly.
on behalf and/or under the direction of the Contractor and whether or not in privity of Contract with the Contractor.

1.4.37 The word "Super Post-Panamax" to mean a dockside ship-to-shore container handling gantry crane also known as quay crane with a minimum outreach to work a container ship stacking at least seventeen (17) containers wide across its beam. In this particular project, the Crane shall reach twenty-two (22) containers (+ one for list) wide across a ship berthed alongside Port Miami Gantry Wharf on Lummus island.

1.4.38 The words "Technical Specifications" to mean the written contents herein, the Sections that are strictly of a technical nature which provide the guidelines for execution of the Work.

1.4.39 The words "Work", "Services", "Program", or "Project" to mean all matters and things required to be performed by the Contractor in accordance with the Scope of Services and terms and conditions of a Contract.

1.5 **ACRONYMS AND ABBREVIATIONS**

1.5.1 The following abbreviations may be used throughout these Technical Specifications;

- **AC** Alternating Current
- **A/C** Air Conditioning
- **ACCC** AC Control Center
- **CMS** Crane Management System
- **CB** Circuit Breaker
- **CCTV** Closed Circuit Television
- **E-House** Electric(al) House/Room
- **ft** feet (foot)
- **ft/s** feet per second
- **ft. lb** foot pound
- **DC** Direct Current
- **DFT** Dry Film Thickness
- **DLCS** Dock Level Control Station
- **DLMS** Dock Level Monitoring Station
- **EMI** Electro Magnetic Interference
- **HVAC** Heating Ventilation and Air Conditioning
- **I/O** Input/output
- **Kg** Kilogram
- **KV** Kilovolt
- **KVA** Kilovolt-ampere
- **lbs** Pounds
- **LAN** Local Area Network
- **LED** Light Emitting Diode
- **LO-LO** Load-on Load-off
- **LS** Landside
- **LT** Long Ton (2,240 pounds)
- **m** meters
- **m/s** meter per second
- **MHCS** Machinery House Control Station
- **MIG** Metal Inert Gas (welding process)
- **mm** millimeters
- **mph** miles per hour (presented in these specifications is based on "statute" miles per hour)
- **MLW** Mean Low Water
- **MT** Metric Ton (2,204 pounds)
- **N.M.** Newton Meters
- **NTP** Notice to Proceed
- **PA** Public Address
- **P.B.** Push Button
- **PDF** Portable Document Format as used in Adobe software.
- **PQM** Power Quality Meter
- **RCMS** Remote Crane Management System
RFP  Request for Proposal
STS  Ship to Shore
RMS  Root Mean Square
SWL  Safe Working Load
T    Ton/Short Ton (2,000 pounds)
TBD  To be Determined
TBP  To be Provided
WS   Waterside
UHMW Ultra High Molecular Weight Polyethylene to protect the Crane structure from wire rope wear

1.5.2 For additional abbreviations related to crane design, fabrication and the Work herein, see the individual General Information sub-section of each of the specific Sections of these specifications.
SECTION 2

GENERAL REQUIREMENTS
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SECTION 2 - GENERAL REQUIREMENTS

The itemization of characteristics, features and requirements enumerated herein below in this section represents a partial listing of these requirements that shall be incorporated in the Cranes and shall not be misconstrued, by the Contractor, as being complete or all inclusive. It is the Contractor’s responsibility to design, fabricate, erect, install and make operational Cranes complete with the minimum characteristics, features and requirements as enumerated and detailed in these Technical Specifications. The following enumerated General Requirements are the minimum required and acceptable by the County.

2.1 GENERAL CHARACTERISTICS

2.1.1 Super Post-Panamax, designed to minimize crane weight and wheel loads.

2.1.2 "H" frame construction: box girders, when not hermetically sealed, provided with access detail for inspection, provided with vent ports to prevent condensation, internal ladders, and conduit chases.

2.1.3 Boom: hinged, luffing type

2.1.4 Main Girder (Landside): fixed

2.1.5 Boom and Main Girder Construction: trapezoidal double box girder of welded steel construction as approved by the County. Single trapezoidal boxed boom and girder design may be proposed.

2.1.6 Machinery House and Electric Control Room: The Machinery House and Electric Control Room shall be the same structure and is to be supported from the landside cross girder and/or on the backreach area of main girder (LS Boom). It shall contain the drive machinery in the Drives Room for the Main Hoist, Main Trolley, and Boom Hoist as well as the Electrical Control Room.

2.1.7 Main and Catenary Trolleys: The Main Trolley and Catenary Trolleys shall be rope towed. The Catenary Trolleys shall be rope towed and driven by the Main Trolley and from one another.

2.1.8 Boom-up operation for maintenance only with empty spreader: with the main Trolley in the parked position only.

2.1.9 Main Hoist (no load) and spreader function shall be possible with Boom-up and Main Trolley in parked position.

2.1.10 Non-articulating Gantry Equalizer System.

2.1.11 All design and fabrication criteria must conform to FEM, AISC, AWS, ASME, NEC, NEMA, NFPA, SSPC, NACE, OSHA, and all other specified codes herein noted. Although FEM will be accepted as the primary design code, the contractor must comply with all applicable codes of the United States of America, State of Florida and Miami-Dade County.

2.1.12 All materials, parts, components, and equipment used on the Cranes shall be specifically designed and constructed for the marine environment of Tropical South Florida. No deviation is permitted.

2.1.13 The Contractor must conform to all local, state, and U.S. federal environmental regulations as required for the delivery, unloading, make operational and commissioning of Cranes to Port Miami.

a) DERM - Department of Environmental Resource Management, Miami-Dade County, Florida, USA
b) FDEP - Florida Department of Environmental Protection, Florida, USA
c) EPA - Environmental Protection Agency, USA
2.1.14 All drives, panels and stations that are being supplied by control system supplier and the elevator shall meet NEMA/NEC standards and shall be manufactured in a UL approved facility and labeled at the time of shipment.

2.2 GEOMETRIC DIMENSIONS

<table>
<thead>
<tr>
<th>2.2.1</th>
<th>Rail gauge (existing):</th>
<th>30.48m</th>
<th>100.0 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.2</td>
<td>Elevation of Landside (LS) rail over waterside (WS) rail:</td>
<td>0.3048m</td>
<td>1.0 ft.</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Setback of waterside (WS) rail from outer face of fender (approx.):</td>
<td>9.84m</td>
<td>32.3 ft.</td>
</tr>
<tr>
<td>2.2.4</td>
<td>Outreach from waterside (WS) rail (Working Outreach) (centerline of waterside rail to centerline of container with Trolley bumpers uncompressed):</td>
<td>72.0m</td>
<td>236.2 ft.</td>
</tr>
<tr>
<td>2.2.5</td>
<td>Backreach from Landside (LS) rail (centerline of Landside rail to centerline of container with Trolley bumpers uncompressed). If counterweight is required, the Contractor may shift location of Machinery House on the backreach as approved by County.</td>
<td>26.0m</td>
<td>85.3 ft.</td>
</tr>
<tr>
<td>2.2.6</td>
<td>Hoisting height (top of WS rail to underside of adjustable spreader):</td>
<td>54.5m</td>
<td>178.83 ft.</td>
</tr>
<tr>
<td>2.2.7</td>
<td>Lowering distance (top of WS rail to underside of adjustable ):</td>
<td>16.0m</td>
<td>52.48 ft.</td>
</tr>
<tr>
<td>2.2.8</td>
<td>Total Lift Height:</td>
<td>70.5m</td>
<td>231.3 ft.</td>
</tr>
<tr>
<td>2.2.9</td>
<td>Clearance between legs for passage of containers:</td>
<td>18.3m</td>
<td>60.0 ft.</td>
</tr>
<tr>
<td>2.2.10</td>
<td>Vertical clearance under portal beam/girder(see 2.2.16):</td>
<td>15.2m</td>
<td>50.0 ft.</td>
</tr>
<tr>
<td>2.2.11</td>
<td>Height to top of sill beam (maximum):</td>
<td>8.0m</td>
<td>26.2 ft.</td>
</tr>
<tr>
<td>2.2.12</td>
<td>Distance of mounting pins of crane hurricane tie-down mechanism(Shall be confirmed by Contractor)</td>
<td>17.2m</td>
<td>56.5 ft.</td>
</tr>
<tr>
<td>2.2.13</td>
<td>Maximum overall length between bumpers (crane width bumpers uncompressed):</td>
<td>27.0m</td>
<td>88.5 ft.</td>
</tr>
<tr>
<td>2.2.14</td>
<td>Distance between pulley blocks center-to-center for attaching the spreader and cargo beam:</td>
<td>4.878m</td>
<td>16.0 ft.</td>
</tr>
<tr>
<td>2.2.15</td>
<td>Overall (Air) height limit:</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

2.2.16 Vertical clearance under portal beam/girder may be reduced from 50 ft (15.2 m) to no less than 36.1 ft (11.0 m) to improve structural design of crane to comply with these specifications and providing for a lighter (less weight) STS Crane resulting in reduction in wheel loads. Should the Contractor use the option to reduce the vertical clearance under the portal beam girder the Contractor shall submit the design and the structural and weight calculations to support the decision to reduce the vertical clearance to the County for review and approval of reduced clearance/height.

2.3 OPERATIONAL FEATURES AND CAPACITIES

<table>
<thead>
<tr>
<th>2.3.1</th>
<th>Spreader:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity under spreader, single lift:</td>
<td>50 LT</td>
</tr>
<tr>
<td>Capacity under spreader, twin lift (Rated Load):</td>
<td>65 LT</td>
</tr>
</tbody>
</table>
2.3.2 The 65 LT capacity is intended as an intermittent, part time rating. The Crane shall have adequate structural strength, stability, mechanical capacity, and electrical capacity to handle two (2) twenty foot (20') containers weighing up to 32.5 LT each, safely and efficiently, but the structural fatigue life, mechanical durability and electrical thermal sizing requirements of the Specification may be based on 50 LT capacity. The Contractor shall state the number of cycles provided in design for the 65 LT rating; however, the minimum number acceptable shall be 600,000 cycles. The Crane shall be capable of unrestricted operations with a 65 LT load for a minimum of four (4) hours without injurious overheating of the electrical equipment (motors). If applicable, the Contractor shall provide the cool-down period required upon completion of four (4) hours 65 LT operation.

2.3.3 Capacity under cargo beam: 100 LT (limited but no less than 100 feet outreach)

2.3.4 Capacity under head block: (Contractor to provide)

2.3.5 Percentage (minimum) of driven wheels: 75% Waterside 75% Landside

2.3.6 Drives shall be synchronized to prevent gantry skewing.

2.3.7 Container handling with boom down (level in horizontal position) and supported by the stays.

2.3.8 Gantry travel with boom down, or in stowed (up and latched) position.

2.3.9 All Crane operations to be controlled from Operator’s Cabin with the exception of boom.

2.3.10 Boom operation from Boom Hoist Cabin only.

2.3.11 Gantry, hoisting and spreader operation from operator’s cabin and Ground Level Control Station for maintenance purposes.

2.4 OPERATING SPEEDS AND ACCELERATIONS (minimum)

2.4.1 Hoisting with twin-lift spreader only (no load): 180m/min 590 ft/min.

2.4.2 Hoisting 65 LT (rated load) with twin-lift spreader: 90 m/min. 295 ft/min.

2.4.3 Hoisting 100 LT with cargo beam: (speed restricted due to operation) 30 m/min. 98 ft/min.

2.4.4 Lowering twin-lift spreader only (no load): 180 m/min 590 ft/min.

2.4.5 Lowering 65 LT with twin-lift spreader: 90 m/min. 295 ft/min.

2.4.6 Lowering 100 LT with cargo beam: (speed restricted due to operation) 30 m/min. 98 ft/min.

2.4.7 Hoist acceleration time w/rated load: 1.88 sec to 90 m/min 295 ft/min

2.4.8 Hoist acceleration time w/twin-lift spreader only: 3.75 sec to 180 m/min 590 ft/min

2.4.9 Trolley travel speed with rated load: 240m/min 787 ft/min

2.4.10 Trolley travel acceleration time w/rated load: 3.5 sec to 240m/min 787 ft/min

2.4.11 Crane travel (gantry): 46m/min. 151 ft/min
2.4.12 Crane travel (gantry) acceleration time

<table>
<thead>
<tr>
<th>6.0 sec to 6.0 sec to</th>
</tr>
</thead>
<tbody>
<tr>
<td>46 m/min 151 ft/min</td>
</tr>
</tbody>
</table>

2.4.13 Boom: raising/lowering maximum time: 5.0 min

2.4.14 The deceleration times shall be less than acceleration times and based on the maximum motor/drive system capabilities. The Contractor shall maximize the performance of the Crane during the design, fabrication, commissioning and testing. Speeds, accelerations and decelerations for intermediate loads shall be based on constant motor horsepower.

2.4.15 Maximum speeds shall be achieved with Maximum Operating Wind from the worst direction. Acceleration and deceleration times shall be based on 50% Operating Wind Load from the worst direction.

2.5 GENERAL OPERATING ENVIRONMENT AND CONDITION

2.5.1 The Contractors shall study the onerous climatic conditions which exist, as failure to do so may result in the production of a Cranes and equipment unsuitable for the required application. The site of the works in Miami is in an area of high temperature and high humidity, which in conjunction with a salty dust-laden marine environment produces very severe corrosive conditions. The design features, all material and equipment supplied and the protective treatment of steelwork must be designed for the following conditions:

<table>
<thead>
<tr>
<th>Item</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>0°C</td>
<td>40°C</td>
</tr>
<tr>
<td>Mechanical</td>
<td>0°C</td>
<td>40°C</td>
</tr>
<tr>
<td>Structural</td>
<td>0°C</td>
<td>40°C</td>
</tr>
</tbody>
</table>

(Plus allowance for solar radiation that may increase surface temperature to 50°C)

(For equipment located in the Machinery House, the maximum ambient shall be 45°C)

Relative humidity 100%

2.5.2 The Cranes and equipment will be designed to operate with minimum maintenance in the defined conditions, and care must be taken to ensure against overheating of the electrical and mechanical equipment, especially where exposed to direct sunlight.

2.5.3 The Crane and its components shall be designed for wind loads as specified by local codes, but no less than those specified in Section 3.8, Crane Design Loads.

2.5.4 The Crane and its components shall be designed for earthquake loads as specified by local codes, but no less than the loads specified in Section 3.8.

2.5.5 The Crane and its components shall be provided with appropriate lightning protection.

2.6 SITE CONDITIONS FOR ACCEPTANCE

2.6.1 The Contractor shall ascertain, by visiting and inspecting the delivery site at Port Miami that all applicable local conditions at the Delivery Site have been considered in the design of the Cranes including the severe climatic and atmospheric conditions, wind load requirements, earthquake requirements, dock interface conditions, and that the Cranes can operate effectively without any restrictions due to conditions at Port Miami. The Contractor shall submit the below required data in writing to County prior to commencement of any fabrication and upon crane completion at the Manufacturing Site prior to delivery of the Cranes to Port Miami.
2.6.2 Maximum allowable unfactored uniformly distributed gantry wheel loads for normal operation with 20.1 meter per second (45 mph) wind based on average gantry wheel spacing are as follows:

Waterside: 74.4 metric tonnes/meter (50.0 kips/ft.)
Landside: 59.5 metric tonnes/meter (40.0 kips/ft.)

Average gantry wheel spacing shall assume distribution of gantry wheel loads at a corner over a length equal to the distance between centerline of end/outermost gantry wheels at the corner plus a distance equal to one average wheel spacing distance. Average gantry wheel spacing shall be calculated as the distance between centerline of end/outermost wheels of a gantry equalizer system at the corner divided by a quantity equal to the number of wheels at the corner minus one (1.0).

The Contractor shall also provide for the County’s information the maximum wheel loads for operation with 28 meter per second (62.6 mph) wind prior to commence of fabrication.

Waterside: TBP
Landside: TBP

2.6.3 Maximum allowable unfactored uniformly distributed gantry wheel loads based on average gantry wheel spacing for the stowed/hurricane condition are as follows:

Waterside: 98.9 metric tonnes/meter (66.5 kips/ft.)
Landside: 83.6 metric tonnes/meter (56.2 kips/ft.)

Average gantry wheel spacing shall assume distribution of gantry wheel loads at a corner over a length equal to the distance between centerline of end/outermost gantry wheels at the corner plus a distance equal to one average wheel spacing distance. Average gantry wheel spacing shall be calculated as the distance between centerline of end/outermost wheels of a gantry equalizer system at the corner divided by a quantity equal to the number of wheels at the corner minus one (1.0).

2.6.4 Maximum allowable stowage pin loads and tie down loads for the stowed/hurricane conditions are as follows:

Horizontal stowage pin load:
Waterside: TBD
Landside: TBD

Tie down uplift loads:
Waterside: TBD
Landside: TBD

These Loads provided with the proposal must be reconfirmed and provided prior to Notice to Proceed (NTP) so the Port Miami may design and construct the Tie Down and Stowage Pins infrastructure prior to the Cranes delivery to Port Miami.

2.6.5 All of the above loads are un-factored. Wind directions shall be for the worst case.

2.6.6 Existing waterside and landside crane rails are 171 lbs/yd installed to the following tolerances:

2.6.7 Rail centers (gage): ± 7.0 mm (± 0.27 inch)

2.6.8 Maximum rail out of levelness: one corner of crane with respect to other three corners ±25 mm (±1 inch)

2.6.9 Rail elevations: top of landside (LS) rail is 0.3048m (1.0 ft) above top of waterside (WS) rail
2.6.10 Site acceptance by Contractor shall include resolution of dock interface conditions including crane rail size, relative elevations, tie downs, stowage pin sockets, rail bumpers, cable trough, power supply, dock allowable loads and shipping clearances including depth of water and width of channel at the delivery location. The Contractor shall assure its procedure to off load the Cranes at delivery location does not cause unacceptable blockage of the channel to other traffic.

2.6.11 The delivery vessel must be berthed parallel to and along-side (port-to or starboard-to) the wharf(s) during it’s berth stay at Port Miami Gantry Crane wharves on Lummus Island.

2.7 DUTY CYCLE

2.7.1 The theoretical duty cycle for use in calculating times and equipment ratings of the main hoist and trolley drive systems shall consist of removing and replacing the containers of a typical hatch on a vessel 22 containers wide with 9 x 8.5 ft. container high stowage above deck and 11 high below deck. The equipment ratings shall also consider the various worst case container handling cycle paths encountered in container handling operations.

2.7.2 Main Hoist, Trolley, Boom Hoist and Gantry drive systems shall be capable of satisfying the duty cycle requirements of this section regardless of the motor classification assigned by the manufacturer. Motor classifications (S1, S3-60, etc) shall be considered as a supplementary rating and shall not indicate compliance with the duty cycle as defined in any way. Satisfaction of the duty cycle requirements requires that the root mean square (RMS) motor torque calculated over the applicable duty cycle shall not exceed the S1 (Continuous duty) torque rating of the motor. See FEM 1.001, paragraph 5.8.1.3.1. The Contractor shall submit calculations and motor specifications with continuous duty ratings as verification.

2.7.3 The duty calculations shall be based on the following:

(a) 50 LT load each way.

(b) All loads are lifted 1m (3.28 feet) clear of the highest obstruction in their travel path.

(c) All loads will be lowered to within 1m (3.28 feet) of surface they are to be set upon, stopped and then lowered onto the surface. Similarly, containers to be put in cells will be stopped 1m (3.28 feet) above the cell guides and then lowered into the guides.

(d) A dwell time of 2 seconds will be allowed for engaging or disengaging twist locks, and for entering cell guides. These are the only dwell times to be considered.

(e) Each motion accelerates, travels and decelerates at the maximum rates for which the system is designed.

(f) Hoist and trolley travel occur simultaneously whenever the container is clear of obstructions.

(g) The cycle is repeated indefinitely.

(h) The wind load is 50% of WLO.

2.7.4 The Contractor shall submit for review, the theoretical duty cycle block diagram for the main hoist and trolley drive.

2.7.5 The theoretical duty cycle for the trim system components shall consider the above main hoist and trolley duty cycle with the trim system completing two operations per container cycle.

2.7.6 The theoretical duty cycle for the purposes of calculating times and equipment designs of boom drive shall be based on the following:
a) Raise boom from operating to stowed position.
b) Lower boom from stowed to operating position.
c) The cycle is to be performed twice with no dwell time.
d) The wind load is 50% of WLO.

2.7.7 The theoretical duty cycle for purposes of calculating times and equipment designs of the gantry drive shall consist of continuous gantry travel (to duty rating of motor for short time rated motors) with empty spreader at any speed to full rated speed against the most severe wind load (including diagonal wind) equivalent to 50% of full operating wind load, unless other specified operating modes govern the design.

2.7.8 In addition to normal operating requirements specified elsewhere, to allow travel of the Crane to a tie down position during high wind, gantry motors and brakes shall provide capability for gantry travel with 32m/s (71.5 mph) wind (into and with) in the least favorable direction, including angled wind. Motors shall have thermal capacity to travel into the worst direction wind for a minimum of 200 m (650 ft) without overheating. The gantry motor brakes shall hold against 32m/s (71.5 mph) wind from the worst direction without use of wheel brakes or other securing devices. Calculations demonstrating this capability shall be submitted for County’s review.

2.7.9 In addition to all normal operating modes of the Crane, the Crane design shall consider all crane certification tests (operations) required to be performed in order to place the Crane in commercial service (ie. OSHA overload tests, etc.). These tests shall be accomplished without requiring any reset or adjustment of crane performance or drive functions – other than temporary overriding of certain operational interlocks (such as overload).

2.8 STRUCTURAL FEATURES

2.8.1 The crane shall be designed for stowing in high wind with boom latched in the stowed position and with boom at level position.

2.8.2 The Boom and Main Girder construction shall be trapezoidal box girder type, trapezoidal double box type with side mounted rails, unless otherwise approved by the County.

2.8.3 All members shall be amply proportioned to provide a rigid structure. Frame stiffness shall be adequate to avoid dynamic resonance.

2.8.4 Fatigue design for Group A8 as per F.E.M. (Class of Utilization U9 - over 4,000,000 cycles).

2.8.5 Access ladders and/or walkways shall be provided to all structural members and maintenance points.

2.8.6 Walkways, stairways, railings and non-painted surfaces to be hot dipped galvanized and painted to match crane color as approved by the County.

2.8.7 All exterior welds and all welds in non air tight areas or in open/non air tight members to be continuous/seal welded; intermittent welding will be allowed only in airtight areas. Interior surfaces of open/non air tight structural members to be primed and painted. All enclosed non airtight areas in members to be provided with adequate drains.

2.8.8 Platforms for cab window wash, trolley service and festoon service shall be provided in the backreach.

2.8.9 Stowed wind load design: FEM 1.001, FEM 1.004. Operating and stowed wind loads for structural, mechanical, and electrical design shall be calculated as specified herein. Wind loads for operating and stowed wheel loads, stability calculations, and tie down/stowage pin design shall be determined from a boundary layer wind tunnel test. The Crane shall be designed structurally, mechanically, and electrically for stowing under stowed wind conditions with the boom fully raised and with the boom in the normal level operating position. The Contractor shall perform the wind tunnel test for determination of stowed
wheel loads for Crane configurations with the boom fully raised and with the boom in the normal level operating position.

2.8.10 Crane stowage pins are to be mounted on the centerline of the Cranes (both rails) and two (2) per rail are to be provided the same as the existing cranes.

2.8.11 Structural joints shall be all welded. Design of bolted field splices shall be pre-approved by County. Field welding of splices is not permitted.

2.9 MECHANICAL FEATURES

2.9.1 Rope towed Main Trolley and Catenary Trolleys (landside and waterside) with Trolley drive machinery located in the Machinery House. Catenary Trolleys to be rope towed from Main Trolley.

2.9.2 Crane drive mechanisms shall be provided for the Main Hoist, Trolley, Boom and Gantry. Each main and auxiliary drive for main hoist, boom hoist and trolley shall be located in the Machinery House, and shall consist of AC motors, brakes, gear reducers, couplings and rope drums. If a Self-Driven Trolley is provided the mechanism maybe on the trolley as approved by the County.

2.9.3 Trolley wheel guide rollers on side of trolley rails.

2.9.4 Machinery House vents located on walls.

2.9.5 Open gearing and worm gears are not acceptable.

2.9.6 Spreader trim (±5 degrees) with control from Operator’s cabin and Dock Level Control Station; list and skew ±3.5 degrees for maintenance personnel only.

2.9.7 Fully closed hydraulic anti-snag system as approved by the County.

2.9.8 Air compressor in Machinery House with rigid airline on Boom and Main Girder to system components.

2.9.9 Overhead Service Crane in Machinery House to remove all Machinery Room components and parts to include electrical and control panels and components from within the E-House.

2.9.10 Floor located maintenance crane access hatches for hoisting and lowering Crane components from the trolleys and Machinery House.

2.9.11 Wire rope re-reeving system.

2.9.12 Drip pans beneath all wire rope drums where feasible, all pans shall be made of stainless steel.

2.9.13 Fully enclosed, weatherproof, force ventilated and pressurized Machinery House located on the landside cross girder and/or on the backreach area of main girder (LS Boom).

2.9.14 Fully enclosed, weatherproof climate-controlled Electric Control House (E-House) located in the Machinery House.

2.9.15 Stowage Pin locking device and automatic emergency braking to be installed on the gantry, both Landside and Waterside of Crane.

2.9.16 Pin connectors for head block to spreader shall be identical as currently in use at Port Miami, see attached Headblock drawing in Section 9 of these Specifications.

2.9.17 Spreaders to be interchangeable with existing of Port Miami Cranes 11 thru 16.
2.9.18 Gantry anti-collision system with slowdowns mounted at ground level.

2.9.19 Gantry motor brakes for high-speed release and total braking capacity adequate for 32.0 m/s (71.5 mph wind).

2.9.20 Storm wheel brakes on all idler gantry wheels for total braking capacity adequate for 40 m/s (89.5 mph wind), in conjunction with the holding power of 100% of gantry motor brakes.

2.9.21 Hydraulic and lubrication tubing, piping and appurtenances shall be stainless steel.

2.9.22 All hydraulic brake lines shall include valves to permit individual shut off and lock out of each brake for maintenance purposes.

2.9.23 Boom latches (thruster operated) at apex on waterside pylon.

2.9.24 Oil drainage system for main and boom hoist reducers and hydraulic systems shall drain down the landside legs to ground level. A drainage system for the trolley reducer shall be provided such that the oil can be transferred to the Machinery House and then to ground level.

2.9.25 Manual maintenance hoists shall be provided at all sheave locations, A/C handler room (inside on top of Drives Room) and at A/C compressors (if outside).

2.9.26 Ganged grease lubrication for gantry, Main trolley and Catenary mechanisms, boom components and pylon head (top of WS apex) shall be provided.

2.9.27 Auxiliary disk brakes for main hoist drum shall be provided.

2.9.28 Auxiliary disk brakes for boom hoist drum shall be provided.

2.9.29 Trolley, Gantry and Boom Latch bumpers (over travel shock absorption device) shall be hydraulic or mechanical. No rubberized bumper is acceptable.

2.10 ELECTRICAL FEATURES

2.10.1 Main power at Port Miami wharf: 13,200 VAC, 3 phase, 60 hertz.

2.10.2 On wharf existing continuous Panzerbelt main power cable trench to cable horn in underground main power pit.

2.10.3 Main Power Cable Reel for power and communications through fiber optic cable on same portal side as elevator. The fiber optic cable in the main power cable and its and associated hardware shall have adequate data communication capabilities (band width) for all RCMS system functions of the base crane and for the optional "Remote Crane Operations System" even the option is not purchased.

2.10.4 AC drive and control system with CMS and PLC.

2.10.5 CMS in the Electrical Room with remote terminals in the Operator's Cabin and Ground Level Monitoring Station, and, with capability for remote monitoring and accessibility through LAN.

2.10.6 Independent Crane electrical drives shall be provided for the Main Hoist and Trolley. Boom and Gantry may be shared with Main Hoist and Trolley drive. The drive configuration shall provide for simultaneous full speed, full acceleration performance of Main Hoist and Trolley Drives. All drives shall be located in the electrical room within the Machinery House.

2.10.7 The crane’s drive and electrical control system for major crane motions (hoist, trolley, boom, and gantry) shall be provided by a single manufacturer of electrical control equipment. The
minor drives such as for cable reels and emergency drives shall be provided by the same main drives supplier or as approved by County.

2.10.8 As a minimum, main function motors, transformers, Medium Voltage (MV) switchgear, digital drives and equipment included in the drive panels, PLCs, I/O devices, management and diagnostic system (CMS) devices and software, shall be supplied by the control system manufacturer. Only equipment readily available from suppliers in the United States with established sales, service and support organizations in the United States may be used.

2.10.9 Power cables, control cables and fiber optic data transmission cables shall be separate cables, except from the trolley to the spreader and main power cable reel.

2.10.10 Display monitor in operator's cabin to show container weight, wind speed, fault log and other real time drive data to include a HD monitor for the cameras.

2.10.11 Power to and control of spreader through powered cable reel located on the Main Trolley.

2.10.12 Trim, list and skew control by electro-mechanical means with hydraulic snag load protection/shutdown. List and skew shall be only operated by maintenance personnel.

2.10.13 Slack rope detection through use of load cell system.

2.10.14 Conduit, electrical gutters or junction boxes on exposed areas of sill beams, portal beams, legs, girders, braces, beams, and horizontals trusses only on areas approved by the County.

2.10.15 Climate controlled E-House, Control Room, Operator's Cab and Dock Level Monitoring Station.

2.10.16 Computer system room type ventilated E-house.

2.10.17 Digital wind speed Real-time readings from WS apex mounted anemometer to be displayed on the crane operator's Floor Mounted Indicator Panel, DLCS and CMS. The system shall be set such that at 35 mph a high wind speed warning shall be issued and at 42 mph a high wind speed shutdown shall occur in which case the control system shall automatically shut down gantry control power and set (even if manually released/opened) all gantry wheel (storm) and motor brakes. A High Wind Bypass button shall be provided at the DLCS panel to allow the maintenance personnel to override the high wind speed shutdown, reset control power, and when safe, gantry the Crane to the stowage position.

2.10.18 Electrical welding machine in the Machinery House with leads in rigid conduit to specified locations on the Crane.

2.10.19 Auxiliary AC drives for Boom Hoist, Main Hoist and Main Trolley travel. Drive performance shall be submitted for review and approval by the County.

2.10.20 Onboard CMS in Control Room and Dock Level Monitoring Station with remote monitoring through fiber optic link in the gantry/shore power cable reel.

2.10.21 Dock Level Control Station for maintenance operation of gantry, hoist and spreader operation.

2.10.22 Power line monitor with recording device.

2.10.23 Power factor correction using IGBT technology.

2.10.24 Harmonic filter panel as required for the drive system custom designed for the existing power system at Port Miami. Unless local power utility and/or relevant code requirements are more stringent, with the drives energized, harmonic filtering shall meet the requirements of IEEE Std. 519, Table 11.1 and Table 10.3 at the point of common coupling for the predominant 5th and 7th order harmonics based on average load of 30 LT over a 30 minute period with main hoist and trolley operating simultaneously.
2.10.25 No I/O boards and appurtenances installation acceptable in the Crane operator’s seat consoles.

2.10.26 FAA regulation aircraft warning lights

2.10.27 Fittings for Cables and Conduits on limit switch enclosures shall be located at the bottom in the normal operating position.

2.10.28 The PLC and CMS to be provide by the same vendor as drive and control system manufacturer. The PLC logic shall be open and available for troubleshooting by maintenance.

2.10.29 Ship Profiling System and spreader soft landing system.

2.10.30 The Machinery House Control Station for local control by maintenance personnel shall be provided for the Main Hoist, Trolley and Boom Hoist individually fitted on a single panel with a removable 50 feet long cable pendant control which shall permit safe operation and positioning of the hoist(s) operator.

2.10.31 Control Station selection switch on all control panels including operator cabin.

2.10.32 A personnel elevator shall be provided with no electrical or mechanical actuator for door functions.

2.11 MISCELLANEOUS

2.11.1 Storm tie-down arrangement shall be compatible with those existing at Port Miami for cranes 13-16. (Size, design loads and capability of existing embedded parts shall be verified by manufacturer.)

2.11.2 Flammable materials storage lockers and work bench with vise in boom house.

2.11.3 Fire extinguishers and safety devices as required by applicable codes.

2.11.4 Electronic and hardcopy detail of shop drawings, calculations, maintenance and operation manuals as required.

2.11.5 Fabricate, erect, assemble, pre-commission and test the Cranes at manufacturing site. Test, commission and certify Cranes at Port Miami Crane Staging Area and gantry wharf.

2.11.6 Delivery Site dock/wharf work area to be provided: approximately 100 m (328 ft.) long parallel to rails x 42 m (138 ft) deep (from the seawall towards landside) at the Port Miami Wharf 5.

2.11.7 High speed laser alignment of all Main Hoist, Main Trolley and Boom Hoist motors and drive mechanisms at manufacturing site.

2.11.8 Elevation of waterside rail above MLW: approximately 3.94 m (12.92 ft.)

2.11.9 Contractor shall make all reasonable efforts to obtain an ECO GREEN ISO certification/label for the Cranes – or portions/systems of the Cranes.

2.11.10 No Cargo (Hook) Beam or test weights shall be provided and accepted by the County with this order.
2.12 PREFERRED SUPPLIERS

2.12.1 The components or parts furnished by the Contractor must be a product of the original licensed (patented) manufacturer or original factory authorized fabricator/supplier. The below list is the minimum required and no substitution will be accepted unless previously approved by the County. These preferences are listed below to maintain commonality on the parts being used on the existing Cranes and the new Cranes to be provide by the Contractor.
### Preferred Supplier List

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>GANTRY</th>
<th>BOOM HOIST</th>
<th>MAIN HOIST</th>
<th>MAIN TROLLEY SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.12.3 Motor Brakes</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
<td>5.16</td>
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<tr>
<td>2.12.4 Motor Brake Couplings</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
<td>5.16</td>
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<tr>
<td>2.12.5 Motor Disk Brakes</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
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<tr>
<td>2.12.6 Gears and Reducers</td>
<td>Falk, Flender, ZPMC or County approved equal</td>
<td>Falk, Flender, ZPMC or County approved equal</td>
<td>Falk, Flender, ZPMC or County approved equal</td>
<td>5.16</td>
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<tr>
<td>2.12.7 Auxiliary Drum Brakes</td>
<td>None</td>
<td>Pintsch-Bubenzer</td>
<td>Pintsch-Bubenzer</td>
<td>None</td>
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<td>2.12.8 Storm Wheel Brakes</td>
<td>Pintsch-Bubenzer, ZPMC</td>
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<td>2.12.9 Thrusters</td>
<td>EMG</td>
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<tr>
<td>2.12.10 Wire Ropes (in inches)</td>
<td>US Manufacturer or as approved by County</td>
<td>4.36</td>
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<tr>
<td>2.12.11 Brake Couplings</td>
<td>Pintsch-Bubenzer Type K with elastic intermediate ring</td>
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<tr>
<td>2.12.12 Drum Couplings</td>
<td>Malmedie, ZPMC</td>
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<tr>
<td>2.12.13 Elevators</td>
<td>Alimak-Hek, ZPMC or County approved equal</td>
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<tr>
<td>2.12.14 Crane Drive System</td>
<td>Siemens, TMEiC, Fuji or ABB</td>
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<tr>
<td>2.12.15 Spreader</td>
<td>ZPMC, RAM, Bromma</td>
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<td>4.9</td>
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<tr>
<td>2.12.16 Spreader Cable Reel</td>
<td>Stemmann with AC inverter Drive</td>
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<tr>
<td>2.12.17 Main Power Cable Reel</td>
<td>Stemmann with AC Inverter Drive</td>
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<tr>
<td>2.12.18 Festoon or Cable Track</td>
<td>Igs, Stemmann, Conductix or County approved equal</td>
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<td>5.44</td>
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<tr>
<td>2.12.19 Main Drive Electric Motors</td>
<td>Wöelfer, TMEiC, ABB, Fuji, Siemens, or others from Crane Drive System supplier as approved by the County</td>
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<tr>
<td>2.12.20 Operator Cabin</td>
<td>Brieda Dynamic Control Station</td>
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<tr>
<td>2.12.21 Circuit breakers and starters</td>
<td>Allen-Bradley, Square-D, Cutler-Hammer, ABB</td>
<td></td>
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<tr>
<td>2.12.22 Switches</td>
<td>Square-D, ABB, Cutler-Hammer, Allen-Bradley as approved by the County</td>
<td></td>
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<tr>
<td>2.12.23 Tachometers</td>
<td>Hubner Giessen a Hubner Berlin or County approved equal</td>
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<tr>
<td>2.12.24 Panelboards</td>
<td>US Manufacturer or County approved equal</td>
<td></td>
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<tr>
<td>2.12.25 PLC, I/Os and CMS</td>
<td>To be provide by the same vendor as drive and control system manufacturer</td>
<td></td>
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<tr>
<td>2.12.26 Electric Motors other than Main Drive motors</td>
<td>Wöelfer, TMEiC, GE, ABB, Baldor, Fuji or County approved equal</td>
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<tr>
<td>2.12.27 Electrical Power Cables and Wiring</td>
<td>US manufacturer (UL)</td>
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<tr>
<td>Control Wiring</td>
<td>U.S. Manufacturer</td>
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<tr>
<td>2.12.28 Flood, Indoor and Walkway</td>
<td>Phoenix LEDs or approved LED equal</td>
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<tr>
<td>COMPONENTS</td>
<td>GANTRY</td>
<td>BOOM HOIST</td>
<td>MAIN HOIST</td>
<td>MAIN TROLLEY</td>
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<tr>
<td>2.12.29 Lighting Protection</td>
<td>Erico System 2000 or County approved equal</td>
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<tr>
<td>2.12.30 Switch Gear, Transformers</td>
<td>U.S. Manufacturer as approved by County</td>
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<tr>
<td>2.12.31 Welding Machine</td>
<td>Miller</td>
<td></td>
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<tr>
<td>2.12.32 Air Compressor</td>
<td>Ingersoll Rand</td>
<td></td>
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<tr>
<td>2.12.33 Communication System</td>
<td>Whelen</td>
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<tr>
<td>2.12.34 PQM</td>
<td>SATEC PM174 or County approved equal</td>
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<tr>
<td>2.12.35 Re-Reeving Machine</td>
<td>Reel-o-matic NK8 or County approved equal</td>
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<tr>
<td>2.12.36 Digital Video System</td>
<td>As approved by the County</td>
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</table>
SECTION 3

STRUCTURAL SPECIFICATIONS
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SECTION 3 - STRUCTURAL SPECIFICATIONS

3.1 GENERAL

3.1.1 The Contractor shall design and shop detail the Crane in accordance with the specified structural provisions herein which shall apply to all portions of the container crane structural framing system, including, but not limited to, Gantry Frame, Boom, Boom suspension, Main Trolley frame, Catenary Trolley frames (landside and waterside), Machinery House, Gantry travel trucks, Electric Control House, machinery and walkway supports and cargo hook.

3.1.2 Structural frame for the container Crane shall be suitable for the service intended. The structural frame shall have the basic qualities of strength, stiffness, lateral stability, torsional stability, elastic stability, ductility, and resistance to fatigue and impact loads. Excessive vibrations of the Crane or vibrations harmful to the Crane shall be avoided.

3.1.3 The Crane design and erection tolerances shall be such that Trolley traverse over the ship from the center of the inboard cell to center of the outboard cell shall not vary from a line normal to the centerline of the waterside gantry rail by more than plus or minus 50mm (2”) with the waterside gantry wheels centered on the waterside rails.

3.1.4 The primary design code shall be FEM 1.001, however, the Crane design, fabrication, erection, assembly, commissioning and operation shall be in conformance with all applicable codes and as noted herein these specifications. Operating and Stowed wind loads, and corresponding wind speeds, shall be as specified in Section 3.10.2 WLO Operating Wind Load and Section 3.10.2 WLS Stowed Wind Load respectively.

3.1.5 Pre-engineered designs used for other clients may not be accepted. The design of all members and enclosures; namely the legs, sill beams, portal beams, vertical braces, box girder boom sections, pylons, horizontal braces, forestays, house enclosures, operator’s cab, gantry trucks, supports, hinges and any other members shall be current and in accordance with requirements including wind loads specified herein. Before fabrication may begin, the specific structural design for Port Miami container Crane shall be submitted for the County’s review.

3.1.6 The Contractor shall submit for the County’s concurrence and/or approval all designs, parts, components, materials and related items to be used in the successful execution of this Work.

3.1.7 All components, parts and materials used in the construction of these Cranes shall be new and free of defects.

3.1.8 Wind loads for structural mechanical, and electrical design shall be based on FEM 1.004 (shape factors, shielding factors, wind pressures, load calculations, etc), for wind speeds specified in Section 3.10.2 and shall be applied in the least favorable direction. Operating and stowed wheel loads, operating and stowed stability calculations, tie downs loads, and stowage pin loads shall be based on wind loads from boundary layer wind tunnel tests as specified herein.

3.2 STANDARDS

3.2.1 Unless otherwise noted, the current applicable regulations of the following organizations shall be used for the execution of the Work:

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>ORGANIZATION</th>
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</thead>
<tbody>
<tr>
<td>1. AISC</td>
<td>American Institute of Steel Construction</td>
</tr>
<tr>
<td>2. AISE</td>
<td>Association of Iron and Steel Engineers</td>
</tr>
<tr>
<td>3. AISI</td>
<td>Association of Iron and Steel Institute</td>
</tr>
</tbody>
</table>
4. ANSI American National Standards Institute  
5. ASNT American Society for Non-destructive Testing  
6. ASTM American Society for Testing and Materials  
7. AWS American Welding Society  
8. BSI British Standards Institute  
9. CMAA Crane Manufacturer’s Association of America  
10. DIN Deutsche Industrie Normen  
11. FEM Federation Europeene da la Manutention  
12. NACE National Association of Corrosion Engineers  
13. OSHA Occupational Safety and Health Administration  
14. RCSC Specification for Structural Joints Using High-Strength Bolts  
15. SDI Steel Deck Institute  
16. SSPC Steel Structures Painting Council  
17. SSRC Steel Structural Stability Research Council

The use of the EN (Eurocode) is not authorized by the County and it is NOT ACCEPTED.

3.3 GENERAL DESIGN REQUIREMENTS

3.3.1 The criteria specified herein represent minimum acceptable standards. If, in the Contractor’s opinion and industry standards, any of the standards specified are inadequate or insufficient for the intended use, it shall be the Contractor’s responsibility to implement the required criteria at no additional cost to the County. Class of Utilization (U9) (over four million (4,000,000) cycles) shall be the basis of design (Group A8).

3.3.2 The total cycles shall be broken down into single cycle and double cycle container handling (load either one way or both ways).

3.3.3 The general requirements and Crane characteristics are delineated in Section 2 of this Specification.

3.3.4 The following loads shall be calculated, and submitted to the County prior to construction:
   a) Wheel loads  
   b) Landside – vertical and lateral  
   c) Waterside – vertical and lateral  
   d) Bumper forces – landside and waterside  
   e) Pin socket (stowed) – landside and waterside  
   f) Tie down (stowed) – landside and waterside

3.3.5 Stiffeners shall be made of material with yield strength no less than the base metal of the member that they are stiffening.

3.3.6 Weld details shall be configured to minimize fatigue stress concentrations. Transition elements (corner gussets, sloped thickness changes, etc.) shall be incorporated to minimize stress concentration factors. Fatigue details with stress concentrations per K3 of Table T. A. 3.6. (1) of FEM 1.001, 3rd Edition Revised 1998.10.01 shall be the basis of design. Allowable fatigue stresses shall be no higher than allowed for FEM 1.001, stress concentration K3. The higher allowable stresses for FEM K2 stress concentrations will not be accepted.
3.3.7 FCM joint designs shall be given considerable attention and shall be specifically discussed and submitted to the County for review. Extreme care shall be exercised in the design of these joints subjected to tension where a stress-relief hole is incorporated - such hole is to be covered with a plate to seal the structure. These joints and design shall be warranted for the life of the crane and any/all cost associated with changes to the original design if required in the future shall be the responsibility of the OEM.

3.4 STRUCTURAL DEFLECTION, TORSION AND STIFFNESS

3.4.1 All members shall be amply proportioned to provide a rigid structure capable of safe and efficient container operation without excessive vibration. All deflection criteria stated herein unless otherwise noted are absolute deflections with respect to a fixed point on ground and include deflections of gantry frame and of the boom or main girder as applicable. Calculations for deflections and natural frequencies shall be included in the calculations submitted to County’s Engineer for review.

3.4.2 The structural design of the crane shall be such that the absolute maximum horizontal deflection of waterside end of rails at boom tip and land side end of rails at backreach is less than 150mm in any direction under maximum operating wind load when the Rated Load is at the maximum outreach or at maximum backreach.

3.4.3 NOT USED.

3.4.4 The design shall be such that the absolute maximum horizontal deflection of waterside end of rails at boom tip or land side end of rails at back reach shall not exceed 400mm in any direction when the gantry is decelerated from rated speed by an emergency stop or by a collision with the trolley located at maximum outreach or at maximum back reach. Stresses and deceleration rates under these conditions shall comply with F.E.M. requirements.

3.4.5 The design shall be such that relative vertical deflection of waterside end of rails at boom tip or land side end of rails at back reach does not exceed 300 mm from the unloaded condition when the Trolley with Rated load travels from centered between the legs to maximum outreach or to maximum back reach.

3.4.6 The design shall be such that the vertical deflection of the boom between forestays and the boom tip shall not impede trolley operations under maximum operating conditions of speeds and accelerations/decelerations set forth in the Specifications.

3.4.7 Structural stiffness of the Boom and Main Girder assemblies shall be adequate to limit angle rotation of the plane formed by the top surface of the trolley rails to no more than .15 degrees from level with worst case eccentric load LLE at maximum outreach or at maximum back reach.

3.4.8 The design shall be such that the calculated natural frequency of the Crane will be greater than 0.85 Hz in the Trolley travel direction and 0.40 Hz in the Gantry travel direction. The Contractor shall submit detailed calculations that will demonstrate compliance during the design phase. The natural frequency in both trolley travel direction and in gantry travel direction shall be measured on one Crane during final acceptance testing to confirm compliance. During field verification of the as-built natural frequencies, to account for influences of the dock/crane rail support structure and the Crane’ gantry travel assemblies, the required natural frequency as demonstrated by the as-built tests shall be no less than 0.65Hz in the trolley travel direction and 0.30 Hz in the gantry travel direction.

3.4.9 The calculated vertical deflection and camber to be manufactured into the boom shall be submitted for review by County’s Engineer.

3.4.10 If any member is proportioned so that it may experience resonance (aerodynamic flutter) in windy conditions, a suitable method of preventing resonance shall be incorporated into the design, and must be approved by the County.
3.5 **GANTRY FRAME**

3.5.1 All construction shall be welded steel. Field welding of splices is not permitted.

3.5.2 Primary structural members (sill beams, legs, portal girders, trolley girders, boom girders and boom support cross girders) shall be box girder type construction. The interior of all non-airtight box members shall be painted with a prime and intermediate epoxy coat, as specified herein, and have adequate drains, as well as continuous internal ladders and passageways for inspection and maintenance. The interior of air tight/hermetically sealed box members shall receive shop/pre construction primer only. Welds in non-airtight members shall be continuous field welded.

3.5.3 All members, except where not practical or otherwise noted (such as the boom and girder members), shall be made airtight by seal welding. Sealed members shall be pressure tested to 0.105 kgf/cm², using soap film to demonstrate air tightness. All airtight structures shall be designed for air test loads and calculations submitted for review by the County.

3.5.4 Weather tight manhole openings with hinged, gasketed steel covers shall be provided on the top of unsealed/non air tight members to allow access to the interior of all box girder compartments. Two (2) manholes shall be installed on any member greater than 65 feet long; one (1) at either end of the member.

3.5.5 Incidental structural members, such as wind bracing, machinery supports, and walkway supports may be of any suitable cross section such as pipe, square tube, angle, channel, or side flange beam. All walkway, stairs, handrails and non-painted surfaces shall be hot dipped galvanized.

3.5.6 Pins shall not be used for connections subject to reversal of loads in the operating condition. The allowable stresses shall be as specified by F.E.M.; however, the basic allowable bearing stress for pins shall be as follows:

- Rotating Pins: 0.4 Fy (Fy = Elastic Limit)
- Non-Rotating Pins: 0.8 Fy
- Equalizer Pins: 0.25 Fy (Operating combinations)
- 0.4 Fy (All other combinations)

3.6 **BOOM AND MAIN GIRDER**

3.6.1 The Boom and Main Girder shall be trapezoidal open/closed dual or single boxed girder design of welded steel construction as approved by the County. No other type will be accepted or considered. All efforts shall be employed to minimize the weight of the boom without compromising the structural integrity and torsion as required by these specifications and applicable codes.

3.6.2 All pipes, gantry equalizers, cross beams on the boom and girder and the apex beam shall be made air tight by seal welding. Other structures/members shall be open. The design of open sections shall avoid pockets that may hold water. Sealed members shall be pressure tested to 0.105 kgf/cm², using soap film to demonstrate air tightness. All airtight structures shall be designed for air tight loads and calculations submitted for County review.

3.6.3 Boom and Main girder and all open/non air tight sections shall require all welds including stiffeners, cross diaphragms and longitudinal web stiffeners to be continuous/seal welded. The interior surfaces of all non-airtight areas of the Crane shall be painted with a primer and intermediate epoxy coat, as specified herein and provided with adequate drains as approved by County.

3.6.4 Welds joining Boom and Main Girder members to end diaphragm plates shall be complete joint penetration groove welds meeting all requirements of AWS D1.1. If backing is used, all requirements of AWS D1.1, Clause 5.9 Backing shall be met. These welds shall be examined 100% using ultrasonic testing with Cyclic Loading acceptance criteria.
3.6.5 Interior areas of the Crane's structure in which access is required shall have hinged lockable
manholes for access into the enclosed space for structural inspection. Edges of openings shall
be raised a minimum of two inches (2") such as it results with doublers so that fluid may not
drain/leach into the enclosed space. Hinged covers with neoprene UV rated rubber gaskets
shall be used to cover and seal all openings.

3.6.6 Steel plate diaphragms of the Boom and Main Girders shall be provided inside box-type
members to back-up all concentrated loads and connections.

3.6.7 The Boom shall be equipped with luffing falls and shall be hinged so that it can be fully raised
to clear the ship's superstructure and rigging. When the Boom is down in the horizontal
position, it shall be supported rigidly by the forestays (tie links) with the luffing falls slack.

3.6.8 The forestays (tie links) shall be made of structural steel. Forestays made of wire rope or
bridge strand are not permitted.

3.6.9 The heel (hinge) end of the Boom shall be so designed to prevent the boom from falling in the
event of hinge pin failure. The hinge and hinge pin shall be designed to transmit the load for
any case of loading and any boom configuration without incurring overstress or wear, and
shall function smoothly.

3.7 **CRANE CLASSIFICATION**

3.7.1 In order to meet the strength and serviceability requirements as generally described in this
Specification the Crane shall have a single group classification, based on a single class of
utilization and a single load spectrum. Designations used herein refer to the Federation
Institute of Steel Construction (AISC) and Deutsche Industrie Normen (DIN) equivalent
classifications and/or later amendments may be approved upon request.

3.7.2 Class of utilization shall be U9 that is, total duration of use of over 4,000,000 hoisting cycles.
a) Load spectrum class shall be Q3.
b) Group classification shall be A8.

3.8 **FATIGUE DESIGN CRITERIA FOR STRUCTURE**

3.8.1 Fatigue design shall generally conform to the requirements of FEM 1.001, except as modified
in this section.

3.8.2 The fatigue lifted load (LLA), lifting system weight, and trolley load (TL) as defined in this
specification shall be used for determining the applied fatigue load per F.E.M. 1.001.

3.8.3 All weld details shall be configured to minimize fatigue stress concentrations. Transition
elements (corner gussets, sloped thickness changes, etc.) shall be incorporated to minimize
stress concentration factors. No fatigue details with stress concentrations worse than K3 of
Table T. A. 3.6.(1) of FEM 1.001, 3rd Edition Revised 1998.10.01 shall be used.

3.8.4 Allowable fatigue stresses shall be no higher than those allowed for FEM stress concentration
K3 as defined in FEM Table T.A.3.6.(1).

3.8.5 Fatigue allowable stresses of the trolley girder and boom shall be based upon F.E.M.
component classification E8 with the exception of the fatigue stresses for the trolley girder
landside of the landside rail and for the boom beyond 75% of maximum outreach maybe
based on F.E.M. component classification E7.
3.8.6 Structural components of components other than the boom and girder including the main frame, boom and trolley girder supports, and boom and girder suspension members (forestays, backstays, etc.) shall be based on component classification E8.

3.8.7 The values of stresses used in the fatigue calculation shall be based on the extremes that occur in the normal loaded or unloaded operation for the full range of trolley travel from the maximum backreach to the maximum outreach.

3.9 **MINIMUM CRANE STABILITY**

3.9.1 Under operating conditions the Crane shall have a stability factor (ratio of stabilizing moments to overturning moments) of not less than 1.05 considering the effects of a 480 N/m² wind pressure (28 m per sec/ 62.6 mph) combined with the moment produced by using a maximum container weight of 2 x Rated Load (130 LT) with the trolley located at the maximum outreach and with the trolley at maximum backreach. Stability shall be based on 2 x the 100 LT Cargo Beam Rating if overturning moment of 2 x Cargo Beam Rating (200LT) is greater. Worst case angled wind effects shall be included.

3.9.2 With the Trolley with Rated Load located at the maximum outreach and at maximum backreach, if any one of the normal operating loads due to wind or inertial affects are increased by 50% and added to the combination of other normal operating loads, none of the legs shall lift off the gantry rail. Worst case angled wind effects shall be included.

3.9.3 Under overload conditions due to stall, earthquake or collision, with the trolley and Rated Load located at maximum outreach and at maximum backreach, if any one of the overloads is increased by 15% and added to the combination of other normal operating loads due to lifted load and operating wind, none of the legs shall lift off the gantry rail. Worst case angled wind effects shall be included.

3.9.4 Under stowed conditions, the Crane shall have a stability factor (ratio of stabilizing moments to overturning moments) not less than 1.2 considering stabilizing moment of tie downs with stress levels in tie downs no greater than allowable stress levels for out of service condition. Worst case angled wind effects shall be included.

3.9.5 Uplift forces in tie downs resulting from horizontal loads on stowage pins shall be considered. Unless otherwise approved, appropriate tie downs shall be installed at all four corners of the Crane.

3.9.6 Stability and wheel load calculations shall be submitted to County for review.

3.10 **LOADS**

3.10.1 Loads and load combinations are as specified in this section. Loads due to temperature effects, erection stresses, shipping stresses, and others based on good design practice and the Contractor’s experience shall be included in the analysis if they cause significant stresses or fatigue damage. If rational analysis indicates loads larger than specified, the larger loads shall be used.

3.10.2 The Contractor shall design the Crane for all possible loads and load combinations. As a minimum, the following loads, in the combinations as set forth in the F.E.M. Standards shall be considered:
a) COLL Collision Load  The loads determined by dynamic analysis assuming that with the Crane traveling at full speed and power off, the gantry bumpers hit the crane stops or hit another stopped crane or (concurrently) the trolley hits its stop at full speed with the power off. No structural damage shall occur.

b) DL Dead Load  The weight of the Crane's structure, including all machinery and equipment permanently attached.

c) EQ Earthquake Load  Earthquake loads shall be as per local codes for leg lift/stability calculations. For structural design, the more stringent of: a) 0.2 (DL + TL + LL) acting in any horizontal direction, or b) the load corresponding to the lateral acceleration required to cause overturning in any direction with Lifted Load raised to maximum height shall be utilized, unless local codes are more stringent.

d) EQS Stowed Earthquake Load code  A minimum load of 0.2 (DL + TL) but no less than local requirements.

e) IMP Impact Load  The loads due to vertical acceleration of the lifted load. Impact loads shall be determined as per FEM 1.001, section 2.2.2.1.1. Impact factor at locations between the crane rails shall be based on FEM's requirements for overhead traveling cranes/bridge cranes and impact factor at locations water side of water side rails and land side of landside rails shall be based on FEM's requirements for jib cranes.

f) LATT Trolley Lateral Load  The loads imposed on the Crane due to positive or negative acceleration of the trolley or other pieces of equipment which move horizontally. The minimum lateral inertia force developed due to trolley travel shall be at least 0.10 (TL) plus 0.025 (LL) parallel to the travel direction plus a simultaneous load of 0.025 (TL) plus 0.006 (LL) perpendicular to the travel direction.

g) LATG Gantry Lateral Load  The loads imposed on the Crane due to positive or negative acceleration of the gantry. The minimum lateral forces developed due to gantry travel shall be in accordance with F.E.M. 1.001, latest edition, but shall not be less than 0.10 (TL+ DL) plus 0.05 (LL) parallel to the travel direction and a simultaneous load of 0.025 (TL + DL) plus 0.01 (LL) to the travel direction. If tractive forces and/or anti-sway devices produce forces greater than specified, the greater forces shall be used.

h) LL Lifted Load  The load which hangs from the Trolley including headblock, portions of the lifting ropes, sheaves, and cargo beam with rated load or, spreader, portions of the lifting ropes, sheaves, and the Rated Load, whichever is greater. For design, the spreader weight shall be no less than 14,500
Kg (32,000 pounds) and the Cargo Beam weight shall be no less than 6.50 metric tonne (14,300 pounds).

i) LLA Structural Fatigue Load
   Lifted Load
   The mean load to be used for structural fatigue stress calculations consisting of a useful load lifted (as defined in FEM 1.001, Section 2.2, i.e. rated load) of 50LT and applied as specified in FEM 1.001, Sections 2.3.1, 3.6.3, 3.6.4 and 3.6.5.

j) LLE Eccentric Load
   The lifted load wherein the weight of the container(s) and its contents are eccentric to the geometrical center of the container toward either end longitudinally and toward either side transversely. For the design containers, the eccentricities shall be as follows:

   Two (2) 20 ft. containers, one at 32.5 LT and one (1) empty container, each with 10% longitudinal eccentricity and with 0.25 meters transverse eccentricity, with all eccentricities in the most severe direction.

   Two (2) 20 ft. 32.5 LT containers each with 10% longitudinal eccentricity and with 0.25 meters transverse eccentricity, with all eccentricities in the most severe direction.

   One 45 ft. container with 50LT load at 1.4m longitudinal eccentricity and .25m transverse eccentricity.

k) LLMF Mechanical Fatigue
   Lifted Load
   The mean load to be used for mechanical fatigue / durability / life calculations of shafts, bearings, couplings, gears and other similar mechanical components consisting of a load lifted (as defined in FEM 1.001, Section 2.2, i.e. rated load) of 50LT and applied as defined in Sections 2.1.3, 2.6.4, and 4.2.1.

l) RL Rated Load
   The maximum under spreader load (container(s) and its (their) contents) for which the Crane is designed and built and as shown on the nameplates.

m) SWL Safe Working Load
   The capacity of the Crane for various modes of operation as shown on the nameplates. 65 LT for twin twenty operation and 50 LT for single container, hatch covers, etc. and 100 LT for hook beam.

n) SN Snag Load
   The load imposed on the Crane due to the headblock and empty spreader traveling at maximum hoisting speed becoming jammed in the ship's cell guides or being accidentally two-blocked against the underside of the trolley, resulting in the kinetic energy of the rotating equipment being dissipated in elastic deflection of the machinery and structure and/or in any energy absorbing devices provided for that purpose.
o) SKW Skew Load
The loads developed due to trolley or gantry wheels rolling along a rail. The force shall be taken as acting normal to the rail and tending to skew the structure. The horizontal force shall be obtained by multiplying the vertical load on each wheel by a coefficient which depends upon the ratio of the span to wheel base. The coefficient shall be as determined by F.E.M. 1.001.

If the Contractor demonstrates that the Trolley and/or Gantry skew load is less than the value shown because of either electrical or mechanical gantry drive control, then the reduced load may be used accordingly.

p) STL Stall Torque Load
The load developed by stalling any motor in the Crane. The load shall be due to the stall and/or breakdown torque of AC drives. For the hoist stall conditions, total stall torque of all hoist motor(s) shall be assumed to be transferred to one set of rope falls.

q) TL Trolley Load
The weight of the Trolley structure including all machinery and equipment permanently attached.

r) TRIM Trim Load
The effect of plus or minus 5.0 degrees trim of the spreader.

s) WLO Operating Wind Load
Operating Wind Loads for structural, mechanical, and electrical design shall be due to an operating wind pressure of 480 N/m² (10.0 pounds per square ft) equivalent to 28 m/s (62.6 mph) wind speed assumed constant over the height of the Crane and assumed to come from any direction, including diagonal wind. The operating wind load for wheel load and stability calculations shall be based on a wind tunnel test as specified herein.

The Crane shall be designed structurally mechanically, and electrically and with sufficient stability for an operating wind speed of 28 m/s (62.6 mph), but wind tunnel testing shall be performed at operating wind speeds of 20.1 m/s (45 mph) and 28 m/s (62.6 mph) for determination of wind loads for wheel load calculations.

t) WLS Stowed Wind Load
The stowed wind load for structural, mechanical, and electrical design shall be due to a basic 3 second gust wind speed of 65.2 m/s (146 mph) at 10 meter reference height assumed to come from any direction. The wind load shall be based on wind speeds and corresponding wind pressures assumed to vary over the height of the crane in accordance with equations for v(Z) and q(Z) on pages 17 and 18 of FEM 1.004, Appendix 2 with factors as follows:

1) \( V_{ref} \), used in the calculations in Appendix 2 and defined as the 10 minute mean storm wind velocity at 10 meter height with recurrence interval of once in 50 years, shall be taken as seventy (70) percent
2) \( v_m(Z)/V_{ref} \), the roughness coefficient, shall be based on coefficient \( \alpha \) equal to .14 and coefficient \( \beta \) equal to 1.0.

3) \( V_g \), the gust amplitude, shall be based on factor \( K \) equal to .0055 and gust factor \( \Phi_8 \) equal to 1.10.

4) \( F_{rec} \), the recurrence interval factor, shall be taken as 1.0.

The wind loads for wheel load, stability, tie down, and stowage pin calculations shall be based on a wind tunnel test for the specified 65.2 m/s (146 mph) 3 second gust wind velocity at 10 meter height (with no reduction for \( V_{ref} \)). Wheel loads, tie down loads, and stowage pin loads determined by the wind tunnel test for the stowed condition shall be considered as unfactored loads for dock foundation design.

### 3.11 LOAD CASES

3.11.1 Load cases and/or load combinations shall be computed in accordance with FEM. All load cases shall be analyzed on the following basis:

a) Boom shall be in the most adverse position.
b) Trolley Load (T) and Lifted Load (LL) shall be in the adverse position.
c) Lateral Loads shall be in the most adverse direction.
d) Wind (W) shall be from the most adverse direction.

3.11.2 Analysis of all load cases shall use the safety factors as defined in FEM unless the stability factors specified are more stringent.

3.11.3 Detail loading conditions submittal shall be provided with the technical proposal.

3.11.4 The stability factors of the Technical Specification shall govern.

### 3.12 GANTRY TRUCKS

3.12.1 The gantry trucks shall be designed and fabricated with a maximum bumper-to-bumper distance of 27 m (88’6”).

### 3.13 LADDERS, STAIRWAYS, CATWALKS, AND PLATFORMS

3.13.1 Ladders (external and internal), stairways, catwalks, and platforms shall be constructed of steel and shall be provided to give proper access to all parts and areas to which access is required for the Crane’s operation, lubrication, service, maintenance and inspection.

3.13.2 Stairways shall be used wherever possible in preference to ladders with the exception of internal ladders. All regular and periodic maintenance locations shall have suitable platforms and access.

3.13.3 Ladders, stairways, catwalks, and platforms, guard rails (hand rails) and cages shall meet all requirements of OSHA and shall be hot dip galvanized and painted to match the color scheme.
Galvanized walking surfaces need not be painted. Handrails shall be heavy wall pipe. Walkways and stairways width shall be no less than twenty-eight inches (28”).

3.13.4 Access from the wharf/dock level on to the Crane shall be at the LS of the landside (LS) crane rail. This point of access shall incorporate a security entrance gate 2500mm high from dock level at the bottom of the access stairs landing to the elevator that can be closed and locked with a padlock. The access stairs shall also have handrails and security railings 2500mm high from dock level.

3.13.5 Ladders, stairways, catwalks, and platforms shall be so located as to not reduce critical clearance dimensions, and to minimize chance of damage from trucks and equipment working in the vicinity of the Crane.

3.13.6 Stairways (stair threads), catwalk floors, and platforms floors shall consist of either bar grating, or “Grip Strut”. Floor of trolley, electric house, and machinery (boom hoist) house shall be 4-way safety diamond plates with a nominal thickness of ¼ inch. Grating shall not be installed on these floor surfaces with the exception of the E-house.

3.13.7 All structural access hatches shall be designed so that they require not more than 30 lbs., of force to operate.

3.14 GANTRY SECURING DEVICES

3.14.1 The Crane shall be designed and equipped with stowage pins (for horizontal forces) and tie downs (for uplift forces for hurricane wind as specified herein) as gantry securing devices.

3.15 STOWAGE PINS

3.15.1 Stowage pins will be engaged when the Crane is stowed. The stowage pins shall mate with existing sockets embedded in Port Miami dock for Cranes 13-16; see attached dock interface drawing included in Section 9 of the Specification.

3.15.2 Stowage pins engagement mechanism shall be designed for ease of manual operation by one workman and shall require a force of no more than 50 pounds to disengage. A mechanical lock shall be provided to maintain each pin in the engaged and raised positions. An electrical fault interlock shall be provided by use of limit switch to monitor both the stow pin’s up and down positions.

3.15.3 The stowage pins shall be designed to withstand the stowed wind force on the Crane without brake assistance. These pins shall be designed for the existing sockets on the wharf for existing cranes 13-16.

3.16 STORM (HURRICANE) TIE DOWNS

3.16.1 Stowed wind tie down links will be engaged when the Crane is stowed and shall mate with the existing tie down links currently installed on the wharf for existing cranes 13-16.

3.16.2 The stowed wind tie down links shall consist of forged steel ratchet turnbuckles mounted on the gantry frame at each corner (not on the gantry trucks or equalizer beams) and shall be attached to tie down links embedded in the dock. When not in use, turnbuckles shall hang from the Crane in the exact location required to mate with below ground links. The mechanism used to support the tie down links while not in use, must be adjustable to allow for alignment adjustments while connecting to underground links.

3.16.3 Adequate space shall be provided between the turnbuckles and the gantry truck frame when all links are connected to permit the maintenance technicians to tighten the turnbuckle without obstruction.
3.16.4 Details of existing tie downs are provided in Section 9 of these Specifications. The Manufacturer shall provide the Cranes’ rail loads for approval of the Cranes’ design.

3.17 MISCELLANEOUS REQUIREMENTS

3.17.1 Minimum thickness of plates for primary structural members shall not be less than 5/16 inches or 8 millimeters.

3.17.2 Pins shall not be used to resist reversing forces during normal operations.

3.17.3 Back to back members in contact or within 2 inches (50 mm) or less of each other are not permitted.

3.17.4 Built up members and latticed members shall be avoided and any use of these type members shall be specifically approved by the County.

3.17.5 Water pockets are not permitted. If a water pocket cannot be avoided, it shall be equipped with a drain hole not less than one (1) inch in diameter. Drain holes shall be machine drilled, not be burned.

3.17.6 All members shall have continuous flange to web welds.

3.17.7 “Local” structural members that support hoisting equipment or other machinery shall be designed for the impact and vibration loads that occur in those areas.

3.17.8 Weather-tight manhole openings with bolted, gasketed steel covers shall be provided to allow access to the interior of all box girders that are not hermetically sealed.

3.17.9 All plate edges shall be ground to a radius sufficient to eliminate burrs and to allow coatings to adhere to the edge of the plate.

3.17.10 Bolts may be tightened by a standard method to the required tension. Bolt tension may be checked at locations selected by the County. Checking of bolt tension shall be done by the Contractor in the presence of the Inspector and in such a manner that the Inspector can read the torque wrench gauge of direct tension indicator during checking.

3.17.11 The County Representative shall have free access at all times to any portion of the fabrication site(s) where work is being performed.

3.18 ENCLOSURES (GENERAL)

3.18.1 This section shall govern the design, fabrication and installation of the enclosures to be provided on the Crane which Works shall conform to the applicable standards and requirements specified herein, AISC and any other applicable state and federal codes and standards.

3.18.2 Two (2) types of waterproof habitable enclosures shall be provided on the Crane; a House Enclosure and Cabins.

a) House Enclosure; a single Machinery House enclosure shall be provided for the Main Hoist machinery, Boom Hoist machinery, Main Trolley drive machinery, Electrical switchgear, Drive and Control Room.

b) Cabins: two (2) different types of cabins shall be provided; air conditioned and non air conditioned. Each cabin shall be walk-in type, totally enclosed, insulated, and air conditioned;
   1) air conditioned; Operator's Cabin, and a Dock Level Monitoring Station.
   2) non air conditioned: Boom Hoist Operator’s cabin.
3.18.3 Enclosures shall be of sufficient size to enclose and protect all of the mechanical, hydraulic and electrical equipment located therein.

3.18.4 All hydraulic units shall be enclosed by a stainless steel enclosure with sufficient door access for ease of maintenance and replacement of parts and components. Design of enclosures shall be approved prior to final design and fabrication.

3.18.5 Enclosures shall be of steel construction; minimum grade not less than A36, and shall be designed the same as the crane structure.

3.18.6 Enclosures walls and support framing shall be designed to withstand wind loads caused by the stowed wind speed specified herein. Wind loads due to positive wind pressure on the windward side and negative wind pressure (vacuum) on the leeward side shall be considered. Wind pressure on enclosure walls shall consider the same variation of wind pressure with elevation as required for design of the main structure. Vibrations caused during normal operations shall be considered in the design.

3.18.7 Enclosure roofs shall be designed to withstand wind loads caused by the stowed wind speed specified herein plus applicable live load plus dead load. Wind pressure on enclosure roofs shall consider the same variation of wind pressure with elevation as required for design of the main structure. Stresses for 244.1 kgf/m² (50 lbs/sq.ft) live load plus dead load case shall not exceed FEM allowable stresses for FEM load case without wind. Total roof deflection for 244.1 kgf/m² (50 lbs./sq. ft.) live load shall not exceed 1/150 of the span.

3.18.8 Enclosures shall be suitably framed and of sufficient strength for required service and loadings.

3.18.9 Enclosures subfloor framing shall be of sufficient strength to support floor loads (live loads); weight of the flooring system; weight of all permanently installed machinery and equipment; live loads, impact, and vibrations imparted by machinery and equipment, weight of machinery house enclosure and all appurtenances, and wind loads, all as specified.

3.18.10 Access doors shall be provided in the siding with weather tight seals, complete with automatic closer and latching devices. Doors and window frames shall be weather sealed to walls. Doors and windows shall have approved weather stripping. All access doors, interior and exterior shall have an approved self-closing lever lockset and a separate Pad lockable Barrel Slide Bolt. All doors shall be steel, 36 inches wide and hinged with safety glass in the upper panel. Door hardware shall be brass or stainless steel. Drip shields shall be provided over doors.

3.18.11 All equipment shall have permanently mounted access systems (ladders, platforms) for maintenance access. This shall include access to the CMS Room roof if applicable. Portable access methods are not acceptable.

3.18.12 Provide access ladder to roof with protective cage and railing as required by applicable safety codes. Pad eyes in compliance with OSHA requirements shall be installed at the roof and on access ladders for workers to secure a safety line. Safety railings shall be installed on the roofs that require access for maintenance of Crane components.

3.18.13 There shall be no wire rope penetrations or penetration of any kind in the house enclosure roof and/or ceiling. Penetrations in the house enclosure walls (such as doors and windows) shall be equipped with drip guards.

3.18.14 The roof shall be constructed of stiff trapezoidal/corrugated steel sheathing properly sloped to permit water to run off. The roof shall be sloped a minimum of 1 on 12 slope to shed water and no greater than a 1 on 8 slope. The roof shall extend at least 50mm (2 inches) beyond walls, or shall be bent downwards and lapped over walls. House walls shall extend below house floor to prevent water intrusion.

3.18.15 The enclosures shall be constructed of heavy wall minimum 2.5mm galvanized trapezoidal/corrugated steel sheathing sandblasted and painted; (including the house walls...
and roof deck). Roof and wall joints shall be sealed by welding, no other method is permitted.

3.18.16 Structural framing members for enclosures shall be open H, C or I Sections. Enclosed tubular members shall be used only with County approval.

3.18.17 No rivet construction and/or attachments are permitted.

3.18.18 Enclosures shall have lighting and convenience outlets as required by applicable codes and these specifications.

3.18.19 Enclosures shall be equipped with doors, with self-closing Padlockable Barrel Slide Boltskeyed lock mechanisms, hurricane proof windows, roof hatch, floor hatch, ventilation, insulation, exhaust fan, louvers, climate control, fire extinguisher, lighting and electric outlets, computer installation, e-house operator table and chair, and intercommunications, all in accordance with the design requirements of house enclosures.

3.18.20 All exterior welds shall be continuous. Bolted section joints shall be seal welded in assembly.

3.19 MACHINERY HOUSE

3.19.1 A weathertight Machinery House, aesthetically appealing, constructed of steel as specified herein, shall be provided on the Crane which house shall be divided into two (2) individually structured rooms or two (2) separate structures; the Machinery Room and the E-house (Electrical Room). The Machinery Room is to enclose all machinery for the Main Hoist, Main Trolley, Boom Hoist, Electrical switchgear, main transformers and miscellaneous equipment as required herein. The second room, the E-House is to enclose the Crane Drive System and Controls.

3.19.2 The Machinery House shall be constructed on a single rigid base frame capable of supporting and integrating the Machinery and E-house separated by rigid walls which construction shall comply with the applicable standards and codes. Special attention shall be given to insulation and compliance with the NFPA and other applicable codes and standards.

a) Machinery Room:

(1) The Machinery Room platform shall be sufficiently stiff to prevent machinery misalignment due to dead load, live load, wind and other forces causing deflections. The Main Machinery House shall have vertical height sufficient so the Overhead Service Crane can hoist and handle any piece of machinery or components therein on the trolley and move it to the access hatch without disassembly and lower it to dock level. The Overhead Service Crane shall be provided in accordance with the specification as herein stated.

(2) A roll-out access hatch shall be provided in the Machinery House deck, sized to permit removal, without dismantling, of the largest piece of equipment within the house, by means of an overhead service crane as required herein. The access hatch shall also provide access to the Main and Catenary Trolleys. A smaller access hatch shall also be provided for handling small equipment and tools. Other separate hatch may be provided as required upon submittal and approval by the County.

(3) The access hatches shall be mounted on tracks with rollers so they can be rolled back manually by use of overhead service crane. A latching device shall be furnished for the open and closed positions. Socketed removable stanchions with safety chains shall be provided around the hatch openings. The house structure, sides and roof shall be designed to accept the overhead service crane and rails. The roof shall be sloped and shall provide handrails at the roof edges for personnel safety while working on the roof. A ladder to gain access to the roof shall be provided. Platforms shall be
provided around all sides of the Machinery House. A waterproof 36 inch wide steel door with locks and safety glass windows in the upper panel shall be provided in the two (2) side walls of the Machinery House.

(4) The Machinery House shall be pressurized with filtered air by a suitable blower and hurricane wind resistant manual louvered arranged to prevent the entry of rain water from tropical storms and hurricanes. The blower size selected shall be of sufficient capacity to change the air in the Machinery House as required by applicable codes to include ASHREA. The Machinery House shall be adequately ventilated to maintain a maximum temperature of 5 degrees above ambient under working condition defined in Section 2.5.

(5) The Boom Hoist lead line shall be so arranged to penetrate the wall of the Machinery Room. The opening shall be shrouded with neoprene rubber flaps to minimize water penetration or a system as approved by the County.

(6) A sign shall be posted at all access doors to the Machinery House indicating: "KEEP DOOR CLOSED WHEN MACHINERY IS IN OPERATION", written in English.

(7) A minimum safe working space in accordance with applicable codes but no less than 28 inches (28") shall be provided around all equipment for inspection and maintenance.

b) **E-House (Drive and Controls Room):**

(1) A separate air-conditioned enclosure (room) within or attached to the Machinery House shall be provided for the electrical and control equipment. Refer to Section 4.24 for additional requirements. This enclosure shall be separated from the rest of the Main Machinery House by a steel wall of double wall construction with sound and thermal insulation between the double layers. Two (2) doors shall be provided at both ends of this wall to allow access between the two (2) areas, the E-House and the Machinery Room. No access shall be provided to the exterior of the main structure. If the HVAC Room access is from within the Drives Room ceiling, the door closes to the HVAC access hatch shall be size large enough so that the Liebert units can be removed thru the door. A County approved fixed ladder shall be provide the access the Room.

(2) The walls of this enclosure (E-House) shall be double wall construction with sound and thermal insulation between the double layers. The floor shall be raised to allow for a crawl space and ventilation of all electrical panels. A continuous rubber mat, with a minimum thickness of 12mm shall be provided where possible.

(3) The E-House shall be separated into separate three (3) separate rooms by a wall of double wall construction with sound and thermal insulation between the double layers. One room shall be the Control Room, the E-House HVAC Room and the Drives Room which shall house all the Drives' panels, PLC and other electrical appurtenances.

(4) The Control Room shall have a desk, chair, and storage cabinet to house all of the Crane's maintenance and operations manuals and for any other maintenance use. The walls between the Control Room and Machinery Room and Drives Room shall be provided with windows to allow full viewing of both rooms.

(5) The ceiling of the E-House shall not be higher than what is required for the equipment installed within but no less than ten (10) ft. This ceiling enclosure shall be designed to allow for the installation of air conditioning equipment on top. Permanently mounted access ladders and associated railings, etc., shall be provided for safe personnel maintenance access to the air conditioning equipment installed on the top of the electrical room.
The layout of electrical equipment shall provide adequate space and access for all required equipment as well as for all future equipment necessary for full crane automation.

No heat-producing elements, such as large resistor assemblies, shall be located in the Machinery House or E-House rooms (Control or Drives).

A minimum safe working space in accordance with applicable codes shall be provided around all equipment for inspection and maintenance but no less than 28 inches (28").

Particular attention shall be paid to provide ease of access to all equipment for inspection, maintenance, replacement and/or repair. This shall include permanently mounted access to the ceiling air conditioning access hatches in the E-House.

The E-House HVAC Room shall have an access opening with door or hatch(s) size so that any equipment in the Room can be removed thru the door/hatch. This/these door/hatches shall be constructed in the manner that are easily opened with effort of the maintenance personnel and comply with the safety requirements herein. It shall be insulated the same as the walls and provided with hinges and locking mechanism shall be provided. The design of the room and access door/hatch shall be submitted and approved by the County.

3.20 SERVICE CRANE - OVERHEAD

3.20.1 An overhead service crane shall be provided in the Machinery House with an electrically powered bridge, trolley and hoist. The lowering of equipment to the ground will be through hatches provided in the floor. The overhead service crane shall have adequate height to remove any piece of equipment in the Machinery House and move it to one of the service hatches. In addition, the overhead service crane shall have adequate lift height to place the hook block on the dock.

3.20.2 The service crane shall be to CMAA Specifications Class A1, or equivalent. The bridge, trolley travel and hoist motions shall be powered and operated from a pendant control. The hoists shall have sufficient spooling capacity and wire rope to reach the top of the dock. Hook coverage shall be provided for all major equipment in the house.

3.20.3 The service crane shall be of the overhead electric powered, under-running type spanning inside the house and capable of centering over, hoisting, traveling, and lowering to the dock surface, any piece of assembled equipment including that located on the trolley. A lifting beam, configured in a manner that will allow the hook to be centered over each piece of equipment, shall be furnished with appropriate slings to move all machinery within the house. The hoist, trolley, and bridge travel shall be electrically powered and the hoist shall be dual speed to accommodate fine positioning. The service crane shall be of standard manufacture and as approved County.

3.20.4 The service crane shall have adequate capacity for handling the heaviest piece of equipment. The Main Hoist reducer may be dismantled for removal from the Machinery House; but the vertical lift of the hoist shall be sufficient for the gear case cover to clear the gears in the assembled position.

3.20.5 A maintenance platform shall be provided to interface with the maintenance hoist to facilitate access to all Machinery House light fixtures and ventilation system for maintenance and replacement. The service crane shall be stored at a convenient location within the Machinery House.

3.20.6 The service crane shall consist of, but not limited to, the following:

(a) Electric wire rope
(b) Standard I-beam mounting
Motorized Bridge

Motorized trolley

Minimum of seven (7) Pushbutton pendant control; bridge forward, bridge reverse, trolley left, trolley right, hoist up, hoist down, stop

Motorized Hoist with two (2) speed hoisting control

Lifting capacity (minimum): 10 ton (20,000 lbs.) or as required by 3.19.2

Speed of lift: 50 feet per minute (minimum high speed)
20 feet per minute (maximum slow speed)

The provided wire ropes shall be anti-rotational.

3.21 **MAIN TROLLEY AND CATENARY TROLLEYS STRUCTURE**

3.21.1 The trolley frames shall be constructed of welded heavy steel plate and structural members and shall be sufficiently stiff to prevent misalignment and strong enough to carry all imposed loads.

3.21.2 The Main Trolley and Catenary (waterside and landside) Trolley frames shall have enough torsional flexibility to allow the individual wheel reactions to equalize and “share” the load. It shall be designed and installed in a manner that will prevent its de-mounting from the boom if derailment occurs.

3.21.3 The Main Trolley and Catenary (waterside and landside) Trolley frames shall be equipped with drop blocks and jacking pads so hydraulic jacks can be used at specific locations on the boom and main girder for lifting the trolley frame in order to dismount the travel wheels. The Main and Catenary Trolleys shall be capable of being completely lifted off the trolley rails by the jacks; all four corners simultaneously, WS or LS ends, or, left-side and right-side.

3.21.4 The Main Trolley and Catenary Trolleys (waterside and landside) shall consist of structural steel frame(s) supported by at least four (4) wheels riding on rails mounted to the crane girder and boom. Side guide rollers shall be provided for the main and catenary trolleys. Side rollers shall be located on the inside face of the trolley rails. Hold down rollers shall be provided as required. The Main Trolley shall have mounted on it the Main Hoist sheaves, and it shall support the Operator’s Cab.

3.21.5 The Main and Catenary Trolley frames shall be designed in accordance with the requirements of Section 3 of this specification and any other applicable requirements.

3.21.6 The main trolley and cab shall be fully accessible at any point in the trolley’s travel and access shall be such that a disabled operator can be removed without special rigging.

3.21.7 Except for rope openings, the main trolley shall be completely decked with grating or checker plate and shall be enclosed with a hand railing and kick plates as required by applicable codes. All openings shall be curbed with kick plates with the required height. All areas, parts and components shall be safely accessible for maintenance and replacement.

3.22 **OPERATOR’S CABIN (GENERAL)**

3.22.1 A cabin shall be provided for the exclusive use of the Crane operator. The primary consideration in the design of the cabin is for the safety, comfort and efficiency of the Crane operator. Special attention shall be given to minimizing noise, vibration and shock within the cabin. The cabin shall be hermetically sealed with adequate ventilation when the door and windows are closed as required by applicable codes.
3.22.2 The Operator’s Cabin shall be provided by Brieda and shall be the Dynamic Control Station model and equipped with, and shall meet at a minimum the following provisions:

   a) A rubber matted anti-slip floor surface for non-graded closed floors shall be provided.

   b) A metal door with robust (heavy duty) hinge, arranged for exterior locking and connecting to an exterior access platform. Locking device and handle shall be identical as for the other house enclosures.

   c) The Contractor shall comply with all International Standards, which have established ergonomic recommendations for the task required by the operator in a container crane operation. These recommendations are to be followed to provide reasonable protection based on studies regarding the musculoskeletal load, discomfort/pain and endurance/fatigue related to static working postures. The contractor is totally responsible for the design of the Crane, including the operators console and other areas related to the safe operation of the Crane by the operator. Owner nor their engineer purport to be the design agent, and no consent or approval of Owner or their engineer shall relieve the contractor of its responsibility in this regard. Both the console and chair shall be submitted to Owner for review. The seat cushion shall be firm for a 250 pounds (113.6 kg) person and covered with a durable non fading material. A foldable and adjustable seat and forearm rests shall be provided. The seat shall also have adjustment to tilt forward and back.

3.22.3 The size of the cabin shall be adequate for the operator and the equipment within, and shall allow ample space to permit convenient maintenance. Minimum size of cabin and passageways shall be as required by OSHA. Access to the operator’s seat shall be provided without requiring the operator to climb over the seat back or controls. The operator’s seat shall have the capability to rotate 180° clockwise and 90° counterclockwise from the front facing position.

3.22.4 All levers, handles, etc., used in controlling the functions of the Crane shall be arranged in a convenient position so as to enable the crane operator to manipulate and control all operations with minimum effort, strain, or chance of error. The console layout shall be the same as on the existing Port Miami Cranes 13-16, see reference Console Layout drawing included in Section 9 of these Specifications.

3.22.5 All warnings system shall be audible within cabin at all times.

3.22.6 Materials treatment shall be as specified in Section 7.8 Surface Preparation and Painting.

3.22.7 The following items shall be provided;

   a) Garment (clothing) hook, NFPA compliant Fire Extinguisher, Address system and signaling horn.

   b) Minimum of two (2) 60 watt equivalent LED lights and appropriate night (red light) LED lighting for night operation inside cab.

   c) Wall mounted Air conditioning unit.

   d) A foldable seat with safety belt shall be provided for a guest passenger.

   e) A foot-operated communication system on operator’s chair, with a ceiling mounted microphone, typical.

   f) An additional monitor (or screen) dedicated for a digital video and recording system mounted on back-reach boom, to improve visibility of backreach area including lay-down area for ship hatches, typical.
3.23 OPERATOR’S CABIN – VISIBILITY AND GLASS

3.23.1 The Operator’s Cabin shall be of the panorama-view type and located and arranged so that the operator has full visibility of all crane operations when seated at the controls to include gantrying. A visibility diagram shall be furnished to the County for review and approval.

3.23.2 The centerline of the operator’s seat shall be properly located with respect to the centerline of the spreader. The operator shall be as close as possible to the spreader alignment to see down into the ship’s cells.

3.23.3 All window glass with the exception of floor mounted shall be laminated safety glass. All glass above the operator’s horizon line (in the sitting position) mounted on the side of the cabin shall be tinted as approved by County.

3.23.4 Glass in the floor of the cabin shall be laminated and a minimum of 30 mm (1.18 inch) thick armor glass (without wire mesh reinforcing) and shall be un-tinted. A 5 mm replaceable tempered top cover glass shall be provided to protect the 30 mm glass from scratching and mechanical damage.

3.23.5 There shall be sufficient visibility to the sides so that the operator can safely perform gantry travel, especially when working close to other Cranes and equipment. The visibility shall be sufficient for the operator to have a clear direct view of all four (4) gantry bumper areas and trucks when the trolley is located at any location immediately behind the boom hinge point to the farthest location at backreach.

3.23.6 Those windows in the front, sides and floor of the cabin surrounding the operator shall be arranged with the minimum amount of framing required to maintain the specified structural integrity while providing maximum visibility and complies with hurricane wind force conditions as required by applicable codes.

3.23.7 The upper window on both sides of the cab shall be so equipped that they can be opened for ventilation. The window locking mechanism shall be of robust structure as approved by County.

3.23.8 Bottom window(s) shall hinge up into the cabin for cleaning accessibility and be a single piece layered.

3.24 OPERATOR’S CABIN – MOUNTING AND ACCESS

3.24.1 The Operator’s Cabin shall be mounted on the Trolley. The design of the mounting bracket to the trolley shall incorporate readily replaceable isolators to minimize shock and vibration. Access to the Operator’s Cabin shall be convenient and safe for the operator.

3.24.2 Access to the Operator’s Cabin from the Trolley deck shall be provided.

3.24.3 The normal route for access to the Trolley and Operator’s Cabin shall be located at the Trolley stowed position.

3.24.4 The Trolley and Operator’s Cabin shall permit safe emergency egress from any location on the boom. All access to the Operator’s Cabin shall fully comply with OSHA.

3.25 OPERATOR’S CABIN – STRUCTURAL

3.25.1 Structural supports for Operator’s Cabin shall be designed for minimum of 100 lbs/sq. ft. uniform load on Cabin floor, weight of permanently installed equipment, weight of the Cabin with appurtenances, and weight of structural support; at AISC allowable stresses or equivalent.
3.25.2 The Operator’s Cabin structure shall be designed to withstand wind loads caused by the stowed wind speed specified herein. Wind loads due to positive wind pressure on the windward side and negative wind pressure (vacuum) on the leeward side shall be considered. Applied wind pressure shall consider the same variation of wind pressure with elevation as required for design of the main structure.

3.25.3 Operator’s Cabin enclosure shall be constructed of plate steel. The sides, floor and roof steel plate of the cabin shall be of a minimum of ¼ inch thick (6 mm). The Cabin shall be fully insulated.

3.25.4 Operator’s Cabin shall be weatherproof designed in accordance with ASHRAE and all other applicable codes. All roof and wall joints shall be sealed by welding.

3.25.5 Operator’s Cabin shall be of fire retardant construction.

3.26 OPERATOR’S CABIN – WINDOW WASHING PLATFORMS

3.26.1 A platform, suitable for exterior maintenance and window washing of the Operator’s Cabin shall be provided at the extreme backreach of the Crane. This platform shall not obstruct the operation of the Trolley, festoon, hoisting ropes, or spreader; nor shall it interfere with any Crane function in the specified operating ranges.

3.26.2 This platform and all access to this platform shall comply with OSHA. The platform shall be accessible from the festoon platform. The platform shall be designed, fabricated and installed in a manner such that deflection and movement of the platform does not affect the balance of multiple maintenance personnel standing on the platform and working on the Operator’s Cabin.

3.26.3 The platform shall be constructed to allow complete access of the Operator's Cabin when Trolley is in its farthest backreach position. It shall be designed in a manner to have adequate clearance from the bottom of the Operator’s Cabin to the floor surface of the platform for cleaning of bottom surface of cabin. The platform shall fully cover the bottom of the Cabin when in the backreach and extending beyond the cabin’s wall to allow for cleaning and maintenance. A removable railing shall be installed on the WS of the platform to permit cabin and Trolley travel. The flooring shall comply with the specifications of Section 3.11.

3.26.4 The platform shall be fitted with access doors equipped with door interlock limit switches / access control system.

3.26.5 The platform shall be design for a minimum of six (6) two-hundred fifty (250) pound persons with cleaning equipment. The structure shall be stiff enough to not convey any vibration while several persons are walking and working on the platform.

3.27 TROLLEY RAIL

3.27.1 The Trolley rails shall be constructed of an appropriately sized Din 536 or County approved equivalent crane rail continuously welded end-to-end and mounted onto the sides of the boom and main girder. The rail shall be heat treated to 321 – 388 BHN. All rail alignment criteria must be followed to avoid Trolley wheel wear and tracking problems.

3.27.2 The Short Rail Piece at the hinged point shall not be less than six meters (6m) long fabricated from solid steel bar stock of the same material and specifications as the trolley rails. The steel bar shall be machined to match the stock rail provided. The web area shall not be machined and left as a square piece with the exception of the end to be welded to the stock rail.

3.27.3 The rail joint at boom hinge of the short rail shall be lapped, or otherwise designed to allow smooth Trolley wheel travel over the transition point of one end to the other. Care shall be taken to prevent this rail joint from binding due to rail creep or thermal expansion. Rail joint design at the boom hinge point shall be submitted for the County’s approval prior to start of fabrication.
3.27.4 The rail shall be attached to the boom by a Gantrex type system with rubber reinforced rail pads or County approved equal. A stainless steel shim plate shall be provided under the Short Rails at the boom hinge in place of the rubber pad and it shall extend no less than 0.61 m (2 feet) beyond the end of the short rail where it is welded to the stock rail.

3.27.5 Adequate rail clips and shear bars shall be provided to locate the Trolley rails laterally on the rail bed. The expected high lateral and impact loads of the Trolley shall be considered in the rail clip selection. The rail clip design, spacing, and means of attachment to the rail bed shall be submitted to the County for review and approval prior to fabrication.

3.27.6 The Short Rail pieces shall be bolted to the rail bed structure. Special attention shall be given to the union of the shim plates and the rubber rail pads. The stainless steel shim plates are to be slightly tapered at the ends adjoining the rubber rail pads.

3.28 MATERIALS

3.28.1 Structural steel (plates, shapes or bars) shall be classified as follows:

a) Classification ASTM Designation

| Fracture Critical Members (FCM) | A709-XXF |
| Non-Fracture Critical Members (NFCM) | A709-XXT |

1) The term XX indicated the appropriate value required by the design
2) The temperature zone shall be Zone 1 per ASTM A709-09, Table 7.
3) Material that was not originally manufactured to the ASTM A709 specification requirements, such as ASTM A36 steel, may be used provided it meets all of the specified requirements for A709 material, including toughness.

b) Supplemental Requirements: In accordance with ASTM A709 High Grade, the following shall be complied with:

1) Frequency of impact and tension tests; shall be in accordance with the complete section
2) Weld repair
3) Charpy V-Notch Impact Tests; shall be in compliance with the complete section.
4) CVN test bars shall be oriented in the appropriate direction for the potential fatigue crack (longitudinal or transverse). The responsible structural engineer shall determine the appropriate direction.

3.28.2 The Contractor’s Structural Engineer shall determine which member or member component is in the FCM category. All FCM’s shall be identified on the drawings. FCM’s shall be accessible for periodic structural inspections. Non-fracture critical members shall be accessible where practical.

3.28.3 Structural steel may be inspected at the fabrication site by the County or his representative. The Contractor shall notify the County where materials have been delivered to the fabrication site and shall give the County at least ten (10) days’ notice before commencing the fabrication of any structural steel.

3.28.4 The Contractor shall furnish to the County a copy of all mill orders, certified mill test reports and Charpy V-Notch Test reports for all structural steel to be used in the work other than unidentifiable stock material. Copies of mill order shall be furnished at the time orders are placed with the manufacturer. Certified mill test reports shall be correlated and furnished prior to the start of fabrication of material covered by these reports. Before the start of fabrication, the County shall have the opportunity to advise of any exceptions.
3.28.5 The Contractor shall maintain material traceability for structural steel from the prime mill source through all manufacturing processed to and including each finished part. For these items the original mill test reports and certificates for supplementary processes and tests shall be furnished as required by the County.

3.28.6 Material use for structural stiffeners shall be the same material or have the same material yield strength as the plate to which it is attached. The use of different grade steels in the cross section of main structural components must be approved by the County.

3.28.7 Specialty steels such as stainless steel, aluminum, etc., shall be of the highest quality type grade available, shall be suitable for exposure to the marine environment and temperatures of the South Florida, USA area. Prior to the Contractor’s procurement of any specialty steel items, parts and components, the Contractor shall provide a submittal for said items, to the County for review and concurrence of material composition and supplier. Stainless steel shall be no less then type 316.

3.28.8 Carbon steel material that at the moment to be abrasively blasted, cut or formed which exhibits the appearance of SSPC Rust Condition B thru G shall not be used on this project. Only SSPC 1 Rust Condition A material is acceptable to be used.

3.29 STRUCTURAL MAINTENANCE

3.29.1 The Contractor shall provide detailed recommendations for a Structural Maintenance Program. This program shall include inspection intervals, locations, and procedures, reporting procedures, repair procedures, and a detailed description of the methods used to determine inspection intervals.

3.29.2 The program shall have a rational basis utilizing fracture mechanics principles.

3.29.3 The program shall be included in the maintenance and inspection manual.

3.29.4 The Contractor’s Structural Engineer shall review the program and certify in writing that the program was reviewed and is satisfactory.

3.29.5 The Contractor shall provide permanent access ladders and platforms at all inspection locations described in the Contractor’s Structural Maintenance Program. Access for inspection shall be provided to all critical areas of the structure and must meet applicable safety laws and regulations and be submitted to the County for review. The use of portable access ladders or manlift/mobile crane to access specific locations on the Cranes shall NOT be permitted unless it is first proposed to the County for consideration: consideration of a proposal does not mean approval.

3.30 AS-BUILT WHEEL LOAD TEST / VERIFICATION

3.30.1 The Contractor shall verify that the Crane as-built wheel loads, in the Boom up and Boom down conditions, comply with the specified maximum dock/rail loads prior to shipment of the Crane from the Fabrication Site. If any modifications are made to the Crane after the Fabrication Site weight verification, the Crane weight shall be verified again prior to final load certification at the Erection Site. Verification shall be accomplished by jacking all wheels (together) on the waterside corners until they are clear of the rails and determining the wheel loads by means of a calibrated load cell or hydraulic jacking system. This procedure will be repeated for the landside wheels, jacking all wheels together. The weight measurements shall be repeated a minimum of three (3) times. Additionally, a separate procedure shall be provided to measure of the weight of Trolley with Operator Cabin and all equipment required for normal operation. The Trolley weight measurement shall be submitted to the County for review prior to installing the Trolley on the Trolley rails.

3.30.2 The Contractor shall submit a written test procedure for County’s review at least six (6) weeks prior to testing and a written report of the results. (See Section 7.9.13, "Corner Load
Measurement”) The as-built wheel loads are to be verified prior to operating the Crane with the Trolley outside the legs.

3.30.3 If the results of this testing reveal that the as-built condition of the Crane does not comply with the specified structural, mechanical or electrical standards as set forth by these Specifications, or if the maximum dock/rail loadings are exceeded, it shall be the responsibility of the Contractor to make any necessary changes to the Crane to assure it is compliance. Any proposed corrective action must be provided in writing to County for review prior to implementation at the manufacturing facility.

3.31 WIND TUNNEL TEST

3.31.1 The Contractor shall make a suitable scale model of the container Crane to be tested at an approved laboratory with boundary layer wind tunnel capabilities. The test results shall be used to confirm the Contractor’s computed wind loading for wheel load, tie down and stability calculations. The test results shall be available at the earliest possible date, but no later than six (6) months from the Notice to Proceed and prior to start of any fabrication. The model shall include aerodynamically equal surfaces for the walks, ladders, and other secondary details as a minimum requirement. The cost of the model, test and report, complete, shall be included in the Contract Price.

3.31.2 The container size shall be assumed to be a High Cube (HC) 9’-6” high by 8’ - 0” wide by 45’ - 0” long.

3.31.3 Results shall be determined for the boom in both the operating/horizontal and the stowed/raised positions and with the trolley located in critical positions with and without load. The Contractor shall perform both boom up (stowed) and boom level (horizontal) testing so that Port Miami can choose the Crane’s stowed position that provides the best wheel load conditions for the dock. Test shall be made with the model positioned at increments not more than 15° through 360° rotation.

3.31.4 The wind tunnel test shall be a boundary layer wind tunnel test configured to meet the specific requirements of ASCE 7-10, Section 31.2, titled “Test Conditions”. Testing for normal operation shall be based on wind speeds of 20.1 meters per second (45.0 mph) and 28 meters per second (62.6 mph) at 10 meter reference height as specified in Section 3.10.2 for Operating Wind Load WLO. Testing for the Crane Stowed condition shall be based on the basic 3 second gust wind speed of 65.2 meters per second (146 mph) at 10 meter reference height specified in Section 3.10.2 for Stowed Wind Load WLS. The boundary layer wind tunnel test shall be configured for the Crane Stowed condition to provide a wind pressure distribution varying over the height of the crane representative of a shore line with flat unobstructed areas and water surfaces (equivalent to ASCE 7 exposure category D as defined by ASCE 7-10, Table 29.3-1) with wind velocity at 10 meter equivalent height equal to the specified 65.2 meters per second (146 mph) 3 second gust wind speed. Wheel loads, tie down loads, and stowage pin loads determined by the wind tunnel test for the Crane Stowed condition shall be considered as unfactored loads for dock foundation design.

3.31.5 In order to obtain reactions due to frame warping, the model shall be reasonably structurally similar to the prototype.

3.31.6 After completion of testing, the model shall be painted and logo’s added such that it is a replica of the actual crane and will be used for display purposes at Port Miami. The scale model shall become the property of the County and shall be shipped to the County.

3.32 HIGHER STOWED WIND DESIGN (Optional)

3.32.1 As an Option, the Crane shall be designed to meet all requirements of the specification at a higher stowed wind speed of 73.8 m/s (165 mph) in lieu of the wind speed of 65.2 m/s (146 mph) specified in the base specification. Specifically, the stowed wind load for structural, mechanical, and electrical design shall be due to a 3 second gust wind speed of 73.8 m/s (165
mph) at 10 meter reference height in lieu of the 3 second gust wind speed of 65.2 m/s (146 mph) at 10 meter reference height specified in Section 3.10.2. Correspondingly, wind loads for wheel load, stability, tie down, and stowage pin calculations shall also be based on a wind tunnel test for 73.8 m/s (165 mph) at 10 meter reference height in lieu of the 3 second gust wind speed of 65.2 m/s (146 mph) at 10 meter reference height specified in Section 3.10.2. Operating wind loads for structural, mechanical, and electrical design and for wheel load and stability calculations remain unchanged and shall be as specified in the base specification.

3.32.2 The maximum allowable unfactored uniformly distributed gantry wheel loads for normal operation specified in Section 2.6.2 remain unchanged.

3.32.3 Maximum allowable values for Crane Stowed wheel loads, tie down loads, and stowage pin loads will increase. Section 2.6.3 in the base specification shall be replaced with the following:

3.32.4 The Maximum allowable unfactored uniformly distributed gantry wheel loads based on average gantry wheel spacing for the Crane Stowed/hurricane conditions are as follows:

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Average gantry wheel spacing shall assume distribution of gantry wheel loads at a corner over a length equal to the distance between centerline of end/outermost gantry wheels at the corner plus a distance equal to one average wheel spacing distance. Average gantry wheel spacing shall be calculated as the distance between centerline of end/outermost wheels of a gantry equalizer system at the corner divided by a quantity equal to the number of wheels at the corner minus one (1.0).

3.32.5 Maximum allowable stowage pin loads and tie down loads for the Crane Stowed/hurricane conditions are as follows:

Horizontal longitudinal stowage pin loads:

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Tie down uplift loads:

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<td>TBD (to be furnished by Contractor)</td>
<td>TBD (to be furnished by Contractor)</td>
<td></td>
</tr>
</tbody>
</table>

3.32.6 The Contractor shall provide proposed stowed wheel loads, stowage pin loads, and tie down loads for the 73.8 m/s (165 mph) Stowed Wind Speed Option with his bid.
SECTION 4

MECHANICAL SPECIFICATIONS
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SECTION 4 - MECHANICAL SPECIFICATIONS

4.1 GENERAL

4.1.1 The Crane(s) shall have the following basic operating modes: general cargo hook/heavy lift, normal containers and rope reeving maintenance. All motion functions shall be instantaneous with no more than a one-second turnaround time. Simultaneous movements shall be only with use of main hoist and trolley, or, gantry and trolley. No other simultaneous movements shall be permitted or required.

4.1.2 All machinery shall be designed in accordance with the best practice in mechanical engineering and in compliance with all applicable codes and standards required herein. In addition, the mechanical parts and components shall be designed to withstand all possible loading combinations with the appropriate durability and safety factors. In designing the mechanisms and components, careful consideration shall be given not only to fatigue failure, but also to harmful vibrations and deformations. It shall be the Contractor's responsibility to dimension, design and detail the Crane(s) to have each function properly in accordance with all requirements herein. The Contractor may offer alternate methods to provide the same function, provided they meet these specification and satisfy the intended reliability, maintainability and as approved by the County. The Contractor shall be responsible for providing adequate sizes and capability of all equipment to accomplish the work specified at the rated capacities, speeds, and duty ratings.

4.1.3 Minimum acceptable duty ratings for the Crane's main drives (including power conversion units and motors) are:

- Main Hoist: Continuous
- Main Trolley Travel: Continuous
- Catenary Trolley Travel: Continuous
- Gantry Travel: 60 minutes
- Boom Hoist: Continuous

4.1.4 All machinery and electrical components shall be furnished with lifting lugs suitable for attaching slings or other fittings for lifting.

4.1.5 The drive mechanisms shall be designed according to the following FEM classifications:

<table>
<thead>
<tr>
<th>DRIVE</th>
<th>STATE OF LOADING</th>
<th>CLASS OF OPERATION</th>
<th>CLASSIFICATION</th>
<th>MINIMUM LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Hoist</td>
<td>L3</td>
<td>T8</td>
<td>M8</td>
<td>50,000 hrs</td>
</tr>
<tr>
<td>Main Trolley Travel</td>
<td>L3</td>
<td>T8</td>
<td>M8</td>
<td>50,000 hrs</td>
</tr>
<tr>
<td>Cat Trolley</td>
<td>L3</td>
<td>T8</td>
<td>M8</td>
<td>50,000 hrs</td>
</tr>
<tr>
<td>Gantry</td>
<td>L2</td>
<td>T6</td>
<td>M6</td>
<td>12,500 hrs</td>
</tr>
<tr>
<td>Boom</td>
<td>L2</td>
<td>T5</td>
<td>M5</td>
<td>6,300 hrs</td>
</tr>
<tr>
<td>Trim, List, Skew</td>
<td>L3</td>
<td>T8</td>
<td>M8</td>
<td>50,000 hrs</td>
</tr>
</tbody>
</table>

4.1.6 Classifications of individual structural and mechanical components shall be consistent with classification of the structure or mechanism containing the components.

4.1.7 The fleet angles of wire ropes shall not exceed the following:

a) To drums, the angle to the axis of the drum grooving at the point of tangency 2.5 Degrees

b) To sheaves with fleet angle or where the varying angle does not pass through zero degrees near the midpoint of travel................................................. 2.5 Degrees
c) To sheaves with fleet angle varying approximately equally either side of zero degrees during normal travel .................................................................3.0 Degrees

d) The fleet angle between trolley and headblock sheaves may exceed 3 degrees when the headblock is within 3 m of its highest position, but shall not exceed 3.5 degrees.

4.1.8 Fleeting sheaves shall not be used.

4.1.9 When the sheave axles are not mounted in a horizontal plane, running wire rope shall be supported by auxiliary sheaves of appropriate size to prevent the wire rope from jumping off the main sheaves and drums.

4.1.10 Main Hoist ropes shall be continuous from the drum through the Main Trolley, Catenary Trolley and Headblock, to the end sheaves and back to the drum. Both ends of each hoist rope shall be secured to the drum to facilitate re-reeving. The Main Hoist wire ropes shall be supported by Catenary trolleys to eliminate the adverse effects of wire rope sag and bounce. Each Main Trolley rope and Catenary Trolley rope where applicable, shall run continuously from the drum(s) through equalizer sheaves and adjustable rope clamps on the Main and Catenary Trolleys and back to the drum(s) to facilitate adjustment and re-reeving of the ropes. A suitable wire rope tensioning system shall be provided in the backreach area for Main and Catenary Trolley travel ropes. The Main and Catenary trolley travel ropes shall also be supported to eliminate the adverse effects of wire rope sag. The two (2) independent ropes for the boom hoist shall lead from the drum to the gantry frame top, then to a multi-part reeve-up between the boom and the gantry frame top. The dead ends of the reeve-up shall be independent but equalized.

4.1.11 Replaceable buffers shall be provided as necessary to prevent bouncing wire rope from contacting structural members. Rollers shall be provided in all locations in contact with running rope. Rollers shall be factory lubricated and sealed anti-friction bearings shall be of a non-metallic material with a life equal to that of the roller bearings and sized to handle the maximum loads to be encountered during operation. All brackets shall be appropriately sized to ensure long life and “jamming-free” operation.

4.1.12 The effect and direction of wind and of wind speeds to 28 m/sec shall be considered for operation and necessary clearances for the festoon systems and wire rope. Under no condition shall there be any chance of interference between the festoon systems and part of the Crane(s) wire ropes, etc.

4.1.13 Wherever possible, designs and layout of equipment shall allow performance of routine maintenance procedures by one man. The Crane shall conform to applicable safety regulations noted in Section 4.5.

4.1.14 A transparent and removable grease shield shall be provided between the wire rope drum(s) and nearby equipment (motors, brakes, etc.).

4.1.15 All major machinery and electrical components shall be furnished with lifting lugs for ease of attaching hoist gear when components are changed with the machinery house service crane. The proposals shall include a description of the method to be used to service machinery house and trolley equipment.

4.1.16 Bolts shall be properly torqued and shall not be subjected to fluctuation stresses. Pins shall not be used to resist reversing forces.

4.1.17 All major machinery and electrical components shall be furnished with identification tags complete with all parameters, serial number, year of manufacture, and contract information.

4.1.18 The Crane(s) shall be rope towed trolley type with Main Trolley and Catenary Trolleys on waterside and landside. The Main Trolley shall be rope driven by drive machinery located in the Machinery House. The Catenary Trolleys shall be towed by the Main Trolley. During boom down operation, the Catenary Trolleys (waterside and landside) shall maintain position half way between the Main Trolley and their respective end stops at the boom tip and in the
backreach. With boom up, the Main Trolley shall be able to traverse the length of the Main Girder (from the waterside to the back reach) at slow speed with empty spreader for maintenance purpose only. For boom up operation, end stops shall be provided at the boom hinge to stop the waterside Catenary Trolley and Main Trolley from traveling beyond the end of the trolley girders. These stops will only be deployed during boom up operation and normal end of travel slow down and over travel limit switches shall also be provided.

4.2 STANDARDS

4.2.1 The current standards of the following organizations shall govern and will be used for design, fabricate, manufacture, install and operate the mechanical equipment. Foreign standards, if more restrictive, may be used as approved by the County.

a) AFBMA Anti-Friction Bearing Manufacturers Association
b) AGMA American Gear manufacturers Association
c) AISE Association of Iron and Steel Engineers
d) AISI American Iron and Steel Institute
e) ANSI American National Standards Institute (American Society of Mechanical Engineers)
f) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
g) ASM American Society for Metals
h) ASME American Society of Mechanical Engineers
i) AWS American Welding Society
j) CBBI Cast Bronze Bearing Manufacturers Institute
k) CMAA Crane Manufacturers and Association of America
l) DIN Deutsches Institut für Normung e.V. (German Institute for Standardization)
m) FEM Federation Europeenne de la Manutention
n) ISO International Standards Organization
o) JIC Joint Industrial Council
p) NFPA National Fire Protection Association
q) NFPA National Fluid Power Association
r) OSHA Occupational Safety and Health Administration
s) RCSC Specification for Structural Joints Using High-Strength Bolts
t) SMACNA Sheet Metal and Air Conditioning Contractors' National Association
u) SAE Society of Automotive Engineers

4.3 MISCELLANEOUS REQUIREMENTS

4.3.1 All parts of the mechanical equipment shall be designed so that they may be easily assembled, adjusted, removed for replacement, accessible for lubrication, inspection and maintenance. Where necessary for accessibility, permanent platforms, catwalks, handrails and ladders shall be provided.

4.3.2 All areas where there is exposed rotating machinery and all other "pinch points" shall be guarded in accordance with OSHA.

4.3.3 Fastenings shall be secured with locking devices. Critical areas, such as trolley wheel keeper plates, shall have fastener groups wired together. Lock nuts, lock washers, set screws and snap rings are unacceptable on rotating equipment. All fastenings ½” diameter and less shall be stainless steel. If it can be shown that the use of stainless steel fasteners will compromise the design of a proprietary manufactured product which otherwise meets the specifications, then alternate means of preventing corrosion and seizing of the fastener may be used as approved by County.

4.3.4 All hydraulic pistons and rods provided shall have Type 316 or better stainless steel components available. Contractor shall provide a submittal for the County's review and concurrence.
4.3.5 Hubs for brake wheels or discs shall be pressed and keyed directly to their respective shaft. Brake wheel couplings shall not be used unless the brake wheel is the rigid half and directly secured to the reducer high speed shaft.

4.3.6 All equipment or groups of equipment shall be independently mounted on rigid subframes or mounted directly to the Crane’s structural frame. Machined support pads (base plates) shall be 25 mm (1”) wider than the footpads of the equipment on all sides. The mounting of bases shall be designed to isolate machinery elements from dynamic deflections of the Crane’s structure. A minimum of 3.0 mm (.125”) stainless steel shims shall be provided under electric motors for alignment and to accommodate shaft height variations of spare motors.

4.3.7 In the case of machined assemblies or weldments such as subframes, trolley frame, travel trucks, sheave assemblies, etc., the following shall apply:

   a) All milled surfaces shall be flat, true, and parallel to other milled surfaces,
   b) All pin and axle holes shall be line bored,
   c) All pin and axle holes shall be true, parallel to each other (or at exact right angles, as the case may require), and located at the proper distance from the other holes.

4.3.8 Alignment of equipment shall be maintained by the use of body fit bolts, dowel pins, shear bars, and/or jack screws as required by application.

4.3.9 Major machinery and electrical components shall be furnished with lifting lugs suitable for attaching slings or other fittings for lifting.

4.3.10 A minimum space as required by OSHA and any other applicable standard but no less than 28 inches (28”) shall be provided around rotating equipment for the safety of personnel. Floor openings around equipment shall have minimum clearance and shall have toe plates in accordance with applicable OSHA regulations.

4.3.11 Prior to commissioning and testing at the manufacturing and assembly facility of the Contractor, all machinery and rotating equipment shall be properly installed, laser aligned, free running without noise or vibration. The Contractor shall confirm these requirements at Port Miami, prior to final acceptance by the County.

4.4 **NOISE LEVELS**

4.4.1 Noise shall be controlled to result in sound pressure levels not exceeding those shown in the table below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Maximum Allowed Sound Pressure</th>
<th>Decibels A-weighted (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator’s Cabin</td>
<td>75 Db</td>
<td></td>
</tr>
<tr>
<td>Dock Level</td>
<td>80 Db</td>
<td></td>
</tr>
<tr>
<td>Average inside Machinery House</td>
<td>95 dB (free air)</td>
<td></td>
</tr>
<tr>
<td>Bells and Horns</td>
<td>OSHA</td>
<td>OSHA</td>
</tr>
<tr>
<td>Controls and monitoring rooms</td>
<td>75 Db</td>
<td></td>
</tr>
</tbody>
</table>

4.4.2 The noise level requirements must be satisfied for the operator’s cabin, the CMS control room and dock-level monitoring cabin. Should the noise levels exceed allowable in other locations, the Contractor shall provide the appropriate County approved warning signs and hearing protection as required by OSHA in those areas shall be stored in a lockable storage cabinet enclosure at each location.
4.4.3 Noise levels shall not exceed OSHA requirements at any location within any house and on the exterior of Crane.

4.5 PROHIBITED ITEMS

4.5.1 The following items will not be accepted:
   a) Cast iron, malleable iron, ductile iron, except for non-structural components and small motor frames as approved by the County.
   b) Chain drives.
   c) V-belt drives
   d) Cast steel axles, shafts and wheels.
   e) Surface finishes in excess of 1,000 microinch roughness.
   f) Cast iron shall not be used for any structural or main function reducer parts
   g) Teflon material for wearable surfaces such as catenary rollers and wear/slap blocks.

4.6 DRIVE MECHANISMS

4.6.1 Three (3) drive mechanisms systems shall be installed on the Crane, the Main Hoist, Main Trolley and Boom Hoist.

4.6.2 Motor brakes must be arranged to permit safe removal and replacement of the drive motors without removal or disassembly of the motor brakes.

4.6.3 The drive machinery beds (or frame) shall be constructed of welded heavy steel plate and structural members. The frames shall be sufficiently stiff longitudinally and torsionally to prevent misalignment of machinery. The frames shall be designed in accordance with the applicable structural code.

4.6.4 The drive machinery frames shall have stiffeners at locations where there are point loads (such as under hoist drum pillow blocks). The bearing surfaces where machinery will be mounted shall be milled flat, true, and to the correct elevation. Shims may be used for alignment of equipment up to a maximum combined maximum thickness of 3.0 mm (.125") at any one location.

4.6.5 Mechanical equipment shall be mounted and aligned using friction grip bolts or body bound DIN Grade 8.8 bolts, nuts and washers. Galvanized bolts, nuts and washers are not acceptable. Jack screws shall be used where provisions for adjustment is required. After final alignment, welded on shear bars shall be installed. All shafts and drums shall be mounted on anti-friction bearings.

4.6.6 The drive mechanisms shall be driven by reducers, with the low speed shaft coupled directly to the drum by means of a flexible coupling. The coupling(s) connecting the wire rope drum(s) to the reduction unit (the gearbox) shall be by Malmedie or County approved equal, and specifically designed and rated for combined shear and torsional loads as evidenced by published catalog data and ratings. The high speed couplings shall be non greaseable type as approved by the County.

4.6.7 Motor brakes shall be designed to set automatically as a fail-safe system.

4.6.8 Magnetic brakes will not be accepted. Provide spring set thruster released disk brakes for all motor brakes. All motor brakes are to be by Pintsch-Bubenzer or County approved equal.

4.6.9 The drive mechanisms shall be designed to allow removal of motor brake disk and coupling, without moving the motor backwards, and without requiring the removal of the drums.

4.6.10 All drive mechanisms shall be located in the Machinery House. All drum drive mechanisms shall be mounted at or near floor level with convenient, safe access for maintenance and lubrication purposes. All exposed projecting moving parts shall be guarded in conformance with OSHA, using removable guards.
4.6.11 All drive mechanism components shall have been shop tested at the manufacturer’s facility to assure free running and alignment.

4.6.12 Oil drip pans provided for drive mechanisms and all other places shall be stainless steel.

4.7 MAIN HOIST MECHANISM

4.7.1 The Main Hoist mechanism shall be installed in the Machinery Room and shall consist of two (2) AC electric motors driving two (2) single layer grooved drums through a single main hoist reducer.

4.7.2 The Main Hoist shall be arranged inside a well-ventilated, weatherproof Machinery House. The Main Hoist machinery shall be mounted and fixed to a single rigid base floor frame in the Machinery House. The frame shall be designed, fabricated and constructed in a form to provide the required structural integrity for any vibration dampening of the main hoist and other system.

4.7.3 The single Main Hoist reducer shall be a completely enclosed helical gear reducer. All gears shall be splash-oil lubricated and run on anti-friction bearings.

4.7.4 Each hoist motor shall be connected to a disk brake with a spring set thruster and a flexible type coupling pressed and keyed directly to the reducer high speed shaft extension. The coupling shall allow removal of the brake disk without moving the motor backward.

4.7.5 The drive end of the drum(s) shall be directly connected to the low speed shaft of the reducer by means of a flexible coupling. The coupling(s) connecting the drum(s) to the reducer shall be manufactured by Malmedie or County approved equal, and specifically designed and rated for combined shear and torsional loads as evidenced by published catalog data and ratings.

4.7.6 Auxiliary, spring set, electro-hydraulic disk brake(s) as manufactured by Pintsch-Bubenzer or County-approved equal shall be provided on each main hoist drum to stop the descent of the load from over speed without any assistance from the motor and brake(s).

4.7.7 A self-aligning anti-friction bearing shall support the idler end of the drum.

4.7.8 The Contractor shall submit the proposed trim system and snag load protection system for the County’s review and approval.

4.7.9 Not Used.

4.7.10 Rope sheaves shall be mounted on anti-friction bearings, and the sheaves shall be provided with sturdy rope guards the same as used on the existing cranes at Port Miami.

4.7.11 A load limit device, i.e. load cell, shall be installed which limits the load carried by the main hoist.

4.7.12 After a Main Hoist fault due to an overload or snag, the hoist may be actuated only in the direction of “lowering”.

4.7.13 The highest and lowest spreader position shall be protected by an automatic control systems slow-down, and hardwired limit switches. The end positions will be approached at reduced speed. The load above the dock (quay) may be lowered from a predetermined height of 20 feet at an automatically reduced speed.

4.7.14 The spreader shall be interchangeable (quick change-out) with existing Port Miami spreaders for Cranes 11-16. That is, the number of pins and their connections, the signals and communications shall be matched to those in the existing spreaders to allow complete interchangeability.
4.7.15 Load sensors shall be provided to weigh the load being lifted, a digital readout of which shall be displayed in the Operator's cab and on the CMS system for viewing and report generation.

4.8 HOISTING ACCESSORIES

4.8.1 Twin-lift Separating Telescopic Spreader(s) and Overheight Adapters shall be provided with the purchase of the Cranes as specific herein. The Cranes must be designed and manufactured to be operated with these hoisting accessories. The provided spreaders and Overheight Adapters shall be interchangeable with the Port’s existing cranes 11-16, spreaders and Overheight Adapter; see reference spreader and Overheight Adapter drawings included in Section 9 of these Specifications.

4.9 TELESCOPIC SPREADER

4.9.1 The Contractor shall provide 8-Point Twin-lift Separating Spreader(s) as required with each Crane. It shall be the Contractor’s responsibility to insure that the Cranes shall be mechanically and electrically adaptable to the spreaders operation in single and twin-lift functions. The following features shall be provided with all spreaders;

- (a) Two (2) wire communication
- (b) Overheight adapter brackets the same as existing
- (c) ISO Floating Twistlocks
- (d) Automatic center housing positioning
- (e) Twin-lift detection/fall-away protection system
- (f) 316 Stainless Steel NEMA 4X junction boxes

4.9.2 The design of spreader(s) shall in all cases meet the requirements of this specification with particular emphasis on the fatigue design. The structure is to be design to withstand heavy shock loads and vibration that occur during container handling operations on the dock and ships. Provide heavy duty design for four (4) million cycles.

4.9.3 The Telescopic spreader shall have the capability to lift either one (1) 20ft, 40ft, 45ft or two (2) 20ft ISO Standard containers. The spreader shall be attached to the headblock of the main hoist by pins so that it can easily be exchanged for another existing spreader or other special hoisting accessories. The twin-lift housings fitted into the separating center housing twin-lift system shall be retractable when not in use from the operator's control console or from the ground control station.

4.9.4 The separating twin-lift housings shall be adjustable up to a maximum gap of 1.6 m (5'-0"). The gap shall be adjustable and set to an automatic distance from the operator's cabin or the ground control station.

4.9.5 The twin-lift housings shall slide vertically from the raised to the lowered position and shall be deployed before the spreader has landed when required. The twin-lift housing operation shall be disabled while the spreader is landed. The raising and lowering of each twin-lift housing shall be by an individual hydraulic cylinder.

4.9.6 All motions of the spreaders shall be controlled from the operator’s cabin and from the ground level control station. A master control disconnect switch to disable the spreader twin-lift housing operation (lower and raise) from operator's cabs on the trolley, shall be installed in the ground level control station.

4.9.7 There shall be provisions made for spreader functions/positions indicating lights on the spreaders, in the operator’s cabin, and in the ground control station as well as in the CMS. The spreader functions/positions indicating lights that shall be provided on the spreader are;

- (a) Blue light, twin-lift housing in lowered position,
- (b) Amber light, twin-lift housing in raised position,
- (c) Red light, twistlocks unlocked,
4.9.8 The indicating lights provided on the spreader shall be the same in appearance as used on existing Port Miami spreaders, see reference spreader drawing included in Section 9 of these Specifications. LED indicating lights with two-hundred seventy degree (270°) all around visibility may be used as approved by the County.

4.9.9 Section 5.33 provides specifications for indicator lights required in the operator’s cabin and at the Ground Level Control Station.

4.9.10 The spreader shall latch onto containers by means of hydraulically operated floating twistlocks which engage the corner castings of the containers. The design and fabrication of the individual twistlocks shall be in accordance with ISO industry standards and twistlocks in use on the Port’s existing spreaders. The twistlocks system shall incorporate a mechanical interlock (blockade) as well as an electrical interlock, which shall use limit switches for the seated position detection and twistlock positions. This system shall prohibit the twistlock actuation until all four corners are completely seated under a single lift mode and all eight corners seated under the twinlift mode of container(s).

4.9.11 Each outer corner of the spreader shall be fitted with an actuator/rotary vane motor operated gather guide (flipper). The aligning arms shall be of replaceable type and provide a gathering capacity of 150mm in any direction. Actuators/rotary vane motors shall drive the gathering guides enabling easy and fast location of the spreader onto containers. The gather guides shall be retractable into the plane of the spreader to enable it to be lowered into the cellular guides of the ship’s cargo hold below deck. The gather guides shall be operated in pairs; waterside and landside paired.

4.9.12 The telescopic system shall provide a positive stop location on centers for 20’, 40’, and 45’ containers under single lift mode and twin-lift modes. The telescopic system shall be driven by a hydraulic motor connected to a chain that is stopped in position by a proximity sensor (as manufactured by Omron) and fixed stops. The draw bars shall be fitted to absorb shock loads. The telescopic system drive chain shall be vertically mounted.

4.9.13 The spreader shall have a blockading system to prevent telescoping in a single lift mode if the twistlocks are locked or if the four (4) landed pins are in the “up” position.

4.9.14 The electrical control junction box shall be located on the top of the spreader in line with the access hatch on the Headblock floor: the same as on the existing Port Miami Cranes 13-16 headblocks (see attached drawing J514A1300 in Section 9, POM2). The electrical control junction box shall be accessible from dock level stepping up the spreader ladder to the headblock deck floor and opening the floor hatch. All electrical and control systems and components design, fabrication, installation and operation shall comply with the electrical requirements as set forth in Section 5, Electrical Specifications.

4.9.15 The outer vertical corners of the end beams shall be fitted with steel wear plates to protect the gather guides actuator motor. Pad eyes shall be provided adjacent to the inside of each corner housing and be rated at 12.5 LT each and on the outside of the main spreader frame corners. Access holes shall be provided in all twistlock housings the same as on Port Miami spreaders Z28 – Z34.

4.9.16 All limit/proximity switches shall be of the same type, brand and model number as currently in use on the existing Port’s spreaders. A height sensor shall be provided with each spreader.

4.9.17 All spreader hydraulic and electrical components shall be of the same type, function and brand as currently used on the Port’s existing spreaders; such as switches, electric panels, fuses, breakers, wiring, connectors, valves, actuators, lights, etc. A component list shall be submitted for review and approval by the County.

4.9.18 The existing Port Miami spreader stops, centerline to centerline of twistlocks, are set at; 19’2-7/16” for 20’ container, 39’3-7/8” for 40’ container, and 44’3-7/8” for a 45’ container.
4.9.19 Spreader communication by way of spreader power cable shall be the same as existing on Port Miami Cranes 13-16.

4.9.20 Center Twistlock housings shall be reinforced the same as the corner housings so the structure cannot be easily damaged. Thicker plate steel, minimum of ½” shall be used on the outer surfaces of the housings, corner and center.

4.9.21 Feeler pin sleeves and twistlock mounting plates shall be reinforced and details submitted to County for review and approval.

4.9.22 All twistlock mechanism parts and components to including plungers shall properly greased prior to assembly and as part of the preparations for shipping to Port Miami.

4.9.23 Biodegradable hydraulic fluids/lubricants shall be used.

4.10 CARGO (HOOK) BEAM

4.10.1 The cargo (hook) beam capacity for design shall be 100 LT.

4.10.2 No cargo beam is required with the initial order (base bid).

The existing cargo beams for Port Miami cranes 13-16 shall be used with these newer cranes for testing and certification purposes.

4.11 BOOM HOIST

4.11.1 The boom shall be capable of being raised and lowered by means of two (2) wire ropes each reeved with multipart reeving. Each rope shall be fixed to an equalizer beam mounted on the waterside pylon (apex) atop the cross tie beam. If one (1) of the ropes should fail, the boom shall be supported by the other rope.

4.11.2 The raised boom shall be drawn against plastic buffers by the luffing ropes, and when in its end position automatically latched to the top of the pylon.

4.11.3 In the lowered position, the boom shall be supported from two (2) separate forestay tie links so that the wire ropes are load free. The bearings on the tie links’ pins shall conform to these specifications bearing criteria.

4.11.4 The Boom Hoist drive mechanism shall be installed in the Machinery Room and shall consist of an AC electric motor driving a single layer grooved drum through an enclosed helical gear reduction unit, reducer. The drive end of the drum shall be directly connected to the low speed shaft of the reduction unit by a Malmedie drum coupling, or County-an approved equal, specifically designed and rated for combined shear and torsional loads as evidenced by published data and ratings. The idler end of the drum shall be supported by a self-aligning anti-friction bearing. A spring set thruster released Pintsch-Bubenzer disk brake, shall be mounted between the motor and the reduction unit with a Pintsch-Bubenzer, or County approved flexible type coupling pressed and keyed directly to the reduction unit high speed shaft extension. The coupling shall allow removal of the brake disk without moving the motor backward.

4.11.5 A spring set/electro-hydraulic release auxiliary boom hoist drum disk brake same type as Main Hoist auxiliary brake, as manufactured by Pintsch-Bubenzer or County-approved equal shall be provided to stop the descent of the boom at any point in its travel from over speed without any assistance from the motor brake.

4.11.6 The welded or bolted rope drum shall have grooves machine cut from solid reels to permit the ropes to lay in one layer. Three dead wraps of each rope remain on the drum at the lowest hoist position for fastening the ropes to the drum. Furthermore, one empty winding shall be provided at the full end of the drum for rope stretch. Lebus systems are not acceptable.
4.11.7 The permissible drum speed is controlled by a centrifugal switch cutting off the electric motor when the speed is excessive, (i.e. exceeds one hundred ten (110) percent).

4.11.8 The rope sheaves shall be mounted on anti-friction bearings and the sheaves shall be provided with sturdy rope guards.

4.11.9 The boom hoist shall be equipped with slow-down and limit switches for either end position. The slow-down switch reduces the speed when approaching the end position. The boom hoist slow-down period shall not be less than three (3) seconds.

4.11.10 Raising and lowering of the boom shall be performed from a boom operation station, an enclosed cabin, on top of waterside cross girder. The boom operation station shall be positioned in such a way, that the boom and latches can be clearly seen during boom operation.

4.12 BOOM LATCH MECHANISM

4.12.1 The container Crane(s) shall be equipped with a boom latch mechanism which will hold the boom when the boom is in the “boom up” latched position.

4.12.2 The boom latch shall be controlled from the Boom Operator’s Station located on top of the waterside cross girder. The boom latch shall be fitted with interlocks and other safety devices.

4.12.3 The boom latch shall have positive engagement.

4.12.4 The boom latch shall be automatic. This means that the boom can be raised into a latch which is in the “latched” position (the latch hooks are down), override the latch (the latch hooks lift), the boom reaches it’s upwards most position, and then the latch lowers back down on to the boom latch pins into the “latched” position, engaging the boom; the boom then eases down minimally slowing onto being suspended from the lower latches.

4.12.5 The latch shall be failsafe. This means that:

   a) a latch cannot be forced into the “unlatched” position when the weight of the boom is on the latch, and,
   b) loss of power causes the latch to go to the “latched ” position.

4.12.6 The latch shall be designed in accordance with FEM. If the latch is shaped like a hook, then classical curved bar theory shall be used (reference: Timoshenko, "Strength of Material, Part I).

4.12.7 The boom latch shall be accessible for maintenance and lubrication; such access shall fully comply with OSHA requirements and this specification. The boom latch shall be equipped for manual operation with the use of the counter balanced weights.

4.12.8 The proposed boom latch system and thrusters shall be as approved by the County.

4.13 MAIN TROLLEY GENERAL REQUIREMENTS

4.13.1 The Main Trolley shall consist of a rigid steel trolley frame as required herein supported on four (4) steel wheels and carrying the load sheaves. The trolley shall have a suspended Operator’s Cabin.

4.13.2 The Spreader Cable Reel shall be located on the Main Trolley.

4.13.3 To facilitate the removal or insertion of parts and components, the Main Trolley shall be positioned below the Machinery Room service hatches.
4.13.4 In addition to the basic features described above, the Main Trolley shall be equipped as follows:

a) A single umbilical cable, AC motor driven cable reel to power and control the spreader.
b) A non-powered festoon system for trolley power and control as specified.
c) Operator’s cabin shall be fabricated of steel and insulated as required herein.
d) Trolley bumpers, hydraulic-pneumatic type, as manufactured by Oleo.
e) A stowed position locking device as specified herein.
f) Safe access.
g) Integral jacking feature(s) to support the trolley at any point of its travel for wheel replacement. Provisions shall be made for convenient wheel replacement. Wheel/axle assemblies and sheaves are readily removable upward. Drop blocks, with 25mm (1") gap between the bottom of the block and the top of the trolley rail, shall be provided to support the main trolley if an axle brakes.

4.13.5 The Main Trolley and Cab shall be fully accessible at any location of the Main Trolley’s travel. Access shall be such that a disabled operator can be removed without special rigging.

4.13.6 Except for rope openings, the Main Trolley shall be completely decked with steel grating and shall be enclosed with hand rails with kick plates. All openings shall be curbed with kick plates as required by OSHA or at least 100 mm high. All Trolley mechanical and electrical parts shall be safely accessible for maintenance and replacement from within the hand rails.

4.13.7 Access platforms shall be provided at the waterside end of the boom and landside end of the trolley girder to provide safe maintenance access to the main trolley and components.

4.14 MAIN AND CATENARY TROLLEY DRIVE MECHANISMS

4.14.1 The Main and Catenary Trolley drive systems shall be rope towed type. The Catenary Trolley shall be rope towed driven from the Main Trolley. The proposed Catenary Trolley rope towed system shall be submitted to the County for review and approval prior to final design review.

4.14.2 Each Trolley shall be driven by two sets of wire ropes. The Main Trolley drive shall consist of an AC electric motor driving a single layer grooved drum(s) through an enclosed helical gear reduction unit. The drive end of the drum(s) shall be directly connected to the low speed shaft(s) of the reduction unit by a County approved flexible drum coupling(s), specifically designed and rated for combined shear and torsional loads as evidenced by published data and ratings. The idler end of the drum(s) shall be supported by self-aligning anti-friction bearing(s). Flexible coupling(s) shall be used to connect the motor shaft to the reduction unit high-speed shaft.

4.14.3 A County approved spring set thruster released caliper disk brake, capable of decelerating the fully loaded trolley from full speed shall be provided. The brake disk hub shall be pressed and keyed directly to one end of the reduction unit high-speed shaft extension. If the brake is mounted between the motor and the reduction unit, a County approved, flexible coupling shall be used and the coupling shall allow removal of the brake disk without moving the motor backward.

4.14.4 The wire ropes shall be located as closely as possible to the trolley wheels to minimize skewing of the trolley. Rope and all drive equipment shall be sized for reversing loads. A rope-tensioning device configured to avoid reverse bending of the ropes, shall be furnished and installed to maintain proper rope tension during normal operation of the Crane. The tensioning device shall utilize sheaves at trolley end of travel position to avoid introduction of additional rope bends. The additional rope forces forthcoming from the tensioning device shall be considered in the rope sizing. Trolley drive machinery shall be located in the Machinery House on machined mounting surfaces. Machinery and equipment shall be arranged to be easily accessible for maintenance.
4.15 MAIN TROLLEY & CATENARY TROLLEY ROPE TENSIONING DEVICES

4.15.1 Independent rope tensioning devices shall be provided for each the Main Trolley and Catenary Trolley rope systems. The tensioning devices shall be configured to avoid reverse bending of the ropes, and shall be furnished and installed in the backreach or as approved by County to maintain proper rope tension during normal operation of the Crane.

4.15.2 The power unit for the tensioning devices if hydraulically operated may be incorporated into the snag protection system, described in Section 4.16.

4.15.3 The tensioning devices shall utilize sheaves at trolley end of travel position to avoid introduction of additional rope bends. The additional rope forces forthcoming from the tensioning device shall be considered in the rope sizing.

4.16 SPREADER TRIM, LIST AND SKEW ADJUSTMENT

4.16.1 The Crane shall be provided with a mechanism to adjust the Trim of the spreader longitudinally to plus or minus five degrees (±5°) from horizontal plane, and, a List and Skew mechanism which shall be adjustable to plus or minus 3.5 degrees (±3.5°) of the spreader longitudinally in the vertical plane. This mechanism shall be provided with an indicator in the operator's cabin which indicates the mid-point and the maximum travel positions in either direction. The mechanism shall be provided with a positive means to operate and maintain the selected spreader position under all operating conditions, including the hoist stall condition. A control shall be provided to home (re-center trim) the spreader automatically.

4.16.2 The Contractor shall suggest the best method(s) for estimating these angles during operation in the operating instructions.

4.16.3 The system's mechanism shall be mechanical, hydraulic with electric motors located at the girder end of the backreach which mechanism shall limit the trim, list and skew angle to the maximum limits indicated above. In addition, overtravel limit switches shall be provided for each of the mechanism's motions.

4.16.4 The installation shall be complete with all stops, limit switches, interlocks and other safety devices required for a fail safe operation.

4.16.5 The Contractor shall provide arrangement, detail drawings and calculations of the trimming, list and skew concept to the County for review prior to finalizing the Cranes' design.

4.16.6 The Crane operator shall only have capability to adjust the spreader's trim. The list and skew functions shall available on the operator's chair console but the switch(es) shall be locked for use by maintenance personnel only.

4.16.7 The Trim, List and Skew mechanism shall be designed to provide the necessary speed and acceleration for the profiling/landing system to operate properly when the crane is in the automatic mode of operation.

4.17 SNAG LOAD PROTECTION

4.17.1 An efficient, energy absorbing snag load device shall be provided. The device shall incorporate hydraulic cylinders supporting main hoist sheaves mounted on pivoting arms at the main girder backreach to absorb the energy of a snag load. The intent is to prevent damage to any part of the Crane, if the empty or loaded spreader is suddenly stopped such as would occur, if, at full hoist speed, the spreader contacts the underside of a vessel's hatch girder. This device must be instantaneous, acting prior to activation of any overload or over current limits. The device shall be continuously re-settable from the electrical control room without requiring maintenance personnel to adjust or reset any device on the snag load equipment. The system shall incorporate dual (redundant) hydraulic pumps and motors. The installation shall be
complete with all stops, limit switches, interlocks and other safety devices required for safe operation.

4.17.2 The hydraulic system shall be a closed system properly designed to prevent accumulation of moisture in the system and resulting corrosion in the cylinders and other components. Hydraulic cylinder rods shall be stainless steel. The low pressure piston side of the hydraulic cylinder shall be oil filled and isolated from the ambient environment at all times.

4.17.3 In lieu of hydraulic cylinders, other types of mechanical energy absorbing systems may be proposed for the County’s review and approval. The Contractor shall provide a technical description of his proposed snag load system for approval by the County prior to design and installation.

4.17.4 The snag system area shall be fitted with platforms and ladders to allow safe access to all components’ location by maintenance personnel.

4.18 TROLLEY BUMPERS

4.18.1 Bumpers shall be provided at each end of the trolley. Stops of sufficient energy absorbing capacity to stop a loaded trolley when traveling at full speed with the power off shall be fitted at each end of the Trolley runway. The bumpers shall have sufficient energy absorbing capacity to stop the trolley, without overstressing or damaging the stops, bumper supports, trolley, or, boom structure. The weight, inertia and other applicable loading criteria of the suspended rated load shall be considered in the total mass being stopped.

4.18.2 Bumpers shall be hydraulic-pneumatic type as manufactured by OLEO or County approved equal. No rubberized material is accepted.

4.18.3 Regardless of bumper selection, the maximum deceleration rate shall not exceed 16 feet per second squared (16 ft/s²) when impacting at the maximum capable specified speed.

4.18.4 The centerline of trolley bumpers shall be located as close as practical to the elevation of the center of mass of the complete trolley.

4.18.5 Bumpers shall meet the applicable provisions of AISE and CMAA Specifications.

4.19 TROLLEY WHEEL AND RAIL SYSTEM

4.19.1 The Trolley rails shall be installed on the sides of the boom, as low to the bottom edge as structurally feasible. An additional ten (10%) percent of safety factor above the required by applicable code(s), shall be used in the design and fabrication of the rail support structure on the boom.

4.19.2 The Trolley rails shall be of a rail section with robust web thickness such as DIN 536 type A or County approved equivalent. Trolley rails shall be supported by a continuous web centered under the web of the trolley rail. The Contractor shall specify squareness tolerances of the rail cross-section and tolerances for the flatness of the rail mounting plate. Calculations of rail web and support web stresses, based on the tolerances, and inspection procedures for maintaining the tolerances shall be submitted for the review by County. Continuous reinforced rubber bearing pads under the rails shall be provided as manufactured by Gantrex or County approved equal, except at the boom hinge where steel bearing pads shall be provided. The rubber pad shall be made from a synthetic elastomeric resistant to wear, crushing, shear, grease, oil and ultraviolet exposure and reinforced with a high strength galvanized steel strip. The steel strip shall be at least 90% of the width of the pad and fully vulcanized to the rubber. The pad shall have an edge seal on both the top and bottom surfaces to prevent the ingress of water and dirt.

4.19.3 No welded joint of trolley rails is permitted within six (6) meters of boom hinge point. The Trolley short rails shall be continuous stock rail as approved by the County and not less than
five (5) meters (16ft – 5in). Special attention shall be given to the short rail section near the boom hinge point as well as with the shear blocks, bolts and bolting pattern and the rail pad joints shall be five (5) meters (16ft – 5in) from each side of the boom hinge.

4.19.4 Trolley rails shall be secured with weldable rail base clips and hex head galvanized bolts, as manufactured by Gantrex or County approved equal. Sufficient clearance shall be provided from the edge of the rail clamp and the main girder or boom structural welds and web plates to provide for weld separation and water drainage. The rail clip weld shall not contact any structural welds. Rail base and mounting surface shall be painted before installation. Trolley rail sections shall be joined by full penetration welding and rail joints shall be staggered from side to side. No bolted joints will be allowed to join rail sections. Rail runs shall be secured against axial movement. Details of the securing method shall be submitted to County for review.

4.19.5 The rail joint at the boom hinge shall be configured (interlocked) to provide a smooth transition with long life. The design shall be submitted to County for review.

4.19.6 Drain holes no less than 50mm (2") diameter and spaced no more than 6 meters (20') apart, shall be provided between the trolley rail and boom and girder webs for plates for water drainage.

4.19.7 The Contractor shall provide all information necessary for County to replace the entire or section of the trolley rail in the Maintenance and Inspection Manual. This information shall include, as a minimum, the tolerances for the flatness of the trolley rail bed, the required trolley rail cross section with the tolerances, any heat treating requirements and the procedure for the heat treatment, the hardness requirements including the depths and tolerances, and the procedures (including any pretreatment, the welding method or technique, and materials) for welding and grinding the trolley rail joints and for welding the trolley rail to the trolley rail bed.

4.19.8 The Trolley wheel and rail system shall be designed to eliminate jamming, binding, and excess skew and to minimize chatter, banging, excessive flanging, and bumping. Trolley wheels shall be adjustable. Fixed wheels are not acceptable. Smooth, low friction, low vibration trolley travel is required.

4.19.9 The Trolley wheels shall be arranged so that the load on all four (4) wheels is equal under static and dynamic rated load conditions.

4.19.10 Wheel centers (wheelbase, parallel to the direction of travel) shall be as far apart as practical to provide a smooth as possible ride, and to minimize the effects of skewing.

4.19.11 The Trolley shall be built to ensure protection against the trolley falling from the Crane in the event of derailment, a broken wheel or axle.

4.19.12 The Trolley guide side rollers shall be mounted at the four (4) corners of the Trolleys. The guide rollers shall rotate about a vertical axis and bear against the inside of the Trolley railhead. The guide rollers shall be designed and installed in a manner that will prevent derailment by having the rollers bear against the rail. The guide roller assembly shall be eccentric aligned and adjustable for Trolley alignment.

4.19.13 The Main and Catenary Trolley wheels and axle assemblies shall be arranged to permit easy removal and replacement for maintenance.

4.20 WIRE ROPE RE-REEVING WINCH

4.20.1 A self-contained motor driven wire rope re-reeving system shall be provided in the Machinery House and shall be arranged to allow convenient re-reeving of the Main Hoist, Boom Hoist, Main Trolley and Catenary Trolley drive ropes during routine rope replacement.
4.20.2 The system shall consist of two (2) identical devices; one to pay out the new rope and one to take up the old rope. Each device shall consist of a winch with variable speed AC drive individually controlled from a pendant.

4.20.3 An access system consisting of platforms and ladders shall be provided to assure safe and convenient access of the re-reeving device for rope setup and maintenance.

4.20.4 The winches shall be equipped with steel reels of a capacity adequate for the size and lengths of the ropes used individually in all the different wire hoist systems and shall have the capability to accommodate regular commercial cable reels.

4.20.5 The re-reeving device shall be located so that the steel wire cable spools can be easily handled (removed and replaced) and installed by the Machinery Room overhead service crane.

4.20.6 Each winch shall give adequate attention to safety and each motor shall include an integral disk brake.

4.20.7 The re-reeving devices shall be located so that the cable spools can be easily handled and installed by the Machinery Room overhead service crane. Hand-applied brakes are not permitted.

4.20.8 Each of the re-reeving winch devices shall be individually fitted with a pendant control with a removable 50 feet cable to allow safe positioning of the re-reeving winch operator close to the hoist, trolley or boom hoist mechanism. The pendant cable shall have a plug at the end for easy connection to the winch device. The pendant shall be removed and stored on a reel in a cabinet in the Machinery House.

4.20.9 A proper sized cable hanger shall be provided for each cable and pendant near the winch device for temporary storage as approved by the County.

4.21 **MAIN TROLLEY STOWAGE**

4.21.1 The Main Trolley shall be equipped with a stowed position-locking device able to withstand maximum wind conditions which device will secure the Trolley to a fixed position when out of service.

4.21.2 This stowed position-locking device may be similar to the gantry travel stowage pins or may be of a different configuration. In any case, it shall be positive, fail safe, and interlocked with the Trolley drive.

4.21.3 The location of the Main Trolley stowed position shall permit entrance and exit from the operator's cab on to the Main Trolley access platform. This stowed position shall also permit lowering of the spreader and head blocks to the wharf's deck. The stowed position shall be equipped with a limit switch to permit boom operation.

4.21.4 The normal route for access to the Main Trolley shall be located at the Main Trolley stowed position via the Main Trolley access platform.

4.22 **MISCELLANEOUS MAIN TROLLEY PROVISIONS**

4.22.1 The Main Trolley shall permit emergency egress and access from any location on the Boom and Main Girder. Access and egress provisions are to be submitted and approved by the County.

4.22.2 The Main Trolley frame shall be fully decked with suitably designed grating except as required for penetrations, and shall be fully equipped with guard rails (hand rails) as required by specified safety codes. All parts of the trolley shall be readily accessible for maintenance and lubrication; such access shall fully comply with OSHA requirements.
4.22.3 Service platforms shall be provided in accordance with OSHA standards to all serviceable equipment to include but not limited to the operator's cabin, under boom and main girder flood lights, main hoist sheaves, load cells and trolley drive mechanism.

4.23 **MAINTENANCE HOIST - MANUAL/JIB**

4.23.1 Maintenance hoists shall be installed at all locations above the portal beam where servicing of heavy items weighing more than 50 pounds, including sheaves, wheels, hydraulic cylinders, anti-snag cylinders, A/C outdoor units, A/C indoor units, hydraulic power units, electrical transformers and similar electrical components, emergency brake calipers and similar mechanical units, will be required. Each maintenance hoist shall have capability to remove the item and transfer it directly to the ground, Machinery House and/or to the trolley where it may be lowered to the ground with the overhead service crane in the Machinery House.

4.23.2 A minimum of six (6), manual, 500 lbs. minimum working capacity jib or monorail type maintenance hoists shall be installed;
   a) one (1) at the apex of the waterside pylon,
   b) one (1) to remove/replace boom hoist sheaves on Boom,
   c) one (1) above the trim platform,
   d) one (1) above the Trolley in the backreach position,
   e) one (1) in the ceiling of the A/C air handler room above the drives room, and,
   f) one (1) at the A/C condensers/compressors area.

4.23.3 A detachable manual block and chain fall shall be provided at each location. The apex hoist shall be designed to enable lifting components from the main girder and trolley structure to the apex access platform surface. The trim, list and skew platform hoist shall be designed to enable lifting components from the trim platform level to the main girder and trolley structure. The trolley hoist shall be designed to service and maintain the Main and Catenary trolleys and lifting system components.

4.23.4 A manual jib and/or monorail type maintenance hoist shall be provided at the snag-load, trim, list, skew and rope tensioning equipment. The hoist location and configuration shall be designed to enable lifting any of the snag-load or tensioning device components and lowering to the main girder and trolley structure.

4.23.5 Manual jibs shall be provided at other locations as required for servicing of heavy components (sheaves, wheels, hydraulic cylinders, anti-snag cylinders, etc.).

4.23.6 The location, design, calculations and components of the hoists shall be submitted for review and approval by the County.

4.23.7 For monorail beam type hoist a County approved trolley with properly sized wheels and pad eyes shall be provide. All jib type hoist shall have the capability to rotate 360 degrees and be supplied with a properly sized County approved pad eye.

4.24 **MACHINERY HOUSE, ROOMS AND CABINS VENTILATION AND AIR CONDITIONING**

4.24.1 All heating, ventilation, and air conditioning criteria shall comply with the standards as set by American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) and all other codes and standards to include NFPA and SMACNA. Refrigerants used in heating, ventilation, and air conditioning units shall comply with latest US environmental standards and codes.

4.24.2 All habitable houses, rooms and cabins shall be ventilated as required by the US codes and standards, including but not necessarily limited to the Florida Building Code, Fifth Edition (2014). The Machinery Room and Boom Hoist Operator's Cabin shall be ventilated from ambient atmosphere. The Crane Operator's Cabin, Control Room, Dock Level Monitoring Station and the Drives Room shall be ventilated by air conditioning systems.
4.24.3 The Machinery Room shall be adequately ventilated by fans to match the required climatic temperature conditions of Section 2.5. The fans shall provide n+1 redundancy, i.e., they shall be connected such that in the event of a failure of one unit, the other(s) will continue to satisfactorily ventilate the space. The fans shall be thermostatically controlled and shall automatically switch on when the power to the machinery is on. The fans shall draw in outside air through MERV 8 filter and shall pressurize the houses.

4.24.4 The fan and inlets shall be of sufficient capacity to change the air in the house as required by ASHRAE. Additionally, the fans shall provide adequate ventilation to maintain the temperature in the house five (5) degrees above ambient, with all machinery and heat generating equipment in the house operating.

4.24.5 Fan inlet opening shall have rain hoods with backdraft louvers made of stainless steel. The hoods shall be designed to incorporate replaceable air filters. All louvers must have manual locks for hurricane wind conditions. All louvers shall have a Miami-Dade County Notice of Acceptance. The notice of acceptance shall include small missile impact acceptance. The notice of acceptance shall also confirm compliance with water intrusion requirements. The Contractor shall assure the fan inlets do not allow entry of moisture into the houses.

4.24.6 No roof mounted ventilation or air conditioning systems are permitted.

4.24.7 Split-system air-conditioning and heat-pump units with separate horizontal split evaporator coil, evaporator-fan and compressor-condenser components shall be provided for the Control and Drives Room. The components shall be of galvanized-steel to include the chassis and drain pan, insulated, with copper-tube refrigerant coil, forward-curved galvanized fan, multispeed motor, Electric Heating Coil and high efficiency disposable filters. The system shall be capable of re-circulating the inside air and control outside air usage.

4.24.8 The basis of design for split-system air conditioning for the Control and Drives Room shall be the Liebert DS Series as installed on Port Miami cranes 13-16 and housed within the E-House HVAC Room. Any changes from these units will require County approval. These systems shall be installed in quantities of three (3) per crane (minimum) and shall be configured to provide n+1 redundancy for the cooling of the Control and Drives Rooms. Indoor units shall be self-contained, factory-assembled units with downflow air delivery. The system shall have a net total cooling capacity meeting the requirements of the heat load calculations.

4.24.9 The frame shall be MIG welded, formed sheet metal. It shall be protected against corrosion using an autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces. The exterior panels shall be insulated with a minimum 1 in. (25 mm), 1.5 lb. (0.68 kg) density fiber insulation. The main front panel shall have captive 1/4 turn fasteners. The main unit color shall be gray.

4.24.10 The system airflow shall be downflow. The supply air shall exit from the bottom of the unit with the air scrolled towards the front of the unit. The return air shall enter the unit from the top.

4.24.11 The filter chamber shall be located within the cabinet, and filters shall be removable from the top of the unit. Filters shall be arranged in a V-bank configuration. Filters shall be deep pleated 4" filters with an ASHRAE 52.2 MERV11 rating (60-65% ASHRAE 52.1). Provide 2" prefilters: ASHRAE 52.2 MERV7 (40% ASHRAE 52.1). One extra set of filters shall be provided with each system.

4.24.12 The blower section shall be designed for the CFM required by the load calculation, at the installed system's calculated external static pressure, but no more than 1.5 in. wg. (Pa). The fans shall be the centrifugal type, double width double inlet and shall be dynamically balanced as a completed assembly. The shaft shall be heavy duty steel with self-aligning, permanently sealed, pillow block bearings with a minimum L3 life of 200,000 hours. A static regain duct shall be factory-installed to the bottom of the blower. The blower fan motor
shall be sized as required by the system total static pressure at 1750 RPM @60hz and shall be mounted to an automatic, spring-tensioning base. The motor shall be removable from the front of the cabinet. The motor shall be totally-enclosed fan cooled. The motor sheave and fan pulley shall be double-width fixed pitch. Two belts, sized for 200% of the fan motor horsepower shall be provided with the drive package. An auto-tension system shall provide constant tension on the belts. Belts, shaft, blower bearings, sheave and pulley shall be warranted for five years. The fans shall be plug/plenum type, single inlet and shall be dynamically balanced. The drive package shall be direct drive, electronically commutated and variable speed. The fans shall be located to draw air over an A-frame coil.

4.24.13 The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification. The electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches, and shall be of adequate size to provide the necessary temperature control when the unit is in dehumidification mode. The unit shall operate in three stages. The reheat elements shall be removable from the front of the cabinet.

4.24.14 The systems shall be equipped with two (2) independent refrigeration circuits and shall include hot gas mufflers, liquid line filter driers, refrigerant sight glass with moisture indicator, externally equalized expansion valves, and, liquid line solenoid valves. Compressors shall be located outside the airstream and shall be removable and serviceable from the front of the indoor unit. The compressors shall be scroll-type with a variable capacity operation capability. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer, and a maximum operating speed of 3500 RPM.

4.24.15 The evaporator coil shall be A-frame design with offset orientation and have a maximum face area so as to accommodate the required air flow rate with a maximum face velocity of 450 cfm per sq. ft. The coil shall be three rows deep. It shall be constructed of rifled copper tubes and aluminum fins. A stainless steel condensate drain pan shall be provided. The coil shall be coated with a high performance polymeric coating process to provide corrosion resistance within 2 to 12 pH range.

4.24.16 The system shall be designed for use with R-407C refrigerant.

4.24.17 The control system shall be the Liebert iCOM system and shall be factory-set for Intelligent Control, which uses “fuzzy logic” and “expert systems” methods. Proportional and Tunable PID shall also be user-selectable options. Internal unit component control shall include the following: Compressor Short Cycle Control, System Auto Restart with programmable time delay, Sequential Load Activation with a minimum of one second delay to minimize total inrush current, Predictive Humidity Control to calculate the moisture content in the room and prevent unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature.

4.24.18 The Liebert iCOM control processor shall be microprocessor based with a 128x64 dot matrix graphic front monitor display and control keys for user inputs. The display and housing shall be viewable while the unit panels are open or closed. The controls shall be menu-driven. The display shall be organized into three main sections: User Menus, Service Menus and Advanced Menus. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus, which include the factory settings and password menus.
4.24.19 Each air conditioning unit shall be provided with a Liebert Model SNMP interface card to permit remote network control. In addition, the aggregate system of three (or more) air conditioners shall be provided with one Liebert Model NVSA network switch. This switch shall be linked to the balance of the Liebert control system by way of Category 5e cabling and shall be programmed to provide lead/lag functionality as well as n+1 redundancy functionality for all the units. The Liebert network components shall be programmed so as to allow County personnel to access the air conditioning control system remotely via the fiber optic cabling that forms an integral part of the crane trailing cable. The access shall be passworded and shall be configured to provide complete control, alarm, and trouble functions to/from the remote station(s). The lead/lag control shall be programmed to cycle the units every twenty four hours during no Crane work periods.

4.24.20 In addition, to providing alarm and trouble functions at the remote station, the system shall be configured to close normally-open relays for the purpose of illuminating the blue light in the crane’s warning light system. Refer to Fire Detection and Warning System specified herein below.

4.24.21 The system shall be equipped with the following features: Disconnect Switch, High Temperature Sensor, Smoke Detector to immediately shut down the environmental control system and activate the alarm system when activated, Dual Float Condensate Pump, with a minimum capacity of 145 GPH (548 l/h) at 20 ft. (58 kPa) head. Condensate Pump shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition, Main Fan Overload, and Compressor Overload alarms.

4.24.22 Condenser Units shall have 360 degree access and shall have a minimum of 900 mm (3’-0”) clearance all around for ease of maintenance.

4.24.23 Air-Cooled Condenser shall be manufactured by Liebert and shall be the low profile, multiple direct drive, propeller fan type. The condenser shall balance the heat rejection of the compressor at 97 °F ambient. The condenser shall be constructed of copper and contain a copper tube, copper fin coil arranged for vertical air discharge. The condenser shall be equipped with variable frequency drive control. The fan motors shall have ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 RPM. The control system shall be complete with transducers, thermostats and electrical control circuit, factory prepackaged in the integral condenser control box. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air-cooled condenser to properly maintain the head pressure. The Fan Speed Control system shall provide positive startup. Condenser shall be equipped with factory installed disconnect switch.

4.24.24 The diffusers and grilles to the Drives Room shall be overhead away from any of the electrical panels and components as approved by the County. Air conditioning and ventilation system located above drive panels in the Drives Room shall be configured to assure no condensation can drip from the system on electrical panels.

4.24.25 The Drives Room ventilation system shall be configured so that the heat from the drives is drawn into the air conditioners’ return air stream before it has an opportunity to mix with the cold supply air. Supply air shall enter the room in the center; return air shall rise into the return air plenum at the perimeter. The supply air shall, as closely as possible be configured in a cold aisle/hot aisle arrangement as required by the equipment manufacturer. Return air grills shall be installed overhead. This ventilation system shall have the components to be able to properly balance the air flow by way of manual dampers.

4.24.26 Metal ducts for supply, return, outside, and exhaust air-distribution systems shall have rectangular ducts and fittings double-wall with duct liner (internal insulation) and formed fittings. The ducts shall have dampers, silencers, turning vanes, duct-mounted access doors. All metal parts and components shall be Galvanized steel construction.

4.24.27 The Contractor shall be responsible for testing, adjusting, and balancing air distributions, measuring electrical performance of HVAC equipment, setting quantitative performance of
HVAC equipment, verifying automatic-control device functions, measuring sound and vibration, and reporting results of activities and procedures as required herein and all applicable codes and standards.

4.24.28 Submittals shall be provided and shall include: Single-Line Diagrams; Dimensional, Electrical and Capacity Data; Piping and Electrical Connection Drawings.

4.24.29 The indoor air conditioning systems (the Liebert DS Series system) for the drives room and the control room shall be installed above the Drives and Control Room in the E-House HVAC Room. The room shall be configured as a return air plenum, with the minimum possible pressure differential between the drives room and control room spaces and the return air plenum itself. To minimize unwanted air infiltration into this negative-pressure return air plenum, the control room/drives room and return air plenum envelope shall be sealed against unwanted infiltration. The completed building shall be tested and the leakage rate of the building envelope shall not exceed 0.4 cfm per square foot at a pressure differential of 0.3 inches water gauge, in accordance with ASTM 779.

4.24.30 The Control and Drives Rooms' air conditioning cooling systems shall be designed to maintain 72 °F and 50% relative humidity under all outside Tropical weather conditions, to include 97 °F outdoor temperature, under conditions of maximum solar heat gain and 100% outdoor relative humidity and maximum equipment heat output.

4.24.31 The Control and Drives Rooms' air conditioning heating systems shall be designed to maintain minimum inside temperatures of 70 °F with an outside temperature of 30 °F and 30 mile per hour winds.

4.24.32 The Operator's Cabin and Dock Level Monitoring Station Cabin shall be equipped with the required thru wall air-conditioning unit(s), as approved by the County. Power for the air conditioning shall come from the same circuit as used for each enclosure's lighting and power.

4.24.33 Air-Cooled Units, 1 to 5 Tons shall consist of the following:
  a) Condenser: Copper-tube, aluminum-fin coil with liquid subcooler.
  b) Condenser Fan: Direct-drive, propeller.
  c) Accessories: Low-voltage thermostats and subbase, precharged and insulated refrigerant tubing, low-ambient kit, crankcase heater, automatic reset timer, and PE mounting base.
  d) Casing: Steel.

4.24.34 Air conditioning equipment and associated electrical controls shall be of U.S.A. Manufacturer or as approved by the County.

4.24.35 The Operator's Cabin, Drives Room, Control (CMS) Room and Dock Level Monitoring Station shall be fully insulated and weather sealed (provided with air barrier) in accordance with the Florida Building Code – Energy Conservation 2014 Edition. Submit blower tests for approval.

4.24.36 All HVAC components shall be furnished with complete U.S.A. Warranty coverage. Provide all information required by the local (Miami-Dade County) manufacturer's representative as he may be required to provide any necessary warranty service. Copies of all warranty and service documents shall be placed in the corresponding equipment control document compartment.

4.25 MACHINERY ROOM MISCELLANEOUS

4.25.1 The Machinery Room shall be equipped with, and shall conform to the following provisions:

4.25.2 Storage lockers shall be provided in the Machinery House with appropriate shelves and bins for storage of spare parts and supplies. A metal framed, wood topped workbench shall be furnished next to the lockers.
4.25.3 A framed hatch to be used in conjunction with the overhead service crane, large enough to accommodate the largest piece of equipment, shall be provided in the floor of the houses. The hatch cover shall be rigidly framed and fitted with flush type lifting devices. The hatch opening shall be protected with removable guardrail sections in conformance with OSHA 29CFR1910 and set in countersunk flush type deck sockets with drain holes.

4.25.4 All windows provided shall be safety glass and comply with the local building requirements. All glass shall all be tinted as approved by the County, and shall be mounted in deep rubber gaskets, and secured in place by continuous metal frames. The metal frames shall be easily removed for window replacement and all windows shall be lockable.

4.25.5 The Room shall be of a size sufficient to accommodate, without crowding, operating machinery, levers, controller, and any other equipment necessary for the proper operation and control of the Crane. No passageway shall be sized less than required by OSHA and US industrial standards. All machinery must be accessible for maintenance, with minimum clearance as required. All machinery, locations, guards, and safety features shall be in accordance with OSHA 29CFR1910, NEC, and this Specification.

4.25.6 All regular and periodic maintenance components/locations shall have suitable permanently installed access – ladders and platforms as applicable.

4.25.7 Fire extinguishers shall be installed in accordance with applicable US codes.

4.26 **WHEELS GENERAL**

4.26.1 All design criteria shall be as specified by FEM, DIN or applicable code unless otherwise noted.

4.26.2 The gantry shall be furnished with double flanged forged steel wheels, minimum 900mm (35.4") tread diameter, and, the Main and Catenary Trolleys shall be furnished with double flanged forged steel wheels, minimum 710mm (28") and 450mm (17.7") tread diameters respectively. The Main and Catenary Trolleys shall be furnished with forged steel side guide rollers, minimum diameter 400mm (15.75") and 140mm (5.5") respectively and the Catenary Trolleys shall be furnished with forged steel hold down rollers, minimum diameter 170mm (6.7").

4.26.3 Wheels shall be mounted on live (rotating) axles. In either case, wheel and axle assemblies shall be arranged to permit easy removal and replacement for maintenance. Heavy bearing fits and pre-loads shall be used in accordance with the bearing manufacturer’s recommendations. Proper provision to handle thrust loads (due to skewing or wind) shall be made.

4.26.4 The wheels live axles shall have no less than a Class 7 Medium Force Fit. Drive wheels shall also be keyed.

4.26.5 All wheel axles shall be mounted on anti-friction bearings.

4.26.6 The maximum imposed static load without impact shall not exceed rated wheel capacity.

4.26.7 Drive wheels shall be supplied in matched pairs within 0.25 mm (0.010 inches) variation on the diameter. Finish on the treads and inside flanges shall be 63 micro inch or finer.

4.26.8 Wheels shall be properly aligned. All wheel axles shall be parallel to each other, horizontal, and at right angles to the rail.
4.27 **MAIN AND CATENARY TROLLEY WHEELS**

4.27.1 Main and Catenary Trolley wheels shall be double flanged with guide rollers. Guide rollers shall be designed using same criteria that apply to trolleys’ wheels.

4.27.2 All Main and Catenary trolley wheels (and guide rollers) shall be forged steel and have straight treads and case hardened or case carburized to 60-63 Rockwell C hardness. Effective case depth (defined as the depth where case hardness is 50 RC) shall be at least equal to the depth at which maximum shear stress occurs (usually about 0.125 inches for most crane wheels). Core material shall be of sufficient strength to support the case.

4.28 **GANTRY TRAVEL WHEELS**

4.28.1 All gantry travel wheels shall be identical except for mounting details. These wheels shall be so arranged in trucks (bogies) and equalizing beams such that the corner load is equally distributed to all wheels of the corner.

4.28.2 Gantry travel wheels shall be designed to operate on 171 lb./yd. crane rail. The rails are in place and flush mounted.

4.28.3 Each motor shall drive one wheel via a reducer. Seventy-five (75%) percent of the LS wheels shall be driven and seventy-five (75%) percent of the WS wheels shall be driven.

4.28.4 The gear reducers shall not be self-locking, so that during failure of the motors, the Crane can be moved with an outside force. The brakes shall be released manually in this case.

4.28.5 The gantry trucks shall be fitted with drop blocks, rail sweepers, hydraulic buffers at the four outer trucks, and automatically operated storm brakes.

4.28.6 In addition, the Crane shall be equipped with pin stowage devices and with hurricane tie downs at the four legs, safeguarding the Crane against traveling under storm conditions and out of service. Tie downs must be designed and installed to be used on the existing tie down system in place at Port Miami, see dock interface drawing included in Section 9 of these Specifications.

4.28.7 The removal of the wheel trucks shall be performed without removal of the equalizing beams. Supports shall be provided for mounting of hydraulic jacks. Provide hydraulic jacks to service the trucks, bogies and wheels. Provide a set of two (2) hydraulic jacks per Crane.

4.28.8 All gantry travel wheels shall have straight treads and be double flanged.

4.28.9 As a minimum, gantry travel wheels shall be rim toughened (or through hardened) to 321-363 Brinell hardness with a hub hardness not exceeding 293 BHN.

4.28.10 Gantry wheels shall be wrought steel wheels meeting ASTM A504 Class C; or fabricated from forged steel. In any event, metallurgy shall be appropriate for the manufacturing and heat treating process, hardness required, and service intended.

4.28.11 Submittals shall include steel mill certifications and test results must be submitted for approval by County. See Section 7.2 for Quality Control requirements.

4.29 **GANTRY TRAVEL BUMPERS**

4.29.1 The gantry travel bumpers shall have sufficient energy absorbing capacity to stop the Crane when traveling at one hundred percent (100%) of full rated speed with the motors de-energized.

4.29.2 Bumpers shall meet all applicable provisions of AISE Standard No. 6, and CMAA Specification #70.
4.29.3 The bumpers must be interchangeable align with those in use at Port Miami on other Cranes, see the General Arrangement Drawing included in Section 9 of these Specifications for existing gantry bumper height and bumper location.

4.29.4 The bumpers shall be hydraulic-pneumatic as manufactured by Oleo or County approved equal.

4.30 **GANTRY TRAVEL TRUCKS – GENERAL**

4.30.1 Gantry travel trucks shall be fully equalized and shall meet all other requirements of this Specification.

4.30.2 Each truck assembly with attached machinery shall form a self-contained unit and shall be shipped to the erection site as such.

4.30.3 The trucks shall be designed and fabricated to comply with the specified overall bumper length of 88’6”

4.30.4 The trucks shall be tested at the Contractor’s facility and pre-commissioned to assure free running and alignment.

4.31 **GANTRY TRAVEL TRUCKS – STRUCTURAL**

4.31.1 The truck housing and equalizer beams shall be constructed of welded heavy steel plate and structural members. The truck structure shall be stiff enough to prevent misalignment of machinery and improper tracking (skewing). The truck structure shall be sufficiently strong to carry all loads and shall be designed in accordance with the chosen structural code.

4.31.2 The trucks width must allow a 25mm (1”) gap between the truck and the hurricane tie down links to facilitate tie down procedure.

4.31.3 The trucks design and fabricated to complying with the bumper base design criteria, must be able to withstand all loading requirements as set forth in these specifications.

4.32 **GANTRY TRAVEL TRUCKS – MECHANICAL**

4.32.1 Gantry gear reducers can be horizontal or vertical mounted as approved by the County. They shall be totally enclosed, and oil lubricated. No open gearing is permitted.

4.32.2 Travel drives shall not be self-locking. All drives shall have brakes. One gantry drive motor shall drive no more than one (1) wheel.

4.32.3 The gantry drive shall be mounted on the crane trucks so as to minimize the danger of damage from vehicles and equipment working in the vicinity of the Cranes. Preferably no part of any drive should extend outside the width of the basic structural truck frame. Any components extending beyond these confines must be protected by a heavy metal frame around the drive system, with schedule 120, 4 inch pipe.

4.33 **GANTRY TRAVEL TRUCKS – MISCELLANEOUS**

4.33.1 The trucks shall be equipped with the following features:

4.33.2 A safety drop block on each bogie 1 inch (25 mm) above top of rail to prevent excessive drop in case of wheel or axle breakage.

4.33.3 Wheel/axle assemblies shall be arranged to permit easy removal for maintenance.
4.33.4 Jacking pads for use when changing wheels.

4.33.5 Guards for moving parts in compliance with OSHA rail sweepers, heavy steel plate type, per AISE Standard No. 6. These sweeps shall be removable to permit removal of wheel/axle assemblies.

4.33.6 Storm Brakes: Provide friction type storm brakes on the gantry with the capability of being turned on or off manually.

4.33.7 Hurricane tie downs and stowage pins shall be provided to match the existing dock locations. Appropriate electrical contacts shall be installed to assure that the travel drive cannot be operated before the pin locking device has been unfastened.

4.33.8 Trucks shall be designed to provide protection to all moving parts. This includes, but is not limited to, seals on bearings and reducers; full guards, dust covers, and shields; no water pockets; a means for cleaning and flushing and easily accessible parts and components.

4.33.9 Fully accessible lubrication points and grease fittings shall be provided.

4.34 LUBRICATION

4.34.1 All areas where sliding or rolling occurs shall be lubricated, this includes pins in equalizer beams, forestays, backstays, and similar pinned structural members.

4.34.2 All enclosed reducers shall run in oil baths. Oil shall be an EP (Extreme Pressure) type recommended by AGMA or the reducer manufacturer. All enclosed oil bath drives shall be fitted with oil fills, breathers (dust proof and drip proof), a means for checking oil level, convenient drains, and catch pans.

4.34.3 Coupling lubrication shall be to the coupling manufacturer’s specifications.

4.34.4 All lubricants shall meet pertinent ASTM, SAE, and API standards.

4.34.5 All other areas shall be grease lubricated. This includes, but is not limited to, the following items:

4.34.6 Sheaves, boom hinge pins and forestay pins, wheels and axles, pillow blocks and other roller bearings; bronze bushing, equalizer pins and swivel trunnions, control linkages, and spreader mechanisms.

4.34.7 Grease shall be water resistant. Gear greases shall be an EP (Extreme Pressure) type. For extreme applications, additives such as molybdenum disulfide are required.

4.34.8 Grease fittings shall be zerk type; size shall be ¼ inch PTF-SAE extra special short. The fittings and components (check ball and spring) shall be stainless steel.

4.34.9 Grease fittings shall be located in central areas and easily accessible. Grease piping shall be of an approved stainless steel material.

4.34.10 Sensitive seals and packing shall be protected with relief passages and/or relief fittings.

4.34.11 Bronze bushings shall have grease grooves in accordance with CBBI. Bushings shall be secured with dowels, or other means to prevent “loss” of a grease path due to a misaligned part.

4.34.12 The Contractor shall provide automatic grease lubrication for boom components and pylon head (top of apex).
4.34.13 Central lubrication points will be installed at any location where there are more than four (4) lubrication fittings located within four (4) meters of the farthest fitting.

4.34.14 The Contractor shall prepare six (6) plastic coated lubrication charts per Crane showing all points to be lubricated and type of lubricant to be used at each of the required location. The charts shall be mounted in the Machinery Room, Control Room and Dock Level Monitoring Station in a convenient location behind clear wipe-clean plastic and the other three (3) shall be provided for the maintenance personnel.

4.35 REEVING, GENERAL PROVISIONS

4.35.1 All portions of reeving, including, but not limited to, wire rope, sheaves, hoist drums, fittings, guides, and rollers, shall be designed so as to maximize wire rope life. Factors which reduce wire rope life shall be minimized or eliminated as far as practical. These factors include: reverse bends, sheave diameters too small; sheave material too soft; hoist drum abrasion or crushing of wire ropes; improper spooling on drum; excessive fleet angles; abrasion of wire rope against fixed surfaces such as improperly positioned guides; improper sheave grooves; overload and impact. The wires ropes shall be standard right lay.

4.35.2 The Contractor shall design the reeving system to the best current practices, recognizing the fact that container Cranes use application of wire ropes.

4.35.3 The details and design of, the reeving system shall meet all provisions of AISE Standard No.6, Sections M.3 (Drums), M.4 (Ropes), M.5 (Equalizer Bar or Sheaves), M.6 (Sheaves and Hook Blocks) and FEM if not covered under AISE.

4.36 WIRE ROPE

4.36.1 Wire rope shall be extra improved plow steel with independent wire rope core as manufactured by a US based company: no exceptions shall be made. Wire rope shall be inspected and tested by an independent testing laboratory. Main Hoist, Main Trolley, Catenary Trolleys and Boom Hoist wire ropes shall be 6 x 36 bright construction, and be supplied in English-system dimensions, not metric. Wire ropes shall have the following safety factors considering reeving efficiency and based on the wire rope manufacturer’s catalogued breaking strength for extra-improved plow steel grade rope:

(a) Main hoist wire ropes with concentric 65 LT load 6.0
(b) Main hoist wire ropes with eccentric design load 4.0
(c) Boom hoist ropes 6.0
(d) Main and Catenary Trolleys 6.0

4.36.2 Rope safety factors for twin-twenty (2-20) spreaders shall be considered with twin-twenty eccentric loads (LLE). A weight of 14,500 Kg (32,000 lbs) shall be assumed for the spreader. Rope forces due to the Main and Catenary Trolley Rope tensioning devices shall be considered in sizing of the Main and Catenary tow ropes.

4.36.3 Each rope is to be supplied with full test certification.

4.36.4 Wire ropes shall be County-approved and shall be internally and externally pre-lubricated at the factory by the wire rope manufacturer prior to delivery.

4.36.5 All wire ropes shall be completely lubricated prior to initial crane start-up testing at fabrication facility, again prior to shipping and again prior to Final Acceptance.

4.36.6 The Contractor shall use methods that avoid reverse bending and the development of kinks, that minimize the size and number of rub blocks and guide rollers, and the need to replace (change) the wire rope. In the Maintenance and Inspection Manuals, he will describe methods to make required re-reeving easier. All wire ropes shall utilize an approved re-reeving system and all systems shall be described in detail in the proposal.
4.36.7 Dead end wire rope terminations shall be by means of thimbles with wire rope clips or open wedge sockets with wire rope clips. Zinc wire rope sockets shall not be used. The Contractor shall recommend the method and timing of periodic inspections, criteria for replacement, and the repair methods for the wire rope connections he uses. The Contractor's selection and recommendation shall consider the potential for galvanic action and/or corrosion. Bolted clamps with threaded plates shall be used to secure the wire rope to equipment as necessary.

4.36.8 UHMW buffers or rollers shall be provided for protection of wire rope at all points where contact with structure could occur.

4.37 **WIRE ROPE FITTINGS**

4.37.1 Spelter sockets shall be poured with zinc only. Babbitt soft material metal and lead are not permitted.

4.37.2 Wire rope clips shall be Crosby brand clip or as approved by County. Clips may be either U-bolt type Crosby G 450 or Fist Grip installed per manufacturer's recommendations, fully torqued, checked, and retorqued after acceptance certification tests.

4.37.3 All wire rope fittings, including shackles, hooks, turnbuckles, thimbles, swaged fittings, spelter sockets and wedge sockets shall be as manufactured by the Crosby Group or as approved by the County, and shall be selected on the basis of published catalog ratings.

4.38 **SHEAVES**

4.38.1 Sheaves for a given size of wire rope shall be identical and fully interchangeable. All sheaves shall be of the same manufacturer. Sheaves shall be of cast or forged steel in accordance with the following requirements:

a) All sheave rope grooves to be fully machined and surface hardened or hard faced to HB 321 minimum.

b) All sheaves in the area around the rope groove shall have one hundred per cent (100%) NDT inspection.

c) Welding repair of castings is not allowed in any area that becomes machined.

d) No porosity or defects of any significance in the metal around the rope groove shall be acceptable.

e) The drawings shall include requirements to assure the cast sheaves are in balance (to reasonable requirements) after machining and that rope grooves are concentric to machined bores. Additionally, drawings shall also include tolerances for lateral deviation/run out of rope grooves from centers of the cast sheave webs.

4.38.2 All sheaves shall be provided with anti-friction bearings. Proper provision to handle thrust loads shall be made. The bearing assembly shall be fully sealed using a lip type neoprene seals. Provisions shall be made to lubricate each sheave individually. Anti-friction bearings shall be proportioned in accordance with this Specification.

4.38.3 Sheaves may be either cast steel, forged steel, or fabricated steel construction. Cast iron or powdered metal sheaves are not permitted. Sheaves shall be of carbon or alloy steel with thread (or groove) hardened to 38-44 Rockwell C, or 11-13 percent (11-13%) Manganese steel (Hadfield's alloy) properly heat treated, or equal.

4.38.4 Sheave grooves shall be fully machined and shall be properly sized to accept English (inch) size wire rope. The diameter of the groove shall be slightly larger than the diameter of the wire rope (for clearance required to avoid pinching) according to current recommended practice and design standards. Other groove dimensions shall be as follows:

a) Groove Depth: Minimum 1-1/2 times wire rope diameter.
b) Sheave Throat Angle: 35 degrees minimum to 45 degrees maximum

c) Included Groove Angle for Wire Rope Support: 135 degrees minimum to 145 degrees maximum.

d) Radius of Throat to Flange Surface Transition: ¼ inch radius minimum

e) Sheave Width at Rim: Approximately 2 times wire open diameter plus ¾ inch.

f) Thickness of Sheave Metal Under the Bearing Portion of the Groove: Minimum one times the wire rope diameter.

4.38.5 All sheaves shall be equipped with rope guards to prevent the ropes from running out of the sheave grooves. The head blocks shall be fitted with easily removable full guards.

4.38.6 No more than two (2) sheaves shall be mounted together between full sized cheek plates. All blocks and sheave assemblies shall be rigid and properly aligned.

4.39 DRUMS

4.39.1 All rope drums shall be welded with grooves machine cut from solid reel to permit the ropes to lay in one (1) layer. The pitch diameter of a drum shall not be less than thirty (30) times the diameter of the wire rope for that drum. Drums shall be rolled steel weldments. Complete penetration welds shall be used for the drum shell. The Boom Hoist drum may be manufactured in two (2) separate drums and bolted together upon assembly and installation. Strict attention shall be given to alignment of the two (2) pieces.

4.39.2 The minimum acceptable grades of steel for the drum are ASTM A36 (rolled) or ASTM A27 Grade 70-36 (cast). Drums shall be surface hardened to a minimum of BHN321.

4.39.3 Drums shall be stress relieved before machining and balanced after machining, with rope clips in place.

4.39.4 Drums shall be sufficiently sized to allow for the full range of hoisting to wrap on one (1) layer only. There shall be no less than three (3) “dead” and two (2) fastening wraps on the drum under any operation condition. The dead end of the drum shall be secured by a bolt clamp capable of developing the maximum rope capacity. One empty winding shall be provided at the full end of the drum for rope stretch.

4.39.5 The drums shall be grooved with groove contour and pitched to allow proper rope spooling under all load and speed conditions without chafing, scrubbing or any other adverse condition.

4.39.6 The drums shall have flanges or surfaces as required for auxiliary disk or band brakes. The opposite end of the drums shall have flanges of adequate diameter that they protrude radially not less than two rope diameters above the top of the wire rope wound on the drum.

4.39.7 Each drum shall be concentric about the drum shaft and round to within AISE and FEM requirements. The drum end discs and shaft shall be sufficiently strong to carry all drum loads to the hoist frame. The drum end discs and shaft shall be sufficiently stiff to not result in any deflection and prevent misalignment of drum gears.

4.39.8 The drum shell shall be sufficiently strong to resist crushing by a safety factor no less than 2.5 for the case of spooling the entire layer at the safe working load of the rope.

4.39.9 The drum shall also be capable of supporting all imposed bending and torsional loads on the basis of methods set forth by AISE and FEM.

4.40 HEAD BLOCK

4.40.1 Each Crane shall be equipped with a quick change head block consisting of a structural frame with two sets of sheave nests that are permanently reeved into the hoisting ropes, the same as used on existing Port Miami Cranes, see reference Headblock drawing included in Section 9 of these Specifications. The headblock shall be provided with a personnel platform complete
with safety railing and grated floor. The platform shall have access from either side, including ladders, while the spreader is resting on the dock. The platform shall be large enough to carry four men and shall have a basket to safely contain approximately 200 twist-locks commonly used to stow containers on vessels.

4.40.2 These head blocks shall be 4900 mm (16’ – 1”) centerline to centerline and shall be configured to allow these Cranes to use existing spreaders owned by the Port.

4.40.3 The Contractor shall verify the dimensions of the existing spreaders and be fully responsible for proper interfacing of the new headblocks with the existing spreaders. The electrical control junction box shall be located on the top of the spreader in line with the access hatch on the Headblock floor: the same as on the existing Port Miami Cranes 13-16 headblocks (see attached drawing J514A1200 in Section 9, POM2). The electrical control junction box shall be accessible from dock level stepping up the spreader ladder to the headblock deck floor and opening the floor hatch. A safety latch to hold “open” the inspection cover for accessing the spreader junction box shall be provided.

4.40.4 Sheaves may be attached to the head blocks in any reasonable arrangement, provided that the center of gravity of all sheave forces coincides with the centerline of the head block for the static load condition.

4.40.5 Padeyes with adequate space/clearance for the lifting gear shall be provided to allow handling of cargo, other than containers, weighing, at a minimum, the rated load plus the weight of the spreader.

4.41 **BEARINGS**

4.41.1 All bearings shall be anti-friction bearing except as specifically noted otherwise in this Specification.

4.41.2 All bearings shall be of either English (inch) size or Standard Plan for the boundary Dimensions of Metric Bearings and shall be of sizes normally manufactured in the United States. All bearings shall conform to standards of the Anti-Friction Bearing Manufacturer’s Association (AFBMA), ANSI and International Standards Organization (ISO).

4.41.3 Acceptable bearing types are radial or thrust, having balls, spherical rollers, hour glass rollers, cylindrical rollers, tapered rollers or needle rollers. Critical high speed bearings shall be as manufactured by SKF, which shall be provided in the following locations as approved by the County:

- a) Headblock sheaves
- b) Snag System sheaves
- c) Main Hoist Bearing Pedestal
- d) Boom Hoist Sheaves
- e) Boom Equalizer Sheaves
- f) Boom Hoist Bearings Pedestal
- g) Trolley Wheels
- h) Trolley Guide Rollers (bearings lands)
- i) Trolley Drum Pedestal Bearings
- j) Main Hoist sheaves
- k) All high speed shafts main functions gear reducers

All other bearings may be Chinese manufacture with at least three (3) spare bearings provided for each type and size of Chinese bearing used on the Crane as approved by the County.

4.41.4 Bearing size shall be selected on the basis of B-10 (also known as L-10) life for the hour rating, loads and speeds per FEM requirements.

4.41.5 In addition, all bearings shall meet provisions of AISE Standard No. 6, Section M.12 (Bearings) except as specifically amended herein.
4.41.6 All bearings shall have inner races. Bearings shall not run directly on the surface of any shaft or axle.

4.41.7 All pillow blocks shall be of cast steel or fabricated steel. Cast iron pillow blocks are not permitted.

4.41.8 Wherever possible, self-aligning type bearings shall be used. Wherever practical, a given shaft shall be fitted with a combination of axially fixed and axially “floating” bearings in such a manner as to allow free expansion of the shaft without introducing unintentional thrust loads.

4.41.9 All bearings shall be arranged for individual lubrication. Either grease or oil lubrication is permissible provided the method of lubrication is appropriate and meets recommendations of bearing manufacturer and AFBMA. Minimum closure designs are:

a) Neoprene type lip or garter seals for all oil lubricated bearings and all grease lubricated bearings operating in a dirty environment; and,

b) annular groove (labyrinth) shield for all grease lubricated bearings operating in a clean environment.

4.41.10 All bearing applications and mounting arrangements, including fits, clearances, alignment, shoulders, race support, pre-load, and closure design shall be per the bearing manufacturer’s recommendations.

4.42 GEAR DRIVES

4.42.1 No open gearing will be acceptable. All gears shall be splash-oil lubricated and run on anti-friction bearings. High-speed gears shall employ helical gearing.

4.42.2 All spur, helical, or double helical gears built to metric dimensions shall be 20 degrees pressure angle full depth involute of standard module. All spur, helical, or double helical gears built to English (inch) dimensions shall be of one of the American Standard Tooth Forms (20 degrees pressure angle full depth involute, 20 degrees stub involute, or 25 degrees full depth involute) of standard diametrical pitch.

4.42.3 Special type gears such as bevel or spiral bevel shall be finished, clearly marked, and installed as matched sets. All gears and reducers shall meet all applicable provisions of the current AGMA Standards and shall be of U.S. manufacturer as approved by the County. All drives shall be totally enclosed, oil lubricated type speed reducers.

4.42.4 All gears shall be mounted on shafts in accordance with applicable AGMA and ANSI Specifications.

4.42.5 All gears shall be mounted on shafts and bearing supports sufficiently rigid to maintain proper alignment under the most adverse load conditions.

4.42.6 Split gearing is not acceptable.

4.42.7 Overhung gears are not permitted except in the case of bevel pinions.

4.42.8 For bevel gears of any type, the face width shall not exceed 30 percent (30%) of the cone radius, and the gear ratio shall not exceed ten to one (4 to 1).

4.42.9 For spur and helical gears, face widths shall be as narrow as practical. Recommended maximum face width shall be equal to the pinion pitch diameter or 8 inches (200 mm), whichever is less. Single reduction gear ratio of spur and helical gears shall not exceed ten to one (10 to 1).
4.42.10 Pinions of spur and helical gears shall have a sufficient number of teeth to prevent undercut. Minimum number of teeth in pinion, for 20 degrees full depth involute tooth form needed to meet this requirement is 18 when gear and pinion have equal addendums.

4.42.11 Long addendum pinion, short addendum gear of AGMA proportions may be used to reduce the minimum required number of teeth in the pinion without causing undercut.

4.42.12 In spur and helical gear sets the pinion shall be at least ¼ inch (6mm) wider than the gear in order to prevent loss of face width in the event of axial misalignment.

4.42.13 All miscellaneous items, such as keys and bolting, shall meet or exceed AGMA recommended practice.

4.42.14 All gears shall be machine cut and shall have the periphery and sides of their rims finished. The minimum quality of any gear shall be AGMA Quality Number 9.

4.42.15 All gears shall be free running, properly aligned, and shall have the appropriate amount of backlash according to AGMA and DIN.

4.42.16 Upon commissioning and completion of all acceptances testing of the Cranes at manufactures facility lubricant samples shall be taken of geared components. The samples shall be tested for any abnormality and contaminants. Should the tested lubricant not be acceptable, the Contractor shall replace any defective component and lubricants prior to loading of Cranes to the satisfaction of the County.

4.42.17 All lubricant collection pans, gearboxes and reducers shall have a County approved specific magnet to collect all metal shavings that fall into or is contained within the lubricant.

4.43 GEAR MATERIALS

4.43.1 Pinions shall be harder than the mating gear by an amount appropriate to result in a “balanced” design. Pinions shall be cut from solid rolled steel or forged steel blanks. Pinions shall be through hardened (quenched and tempered) alloy steel, or surface hardened. Case carburizing, flame hardening and induction hardening are permissible hardening methods. Pinion steel chemistry, hardening method, core strength, hardening depth and rated horsepower of hardened pinions shall be appropriate for the service intended. Case carburized pinions and gears shall be finished ground after hardening. Minimum pinion hardness shall not be less than 300 BHN.

4.43.2 Gears shall be cut from solid forged steel blanks, rolled ring forgings attached or welded to a fabricated steel web and hub, or cast steel blanks. Cast, unfinished gear teeth are not permitted. Gears shall be quenched and tempered. Minimum gear hardness shall not be less than 240 BHN.

4.43.3 Gearing shall have suitable gear tooth protuberance when case hardened and ground. Fillet of ground gears shall not be ground.

4.43.4 All gear steels hardening methods shall meet ASTM, AISI and AGMA as appropriate.

4.44 STRENGTH AND SERVICE FACTORS FOR GEARS AND REDUCERS

4.44.1 Service Factors shall be as specified by AGMA, consistent with the duty and application but shall not be less than as stated herein or as shown in the table below.

4.44.2 No Service Factor shall be less than 1.0 (unity). Service Factor for rated thermal horsepower of any reducer shall be not less than one. Service Factors for strength and durability shall be no less than shown on the table below.
4.44.3 Gearing and bearing design loads will be based on F.E.M. 1.001 (latest edition) combined operating conditions which include inefficiency, 50% operating wind load, and specified speeds and acceleration/deceleration rates.

a) Maximum operating loads for hoist motions (Main Hoist and Boom Hoist) shall be calculated per F.E.M., section 2.6.4.1. Maximum loads for horizontal motions (gantry, catenary trolley, and trolley) shall be calculated per F.E.M., section 2.6.4.2. Amplifying coefficient shall be per F.E.M requirements for state of loading, class of operation, and classification specified in Section 3.6.

b) Mean load for calculating reducer gear and bearing life/size shall be per F.E.M, section 4.2.1.2 calculated by modifying the appropriate maximum operating load by the cube root of the maximum load spectrum factor for the specified state of loading. The load spectrum factor shall be per F.E.M. requirements for state of loading, class of operation, and classification specified in Section 3.6 (i.e., cube root of load spectrum factor .25 for state of loading L2, cube root of load spectrum factor .5 for state of loading L3).

c) Safe working load for maximum and operating load calculations shall be based on continuous duty cycle rating of 50 LT.

4.44.4 Gear stress calculations and allowable stresses shall be based on AGMA standards (AGMA 21.01 latest edition).

4.44.5 Allowable stresses at FEM combined operating loads shall be per AGMA with service factors as below:

<table>
<thead>
<tr>
<th>Minimum Service Factor (Mechanical) for Gears and Reducers</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRIVE</td>
</tr>
<tr>
<td>Boom Hoist</td>
</tr>
<tr>
<td>Gantry Travel</td>
</tr>
<tr>
<td>Main Hoist</td>
</tr>
<tr>
<td>Trolley Drive</td>
</tr>
</tbody>
</table>

4.44.6 Reducers shall be designed for no less than ten million (10,000,000) cycles except for the final reduction (low speed end) on any drive. Final reduction shall be designed for no less than one million (1,000,000) cycles.

4.44.7 Care shall be taken to appropriately determine all the factors that relate to both the strength rating and surface durability (pitting) rating of all gears and gear sets. They are: dynamic factor; overload factor (this shall be taken as not less than the service factor per the above table); size factor; load distribution factor; geometry factor, life factor (1.0 for 10,000,000 cycles); temperature factor; Factor of Safety (shall not be less than 1.0), surface condition factor (may be taken as 1.0), and hardness ratio factor.

4.44.8 In case of idler gears and other gears where teeth are loaded in both directions, the AGMA allowed design bending stress shall be multiplied by 0.70. This provision is also applicable to planet gears. Additionally, in planetary gear sets, the rated capacity shall not exceed 100 percent of the first planet gear plus 90 percent of the rated capacity of each additional planet gear.

4.44.9 All drives and reducers shall be capable of carrying a momentary or starting load of no less than 200 percent (200%) of FEM operating load and no less than maximum brake load.

4.45 **NOT USED**
4.46 REDUCERS AND GEAR CASES

4.46.1 Each reducer shall be provided with a permanently attached nameplate containing the following information: manufacturer's name, reduction ratio, rated speed, rated capacity (horsepower), service factor, date of manufacture, model number, and recommended lubricant.

4.46.2 All gantry reducers shall be identical to allow interchangeability between all gantry reducer locations, waterside and/or landside.

4.46.3 All reducer bearings shall be of the anti-friction type.

4.46.4 Bearing life will be based on the appropriate mean operating load with design life equal to the maximum value of the range specified by F.E.M. 1.001 for the class of utilization specified in specification Section 4.1.5 (i.e., 6,300 hours for T5, 12,500 hours for T6, 50,000 hours for T8).

4.46.5 Reducer cases shall be of fabricated steel or cast steel. Cast iron gear cases are not permitted.

4.46.6 Reducer shall meet all provisions of AGMA 420.04 (Practice for Enclosed Speed Reducers).

4.46.7 Reducers shall be selected or designed giving full attention to overhung loads (amount, direction, and type). Appropriate Overhung Load Factors shall be used. If an overhung load is too large for a given reducer, then an out board bearing shall be used.

4.46.8 All gear cases shall be oil tight and horizontally split so that oil does not lay on a split line. The top section shall be easily removable for repairs and replacement of gears. Removal inspection plates shall be provided to permit inspection of all internal components. Fan cooled reducers shall be permitted in the machinery house enclosure only.

4.46.9 Gear cases shall be provided with easily accessible valve and drain plugs, breathers, means for checking the oil level, and lifting lugs on the cover. The reducers provided shall be as compact as possible and comply with all specifications and standards required herein.

4.47 SHAFTS AND AXLES

4.47.1 Shafts shall be designed in accordance with ASME Standards, and shall include acceptable allowances for stress concentrations at fillets, keyways, and lubrication holes.

4.47.2 All shafts shall be of hot rolled, cold rolled or forged steel; all grades used shall be properly heat treated for the service intended.

4.47.3 Cast steel shafts and axles are not permitted. Leaded steels are not permitted.

4.47.4 Particular attention shall be paid to shaft details and other factors which may adversely affect shaft fatigue strength. These details include the following:

   a) Shoulders shall have generous fillet radii.
   b) Relief grooves or other details shall be used (if required by the loads) where gears or wheels are heavy press fit or shrunk fit on shafts.
   c) Ends of keyseats shall be rounded.
   d) Splines, gear teeth, or threads shall run out smoothly or shall be undercut.
   e) Surface finish shall be as smooth as practical (or as required) and shall be free of injurious defects such as cracks.
   f) Shafting shall be heat treated, or otherwise processed to minimize residual tensile stresses on surface of the shaft.
4.47.5 All attachments to shafts which transmit torque to the shaft shall be attached in a positive manner. Acceptable methods are keys, splines, or bolts. Friction type clamps are not permitted.

4.47.6 Grooves for spring clips shall not be located in areas of shafts subject to bending loads.

4.47.7 Shafting shall be of sufficient diameter and supported in such a manner as to prevent harmonic vibrations.

4.47.8 Wherever possible, indeterminate support (3 or more bearings) for shafts shall be avoided.

4.48 KEYS

4.48.1 Recommended key style is square plain parallel stock. The recommended key size is approximately one fourth of the shaft diameter unless there are space limitations.

4.48.2 Allowable stresses for keys shall be in accordance with AGMA. Multiple keys may be used, however, the rated capacity shall not exceed 100 percent for the first key plus 50 percent for each additional key.

4.48.3 All keys shall be retained by a set screw or some other means.

4.48.4 All keys shall have a snug to tight fit.

4.49 SPLINES

4.49.1 All splines application shall meet provisions of AGMA unless otherwise noted.

4.49.2 Splines are an acceptable substitute for keys. Either square or involute splines are acceptable. Spline configuration, number of splines, and fit shall be appropriate for the service intended.

4.50 FASTENERS

4.50.1 All fasteners shall be correctly selected for size and type, and shall be suitable for the service intended.

4.50.2 All fasteners less than 12 mm (½ inch) in diameter shall be stainless steel.

4.51 BOLTS/ BOLTED CONNECTIONS

4.51.1 Structural and mechanical bolted joints shall be provided in accordance with the "Specifications for Structural Joints using ASTM A325 or A490 Bolts" or other County approved recognized international standard. Galvanized A490 bolts shall not be used. The surface of all plates or members intended to be joined together shall be in contact in accordance with AISC but no less than 75% over the whole area, and where stiffeners are necessary, they shall bear tightly both at the top and at the bottom. Prying action and bolt fluctuating stress shall be considered. The faying surfaces of all main structural friction-type bolted connections shall be machined. Access shall be provided to all bolted connection areas of the Crane structure.

4.51.2 All bolts 12mm or less shall be stainless steel. High strength bolts shall not be galvanized. All bolts shall have a maximum of two to three threads remaining outside the nut after tightening. All bolted connections shall be designed to resist all loads and combinations of loads for “local” loads, with a Factor of Safety.

4.51.3 Design of bolted connections in structural type locations (hoist frames, etc.) shall be in accordance with AISC “manual of Steel Construction”. However, if a different design criteria
are to be used it shall be submitted to the County for review and approval of bolted connection design.

4.51.4 Bolted connections subject to vibration or where alignment is critical shall be secured per these standard specifications with approval of the County.

4.51.5 All bolt holes shall be spot faced unless the faces are already flat or finished.

4.51.6 In locations where bolts are inserted into tapped holes in the base material, the bolt nominal diameter shall not exceed the thickness of the base material, nor shall the tapped portion of the hole have a depth of less than an amount equal to nominal bolt diameter.

4.52 **SET SCREWS**

4.52.1 Set screws will not be permitted as the only fastenings or stops in any equipment that plays any part in the safety of the Crane’s operation. All set screws shall be headless with hex sockets and cone or cup points.

4.53 **COUPLINGS**

4.53.1 Except as noted herein, all flexible couplings shall be of the gear type, except those at the brake disks, which shall be elastomeric type. Gear couplings shall have crowned involute spline type engagement. Service Factor for all crane mechanical drives shall be not less than 2 for motor peak overload torque or brake torque, whichever is greater. All couplings shall have a Factor of Safety of 5 or greater based on the manufacturer’s published breaking strength.

4.53.2 All couplings shall be fully guarded in accordance with OSHA with removable steel guards.

4.54 **CHAIN DRIVE**

4.54.1 If Chain drives are necessary, their use will require County approval.

4.54.2 Chains and sprockets of roller chain power transmission drives shall be designed in accordance with ANSI B29.1 or County approved equivalent internationally accepted standard. Maximum operating chain load including centripetal affects shall not exceed the 15,000 hour rated capacity of the chain considering appropriate application factors for number of sprocket teeth and type of driving and driven loads. Additionally, the minimum chain factor of safety against breaking strength at maximum operating load shall be no less than 10.0. Number of teeth on sprockets shall be no less than 19 and no more than 114. Minimum angle of wrap of chains around sprockets shall be no less than 120 degrees. Sprockets shall be machined steel and suitably hardened. Chain drives shall be properly aligned and lubricated.

4.55 **IDLER ROLLERS AND SLAP BLOCKS**

4.55.1 All idler rollers, and, wear and slap blocks shall be replaceable and made of UHMWPE (Ultra-high-molecular-weight polyethylene) anti-friction material as approved by the County which shall be provided to prevent slapping wire ropes from damaging or premature wearing of the crane structure and components. All UHMWPE material shall comply with ASTM D4020-96 and shall have a density of 0.93 to 0.97 G/CC range. The material shall have UV protection for the 100% humidity South Florida environment.

4.55.2 All rollers with anti-friction bearings and seals shall be provided as necessary to prevent running wire rope from contacting any obstruction. The roller surface in contact with the ropes shall be easily replaceable anti-friction material sleeve at least 12 mm (½”) thick. All sleeves shall be of the same diameter and equal sleeve length. For intermittent contact with sagging running wire ropes, individual interchangeable UHMWPE discs rotating directly on polished stainless steel shafts shall be used. Sheaves shall be machined from solid anti-friction materials and provided with anti-friction bearings and seals.
SECTION 5

ELECTRICAL SPECIFICATIONS
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SECTION 5 - ELECTRICAL SPECIFICATIONS

5.1 GENERAL

5.1.1 The work covered by this section consists of furnishing all labor, material, and equipment to design, fabricate, assemble, transport, and install all required equipment and appurtenances of the Cranes’ entire electrical equipment. The objective is to design the system for simplicity, maintainability, and maximum reliability, that is, it provides reliable power and control for rapid and precise handling of containers, general cargo and be suitable for use with a cargo beam (hook).

5.2 DESIGN STANDARDS

5.2.1 The following international standards shall be applied for the design, selection and installation of the electrical equipment:

a) MOTORS AND ENCLOSURES

1) F.E.M. 1.001 3rd Edition 1987, 10.01 Power/Torque Requirements
2) V.D.E. 0530 - Rating
3) I.E.C. 34-1- Rating and Performance
4) NEMA - National Electrical Manufacturer Association

b) ELECTRICAL INSTALLATION

1) NEC National Electrical Code
2) NFPA National Fire Protection Association
3) I.E.C. International Electrotechnical Commission
4) V.D.E. Regulations for the Erection of Power Installations (rated voltages <1000V)
5) I.E.E. Regulations for Electrical Installations

c) CABLES

1) NEC Regulations for Cables and Flexible Cores for Electric Power and Lighting.
2) V.D.E. DIN 57281/VDE 0281P.V.C. Cables in Power Installations
3) DIN 57282/VDE 0282Rubber- Insulated Cables in Power Installations

5.3 MAINTAINABILITY

5.3.1 The crane drive and control systems manufacturer and supplier shall be TMEiC, Siemens, Fuji, ABB, or as selected by the County. The drive and control system design, fabrication and operation shall comply with all the severe duty requirements of dockside Cranes in the 100% humidity environment of South Florida. The control system shall be based on the latest digital technology incorporated in the power conversion equipment and include a programmable controller. Protective devices and safety features consistent with the best modern practice for container crane devices shall be incorporated, and all equipment designed to provide safe and reliable operation over long periods with a minimum of attention. The proposed system and equipment shall have thoroughly been used and proven durability and efficiency successfully.

5.3.2 In the event of any failure of the inverters or converter, it shall be possible to replace the faulty or the major component(s) like IGBT stack and control cards. Replacing the entire drive for a component failure is not permitted.

5.3.3 Individual replaceable components and IGBT units (for converter and inverters) shall weigh less than 65 lbs (29.5 kg) which allows for the replacement of the same by a single maintenance technician to perform the replacement work. The component shall easy to handle
from the storage rack to a vehicle by the technician to be taken up the crane in the elevator and into the room where it is to be installed in the panel.

5.3.4 It shall be possible to replace the drive cooling fans and any other fan without the removal of any other components.

5.4 GENERAL PROVISIONS

5.4.1 The control system for the Main Hoist, Main Trolley, Boom Hoist and Gantry drives shall be AC variable frequency/voltage, stepless, regulated, reversing and regenerative over the entire range of speeds. The system shall unless otherwise approved by County, utilize an IGBT active front end with common DC bus.

5.4.2 Common electrical components such as Circuit Breakers (CBs), Contactors, Relays, etc., shall be commercially and readily available in the United States of America. Special equipment such as IGBT Drives and Motors are to be supported by electrical system supplier in the US (including engineering personnel located in the US).

5.4.3 All equipment shall be new and free from defects. The materials, equipment and workmanship shall conform or exceed to the applicable current standards of NEC, UL, IEEE, IPCEA, OSHA, AISE, NEMA, and ANSI.

5.4.4 In order to localize responsibility in the event of a system malfunction and to facilitate spare parts interchangeability, the Contractor shall utilize electrical equipment and parts that are commonly used by the Port Miami and are readily available within 24 hours of written order and for fifteen (15) years after delivery and acceptance of each Crane at Port Miami.

5.4.5 All electrical equipment/component/part provided on the Crane shall retain the original manufacturer’s nameplate, bearing all pertinent data necessary for the replacement of the component, including model and part numbers.

5.4.6 Component of the electrical control system shall be of modular construction and shall employ plug-in printed circuit boards.

5.4.7 The Contractor shall be responsible for providing adequate sizes in all equipment to accomplish the work at the rated speeds, loads, and duty specified herein. The electrical equipment shall be selected for torque ratings, speed, and thermal capacity.

5.4.8 Adequate space and/or mounting surfaces shall be provided on the structure, in the electrical and other houses, in electrical enclosures, junction boxes, conduit, festoon systems and other cabling, etc., to accommodate the associated control circuits, future-automation, monitoring circuits and other additions and/or modifications (Easy and convenient access must be provided to all equipment and wiring).

5.4.9 All electrical equipment, including that required for programmable controllers, computers, digital drives, I/O devices, etc., shall be operable over the range of temperatures experienced at Port Miami, Florida.

5.4.10 All circuit boards and components shall be coated making them impervious to moisture and other corrosive environmental conditions and for the marine environment.

5.4.11 Provide thermostat control for space heaters in enclosures. Provide switching for space heaters in motors to energize them when equipment is not operating.

5.4.12 All electrical enclosures and equipment shall be dust-proof, heated and shall be designed to resist deterioration from corrosion when subjected to severe moisture conditions in a marine environment. All fasteners (screws, bolts, washers and nuts) and fittings shall be of stainless steel.
5.4.13 The Crane must be symmetrically grounded to the dock rails through spring-loaded grounding shoes at each gantry corner (4 required), and on at least one side of the main trolley to the trolley rails (at least one required). If trolley is grounded by way of festoon cable to the structure, no grounding shoes is required on trolley rail. Ground straps from the dock level grounding shoes across the equalizers to the frame shall be provided (4 required). To minimize spares at Port Miami, the grounding shoes shall be Conductix XA-18706 or equivalent” as used on Port Miami Cranes 13-16.

5.4.14 All sensitive electronic devices and inverter drives (including spreader cable reel, gantry cable reel drives, etc.) shall be installed in the air conditioned electrical control room. Systems must be properly wired and filtered with all communication (outside of the E-House) via fiber optics.

5.5 **POWER SUPPLY**

5.5.1 The primary power supply (see Section 5.6) shall be through use of a portal beam mounted cable reel with cable routed thru the existing on-dock/wharf Panzer Belt cable trench system, cable horn and tension drum in underground electrical pit, and plug to existing power and fiber junction box. A secondary, auxiliary power supply (see Section 5.46.3) shall be provided from fixed 480 volts power outlets on the water’s edge bulkhead of the wharf.

5.6 **SHORE POWER PROVISIONS**

5.6.1 The primary power shall be 13,200 VAC, 3 phase, 60 hertz. The Crane shall be supplied with one or more medium voltage drive isolation and auxiliary power transformers. The transformers shall be convection cooled dry type and designed for operation at rated KVA as defined in accordance with applicable previously noted standards. Transformers shall be 13.2 KV primary, with approved secondary voltages, 3 phase, 60 Hz to step down power from the line voltage to the voltages for: (1) the main hoist/gantry drives, boom hoist/trolley drives; (2) the 480 volt motor control center; (3) and all other electrical services. Provide space as required for the transformers in the boom hoist machinery house to be protected from the weather.

5.6.2 A minimum of two (2) 2½% full capacity taps above nominal voltage and two (2) 2½% full capacity taps below nominal voltage shall be provided at the tap board of each transformer. Insulation shall be selected for long life under specified operating ambient temperature conditions. Core-coil assembly shall be mechanically braced to withstand short circuit tests and verified by testing. Coil construction and bracing shall be designed for crane duty and shall prevent mechanical breakdown of insulation during short circuit.

5.6.3 Each drive isolation and auxiliary power transformer primary shall be protected against over currents and overloads utilizing overcurrent relays in conjunction with SF6 circuit breakers or electrically operated fused SF6 interrupter switches of adequate voltage rating and interrupting rating suitable for the maximum voltage and short circuit capacity of the terminal utility system. (Current limiting fuses shall be supplied when necessary to achieve the fault interrupting capability required.) If fuses are used, they must be properly coordinated with the utility feeder protection switchgear overcurrent relays. The medium voltage switchgear on board the Crane shall also include detection and protection against undervoltage, overvoltage, ground fault, and phase loss. When SF6 circuit breakers are employed, they shall be equipped with low bottle gas pressure detection, alarm, and lockout. The lockout feature shall prevent closure of the breaker if low gas conditions exist. Each vacuum contactor/disconnect of SF6 circuit breaker shall be provided with visual indication that the device is closed, open, or tripped. If stored energy spring operators are employed, there shall be a visual indication that the spring is fully charted. A SATEC PM174 Power Quality Meter (PQM) or County approved equivalent and transducer unit shall be provided which allows continuous, real time monitoring of:

a) Line to line Voltages (A-B, B-C, C-A)
b) Line Currents (A, B, C)
c) Line Frequency
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5.6.4 Signals shall be provided from power quality monitor to the CMS to enable monitoring of data from the power quality monitor.

5.6.5 Drive isolation transformers and auxiliary power transformers shall be supplied with grounded electrostatic shields and primary lightning arresters (GE Tranquell ZEP MOV type or equal). Each transformer secondary shall be provided with molded case circuit breaker secondary protection and appropriate ground fault equipment. Drive isolation transformer secondary neutrals shall be high resistance grounded with ground fault detection and protection. Auxiliary power transformer secondary neutrals shall be solidly grounded with differential current ground fault detection and protection.

5.6.6 The Gantry Cable Reel for power and communications through fiber optic cable shall be mounted on the waterside end of the right portal beam, see General Arrangement drawing in Section 9 of these Specifications for reference. The power cable shall feed from reel through a cable trench on the landside of the waterside crane rail. The cable through the trench shall connect to a below wharf power vault outlet through a cable horn as provided by the Port.

5.7 MAIN POWER CABLE REEL

5.7.1 The main power cable reel shall be a mono spiral type, as manufactured by Stemmann or County approved equal, with AC motor and inverter drive. The cable reel system shall be installed on the right side portal beam, looking from the backreach toward the water. The drive shall be installed in the electrical room. The main power cable reel drive system must be completely separate from the spreader cable reel drive system cabinet.

5.7.2 One end of the power cable will be connected at a fixed outlet slip ring assembly for power and communications on the portal beam cable reel station. The other end will be able to be connected to the below wharf power vault and communication outlet. A reserve cable length of 25m shall be allocated for termination and spare cable length in the cable termination pit.

5.7.3 All the constitutive parts of the cable reel system shall be protected against any kind of collision.

5.7.4 Gantry travel shall be 2,132 feet (650 meters) each side of the wharf's power cable feed termination point, for a total gantry travel of 4,264 feet (1,300 meters).

5.7.5 A multi-roller, radius cable guide mounted on the leg adjacent to the reel shall be provided to lead the cable from the reel down the leg in order to prevent whipping during gantry travel or high wind conditions.

5.7.6 A bi-directional multi-roller, cable guide (diverter) shall be provided at the wharf level so the cable can be retrieved from either direction parallel to the rails. The radius of all cable guides shall be as recommended by the cable manufacturer. The layer width of the cable reel body shall be adjustable in order to permit the matching of the reel to different cable sizes.

5.7.7 The following shall be observed;
   a) The torque of the system shall be adjustable.
   b) The cable reel system shall be equipped with the following interlocks:
5.7.8 The high-tension cable shall be Panzerflex or Prysmian Protolon (SMK) of adequate voltage and ampacity rating as approved by County.

5.7.9 A platform and ladder as required shall be provided to access the cable reel, gearbox, motor and slip ring. A local manual operating station shall be installed for maintenance and start up purposes at ground level by the cable guide (diverter).

5.8 POWER FACTOR CORRECTION

5.8.1 A power factor correction system shall be provided as required to meet the local utility (Florida Power & Light, Co.) requirements, and as a minimum to ensure that the power factor does not fall below 0.9 lagging average over a 15 minute demand period at the point of common coupling (operating at 60% rated load).

5.8.2 The power factor correction system shall be designed to use the existing power source at the Gantry Crane wharf at Port Miami.

5.9 ELECTRICAL DRIVES

5.9.1 The Crane shall be fitted with electrical drives supplied and installed by the single chosen crane drive and control systems vendor. The drives shall be capable to perform main hoist and trolley, or, gantry and trolley operation simultaneously. The boom function shall only be singularly capable to perform.

5.9.2 The main hoist, trolley and gantry shall be controlled by master switch(es) on the operator chair/control counsel. The boom motions shall be controlled by push button from the boom hoist cabin. The operator shall be able to increase or decrease the speed of the drives and change their direction by moving the master switches in the proper direction. The acceleration and deceleration shall be limited automatically to predetermined adjustable values.

5.10 POWER CONVERSION UNITS

5.10.1 The electrical drive system shall provide reliable power for the rapid, smooth, and precise handling of containers through the use of power conversion units controlling the AC motor(s) for main hoist, boom hoist, trolley, and gantry motions. The system shall be designed for maximum simplicity and maintainability.

5.10.2 The IGBT converter/inverter units for AC powered drives shall be provided by an experienced manufacturer which system has been successfully proven its operation for a period of five (5) years in the STS gantry container crane operation. Contractor shall supply a list of such installations with the proposal and with shop drawing submittals. Newer models of such existing IGBT units may be submitted with detail design information, calculations and specifications for review and approval by County.

5.10.3 The IGBT converter/inverter units shall be designed to be capable of operating continuously with voltage fluctuations under any loading condition from no load to rated load in accordance with current STS container gantry cranes applications and standards. As a minimum, the units shall accommodate voltage fluctuations of plus or minus ten percent (10%) at full capacity.

5.10.4 The power factor conversion/correction system shall be installed inside the environmentally controlled air conditioned Electric Drives Room (E-house).
5.10.5 The IGBT converter/inverter units shall contain but are not limited to the following protective devices and functions:

a) AC line over current protection for the conversion units shall be provided only through circuit breakers of a type which can sustain the continual over current tripping that may be required by this type of service without damage or a significant increase in interruption time. Contractor shall supply supporting information to the County’s Representative within sixty (60) days after Notice to Proceed verifying that the interruption characteristics of the circuit breakers and fuses with respect to the over-stress characteristics of the power IGBT’s meets these requirements. The supplied information shall show that the protective devices adequately protect all power IGBTs to which they may be subjected in the IGBT conversion unit, including standard bolted fault.

b) Voltage transient protection shall be provided by properly rated metal oxide thyristors (MOVs) or other equivalent similar devices.

c) Static, instantaneous over current protection shall be provided in each thyristor conversion unit.

d) Static, instantaneous, single-phase, and phase-reversal protection shall be provided in each motor drive IGBT conversion unit.

e) A temperature sensing devise shall be provided in each power conversion unit to automatically interrupt the AC control power in the event that the heat sink temperature in the IGBT conversion unit rises above safe operating temperature.

f) A static current limit override shall be installed in each IGBT conversion unit to limit current to some predetermined value set by the OEM. Provisions for different settings of current limiting with automatic selection shall be provided for different drives using the same thyristor conversion unit.

g) A diagnostic panel, instruments, and meters shall be provided to facilitate maintenance and performance checking of the IGBT conversion units.

5.11 MAIN HOIST DRIVE

5.11.1 The main hoist drive shall consist of two (2) AC motors, driving a single gear reducer and two (2) hoist drums.

5.11.2 A pulse tachometer and/or absolute encoder shall be mounted on the non-drive end of each motor, with the device output used for digital regulated speed control, and/or hoist position control functions.

5.11.3 Position limits shall be set in software and expressed in engineering units. Settings shall be protected by password security.

5.11.4 A highly accurate absolute encoder with constant self-supervision driven by the hoist drum shall provide redundant signals for slowdown positions and resynchronize the pulse counting system and over travel stop function. Failure of the encoder shall trigger a hoist stop. If further movement is required it shall be done under unsynchronized speed reduction. The encoder device shall consist of a basic unit installed on the drum shaft end and electronic function modules to be installed in the control panel (cabinet). The basic unit and modules shall be connected by optical fiber cables which are immune to EMI.

5.11.5 The drive shall provide field weakening concept or power optimization similar to DC drives under light load, operating at constant power. Acceleration and deceleration rates shall be independently adjustable. A current limit circuit shall limit maximum permissible torque.
5.11.6 The hoist shall be normally operated from the operator’s cab by a digital master switch, which provides flexibility in generating a response vs. position characteristic, such as S-curve response. It shall provide rapid response with no time wasted on A/D (Analog/Digital) conversion. The master switch signals may thus be transmitted via the high-speed Master Field bus serial communication link to the main programmable logic controller.

5.11.7 The Main Hoist shall have the capabilities to be operated for maintenance purposes ONLY at slow speed from the Dock Level Control Station and from the Machinery House Control Station. In addition, local control shall be available for maintenance purposes at the converter panel door station, bypassing the programmable logic controller and subject only to hard-wired safety stops.

5.11.8 A load sensing system shall be installed which shall provide individual analog outputs from the main hoist dead ends.

5.11.9 The sensor for trim, list and skew shall be located on the anti-snag hydraulic cylinders.

5.11.10 Both main hoist motors shall be identical.

5.12 MAIN AND CATENARY TROLLEY DRIVES

5.12.1 The Main Trolley drives shall consist of one (1) AC motor for each drive; each motor shall be controlled by a single IGBT converter. A pulse tachometer located on the non-driven end of each motor shall generate a speed feedback signal, providing digital regulated speed control. A ramp generator shall control acceleration and deceleration ratings, and maximum permissible driving torque limited by a current limit circuit.

5.12.2 The Main Trolley drives shall have encoder positioning systems similar to the main hoist, except that proximity switches shall generate the redundant back-up signals and check signal. The drives shall incorporate a “Smart Slowdown” circuit similar to the Main Hoist.

5.12.3 The trolley shall be normally operated from the operator’s cabin by a digital master switch. In addition, local control shall be available at the converter, bypassing the programmable logic controller and subject only to hard-wired safety stops.

5.12.4 The Main Trolley drives shall be equipped with contactless slow-down switches and mechanically operated limit switches. The slow-down switches shall reduce the motor speed at a specified OEM set distance from the end positions at the outreach and backreach of the boom and main girder. Stop mechanical limit switches shall be used at a specified distance from the end positions as specified in Electrical Specifications herein as set by OEM.

5.12.5 The Main Trolley drives will be electrically interlocked with the Boom Hoist in a manner that will prohibit the Boom from being raised until the Trolley has traveled to landside passed the boom hinged and the Trolley boom up stop limit switch. The interlocking will also prohibit movement of the Trolley until the waterside boom is in its operating position.

5.12.6 The Main Trolley Hoist shall have the capabilities to be operated for maintenance purposes ONLY at slow speed from the Dock Level Control Station and from the Machinery House Control Station.

5.13 GANTRY DRIVE

5.13.1 The main hoist/gantry controls shall be interlocked on a first come-first served basis. The gantry drive shall consist of AC motors connected in a parallel connection. Control system features shall insure load sharing. Speed control shall be achieved by means of speed feedback. The gantry drive accelerating/decelerating ramps and current limit setting shall be independent of the main hoist drive. Mechanical limit switches provide the necessary position
and protective signals. Switch-over time of main hoist to gantry, or, gantry to main hoist shall not exceed two (2) seconds.

5.13.2 The gantry drive shall be operated from the Operator’s Cab or the Dock Level Control Station and also by local control at the converter.

5.13.3 The thermal capacity of the gantry drive shall be sufficient to assure that the gantry can travel a minimum of 304.88 m (1,000 feet) along the dock against the operating wind load and 198 m (650 feet) against a wind of 32m/s (71.6 mph) without injurious heating. Calculations shall be submitted for verification with compliance.

5.13.4 A pulse tachometer shall be installed on the non drive end of at least one gantry motor on each rail (landside and waterside) to provide speed feedback. All gantry motors shall be identical.

5.13.5 The gantry travel system shall drive 75 percent of the waterside wheels and 75 percent of the landside wheels. Gantry motor may be arranged vertically or horizontally as approved by County. Multiple gantry drives shall be synchronized to prevent skewing.

5.13.6 To avoid slipping of wheels of less loaded corners, the gantry travel mechanism shall be equipped with a regulated drive with speed feedback. This further provides for accurate and sensitive positioning.

5.13.7 The gantry shall have the capabilities to be operated for maintenance purposes ONLY at slow speed from the Dock Level Control Station.

5.14 BOOM HOIST DRIVE

5.14.1 The Boom Hoist drive shall consist of an AC motor controlled by the Main Trolley drive, with a transfer circuit interlock operating on a first come – first served basis. A pulse tachometer shall be mounted on the non-drive end of the Boom Hoist motor, with the pulse information used for digital regulated speed control, and hoist position control functions.

5.14.2 The Boom Hoist drive accelerating/decelerating ramps and current limit settings shall be independent of the trolley drive.

5.14.3 The Boom Hoist position signals shall be generated by a highly accurate absolute encoder with constant self-supervision or by a rotary cam limit switches, with final over travel stops via lever type limit switches on the waterside pylon apex.

5.14.4 The Boom Hoist shall be normally operated from the Boom Hoist Control Station, but may also be operated by local control at the converter.

5.14.5 The Boom Hoist shall have the capabilities to be operated for maintenance purposes ONLY at slow speed from the Machinery House Control Station. In addition, local control shall be available for maintenance purposes at the converter panel door station, bypassing the programmable logic controller and subject only to hard-wired safety stops.

5.15 MOTORS

5.15.1 All motors, including main function motors shall be totally enclosed and waterproof (IP55 rating) with appropriate cooling provisions as approved by the County. NEMA or IEC motors are acceptable. UL listed motors are not required.

5.15.2 All wiring external to the motor shall comply with NEC. All electric motor brakes shall be totally enclosed and waterproof (IP55), except where housed in watertight enclosures or the Machinery House.
5.15.3 Covers on motor mounted brakes required to be removed for routine maintenance shall not weigh more than twenty (20) pounds and shall be easily accessed and removed by one person. Aluminum or aluminum alloys shall not be used for enclosures or windings.

5.15.4 All main function motors shall be of the same manufacturer, in order to facilitate maintenance and minimize spare parts requirements. The motors shall be made by a manufacturer with an excellent service record and a worldwide service organization with service available in close proximity to Miami. Main crane function motors shall be by a County-approved manufacturer. Where multiple motors are used for a system, all motors shall be identical for the purpose of simplifying spare parts requirements. For example, although all gantry motors may not have a tachometer attached, all gantry motors shall be identical such that they are physically interchangeable with each other either a motor with or without a tachometer. Type F insulation shall be used as a minimum. They shall be rated for inverter duty.

5.15.5 All motors and brakes shall be sized for torque ratings and thermal loadings of design requirements specified elsewhere and shall meet requirements of applicable codes and regulations.

5.15.6 Main Hoist, Boom Hoist and Main Trolley motors shall be mounted in the Machinery Room and shall be waterproof totally enclosed with continuous duty rating. Gantry motors, shall be waterproof, totally enclosed, with minimum of 60 minute duty rating.

5.15.7 The Control System Supplier shall formally establish motor warranty and post warranty agreements with a local motor repair vendor prior to Final Completion.

5.15.8 Waterproof motors shall be provided with suitable drain plugs and breathers as recommended by the manufacturer.

5.15.9 All motors shall have an energy efficient rating and shall be equipped with sealed anti-friction bearings designed to meet the requirements of thrust and radial loads and to provide a 50,000 hour minimum life expectancy, except fan motors which shall have a 100,000 hour minimum life expectancy. The use of motors with bearings requiring periodic lubrication shall be approved by the County for each specific case.

5.15.10 Thrust bearings shall be provided as required and shaft end play shall be limited to the clearance in the bearing. Motor bearings shall include resistance to damage due to induced currents in bearings.

5.15.11 All motors equipped with anti-friction bearings using pressure grease fittings shall have relief plugs so designed that grease cannot be forced into the motor windings.

5.15.12 Where motors are fitted with brakes or gears, if the design precludes the use of conventional wheel pullers, tapped holes or other means shall be provided for removal of brake or gear shall be provided. All motor connection box covers shall have at least four bolts.

5.16 BRAKES (GENERAL)

5.16.1 All motor brakes shall be fail safe, spring set, thruster operated AC type, with manual release, as manufactured by Pintsch-Bubenzer, or County approved equal. All brakes selected for use by the Contractor must be the standard product of the brake manufacturer, and be in current use in container handling equipment.

5.16.2 In normal operation, deceleration shall be accomplished by regenerative braking with motor brakes being applied when the motion has slowed (parameter to be adjustable) to essentially a stopped condition. All brakes, however, shall have sufficient torque and thermal capacity to stop any drive from the full load/full speed condition without motor assistance.

5.16.3 Brakes exposed to the weather shall have a minimum of NEMA-4X enclosures, with condensate drain installed at the low point, fabricated of stainless steel material as required for the marine environment.
5.16.4 Brake design and selection shall be generally in accordance with AISE Standard No. 6.

5.16.5 The brake manufacturer shall list the type and characteristics of lining used in the Main Hoist, Boom Hoist, Gantry, and Main Trolley brakes, and shall clearly state lining requirements in operation and maintenance procedure. No asbestos material will be acceptable.

5.16.6 All pins in brakes shall be of high strength bronze or stainless steel.

5.16.7 All brakes shall set immediately if control power is interrupted or if power failure occurs. The brakes shall be electrically interlocked to the control system as required in these specifications.

5.16.8 The Contractor shall properly torque and time rate each brake for its particular service. The brake duty rating shall not be less than the motor duty rating for that particular drive.

5.17 **MAIN HOIST BRAKES**

5.17.1 The thruster operated motor disc brake shall have a release limit switch, automatic wear compensation and a self-centering feature.

5.17.2 Each main hoist motor shall be provided with a spring set, thruster release caliper disc brake as manufactured by Pintsch-Bubenzer type SB, or County approved equal. Each brake shall have a rating equal to at least 110 percent (110%) of the torque required when hoisting the maximum rated load at the shaft where the brake is mounted. Each brake must have the energy absorption capability to bring the hoist to a complete stop from the highest lowering speed with maximum Lifted Load, under emergency stop conditions. The main hoist brakes shall include a manual release lever, brake released limit switch, automatic wear compensation and be self-centering. Brake torque settings shall be clearly identified and accurately adjustable. The calibration of the adjustments shall be certified during the dynamic testing.

5.17.3 Redundant/auxiliary spring set, electro hydraulic released disk brakes as manufactured by Pintsch-Bubenzer (or County approved equal) shall be provided on the flange of the non-driven end of rope drum. These brakes shall be capable to stop the descent of the load at any point in its travel from over speed without any assistance from the motor brakes. There shall be at least two (2) main hoist drum (emergency) disc brakes (one for each drum), with a total torque rating no less than two hundred percent 200% of the maximum torque required to raise the load.

5.18 **MAIN TROLLEY DRIVE BRAKES**

5.18.1 The Main Trolley Drive motor(s) shall be provided with spring set thruster release disk brake(s) as manufactured by Pintsch-Bubenzer or as approved by the County. The brakes shall be adequate to hold the Main Trolley with stowed wind load from the least favorable direction and have the thermal capability to stop the Main Trolley from rated speed with rated load. The braking torque of the brakes will be at least 200% of the motor rated torque. The Main Trolley brakes shall include a manual release and brake release limit switch.

5.19 **GANTRY DRIVE BRAKES**

5.19.1 Each gantry drive motor shall be provided with a spring set, thruster released caliper disk brake, as manufactured by Pintsch-Bubenzer as approved by County. The gantry brake shall be located between the motor and the reducer. They shall have a torque rating no less than 250 percent of motor rated torque, and shall have adequate thermal capacity to completely stop the Crane while in gantry motion from the maximum rated speed, with a 32 m/s (71.6 mph) wind in the least favorable direction. Each brake shall be supplied with a watertight, easily assessable enclosure, and have auxiliary interlocks to prevent operation of the gantry
unless all brakes are released. Brakes shall set after an adjustable time delay and shall be fitted with manual releases.

5.19.2 The brakes, if vertically mounted motors are used, shall be located no higher than 1.75 m above ground level for ease of maintenance. The brake cover shall be easily removable and have an access opening for quick manual release without the removal of any cover plate. The access opening cover plate may be hinged.

5.20 **STORM BRAKES**

5.20.1 Automatic caliper type storm (wheel) brakes as manufactured by Pintsch-Bubenzer or County approved equal, shall be installed on each of the gantry idler wheels. The brakes shall be capable of holding the Crane on wet rails at any location on the wharf, against a 40 m/s (90mph) wind load in the most adverse direction in conjunction with the holding power of 100% of the gantry brakes. The brakes shall be fitted with renewable shoes that bear on the side of the gantry wheels.

5.20.2 The storm brakes shall be capable of application with the Crane in motion without inducing severe dynamic braking loads in the Crane and their dynamic braking torque shall be no less than the required static braking torque.

5.20.3 The control for the storm brakes shall be connected to the Crane control system to automatically set and release in conjunction with the motor brakes on the Crane gantry drive. The storm brakes shall release completely and permit gantry motion within 2.0 seconds after release motion of the gantry drive motor brakes is initiated.

5.20.4 The storm brake system shall have a selector switch on the operator’s seat console, and, a selector switch and a Master Selector Switch in the Dock Level Control Station. The selector switch on the operator’s seat console shall have three (3) different mode settings:

a) Set – manually activates and closes all the brakes, locking all storm brakes.

b) Auto – sets the brake operation to automatic as specified in this section and interlocked with gantry motion of the Master Switch handle and the anemometer.

c) Open – manually opens (disengages) the storm brakes. This function is only enabled from the master selector in the Dock Level Control Station.

5.20.5 The Master Selector Switch in the Dock Level Control Station shall have two (2) different mode settings which shall control the mode of the selector switch:

a) Manual – give manual control of the storm brakes to manually set/activate and closes all the brakes, locking all storm brakes and to de-activate and open all the brakes.

b) Auto – sets the brake operation to automatic as specified in this section and interlocked with gantry motion of the Master Switch handle and the anemometer.

5.20.6 When the storm brakes are set in the “Auto” mode, the storm brakes shall automatically activate when the gantry drive motor brakes have been activated and set. The brakes shall be released when the operator initiates gantry motion by use of the gantry master switch handle controlled from the Operator’s Cabin seat console or the Ground Level Control Station. The storm Brakes shall release prior to the Gantry Drive Motor Brakes release. The release mechanism shall be electro hydraulic (unless otherwise approved by County). Appropriate electrical interlocks shall be provided to assure that the Crane does not gantry before the storm brakes and gantry motor brakes are released.

5.20.7 An adjustable time delay shall be provided to delay setting of the wheel brakes between 0.1 and 15 seconds for the following events:
a) If control power is interrupted.
b) If a power failure occurs.
c) If the Emergency Stop push button is actuated.
d) If the Master Switch for the gantry drive is returned to the “Neutral” position.
e) When the master selector switch is actuated to the “Set” mode.
f) Wind conditions are greater than 20 m/s (45 mph). The storm brakes shall be interlocked with the anemometer.

5.20.8 The stop time delay shall be sufficient for the gantry to come to a full stop from full rated speed, with no wind and an adjustable reserve up to 15 seconds. The intent of this is to prevent the storm brakes from setting while the gantry is traveling in any but the most extreme emergency operating circumstance. The time delay mechanism shall be pneumatic, hydraulic or mechanical in order to permit proper functioning upon loss of power.

5.20.9 Under an emergency stop situation the storm brakes shall be capable of dynamic braking. Upon activation of the emergency stop and after the motor brakes are fully activated, the storm brakes shall activate in a progressive force manner until full brake contact pressure is applied. The progressive contact pressure shall be applied to the wheels through an adjustable time period, 3s to 15s.

5.21 BOOM HOIST BRAKES

5.21.1 There shall be at least one boom hoist motor (holding) brake with torque rating no less than 200% of the maximum torque required to raise the Boom, and shall include manual release and brake release limit switch. The brake shall be a spring set, thruster released Pintsch-Bubenzer disk brake, or County-approved equal, and shall be mounted between the motor and the reduction unit.

5.21.2 In addition to the motor brake, there shall be provided, an auxiliary boom hoist drum mounted spring set electric or hydraulically released disk brake as manufactured by Pintsch-Bubenzer or County-approved equal. It shall be provided to stop the descent of the boom at any point in its travel from over speed without any assistance from the motor brake.

5.22 AUXILIARY DRIVES (GENERAL)

5.22.1 Auxiliary single speed AC drive systems shall be provided to allow safe slow speed operation of various functions by maintenance personnel if a main drive or main power supply malfunctions. The auxiliary drives shall be configured for maximum reliability and safety and operate regardless of any main control system failure if electrical power from the main high voltage transformers is available or if the Crane is powered by an external maintenance power supply.

5.22.2 The mechanical drives of the emergency units may be mechanically disconnected from the primary equipment during normal crane operation, but, when needed, shall be capable of quick and convenient engagement by means of quick disconnect couplings or similar devices.

5.22.3 The auxiliary drives shall utilize dedicated motors for each function with jaw clutch type couplings; no chain drives are acceptable. Each auxiliary drive motor shall be equipped with an adequate thermal capacity motor mounted with adequate sized disc brake which shall operate in conjunction with the primary brakes. Auxiliary drives for main hoist and boom hoist shall include appropriate over speed shut down features.

5.22.4 All auxiliary drive’s components shall be easily accessible for operation and maintenance. OSHA compliant platforms shall be provided where needed for accessibility of maintenance personnel to all components.

5.22.5 The auxiliary drive system to include all components shall be completely commissioned and tested at manufacturer’s facility as enumerated in the Test and Check-out manual. Full cycle ‘runs’ shall be successfully completed before crane acceptance for loading on transport ship.
5.23 **AUXILIARY MAIN HOIST DRIVE**

5.23.1 An auxiliary main hoist drive system controlled from the Operators Cabin shall be provided to allow slow speed raising or lowering of full rated load if electrical malfunction of the main hoist drive system occurs. The system shall be capable of raising or lowering rated load at 2.5% of rated load speed and shall have adequate thermal capacity to perform one operation of raising or lowering (one direction only) rated load the total lifting height of the Crane (sum of maximum spreader height above rails plus maximum depth below rail) without overheating or thermal shutdown.

5.24 **AUXILIARY BOOM HOIST DRIVE**

5.24.1 An auxiliary boom hoist drive system controlled from the Boom Control Station shall be provided to allow slow speed raising or lowering of the boom if electrical malfunction of the main boom hoist drive system occurs. The system shall be capable of raising or lowering the boom between the operating position and the stowed position in no more than thirty (30) minutes and shall have adequate thermal capacity to perform one operation of raising or lowering the Boom (one direction only) between operating and stowed position without overheating or thermal shutdown.

5.25 **AUXILIARY MAIN TROLLEY DRIVE**

5.25.1 Auxiliary drive systems controlled from the Operator Cab shall be provided to allow slow speed Main Trolley travel if electrical malfunction of the primary drive systems occur. The systems shall be capable of travel at 2.5% of rated speed and shall have adequate thermal capacity to perform one operation of travel between maximum backreach and maximum outreach (one direction only) without overheating or thermal shutdown. Control for the emergency trolley drive shall be located in the Operator’s Cab.

5.26 **CONTROLS**

5.26.1 All electrical control systems shall be provided by the County approved crane drive and control systems which shall provide the latest state-of-the-art digital AC adjustable voltage frequency control system.

5.26.2 The drive system supplier shall complete a power system analysis. The study shall include power flow, voltage drop and short circuit calculations to be used in selection of the crane power distribution equipment and coordination with the terminal power distribution system contractor and utility company. The results shall be submitted to the County within ninety (90) calendar days after Notice to Proceed.

5.26.3 In addition, the drive system supplier shall perform an arc flash study verifying compliance of the Crane with applicable arc flash requirements of OSHA, NEC and NFPA 70E.

5.26.4 In general the control system shall include the following equipment:

   a) Digital direct power conversion units for variable speed control of all Crane functions.

   b) Programmable logic controllers with user-friendly ladder diagram programming for drive coordination and sequencing or other County approved programming.

   c) County approved network for remote input/output data collection and communication bus link to master controllers.

   d) User-friendly diagnostic system.
5.26.5 For each Crane, one set of all instruments, test devices, monitors, computers, and other devices required for control system diagnostics, crane production data, troubleshooting, or maintenance shall be provided. This quantity shall include all devices and software necessary to backup, upload, download, or change software. All licenses to include software are to be transferred and provided to, and become the property of the County.

5.26.6 The Contractor/control system supplier is responsible for supplying any other devices required for reliable, safe, and efficient Control of a Crane meeting the intent of these Specifications.

5.26.7 The control system supplier shall be required to attend at least the first two (2) design review meetings to facilitate communication and coordination.

5.26.8 The control system supplier shall have responsibility to review the design and installation of the entire Cranes’ electrical system and certify to County that the design and installation are in conformance with the drive requirements, and shall have within their scope all parts, components and systems that affect performance of the drive system.

5.26.9 The Contractor shall submit electrical system installation drawings of sufficient detail to facilitate the evaluation/certification by the control system supplier. The electrical system installation documentation shall include the following as a minimum:

a) Wire and Cable Pulling Schedules indicating destinations, type of cable or wire, wire and cable sizes and ratings and raceway routing.

b) Cable and wire specifications that provide complete descriptions of insulation systems, configuration, vendor part numbers, wire sizes, ampacity, etc. so the wire and cable can be properly evaluated.

c) Breaker schedule including breaker ratings.

d) Electrical equipment arrangement drawings showing locations and mounting methods.

e) Raceway (conduit, cable tray, etc.) layouts that indicate arrangement and location on the Crane, barrier and cover design details, and wire and cable content in each raceway by notes or reference to cable and wire pull numbers in the cable and wire pulling schedule. All cable trays shall be detailed as to the overall dimensions including indication of the separation distances between isolated sections in the cable tray.

5.26.10 The above electrical system documentation shall be submitted to the control system supplier and County for review at least six weeks prior to manufacture/assembly.

5.26.11 The electrical drive system for Main Hoist, Boom Hoist, Main Trolley and Gantry motions shall provide reliable power for rapid, smooth, and precise handling of containers through the use of AC variable voltage/frequency power conversion units controlling AC induction motors. The system shall be designed for maximum simplicity, maintainability and failsafe operation in the case of any one failure. An automatic control system shall be provided for main hoist motion to provide a continuous load vs. speed curve of approximately constant horsepower throughout the speed range of the hoist. The systems shall be fully regenerative into the power grid and safely regulate zero speed. Control of the load limited main hoist speed shall be regulated by internal drive current feedback, (not via external load cells).

5.26.12 Protection against loss of motor regenerative capability shall be provided in all hoist control systems. The circuit shall sense any difference between reference speed and actual speed and in such a case initiate a controlled shutdown of the drive. The torque-proving circuit shall be provided to prevent release of the motor brakes unless the motors are developing torque to control the load based on current and voltage feedback.

5.26.13 All main functions shall be provided with a pulse (digital) tachometer feedback (speed feedback). At least one motor controlled by the drive shall provide tachometer feedback to that drive.
5.26.14 Control of Main Hoist, Boom Hoist, Main Trolley and Gantry motors shall be stepless, digitally regulated, and regenerative over the entire operating range of the equipment and shall be failsafe from any one (1) failure.

5.26.15 Master switches shall be either inductive or digital without sliding contacts. The operator shall be able to increase or decrease the speed of the drives and alter their direction by moving the master switches in the appropriate direction and manner. The Master Switches shall have dead-band function which allows for zero position although the actual zero position is not precise due to wear of the switches’ hardware. The Master Switches’ hardware components must be precise, sturdy, made of none-wearable material so as to not impact the zero positioning and the safe operation of the Crane.

5.26.16 The acceleration and deceleration of the drives shall be under the control of the operator, except that if the operator moves the master switches rapidly, acceleration and deceleration shall be limited, automatically to predetermined adjustable values. The linear time ramps for the Main Hoist, Boom Hoist, Main Trolley and Gantry motions shall be asymmetrical and independently adjustable for acceleration and deceleration times. The deceleration time shall be less than the specified acceleration time and shall be based on the motor/drive system’s capabilities. All ramps shall have capability for adjustable rate of change of both acceleration and deceleration independently. When the operator moves the master switch toward the “off” position, the motion shall be slowed electrically. The speed of all motions shall be infinitely variable from full speed through zero to full speed in the opposite direction with no dead band.

5.26.17 The controls shall electrically stop all drives on motor torque before setting brakes. Normal holding brakes for the Main Hoist, Main Trolley and Gantry shall set after independently adjustable time delays (0-30 seconds) in the PLC, when the master switches are returned to the off position. The control circuits shall be so designed that all brakes are delayed in setting during normal operation until the associated motor has stopped (zero speed) by means of regenerative braking with energy dissipated back to the power grid, at which time the adjustable delay shall begin. Motor torque shall be maintained until the brakes have set. If the control power has been removed for any reason, all brakes shall set immediately.

5.26.18 Brake control relays shall be adequate to extinguish the arc upon opening under all operation conditions. Under some operating conditions, Main Hoist, Boom Hoist, Main Trolley and Gantry brakes will be maintained in the released mode by timers or controls when the associated drive is at zero speed.

5.26.19 All Crane motion initiated by master switches shall have an independent backup circuit which monitors motion of the master switch and the corresponding Crane movement - sometimes referred to as a “tach loss” circuit. If a preset error difference is exceeded, a fault shall occur, the motion shall stop, and the brakes shall set.

5.26.20 The time between the initial movement of any master switch and the start of rotation of the corresponding machinery, excluding change over time for changing for one motion to another motion with shared drives (such as hoist/gantry), shall not exceed seven tenths (0.7) of a second. The time between initial movement of the master switch and start of rotation of corresponding machinery when changing over from one motion to another (such as hoist to gantry motion or gantry to hoist motion) using common/shared drives shall not exceed 2.0 seconds.

5.26.21 The hoist drive shall operate without steps in the constant horsepower range.

5.26.22 Each power conversion unit assembly shall be selected using the following criteria, as a minimum:

a) The nominal current rating of the assembly shall exceed the RMS current of the motor as determined by the theoretical duty cycle.
b) The continuous current rating of the assembly shall exceed the motor current required to lift the rated load.

c) The 60-second current rating of the assembly shall be 150% of the required RMS current as determined by the theoretical duty cycle.

d) The 10-second current rating of the assembly shall exceed the current limit setting established to meet the acceleration and deceleration rates required by these Specifications as approved by the County.

e) All the above ratings shall be based on the maximum specification design ambient temperature.

5.26.23 All power wiring termination shall be brought to terminal studs or bus bar flags mounted at the bottom of the control panel. Control wiring terminations shall be mounted in the control cabinets such that they are easily accessible and at a comfortable working height. In no case shall external power or control connections be made directly to drive control units.

5.26.24 The programmable logic controllers furnished shall allow register values to be changed, inputs and outputs to be forced on or off without halting the machine process or editing the program. All functions shall be connected to the drive controller, and communicated to the programmable logic controller via a local area network.

5.26.25 All terminal blocks, wires, conduit space, and cable tray space shall have 15% spares provided, with a minimum of 1. Power cable for gantry motor shall have one spare (minimum) provided in each gantry leg, to be reviewed to a mutually agreeable solution in the design review phase. The requirement for conductors and conduit fill will be reviewed on a case by case basis and applies to all runs outside the Machinery House. Spare wires or cables directly into a component or spare terminal blocks inside a component are not necessary.

5.26.26 Provide drive enclosures with master circuit breakers or isolation switches that will de-energize all electrical components in the cabinet.

5.26.27 Arrange each drive cabinet to provide access to the power conversion unit assembly without moving or removing other regulator components.

5.26.28 Convenient means shall be provided to electrically isolate all motor circuits from regulator and converter circuits for maintenance and troubleshooting.

5.26.29 Hoist/gantry controls shall be interlocked on a first-come, first serve basis. Gantry motors shall be driven by both main hoist drives with each drive controlling half of the motors on each rail (landside and waterside). Main hoist and trolley motions must be capable of operating simultaneously at full performance (full rated load, full rated speed, and maximum acceleration).

5.26.30 The drive must be organized such that problems can be resolved by replacement of drive modules (boards) which are interchangeable, as much as possible, between all motions on the Crane.

5.26.31 The control system shall incorporate a state-of-the-art County approved programmable logic controller using ladder logic, function block language, or County approved equivalent for general crane control, interlocking, and sequencing except for emergency stops and end of travel circuits. Emergency stops and emergency end of travel stops for all motions in all directions shall be hard wired external to the controller. The PLC cabinet shall be a separated unit.

5.26.32 Where applicable, remote I/O blocks shall be installed to reduce electrical components and wiring. For the Operator’s Cab, remote I/O shall be located in the Operator’s Seat console. Any instruments or equipment required to test or configure I/O blocks shall be provided; one complete set of required equipment shall be provided for each Crane.
5.26.33 Computer(s) with the required software installed for programming and troubleshooting shall be provided with each Crane control system. An appropriate color printer, storage case (if removable), program disks, instruction manuals, etc. shall be included for each Crane. Acrobat shall be installed on the computer.

5.26.34 The electrical control system shall have an integral diagnostic system which will provide integral monitoring, and diagnostics. All diagnostic messages and status data shall be user-friendly and programmable.

5.26.35 All data and calculations shall be displayed, stored, and/or performed only in the standard English system units.

5.26.36 The drives shall have the capability of operating at reduced power after the failure of a single power conversion unit in the active front end, or in the hoist. A selector switch shall be mounted on the control panel that allows selecting the operating mode for the function and that automatically modifies or recalibrates the PLC parameters and logic for the selected mode or as approved by the County.

5.26.37 The drive control panels shall be equipped with filtered fans that circulate the air and cool the panels by bringing in outside, cool air from the electrical house. The entire electrical house shall be cooled by two separate, thermostatically controlled air conditioning units, each capable of maintaining 65°F inside the electrical house under all operating conditions. All control panel openings and/or access doors shall be gasketed. An interior electric light will operate when the cabinet door is opened and shut off when the door is closed. Standard electrical outlets with ground protection shall be provided in each section (120 VAC).

5.26.38 The AC Control Center (ACCC) shall be NEMA Class II, Type B with dead front end. The motor control centers shall consist of vertical sections constructed of sheet metal meeting UL gauge specifications and suitably reinforced to provide a rigid free-standing structure. Each section shall have a vertical trough for wiring. Each motor control center shall have a full capacity, horizontal, main three-phase bus rated at no less than 600 amperes continuous. The main bus shall extend through all vertical sections. Wiring shall be not less than 14 AWG stranded with THHN 600 volts, 90°C thermoplastic insulation. Ten percent (10%) additional terminal points shall be provided for spare control wiring tie-points. Plug in type terminals will not be accepted.

5.26.39 Motor starters shall be circuit breaker combination type, one spare convertible auxiliary contact, and three (3) ambient compensated overload relays.

5.26.40 The lighting transformer shall not be included in the motor control center and provisions shall be made for dissipating the heat generated.

5.26.41 Each control panel compartment shall be furnished with an engraved nameplate describing the appropriate function(s) of the compartment.

5.26.42 An auxiliary control panel which houses the main disconnect, spreader hydraulic pump controls, protective devices, cab air conditioner, trolley lighting contactor, windshield wiper DC supply, remote programmable controller unit and spreader controls shall be installed in the operator's cab. Space heater shall be provided. In order to provide suitable noise immunity, the communication link between the cab remote I/O unit and the PLC in the e-house shall be via a fiber optic cable.

5.26.43 A transfer switch shall not be used to transfer control power to or from any station. Beginning with "Control Off", pressing the "Control On" push-button at any station shall transfer control power to that location.

5.26.44 The manufacturer of the Cranes’ main electrical drive shall have representation and service facilities in the Southeast Florida area. All components and parts for repair or replacement shall be readily available in the U.S. within twenty-four (24) hours. If a part or component is
not or will not be available within (24) hours, it must be listed as required herein Section 1.1.15.

5.26.45 Blowout coils for AC contactors shall be sized for the load on the contactor.

5.26.46 All motor control devices are to include starters, circuit breakers and loop contactors and shall be of an industrial type as approved by County.

5.27 PROGRAMMABLE LOGIC CONTROLLER (PLC)

5.27.1 The Crane shall be provided with a PLC supplied by the drive system manufacturer as approved by the County. The PLC shall collect data from monitoring and operating devices on the Crane, provide the logic sequence control for the Crane, communicate with the digital converters and remote I/O via a latest field bus technology, and furnish data to the Crane Management System (CMS) via latest technologically advanced system. The PLC hardware shall be mounted in a NEMA 12 dust tight enclosure and include a CPU(s) power supply, communication modules, I/O cards, connection boards, internal light, space heater adequate cooling system and 120V receptacle.

5.27.2 Fifteen percent (15%) of spare digital I/O points shall be provided. All digital outputs shall have fuse protection. Communication between the PLC and any remote I/O units shall be through the use of fiber optic cable. The fiber optic cables must be of standard use, and be available in Southeast Florida.

5.27.3 The drives and PLC must be easily reprogrammable in the field by the CMS computer in Control Room and by the mobile laptop provided in the case the CMS computer fails. Remote monitoring station shall only have monitoring and report writing capabilities. Burn in of custom chips for PLC control is not acceptable. The monitoring from the remote station shall be an option that can be disabled at the main CMS in the electrical house. In case of power loss the PLC must have the capability to reload the application software from its own flashcard.

5.27.4 Monitoring and diagnostic stations for the CMS shall be provided for the control of the PLC’s programs. One (1) industrial type desktop PC and one (1) mobile industrial laptop computer or equivalent shall be provided with all necessary hardware and software with each Crane.

5.28 CRANE CONTROL AND FAULT DIAGNOSTICS

5.28.1 The Crane Control and Fault Diagnostics shall be performed by use of a CMS (Crane Management System) that shall be provided by the crane drive and control systems manufacturer which shall consist of a complete platform for collecting, monitoring, displaying, record, analyzing, editing and distributing all pertinent systems data on the Crane. The diagnostic system program shall operate in a multi-tasking environment, so that the diagnostic data collection continuous while other tasks are being performed.

5.28.2 The diagnostic system program shall provide display screens that shall be customized to the specific requirements of the County. The CMS shall have the capability to monitor, record and display Crane productivity data such as container size, containers moved per ship, containers per hour per shift, average weight of container moved, maximum weights of container moved, average wait time between moves, maximum wait time between moves, etc.

5.28.3 The Crane shall be provided with monitoring and diagnostics stations as required by this specification. The monitoring stations shall have advanced Crane diagnostics as approved by County. The Crane control system and equipment shall be a minimum Level 5 Diagnostics System that includes advanced diagnostics, Crane production monitoring, data logging, preventative maintenance data logging and alarms.

5.28.4 Monitoring and diagnostic stations shall be provided in the Control Room of the E-House, Dock Level Monitoring Station, Operator’s Cabin and remote stations. All stations must be in an air conditioned control cabin or room.
5.28.5 The Control Room monitoring station shall include the following equipment or County approved equal:

a) NEMA 12 dust-tight enclosure
b) Latest PC and CPU technology available
c) Minimum 512 GB SSD
d) 3 ½” floppy drive
e) Blue Ray/DVD/CD-RW
f) Video card 2 GB VCM
g) Network card as required
h) Minimum 17” LED 1080 HD color monitor
i) Keyboard, Logitech mouse and pad
j) Latest Windows OS as approved by County
k) Crane Management System (CMS) as approved by County
l) PLC Programming Software Installed
m) PLC Network Card and Cable
n) Wireless hardware Norton 360 or equivalent
o) Hard Disc Backup/Restore Software
p) Laser Jet Printer as approved by County
q) Uninterruptible power supply (by APC or County approved equal)

5.28.6 The monitoring stations located in the Ground Level Monitoring Station and Operators Cabin shall have monitoring functions only with the required hardware the same as Section 5.28.5.

5.28.7 All computer software with the exception of the crane diagnostic proprietary software shall be off the shelf software, upgradable. All software licenses must be provided to Port Miami at the time of the Crane delivery to the Port Miami.

5.28.8 The requirements of the CMS shall be as follows;

a) The CMS shall be housed in free-standing floor-mounted industrial computer unit/rack and installed in the air-conditioned E-House Control Room within the Machinery House on the Crane.

b) A Windows based software drive tool shall be provided that can be used to interface with the PLC and drives. The tool shall have the ability to display live block diagrams, add use modifiable notes and provide a search feature to search product documentation.

c) The system shall include data logger and playback functions, and, have the capability of monitoring drive functions, storing data, and plotting of at least six (6) curves simultaneously. It shall be capable of storing all CMS parameters including speed reference, speed feedback, voltage feedback, load cell versus time. etc, for thirty (30) day period in sufficient detail to be capable of analysing and troubleshooting the drives and performance of the crane. The system should be able to collect global data from the whole system data base including drive system, I/O, etc. This shall eliminate the need to introduce strip chart recorders to troubleshoot the drives.

d) The system shall be capable of storing, displaying, printing the fault log of at least 200 fault events, graphically displaying the status, display position/status of all drives and motions for which there is state or position sensing. It shall display which station and drive is in control and the status of that drive. Should a fault develop, in addition to the listing of the fault that caused the shutdown, it shall direct the viewer through the fault tree to the source of the fault.

e) The system shall record and update files listing the running time of the Crane and each of its drives. It shall provide and store files listing total elapsed hours at the end of each day.
f) A cab mounted operator display screen shall be provided for the viewing of the crane operator and/or maintenance personnel. The screen shall display a series of messages which shall illustrate the status of the various drive, functions and accessory systems on the Crane. It shall list the weight of the load suspended, the wind speed, and any active faults. The user/operator shall not be capable of making any changes to the Crane system from this terminal.

g) The monitoring system shall display and store fault diagnostic data to assist the maintenance personnel in rapidly resolving faults. Fault listings shall clearly indicate the first fault, time and date of each event. Printed reports shall contain Crane designation headers on each page.

h) The monitoring system shall include a programmable signal to drive a relay that, upon closure, causes the yellow "power fault" warning light to illuminate. Refer to Fire Alarm System and Warning Light System as specified herein below. The system shall be initially programmed to illuminate the yellow light only on “power fault” but shall be programmable to illuminate said light on any fault listed below.

i) As a minimum, faults to be displayed and specifically identified shall include:

1) Motor over-temperature
2) Motor timed over-current
3) Motor over speed (main hoist and boom hoist and trolley gantry too)
4) Motor ventilation loss (blower ventilated motors)
5) Drive instantaneous over current
6) Drive circuit breaker trip
7) Drive blown fuse trip (armature)
8) Drive open IGBT
9) Drive Shorted IGBT
10) Drive over-temperature
11) Ground fault (transformer secondary)
12) Under voltage
13) Phase sequence
14) Brake Failure
15) Drive board failure
16) Reference/Speed mismatch
17) Overload
18) Snag load
19) Emergency stop push-button operation (identify push-button location)
20) End over travel limit switch operation
21) AC phase loss
22) CPU low battery
23) Loss of DC power supply, if applicable
24) Remote I/O failure
25) High wind warning (light and audible)
26) High wind shutdown (light and audible)
27) Gantry stowage pins
28) Trolley stowage pins
29) Fire Warning

5.28.9 The monitoring system shall maintain a 16 variable data messages available including the messages listed below that shall be updated real time:

a) Control power on hours
b) Main Hoist elapsed time hours
c) Main Hoist elapsed time with load (twist locks locked)
d) Main Trolley elapsed time hours
e) Catenary Trolley elapsed time hours
f) Gantry elapsed time hours
g) Boom Hoist elapsed time hours
h) Net run time hours
i) Main Hoist position  
ii) Main Trolley position  
iii) Boom position  
iv) Catenary Trolley position  

5.28.10 The following display screens shall be included:

a) Status real time, overall crane  
b) Status real time, individual motions  
c) Status real time, subsystems  
d) Faults/alarms  
e) Warnings  
f) Permissive interlock status  
g) Event Summary  
h) Event Trouble-shooting screens  
i) Line diagram dynamic view  
j) Limit switch dynamic view  
k) Spreader dynamic view  
l) Real time graphics signal level charts  
m) Historical trend charts  
n) Crane utilization reports  
o) Maintenance schedule reports  
p) Production reports  
q) Access control  

5.28.11 On-site screen modification and development by County shall be available; analog and digital data collected by CMS may be logged or copied to a floppy disk, Blue Ray, CD-ROM, DVD-RW, USB Drive, MS Access and MS Excel as approved by County.

5.28.12 An enhanced remote control system diagnostic, monitoring and management system, hereafter called RCMS (Remote Crane Monitoring and Management System), shall be provided in addition to the CMS on the Crane. In addition to advanced control monitoring system, diagnostics, management and drive programming on the Crane, the RCMS shall provide remote monitoring/programming of the CMS at six (6) remote PC sites. The Crane shall be supplied with all required RCMS equipment for communication between the Crane and the remote sites through fiber optics in the shore power trailing cable. The RCMS on the Crane shall integrate with Port Miami’s existing crane management system locate in the existing Switch Gear Room.

5.28.13 A mobile industrial laptop shall be provided that shall have the following requirements as approved by the County;

a) Latest CPU, motherboard and memory technology available  
b) The most Memory able to operate  
c) 15” TFT screen be installed  
d) Latest modern technology  
e) SSD 512MB min  
f) Blue Ray/DVD/CD Read/Writable  
g) Floppy drive, USB drive  
h) keyboard and pointing device (mouse)  
i) Latest Windows OS (64 bit) the same as used on PCs  
j) PLC Programming Software Installed  
k) PLC Network Card and Cable  
l) Wireless (Wi-Fi and Bluetooth) hardware  
m) Adobe Acrobat  
n) Software and cable to load Operator Interface Panel applications  
o) Hard Disk Drive Backup/Restore Software  
p) carrying case/backpack  
q) required electronic appurtenances for mobile communications
5.29 **WIRING AND CONDUIT**

5.29.1 **Conduit**

a) All conduits, appurtenances and fittings including exposed threaded sections shall be hot dipped galvanized steel to prevent any type of corrosion. Any galvanized components of the conduit system that becomes exposed through drilling or threading, shall be coated as required by applicable code after exposure to prevent any future corrosion of any type.

b) All conduits shall be rigid, heavy wall, hot dipped galvanized steel, minimum ¾ inch and UL Listed. Conduits shall be concealed and fastened inside the box framing of the crane structure where non sealed structures are used. Conduits shall not be run on the exterior sides or top surface of the sill beams. Conduits may be run on the exterior surface of the bottom side of the sill beams. External conduits on other members shall not be located where they might be damaged by swinging containers or vehicle traffic. Exposed conduit runs shall be watertight, clamped to Kindorf channel at intervals not exceeding six feet, mounted in such a way to permit proper painting of structure and brackets beneath conduits, and shall be run parallel or perpendicular to walls, structural members or intersection of vertical panels and ceilings with right-angle turns consisting of cast-metal fittings or symmetrical bends. Offsets in conduits shall be avoided where possible but when necessary, bends shall be made with approved conduit bending machine in accordance with NEC standards when necessary. Alternately, with County approval, wiring may be run in external cable trays or raceways. The cable trays, if approved for use, shall be either integral to the structure of the Crane or stainless steel, grade 316, suitable for installation in a marine environment and shall have a minimum wall thickness of 2.0mm. They shall be installed parallel to walkways, stairs, and ladders to be readily accessible for maintenance at any part of the run.

c) Conduit straps shall be of stainless steel fabrication. Threadless-type fittings shall not be used. Approved pipe-compound tape shall be used on all joints. Flexible conduit shall be synthetic-jacketed, spirally wound, galvanized steel, and shall be oil-proof, weatherproof and not over four (4) feet in length.

d) Conduit fittings shall be hot dipped galvanized steel, corrosion resistant finish, of size, shape and proper tapping to suit conditions.

e) Conduit entrances to all panel boards, junction boxes, pull boxes or cable and wire gutters, etc., exposed to the weather shall be from below, and shall be properly sealed from water and weather intrusion under hurricane wind pressure conditions. Conduit entrance for Boom limit switches, etc. should be from the bottom while boom is in the “up” stow position.

f) All external junction boxes and cable trays exposed to the South Florida environment shall be constructed high grade stainless steel as approved by the County. Internal cable trays not directly exposed to the South Florida environment shall be Hot Dip Galvanized type.

5.29.2 **Wiring**

a) All wiring shall be provided by an U.S. manufacturer or equal specifically approved by the County.

b) All wiring used on the Crane, except as otherwise noted, shall be 600-volt stranded copper. Wiring for power and lighting shall be type THHN rated 90° C and shall be no smaller than 12 AWG stranded copper. Wiring in panels for relays, contactors, resistors and special equipment shall be sized by the manufacturer. All wiring (power and communications) shall be of United States manufacture.
c) Wiring in control panels, panel boards, gutters and junction boxes shall be neatly bundled and laced, and sufficient extra wire length shall be allowed to permit the transfer of circuits or reconnection of wiring.

d) Wiring of AC power and AC control as applicable shall each be adequately separated and isolated from each other to avoid induction of currents and feedback circuits.

e) All programmable controller communication shall be performed thru all fiber optical cables. Intercom and other communication wire shall be isolated throughout from all other conductors and shall be shielded and twisted pairs or fiber optical cable or wire. All fiber optical cables and wires shall have their own junction boxes and conduit.

f) All conductors of wire size 12 AWG and smaller diameter shall be terminated at terminal strips in accordance with the NEC. All conductors of wire size 10 AWG and larger diameter shall be terminated at terminal strips having screw-type terminals with self-insulated ring-tongued, pressure-indent, solder-less lugs or terminals. Terminals and splices shall have tin plated copper body, extra wire support sleeve and insulation sleeve. Installation shall be made with matching ratchet-type tools as approved. Set screw-type or bolted pressure type terminals shall be use for larger conductor sizes. All conductors on the Crane, both inside and outside the control panels with the exception of ribbon cable, shall be labelled at both ends and shall match the schematic diagrams. Terminal blocks shall have the same label markings as the wires connected to them.

g) High-voltage splices and terminations shall be with materials as recommended and supplied by the cable manufacturer according to NEC or the approved applicable code. Splicing procedures shall be in accordance with recommendations for the voltage, rating and type of cable used in the installation.

h) All taped joints shall be given two (2) coats, G.E. No. 1201 Glyptal or approved equal.

i) All motor conductors shall have isolated circuits throughout. Common or grounded conductors shall not be used.

j) All motor conductors shall be terminated and interconnected at terminal blocks located in the main control enclosure in the electrical house.

k) All conductors to the operator’s cabin control consoles shall have a minimum of four (4) feet of slack.

l) Portable cords or cables shall be rated at 600 volt and be type SO for gauges 10 AWG and smaller, and type W for 8 AWG and larger.

m) Wiring and connections in solid state electronic equipment as used for interlocking controls, fault diagnostics and microprocessor communication shall be suitable for their environment. If necessary, provisions must be made to isolate the equipment from the hostile surroundings, and South Florida marine environment.

n) Low voltage wire in conduit or cables shall be type THHN, multi-conductor, multi-strand control cable, 600 volts insulation, rated 90° C temperature rise. The ampacity of each conductor shall be de-rated as prescribed in the NEC. Conductors shall be color coded and numbered in addition to the marking sleeves specified. Cables shall have approximately 10% spares connected to identified spare terminal blocks.

o) Computer and PLC shall have 100% spare communication cables, having the largest gauge wire that is compatible with the hardware used.

p) (the PLC and I/O circuits should have equipment ground) AC common wiring shall be isolated from each other. The NEC color-coding scheme shall be used for DC and AC power wiring, control power wiring and accessory power wiring.
q) Wiring for contactors and relays shall be rated at least the ampacity of the devices to which wiring is terminated.

5.29.3 Wiring Devices

a) All AC switches, receptacles and cord connectors shall be “Specification Grade” with switches being rated 20 ampere, 125 volts, and receptacles rated 20 ampere, 125 volts. All switches and receptacles shall be installed in NEMA 4 enclosures made from the highest corrosion resistance material available for the marine salt water environment of South Florida and have screw caps and gaskets.

b) All switches, receptacles and cord connectors shall be provided by an U.S. manufacturer or as specifically approved by the County.

5.30 SPREADER REEL AND CABLE (Trolley to Headblock)

5.30.1 A spreader cable reel with inverter drive as supplied by Stemmann or County approved equal shall be provided on the Main Trolley. The inverter shall be installed in the Drives Room of the E-House. The spreader cable reel drive system must be completely separate from the main power cable reel drive system cabinet.

5.30.2 The spreader cable reel shall be properly integrated with the crane control system to allow for drive fault and diagnostic monitoring and proper reeling and paying out of the cable at maximum hoist and lowering, and trolley speeds and accelerations with wind speed of 28 m/s. The method and detail of the headblock cable restraint shall be as specified and provided by the cable reel manufacturer.

5.30.3 A single power and control cable shall be provided for spreader operation. The cable shall be installed and run from the trolley to the spreader headblock.

5.30.4 Power and control functions shall be provided through a heavy-duty, multi-conductor flexible cable. There shall be sufficient number of conductors for all remote controlled spreader functions, spreader power and at least four (4) spare conductors as approved by County.

5.30.5 The upper end of the cable shall be connected to the cable reel drum on the trolley. The reel shall have a collector ring assembly for connecting the cable conductors to the circuits from the trolley and easily accessible for maintenance by personnel. The cable reel shall be driven by an AC motor and inverter drive, and manufactured by Stemmann, or County approved equal. The reel shall have enough torque and cable capacity to function properly throughout the entire hoisting range. The cable reel, and communications wiring, and supervision of the installation shall be provided by the Spreader Reel Manufacturer.

5.30.6 The cable shall be PRYSMIAN Cordaflex (SMK) -V (N)SHTOEU 0.6/1 kV (5DH3298), Cross section 44x2.5 mm² with 10 kN support elements; the cable shall be 82 meters - same as used on Port Miami cranes 13-16.

5.30.7 The headblock short cable shall have a Pyle National connector to mate with the receptacle mounted on the spreader main electrical junction box. This connection shall be such that all existing Port Miami 65LT capacity spreaders shall be interchangeable with these three (3) new Cranes.

5.30.8 The trolley to head block cable shall provide for a minimum 10 feet of “dead” cable at the bottom of the lower extremity of the total lift capability.

5.30.9 The Head Block junction box shall be horizontally mounted with the hand rails of the Head Block.

5.30.10 No quick-change “canon” type cable plugs shall be used at the ends of the cable from trolley to head block. Instead, the cable ends shall be hard wired to terminal strips in junction boxes.
on the trolley and head block. The terminal strips will be numbered in accordance with NEC and shall match the cable conductor numbers. The cable from the head block junction box to the spreader shall be hard wired to the head block junction box and utilize a Pyle national plug for connection to the spreader with proper radius bent of pigtail cable and secured. The spreader end of the cable shall be heat-shrunk for weatherproof.

5.31 LIMIT SWITCHES AND INTERLOCKS

5.31.1 All limit switches shall be by the same manufacturers used on existing Port Miami Cranes 13, 14, 15, 16 or as approved by the County. All switches shall be heavy duty, dustproof, oil-resistant watertight, and suitable for the marine environment use. Fork lever switches shall not be used for general functions.

5.31.2 All limit switches shall be mounted in easily accessible positions to facilitate adjustments, maintenance, and replacement. Limit switches shall not be mounted in access systems where they are subject to damage or present a tripping hazard. All Limit Switches shall be installed and oriented so that all its Fittings for Cables and Conduits shall be located at the bottom of the limit switch enclosure. Limit switches on the boom shall be installed so that all its Fittings for Cables and Conduits shall be located at the bottom of the limit switch enclosure while boom is in the level position and also prevents water from entering the limit switch with the boom in the raised position.

5.31.3 Rotary limit switches shall be such that if one of the contacts in the unit is operated while traveling in a given direction, it will remain in that direction and will reset only when rotated in the opposite direction. Each switch shall be easily adjustable to operate at any point within the entire range of travel. Lever operated limit switches shall be rated for the speed of the tripping cam and shall be heavy duty type.

5.31.4 Limiting and interlocking functions may be achieved through an appropriate PLC unit with the exception of those functions to be operated with complete mechanical switch gear as required for safety, applicable codes, and certifying organizations or otherwise specified in these specifications.

5.31.5 In addition to the functions specified or identified elsewhere in these Specifications, the Contractor shall furnish the necessary switches and interlocks for any additional functions that due to peculiarities of the system design are required for safe and efficient operation. Such switches and interlocks at a minimum shall be as specified herein.

5.31.6 Interlocks: Adverse results of system faults and incorrect operation shall be avoided through a failsafe design based upon a variety of interlocking functions. The control system shall always be safe in the event of any one failure. Interlocks shall be provided for, but not necessarily limited to, the following:

a) Interlocks to prevent boom hoisting until the trolley is over the dock in a position for boom hoisting.

b) Interlocks to prevent trolley travel until the boom is entirely lowered or raised and secured.

c) Interlocks to prevent main hoist, trolley travel, and gantry travel during hoisting and lowering of the boom.

d) Interlocks to prevent spreader hoisting until all connection pins on quick-change headblock are correctly located.

5.31.7 "Smart" Slow Downs: To maximize productivity and efficiency of crane operations "Smart" slowdowns shall be provided by the drive system:

a) Main hoist up slow down.
b) Main hoist over dock slow down.

c) Main hoist over water down slow down.

d) Main Trolley end of travel slowdowns at landside and waterside for both boom up and boom down/horizontal operation.

e) Main Hoist and Main Trolley slowdowns associated with Sill Beam protection.

f) Boom Hoist up slowdown and Boom Hoist down slowdown.

Initiation of slow down shall depend on function speed such that slow down commences no earlier than necessary to decelerate to slow speed as the motion reaches the end of travel limit switch.

5.31.8 Limit switches, interlocks or equivalent devices as appropriate shall be furnished and installed for all crane functions for safe and efficient operation. The type of switch(es), interlock(s) and device(s) for each function shall be at a minimum of software or hardware actuation as noted in the following sub-sections;

5.31.9 Main Hoist Travel

a) Incremental/absolute encoders shall be provided as approved by the County which shall be coupled to the main hoist drums to provide hoist/lowering speed, slowdown and stop functions at the upper and lower limits of the main hoist travel, slowdown over dock and other functions as approved by the County.

b) The main hoist shall have a block operated limit switch mounted on the trolley hard wired to the drive controller for emergency stop of Hoist up Over Travel protection.

c) Hoist Up Travel Slowdown (Software): to slow main hoist up travel speed to a predetermined value when approaching the up stop (normal) of spreader hoist travel.

1) A highly accurate absolute encoder with constant self-supervision shall be provided and coupled to one of the main hoist drums for slowdown, synchronization and over travel stops.

2) Over speed switch: Overspeed switches shall be fitted to the main hoist drums to shut down the drive and set/engage/close the brakes if the hoist travel exceeds 115% of rated speed. This feature is also to protect either of the hoist drums by setting/engaging/closing the auxiliary disc brakes in case of drum coupling failure.

d) Hoist Up Travel Stop (Software): to stop main hoist up travel at the extremes of spreader hoist travel.

e) Hoist up Over Travel - Stop (Hardware): to stop main hoist up travel 500mm minimum below the extreme spreader hoist physical upper/over travel limit (bottom of trolley frame) if the Up Stop switch fails. The hardware switch shall be hardwired and cause an emergency stop. The distance provided shall assure sufficient room to decelerate safely the headblock with from maximum empty spreader speed without damaging equipment.

f) Dock Slowdown (Software): to slow main hoist lowering speed to a predetermined value when the trolley is over the dock and the spreader descends to a level of 20 feet (6100 mm) (adjustable) above the dock.

g) Slowdown (Software): to slow main hoist lowering when five (5) turns are left on the cable drum.

h) Stop (Software): to stop main hoist lowering when three (3) turns are left on the cable drum.
i) Sill beam protection (Software): To stop main hoist lowering when ten foot (10 feet) above the sill beam.

j) Slow down and Stop - Flipper Down (Software): motion to be interlocked with the Ship Profiling and Landing System.

5.31.10 Main Trolley Travel

a) An incremental and absolute encoder/tachometers shall be directly coupled to the Main Trolley motors to provide slowdown and stop functions at the forward and reverse limits of travel, interconnection with main hoist for slowdown over the dock and other functions as approved by the County.

b) Waterside Main Trolley travel slowdowns (Hardware) (two-one for normal operations and the other for stowed boom): to slow trolley speed when approaching the waterside end of travel position and, for boom up operation, with the boom in stowed position.

c) Waterside Main Trolley end travel stops (Software) (two-one for normal operations and the other for stowed boom): to stop trolley at the waterside end of travel position, maximum outreach and, for boom up operation, with the boom stowed position.

d) Waterside Main Trolley over travel stops (Hardware-Lever Arm Limit Switch) (two – one for normal operations and the other for stowed boom): if the normal end of travel switches (slowdown and stop) fails to work and stop the trolley at the waterside end of travel with the boom down/horizontal and, for boom up operation, with the boom in stowed position.

e) Landside Main Trolley travel slowdown (Hardware): to slow trolley speed when approaching the landside end (Back reach) of travel position.

f) Landside Main Trolley end travel stop (Software): to stop trolley at the landside end of travel position.

g) Landside Main Trolley over travel stop (Hardware): if the normal end of travel switch (Landside Stop) fails to work and stop trolley at the land side end of travel.

h) Boom Clear (Hardware-Proximity Limit Switch): to interlock with boom hoist control so that the boom cannot be raised unless the trolley is over the dock behind trolley forward slowdown check when boom is in up stow-position.

i) Boom Clear (Hardware-Proximity Limit Switch): to interlock with boom hoist control so that the boom cannot be raised unless the Catenary Trolleys are properly stowed.

j) Trolley Clear (Hardware –Limit Switch): to interlock with the boom hoist control so that the trolley cannot travel unless the boom is in the lowered position and supported by the forestays or in the fully raised and stowed position.

k) Sill beam protection (Software Encoder): To stop trolley with the spreader in the lowered over dock position from travelling into either side of the sill beams (stop set at 10 feet of WS and LS of sill beams).

l) Slow down and Stop - Flipper Down (Software): motion to be interlocked with the Ship Profiling and Landing System.

5.31.11 Boom Travel

a) Rotary cam limit switches or incremental/absolute encoders as approved by the County shall be coupled to the boom hoist drum to provide slowdown and stop signals at the upper stowed positions and lower limits of travel during operation. Interlocking shall be
provided so that other motions cannot operate unless the boom is in the operating or stowed position.

1) Boom Latch Switches
2) Up Travel Switches

b) Boom Down Travel (Hardware, Lever Arm Limit Switch): To prevent lowering of boom without unlatching the boom.

c) Down Slowdown (Hardware, Cam Limit Switch): to reduce the speed of the drive when the boom is near the down position so that shock loads to forestays, boom pins and reeving system is minimized.

1) Down Stop (Hardware, Cam limit switch): to stop boom lowering when the weight of the boom is supported by the forestays. The switch shall be interlocked with hoist and trolley motions to prevent trolley travel onto the boom unless the boom is supported by the forestays.

2) Up Stop (Hardware, Lever Arm Limit Switch): to stop the boom in the raised position after it has entered the boom locking devices. This switch shall reset before the boom is lowered from the locking devices so that the locking devices may be released.

3) Boom Up Travel (Hardware, Lever Arm Limit Switch): To prevent safe boom up motion and not damage the boom latches if they are in the lowered position.

4) Up Slowdown (Hardware, Cam Limit Switch): to reduce the speed of the drive and to recalibrate the boom hoist motor current limit so that the stall torque of the drive will not damage any part of the Crane if the Upper Stop fails.

5) Boom Up Over Travel Stop (Hardware, Lever Arm Limit Switch):

5.31.12 Gantry Travel

a) Gantry travel shall not be permitted until interlock contacts sense that all of the following are satisfied;

1) (Hardware, Lever Arm Limit) Stow Pin disengaged.
2) All automatic storm brakes are released.
3) All gantry motor brakes are released.
4) No gantry motors indicate excessive temperature.
5) Boom is in full stowed, or in operating position (completely lowered).
6) Cable Reel is in operating condition and the slack is removed.
7) Power cable is not completely payed out.

5.31.13 Sill Beam Protection

a) Sill Beam protection utilizing slowdowns and stops as described herein and as necessary to prevent collision in both vertical and horizontal directions between the spreader (or container) and both Sill Beams (waterside and landside). The system shall provide necessary protection with minimum effect on productivity. The system shall be user-friendly and allow adjustment of the size of sill beam protection zones by maintenance personnel. A bypass shall be provided in the CMS for maintenance personnel and at the Dock Level Control Station.

5.31.14 Over speed Switches:

a) An over speed switch shall be provided on the main hoist and boom hoist drum to trip control power and set the main hoist motor brakes and boom hoist motor brake and the
emergency drum disc brake at 115% of full load rated speed. Over speed switches shall require manual reset by maintenance personnel after an overspeed trip.

5.31.15 Overload Protection:

a) An overload protection system shall be incorporated which will prevent hoisting if a preset load weight limit is exceeded. This will be incorporated in the Weight Indicator Device.

5.31.16 Miscellaneous:

a) A key operated bypass shall be provided in the E-House to allow maintenance bypass if the system malfunctions snag load – not overload.

b) All other functions that are necessary to the safe and efficient operation of the Crane.

5.32 ELECTRICAL PROTECTIVE AND CONTROL DEVICES

5.32.1 Control equipment shall incorporate under-voltage protection and thermal and instantaneous overload protection. Each power conversion unit shall have over-temperature protection and/or fan loss protection. Instantaneous over current relays and phase loss relay shall be provided for the Main Hoist, Boom Hoist, Main Trolley and Gantry motors. Instantaneous over-current protection for the main hoist and trolley may be provided by the static IOC (Instantaneous Over Current) feature in the conversion units.

5.32.2 It shall be necessary to have all master switches in the neutral position in order to reset control power. The master switches provided must be durable easily obtained and must have at least a five (5) year warranty for durability and wear-and-tear. (NOTE: the ‘scratchers’ must be durable as approved by the County).

5.32.3 Circuit breakers used in panel boards shall be industrial molded case type, quick-break, with inverse time tripping characteristics on over-loads and instantaneous trip device for short circuits.

5.32.4 Fuses shall be non-renewable NEC standard cartridge type except for special applications such as current limiting fuses.

5.32.5 Phase loss protection for AC motors.

5.33 OPERATOR’S CABIN

5.33.1 The Operators Cabin shall consist of a County approved ergonomic interior system which consists of an Operator’s Chair, indicator panel, control consoles, control panels, CMS display, camera HD display monitors, lighting and other appurtenances as required herein these technical specifications. The County approved ergonomic chair shall consist of a Left and Right consoles with all the necessary indicator lights, selector switches, toggles, push buttons and the master switches.

5.33.2 All push buttons, indicating lights and switches shall be easily removable and replaceable. The wiring connection to these electrical components must have disconnecting wire connectors. No buttons, indicating lights and switches shall be directly soldered to the wiring or vice versa.

5.33.3 Operator Floor Mounted Indicator Panel

a) The Crane’s operator shall have a series of indicator lights for visual confirmation of Crane functions. These indicator lights shall be installed at floor level in front of the operator’s seat against the front window in a single display bank, for ease of viewing while working the crane. The light arrangement and digital displays noted below is specifically for the floor mounted indicator lights. The mountings on the operator’s set
console shall have a different arrangement. All indicator light components and enclosures shall be of stainless steel fabrication as approved by County.

b) The following is a summary listing of the floor mounted indicator lights and digital displays from left to right (numbered 1 to 19) shall be provided in the Operator’s Cab (see drawing POM-10 in Section 9):

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gantry storm brake released</td>
</tr>
<tr>
<td>2</td>
<td>Gantry storm brake set</td>
</tr>
<tr>
<td>3</td>
<td>Twinlift housings down</td>
</tr>
<tr>
<td>4</td>
<td>Hoist Position</td>
</tr>
<tr>
<td>5</td>
<td>Trim Position</td>
</tr>
<tr>
<td>6</td>
<td>Spreader 20’</td>
</tr>
<tr>
<td>7</td>
<td>Spreader 40’</td>
</tr>
<tr>
<td>8</td>
<td>Spreader 45’</td>
</tr>
<tr>
<td>9</td>
<td>Separating Function ON</td>
</tr>
<tr>
<td>10</td>
<td>Main Hoist Overload</td>
</tr>
<tr>
<td>11</td>
<td>Main Hoist Slack Rope</td>
</tr>
<tr>
<td>12</td>
<td>Load Weight</td>
</tr>
<tr>
<td>13</td>
<td>Spreader Twistlock Locked</td>
</tr>
<tr>
<td>14</td>
<td>Spreader Twistlock Unlocked</td>
</tr>
<tr>
<td>15</td>
<td>Spreader Landed</td>
</tr>
<tr>
<td>16</td>
<td>Crane FAULT</td>
</tr>
<tr>
<td>17</td>
<td>High Wind Shutdown</td>
</tr>
<tr>
<td>18</td>
<td>High Wind Warning Light</td>
</tr>
<tr>
<td>19</td>
<td>Wind Speed</td>
</tr>
<tr>
<td>20</td>
<td>Main Hoist Slack Rope</td>
</tr>
</tbody>
</table>

5.33.4 The High Wind Warning Light shall illuminate and audible warning sounds at a wind speed of 35 mph. At 42 mph a High Wind speed shutdown shall occur that shall automatically shut down the gantry control power and set the brakes (even if manually released/opened) all gantry wheel (storm) and motor brakes.

5.33.5 Operator Seat Consoles

a) The ergonomic operator seat shall consist of a Left and Right ergonomic control consoles. No I/O boards and appurtenances installation are acceptable in the seat consoles or under the crane operator’s seat. I/O’s are only permitted inside the seat consoles. In addition, the following devices shall be mounted in the Operator’s seat console within the cabin as currently in use on Port Miami cranes 13-16. See Operator’s seat console arrangement drawing included in drawing POM-7, POM-8, POM-9 and POM-11 in Section 9 of these Specifications.

b) **Left Console**

1) Trolley and Gantry operation master switch
2) *High Wind Bypass – Blk P.B. (Activation of Switch at Dock Level Control Station High wind bypass Black)
3) *Spreader feeler pins bypass – Yel P.B
4) *Twistlock Lock – Grn P.B
5) *Twistlock Unlock – Red P.B
6) Spreader Twistslocks Unlock
7) Spreader Twistslocks Lock
8) Spreader feeler pins bypass
9) Flippers waterside up/down (toggle switch)
10) Flippers landside up/down (toggle switch)
11) Spreader Twinlift Up/Down toggle switch
12) Spreader telescope extend/retract
13) Twin-20 Housing Spacing Increase/Decrease
14) Main Hoist slack rope bypass – P.B.
15) Twin-20 Auto Mode On/Off
16) Trim zero “0” level
17) Operation Mode - Container/Cargo/Reeve (Activation of Switch at Dock Level Control Station)
18) Ship Profile/Landing auto mode - switch On/Off (Activation of Switch at Dock Level Control Station High wind bypass Black)

c) Right Console
1) Main Hoist and Trim operation master switch
2) *Tare Weight - P.B.
3) *Spreader cable Jug Up – P.B.
4) *T20 Store: Preset Spacing WS - P.B.
5) *T20 go to Preset WS - P.B.
6) *T20 Store: Preset Spacing LS - P.B.
7) *T20 go to Preset LS - P.B.
8) *Spreader cable Jug Down – P.B.
9) *Alarm Horn – P.B.
10) TTDS Fault Bypass – P.B.
11) Spreader Height - Indicating light
12) Main Hoist not Sync - Indicating light
13) Trolley not Sync - Indicating light
14) Wheel Brakes – 3 Position (Set/Auto/Open)
15) Control ON – Illum Grn P.B.
16) Control OFF - P.B.
17) Emergency Stop - Mushroom Push-Button (turn release)
18) Crane Fault Alarm Reset – Red P.B.
19) Lamp Test – P.B.

d) Main Side Panel
1) Port Miami Radio (NIC)
2) PA System Radio
3) Emergency Drive Select - Off-MH-Trolley
4) Spreader hydraulic pump – ON GRN indicator light
5) Wind Shut down – Red Ind light
6) Selected Emergency Drive – down/WS P.B.
7) Spreader hydraulic pump – OFF indicator light
8) Trolley Park Position – Yellow Ind Light P.B.
9) Selected Emergency Drive – down/LS P.B.
10) Crane Boom Flood Lights - ON/OFF P.B.
11) Operator Trolley Ship Flood Lights ON/OFF P.B.
12) Flood Lights 50%/100% - Sel Switch 2-Pos
13) Portal Beam Floodlights - ON/OFF Ylw P.B.
14) All Walkway Lights - ON/OFF Wht P.B.
15) Trolley Walkway Lights - ON/OFF Wht P.B.
16) Normal Cabin Light - Sel Switch 2-Pos
17) Trolley Anchor Pin Engaged - Wht indicator light
18) Gantry Stowed Pins Engaged - Wht indicator light
19) TTDS Fault Signal - Red indicator light
20) Spreader Cable Reel Auto-Manual - Sel Switch 2-Pos
21) TTDS Fault Bypass – P.B.
22) Cabin Lights - Sel Switch 2-Pos
23) Thermostat

e) Operator Cabin light dimmer switch (rheostat) for normal LED lighting. Individual light switch independent Blue and Red cabin lighting for night operations.

f) The Operator Cabin control console arrangement shall be as currently in use on Port Miami Cranes, see Operator Console Layout included in Section 9 of these Specifications.
An Operator Display Monitor shall be installed in the Operator Cabin that shall display the CMS Crane faults as well as the other CMS screens.

g) High Definition (HD) display monitors shall be installed inside the front of operator cabin at ceiling level. A monitor shall be provided for each digital camera.

5.34 EMERGENCY STOP SWITCHES

5.34.1 In accordance with OSHA, requirements Emergency Stop (E-Stop), red mushroom head, turn release push-buttons shall be provided for at least the following locations within easy reach of personnel:

a) Operator’s Cab
b) Boom Hoist Operators Cabin
c) Both sides of the waterside sill beam, at each leg
d) Both sides of the landside sill beam, at each leg
e) Control Room
f) Drives Room (a minimum of two, one at each end)
g) Machinery House (a minimum of two)
h) Dock Level Control Station
i) Dock Level Monitoring Station
j) Headblock
k) Window Wash Platform
l) Main Trolley

5.34.2 Identification signs of adequate size shall be provided for Emergency Stop push-button at all locations.

5.34.3 Signs for waterside and landside sill beams locations shall be installed 6’ feet above the surface of the dock. Signs shall be painted with porcelain enamel with red background and 4” white letters. Crane lighting should clearly illuminate the push-buttons.

5.34.4 E-Stop switches shall interrupt main A/C control power. Control power shall be reset at indicated locations in the operator’s cab, boom hoist/machinery house, boom hoist cabin, electrical house, trolley platform and Dock Level Control Station.

5.35 BOOM HOIST OPERATOR’S CABIN

5.35.1 The boom hoist operator’s cabin shall have a control panel with the following operations:

a) Emergency Mushroom - P.B. Turn Release (Red-Yellow)
b) Control ON – P.B. (Illuminate Green)
c) Control OFF - P.B. Black
d) Station Selection Normal/Select - Selector Switch
e) Lamp Test – P.B. Black
f) Boom Latched Light - (Illuminate yellow) ”Boom Secured”
g) Boom Up – P.B. (Illuminate Green)
h) Boom Stop – P.B. Black
i) Boom Lower/Down – P.B. (Illuminate Green)
j) Man on Boom indicator light
k) Boom Down Horizontal indicator light - (Illuminate Green)
l) Boom Hoist Latch Up - P.B. Black
m) Boom Hoist Latch Down - P.B. Green
n) Boom Hoist Auto/Manual - Selector Switch
o) Emergency Drive Selected Normal/Select – Keyed Selector Switch)
p) Emergency Drive Up - P.B. Black
q) Emergency Drive Down - P.B. Black
5.35.2 The Boom Hoist Operator Panel control console arrangement shall be the same as currently in used at the Port Miami, see drawing POM-12 included in Section 9 of these Specifications.

5.35.3 All around access to the glass window on top of cabin shall be provided for cleaning and maintenance.

5.36 DOCK LEVEL CONTROL STATION / CABINET

5.36.1 A control station panel inside a cabinet shall be provided on the waterside of the landside gantry assembly, at ground level to permit the crane maintenance technicians to operate the crane’s hoist, spreader functions, and gantry motions. The control panel arrangement shall be as currently in use at the Port Miami’s Cranes 13-16, see the reference DLCS console arrangement drawing POM-13 included in Section 9 of these Specifications.

5.36.2 The Dock Level Control Station (DLCS) shall be a watertight/weatherproof lockable Enclosure/Cabinet as specified in Section 5.48.5. The locking mechanism and key shall be same as on the existing Port Miami cranes and as approved by the County.

5.36.3 The Dock Level Control Station (DLCS) shall have the following functions and operations:

a) Emergency Mushroom - P.B. Turn Release (Red-Yellow)
b) Station Selection Normal/Select - Selector Switch
c) Control On - P.B. (Illuminate Green)
d) Control OFF - P.B. Black
e) Lamp Test - P.B. Black
f) Fault Acknowledge/Indication Reset - P.B. (Illuminate Red)
g) Main Hoist Up/Down - Joystick Switch
h) Gantry Left/Right - Joystick Switch
i) Slack Rope Bypass Normal/Select - Selector Switch
j) Snag Load indicating light (Illuminate Red)
k) Snag Load Normal/Reset - Selector Keyed Switch
l) Gantry Wheel Brakes Auto/Manual - Selector Switch
m) Gantry Wheel Brake Release - P.B. (Illuminate Green)
n) Gantry Wheel Brake Set - P.B. (Illuminate Red)
o) Spreader Control Hardware/Bus - Keyed Selector Switch
p) Spreader Hydraulic Pump ON/OFF - P.B. (Illuminate Green)
q) Spreader Landed (Feeler Pin) Bypass Normal/Bypass - Keyed Selector Switch
r) Twistlocks - Toggle Switch Lock/Unlock
s) WS flipper Left Enable - P.B. White
t) WS Flipper Right Enable - P.B. White
u) LS flipper Left Enable - P.B. White
v) LS Flipper Right Enable - P.B. White
w) Selected Flippers Up/Down - Toggle Switch
x) Spreader T20 Housing Mode On-Down - P.B. (Illuminate Green)
y) Spreader T20 Housing Mode Off-up – P.B. (Illuminate Green)
z) HeadBlock Bypass Normal/Bypass (Container/Cargo) - Select Switch Black
aa) High Wind Warning/Bypass - P.B. Yellow
bb) Gantry Maintenance Mode ON/OFF - Selector Switch Black
c) Stow Pins Engaged - (illuminating Yellow)
d) Operator Ship Working Floodlights - P.B. White
ee) Portal Beam Floodlights On/OFF - P.B. White
ff) T20 Spacing Incr-0-Decr - Selector Switch Black
gg) T20 Store: Preset Spacing WS - P.B Black
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5.37 MACHINERY HOUSE CONTROL STATION

5.37.1 A control station panel shall be provided in the Machinery House Control Station to permit the crane maintenance technicians to operate the crane's main hoist, boom hoist and trolley functions, and gantry motions for maintenance and repair work. The control panel arrangement shall be as currently in use at the Port Miami’s Cranes 13-16, see the reference referenced panel arrangement drawing POM-14 included in Section 9 of these Specifications.

5.37.2 The Machinery House Control Station (MHCS) and cable with pendant storage cabinet shall be a watertight/weatherproof lockable Enclosure/Cabinet as specified in Section 5.48.5. The locking mechanism and key shall be same as on the existing Port Miami cranes as approved by the County.

5.37.3 The MHCS shall be individually fitted with a pendant control with a removable 50 feet cable to allow safe positioning of the hoist operator and operation in the vicinity of the hoist, trolley or boom hoist mechanisms. The pendant cable shall have a plug at the end for easy connection and disconnection to the MHCS. The pendant shall be removed and stored on a cable reeled hanger inside a properly sized cabinet next to the MHCS.

5.37.4 A proper sized cable hanger shall be provided for the cable and pendant next to the MHCS panel for storage as approved by the County.

5.37.5 The MHCS shall have the following functions and operations:

- **Emergency Mushroom** - P.B. Turn Release (Red-Yellow)

  **Crane Controls**

- **Station Selection Normal/Select** - Selector Switch
- **Control On** - P.B. (illuminated Green)
- **Control Off** - P.B. Black
- **Lamp Test** - P.B. Black
- **Fault Acknowledge/Indication Reset** - P.B. (illuminated Red)
- **Main Hoist Up-0-Down** - Selector Switch Black
- **Main Trolley Forward-0-reverse** - Selector Switch Black
- **Boom Hoist Up-0-Down** - Selector Switch Black
- **Reduced Speed Slow/Fast** - Selector Switch Black
- **Boom Girder/Backreach Legs Floodlights** - P.B. White
- **Portal Beam Floodlights** - P.B. White
- **Logotype Floodlights** - P.B. White

  **Rope Reeving**

- **Rope Reeving 1 OFF/ON** - Keyed Selector Switch
- **Rope Reeving 1 Reel-0-Unreel** - Selector Switch
- **Rope Reeving 1 Stop** - P.B. Black
- **Rope Reeving 1 Running light** - (illuminated Green)
- **Rope Reeving 2 OFF/ON** - Keyed Selector Switch
s) Rope Reeving 2 Reel-0-Unreel - Selector Switch  
t) Rope Reeving 2 Stop – P.B. Black  
u) Rope Reeving 2 Running light - (illuminate Green)

5.37.6 The pendant shall consist of a minimum of eight (8) Push Buttons and Selector Switches; six (6) for use as follows and two (2) spares for future configuration:

  a) Emergency Stop  
  b) Main Hoist Up-0-Down - Selector Switch  
  c) Rope Reeving 1 Reel-0-Unreel - Selector Switch  
  d) Rope Reeving 1 Stop – P.B.  
  e) Rope Reeving 2 Reel-0-Unreel - Selector Switch  
  f) Rope Reeving 2 Stop – P.B.  
  g) Spare  
  h) Spare

5.37.7 Submit pendant information and configuration for review and approval by County

5.38 BACKREACH GIRDER CONTROL STATION

5.38.1 A control station cabinet panel shall be provided at the backreach area of the girder at the hydraulic system platform to permit the crane maintenance technicians to operate the hydraulic anti snag, trim/list/skew and wire rope tensioner system for maintenance and repair work. The cabinet shall be at a protected easily accessible location that allows work visibility of the controlled equipment components. The control panel arrangement shall be as currently in use at the Port Miami’s Cranes 13-16, see the reference referenced panel arrangement drawing POM-15 included in Section 9 of these Specifications.

5.38.2 Backreach Girder Control Station (BGCS) and cable with pendant storage cabinet shall be a watertight/weatherproof lockable Enclosure/Cabinet as specified in Section 5.48.5. The locking mechanism and key shall be same as on the existing Port Miami cranes as approved by the County.

5.38.3 The BGCS and cable with pendant storage cabinet shall be a watertight/weatherproof lockable Enclosure/Cabinet as specified in Section 5.48.5. The locking mechanism and key shall be same as on the existing Port Miami cranes as approved by the County.

5.38.4 The BGCS shall have the following functions and operations:

  a) Emergency Mushroom - P.B. Turn Release (Red-Yellow)  
  b) Station Selection Normal/Select - Selector Switch  
  c) Control On - P.B. (illuminate Green)  
  d) Control OFF - P.B. Black  
  e) Lamp Test - P.B. Black  
  f) Fault Acknowledge/Indication Reset - P.B. (illuminate Red)  
  g) Main Hoist indicating light - (illuminate Red)  
  h) Snag Pump OFF/ON - P.B. Black  
  i) Snag Cylinder A Retract-0-Extend - Selector Switch Black  
  j) Snag Cylinder B Retract-0-Extend - Selector Switch Black  
  k) Snag Cylinder C Retract-0-Extend - Selector Switch Black  
  l) Snag Cylinder D Retract-0-Extend - Selector Switch Black  
  m) Trim Go to Base Position – P.B. Black  
  n) Trim Go to Home Position – P.B. (illuminate White)  
  o) Trim Set Home Position – P.B. White  
  p) Backreach Maintenance Floodlights - P.B. (illuminate White)
5.39 MONITORING STATIONS

5.39.1 An on-Crane monitoring system and a Remote Monitoring System (RMS) shall be provided on each Crane and each Crane shall have the capability to be monitored at the Gantry Crane Maintenance Facility as currently configured at Port Miami and as approved by the County.

5.39.2 All hardware and software required for the monitoring stations’ systems shall be supplied, commissioned and tested by the Contractor. The Cranes hardware shall be installed and tested at Contractor’s assembly facility.

5.39.3 All communication hardware and cabling shall be the latest Fiber Optic or Network CAT wiring as approved by the County.

5.39.4 A separate video feed for and from the on-Crane cameras shall be provided, installed and configured by the Contractor to include setup in the monitoring stations and remote access by way of the Switches Gear Room at Port Miami network access (Lummus Island NAP).

5.39.5 Dock Level Monitoring Station

a) A walk-in type Dock Level Monitoring Station (DLMS) shall be provided and located at the centerline of, under and at the landside sill beam level. The DLMS shall be totally enclosed, insulated, and air conditioned to the South Florida HVAC requirements. The enclosure shall be provided with a lockable door, windows, chair, and a shelf for a CMS Monitoring Station with monitor, keyboard and mouse. No overrides/bypass shall be permitted from this station. The Master CMS located in the E-House Control Room shall control the access parameters of this station.

b) The Crane maintenance technicians shall be able to monitor and perform system analysis from this station, the Crane hoist, spreader functions, gantry motions and the CMS. The control consoles and panels shall be constructed of stainless steel as approved by Owner.

5.39.6 Remote Monitoring Stations

a) The Manufacturer shall provide Remote Monitoring Stations (RMS) which shall have the Remote Crane Management System (RCMS) installed on an existing desktop or laptop computer as stated herein and approved by the County.

b) The Manufacturer shall provide all the hardware and software required on the Cranes as approved by the County to remotely interface with and monitor each of the Cranes that are provided under this Contract.

c) All hardware and software required for the integration of the new Cranes into and/or in parallel to the existing systems at the Port Miami Lummus Island Switches Gear Room NAP shall be supplied, commissioned and tested by the Contractor.

d) The Stations shall consist of the latest hardware, software and have the capability to operate with additional software. It shall have the capability of polling the status of any of the cranes on the wharf through the communications link provided. Should a crane generate a fault while this system is monitoring a different crane, the system shall alert the operator and with a short key stroke or command shall transfer to the faulted crane.

e) When the user is logged-in the RMS shall automatically receive, store, assemble and display Real-Time crane operating system, productivity and maintenance data from each crane. The RMS shall be capable of down loading files from each of the Crane’s monitoring system but shall not have the capability of altering the crane’s operational values and parameters.

f) The system provided shall have the capability to monitor a minimum of ten (10) STS Gantry cranes of the same complexity as in these specifications. The fiber optic
communication cables between the remote office site(s) and the cable in the Electric Pit are existing and not in the scope of supply of the Contractor. The system shall communicate utilizing the existing Port Miami NAP at the Switch Gear Room where the current remote monitoring server and the County NAP (network Access Point) is located.

g) The Contractor shall coordinate with PMCM engineer and the County IT personnel to permit required connections and access in the firewall to provide access to the Cranes from on (remote station) and off Port Miami system.

h) The RMS shall have the capability to individually schedule automatic crane systems operating stored data transfer which shall initially be set to occur daily at 12:00 midnight.

i) The primary RMSs are located in the existing Crane Management offices located at 2886 Port Blvd, Miami, FL USA. The RMSs shall be configured on the following computers;

1) PMCM CEO’s laptop
2) Crane Electrical Engineer’s desktop
3) Crane Maintenance Manager’s desktop
4) Crane Project Engineering Manager’s desktop
5) Crane Foremen’s desktop (3 desktops)
6) Crane Dispatch Office’s desktop
7) Two (2) Others TBD

5.40 REMOTE CRANE OPERATIONS SYSTEM (Optional)

5.40.1 One (1) Remote Crane Operation System (RCOS) shall be provided at a designated office area where the gantry crane RMS (Remote Monitoring System) is displayed with the capability to control multiple cranes. The three (3) Cranes shall be provided as specified below to be functional for Remote Crane Operations.

5.40.2 The Remote Crane Operation System is a system that enables the crane operator to operate the crane at a Remote Operation Station in which all the crane functions to perform container LO-LO operation is same as that in the Crane’s Operator cabin mounted on the Crane’s trolley.

5.40.3 The Contractor shall provide a system and hardware that is in use on gantry cranes and proven at a major seaport container terminal. No generic hardware and brands are acceptable.

5.40.4 In the remote operation mode, the performance of the crane shall be the same as that in normal operation mode in terms of equipment safety, productivity, reliability and maintainability.

5.40.5 Safety is the most important and the first factor the Contractor shall consider, identify and take into consideration in the design, fabrication, installation, testing, commissioning, training, make operational and during any functional use specifically for container operation.

5.40.6 Container operation in the ship and quay areas will be viewed by CCTV system with operator adjustable (using joy stick c/w direction and zoom control) camera located on the trolley and on the crane. Container operation to and from the ship will be in the semi automation mode with laser sensors (as described in SECTION 5). The operator will make the final lowering including entering the cell guides, landing the container and engaging and disengaging twist lock. The laser depth sensors will provide the “smart slow down” zone for landing.

5.40.7 The Contractor shall conduct safety analysis and risk assessment for the Remote Operation System, report and plan shall be submitted for approval.
5.40.8 The safety analysis and risk assessment shall consider all possible hazard and system failure incidents. Reliable and “fail-safe” protections including but not limited to anti-collision protection and safety interlocking systems shall be installed.

5.40.9 Sufficient User interface for transmitting real time data including but not limited to crane and operation data, audio communication and image signals necessary for the safety and efficient remote operation of the crane shall be provided.

5.40.10 The desktop computers for the Remote Operation System shall use latest version of MS Window Operating System with regularly updateable anti-virus software to protect the system from the attack of malicious software. The latest and proven hardware such as CPU, VGA, RAM, SSD and HHD shall be provided.

5.40.11 The Contractor shall include the submission of the proposed Remote Operation System for approval including but not limited to design concept, system construction, functional description and components selection as per this specification.

5.40.12 The Remote Operation System shall be designed for operating 365-day a year and 24-hour a day, and under all weather conditions.

5.40.13 Provide sufficient equipment such as digital video cameras, laser scanners, sensors, interlocking and audio systems and lighting for all-day vision for the safe and efficient remote operation.

5.40.14 Provide a data communication system for effective and no time delay transmission of images and commands through the fiber optic data network on the crane(s), NAP in Switch Gear Room to designated office where this new Remote Operation Station shall be installed and configured.

5.40.15 Provide two spare “two-way” data communication connections for other remote operation stations (to be established in future).

5.40.16 Provide additional safety protection and interlocking system for remote operation.

5.40.17 The Contractor shall provide space and make provisions for future installation of hardware and software provisions where required on the Cranes for Port Miami to installed equipment for the following functions to enable the safe and efficient remote operation of the crane;

a) Trailer position device
b) Sway control system
c) Anti-collision system
d) Smart Slow Down System
e) Ship Profile and Landing System

5.40.18 Conduct system safety analysis and risk assessment which shall cover the whole container operation environment in terminal including but not limited to the Remote Operation Stations, cranes, operation and maintenance personnel, berthing ships, and vehicles.

5.40.19 Sufficient hardware such as cable conduits, junction boxes and panels (power and communications) for the future installation of Remote Operation System shall be reserved and provided for four (4) other cranes.

5.40.20 Notwithstanding the above, the Contractor shall carry out everything necessary for the proper execution of the Remote Operation system, whether or not such design, material and equipment are expressly shown on the Specification.

5.40.21 The Contractor shall perform all inspection and testing of the remote operation system in accordance with the requirements of these Specification. All necessary equipment, tools and labor necessary for the testing and commissioning of the ROS shall be provided by the Contractor as required herein.
5.40.22 The Contractor shall submit the testing and commissioning plan demonstrating the safe and satisfactorily remote operation prior to the performance test at factory and acceptance test at the terminal.

5.40.23 The Contractor shall prepare and submit the herein required submittals, instructions, maintenance and operations manuals, testing documentation, results and training documents and provide training for both operator and maintenance personnel.

5.40.24 **Remote Operator's Station**

a) The Station shall be installed in an air conditioned office type space ergonomically designed with a control desk, seat, video monitors, computer monitor, controllers, switches, indication panels, intercom and the other necessary accessories as required herein for the crane operator cabin.

b) A detailed layout drawing of the Station and required room space to include but not limited to access door, window, control desk, screens and indicators shall be submitted along with the operator cabin submittals.

c) The internal space of the Stations room shall be large enough to accommodate one additional seat (not in contract) for trainer and five (5) standing visitors.

d) Indicators and monitoring of operation status of crane and operation priority shall be provided as follows:

1) Operating in Operator’s Cabin on Trolley.
2) Operating in Boom control station
3) Operating in Gantry control station
4) Operating in Ground level station
5) Operating in Machinery House
6) Operating in this remote Cabin or other remote Cabins.

e) The screens at the Cabin shall display all necessary operating information including but not limited to real-time pictures of sites, status of hoisting, trolley, boom and gantry, profile of containers on ship and other necessary information for the remote operation.

f) Adequate number of screen with suitable size (at least 21-inch) and HD quality shall be provided at the control desk such that all real-time images necessary for the remote operation can be displayed simultaneously without manual switching by the operator. The Contractor shall submit a list of the real-time images of the remote operation for prior approval.

g) All faults during remote operation shall be captured by both CMS and the Remote Operation System.

5.40.25 **Video System**

a) A reliable CCTV system shall be provided on the crane for operator to view any necessary pictures in the vicinity of crane during remote operation.

b) The CCTV system shall have sufficient camera installed at different locations of the crane in order to ensure that the operator is able to control the remote operation of the crane with high level of confidence.

c) The camera shall be of HD quality equipped with fixed-focus, auto-focus or with pan/tilt/zoom features depending on the installation location and the intended purpose so as to capture good quality pictures for the operation.

d) All cameras shall be industrial and weather proof type, durable, compact and anti-vibration proof and suitable for outdoor application in marine environment.
e) Additional lighting shall be provided on the crane such that the crane operator can view the pictures clearly through the CCTV system under all weather and day and night conditions.

f) The Contractor shall submit the system specifications, configuration, components’ brand and layout and location plan of the cameras and additional lighting to the County for prior approval. All lighting shall be LED.

5.40.26 Data Communication System

a) The data communication system shall be suitable for transmission of PLC control signal, pictures and telecom voice traffic with sufficient network capacity to ensure that the transmission of the control signal, real-time images and other crane information between the crane and remote operator’s cabin is free of error. Multi mode optical fibers shall be used as the transmission media for the data.

b) The data communication system shall be proven to have immunity from all electromagnetic or radio frequency interference to include those from container ship radars and communications. Type test report or certification to demonstrate the compliance of the said requirement shall be submitted for approval.

c) The data communication system shall have sufficient spare capacity to maintain the reliability and availability of the system as well as future system improvement.

d) The data communication system shall be designed as “fail-safe” such that all crane motion will stop immediately when the signal or command from remote operation become ineffective.

e) Data storage shall be provided for at least 24-hour for the routine operation data, pictures and video. There shall be ample additional space should the County decide to add storage in the future.

f) The Contractor shall submit the system specifications, configuration, layout, construction, components’ brand, and interface details to the County for approval.

5.40.27 Anti-Collision System

a) Safety in operation is utmost importance for the crane which must not be jeopardized by using the Remote Operation System. In addition to the collision protection system as stipulated in the Specification, the Contractor shall further design and provide anti-collision system to protect the crane from collision arising from the trolley travel, gantry travel, main hoisting and boom hoisting during remote operation.

b) The anti-collision system shall be a proven product and have been satisfactorily applied in container terminals.

c) The Contractor shall submit the specification, design and brand of the anti-collision system for approval.

5.40.28 Safety Protection System

a) The Remote Operation System shall be “fail-safe” design with a safety protection and interlocking system to ensure a safe remote operation.

b) Interlocking system with safety key shall be provided among the Operator’s cabin on trolley, boom/gantry control station, ground level station, machinery house and Remote Operation Station to ensure and warrant that only one control station can be operated simultaneously. The priority of operation shall be as mentioned in Section 6.34.3.1.
c) Mechanical safety interlocking device with safety key shall be provided for all access / door of the control stations (as specified in Section 6.34.3.1) such that person gaining access to the station to operate the crane must use safety key.

d) The Contractor shall submit the design concepts and system schematics of the safety protection and interlocking system to demonstrate the functionality to the Engineer for approval.

5.40.29 Safety and Risk Analysis

a) The Contractor shall submit for approval a safety analysis and risk assessment plan/report identifying, according to relevant international standards, the safety in operation, potential hazards, precautionary measures and possible solution of the Remote Operation System so as to mitigate the risk.

b) The safety analysis and risk assessment shall cover all remote operation procedures as follows:

1) System, subsystem and interface hazard analysis.
2) Operational safety hazard analysis.
3) Failure hazard analysis (including failure modes, effects and criticality analysis).

5.40.30 The Contractor shall provide a complete description of the proposed Remote Crane Operation System with the Proposal.

5.41 SLACK ROPE/SNAG AND OVERLOAD PROTECTION

5.41.1 The Crane shall be equipped with a load measuring system utilizing four (4) high precision load cells, located on the Crane so they are readily accessible for maintenance and where they will not be damaged by lightning strikes. The location of the load cells shall be approved by the County. System functions shall include: slack rope, hang load, differential load of hoist cables, overload and snag load shutdown.

5.41.2 The slack rope function shall prevent the main hoist ropes from paying out when the ropes start to slack. The function shall be electrically interlocked with the load cells. After the set automatic slow-down function is activated, the slack rope function shall stop the lowering action. The stop action shall be initiated by the load cell sense of no load weight. The load weight parameters shall be adjustable. The stop function shall have an adjustable time parameter of 0.10 seconds to 2.0 seconds. A Slack Rope bypass switch shall be provided on the operator's seat console and at the DLCS.

5.41.3 In the hoisting direction, the system shall limit the hoist speed to approximately 15% of the rated speed until the load of the head block has been supported by the ropes.

a) Tare weight load function of the system will accurately display the working load suspended on the Crane in the Electric House CMS and Operator's Cabin. It will be possible to zero the weight at the spreader twist locks or the cargo beam hook so that the actual weight of the cargo being hoisted can be determined and displayed. The weight of the spreader or cargo beam attached to the head block shall not cause an inaccurate display.

5.41.4 Differential load of hoist cables will be the comparison of one of any load cell signal to another load cell signal. This function will prevent hoisting should the difference between any two become excessive (this is attempting to hoist a container or load that is latched to the lip on one side, etc.). Additionally, the differential load of the hoist will be the comparison of the sum of the left side load cells signal to the sum of the right side load cells signal.

5.41.5 The system shall have separate overload protection settings, for the rated load of spreader (65 LT) under a twin lift mode, 50LT under the single spreader mode, and 100 LT cargo beam mode.
5.41.6 Overload protection will prevent hoisting up, but still permit to lower the load if the load is greater than the safe working load of the Crane at the initial load pick-up or during hoisting. This function will not prevent hoisting due to loads experienced during trolley and hoisting acceleration. The overload will be automatically recalibrated when the appropriate mode is selected.

a) Snag load protection will be provided in the system. Any load cell or the sum of all may detect a snag load. Should a snag condition occur, the system will display and print the date, time and peak load.

5.41.7 All load sensor functions and adjustments will be software tunable. No potentiometers shall be used. The slack rope/overload system shall not inhibit the normal operation of the Crane.

5.41.8 Redundant to the slack rope system, limit switches will be installed at the four corners of the spreader frame at the end of the locking pins location. The switches will sense the following;

a) All four (4) head block pins are set engaged into spreader.
b) Enable the main hoist operation
c) Limit hoist speed until no slack rope is detected.

5.42 GANTRY WARNING DEVICES

5.42.1 Four (4) electrically-operated audible gantry travel warning devices shall be provided. The devices shall be mounted on the top area of each main equalizer outboard of the legs. The devices shall be activated when the gantry master switch is moved off center in either direction, and shall cease to sound when the gantry master switch is returned to the center-off position. The sound level shall be adjustable from the minimum to the maximum permitted by OSHA.

5.42.2 In addition, four (4) red dome weatherproof strobe lights shall be mounted on the top area of the gantry main equalizer beams at eye level and shall operate when the gantry directional commands are energized. The strobe lights shall be as manufactured by Federal Signal and in compliance with OSHA Requirements.

5.43 ELECTRICAL DRIVES ROOM

5.43.1 A Drives Room shall be provided inside the Machinery House to house all electric drive control panels and associated equipment. The room shall be ventilated as herein required. It shall have two (2) access doors at each end; one leading into the Controls Room and the other into the Machinery Room.

5.43.2 All drive control panels in the Drives Room shall contain analog or digital meters mounted on the partial front panels of the electrical control cabinets (panels) to indicate the following:

a) Incoming line voltage meter shall be non-linear, circular scale meter displaying expanded scales in the nominal voltage range.
b) Motor voltage, current or torque, and speed:
   1) Main Hoist
   2) Boom Hoist
   3) Main Trolley
   4) Gantry
   5) DC bus voltage

5.43.3 The auxiliary control panels shall also contain the following indicating devices:

a) “Emergency Stop” push-button turn release with maintained latch red mushroom head. Red illuminated push-button for “Crane Main Power On”
b) Elapsed time meters up to 99,999.99 hours shall be provided for the following parameters:
   1) Crane Main Power On
   2) Main Hoist Operating Time
   3) Main Trolley Operating Time
   4) Gantry Operating Time
   5) Boom Operating Time
c) Push-buttons and red indicating light shall be used for “Floodlights On-Off”.
d) Select switch for photocell for walkway, platforms, main boom and girder lights shall be provided.
e) A line AC voltmeter shall be provided with a non-linear, circular scale meter displaying expanded scales in the nominal voltage range.
f) Meters must be able to be easily read during emergency lighting conditions

5.43.4 Additional shall be provided as required.

5.44 PANEL BOARDS

5.44.1 Space requirements for all panel boards shall comply with requirements of the NEC.

5.44.2 Panel boards shall be of the circuit-breaker type and shall be installed only in dry waterproof locations. Circuit breakers shall have combined thermal and magnetic trip units. Panel boards rated 120/240 volts shall be the NAB type. Panels rated for 480 volt shall be of the NHB type as provided by a US manufacturer or a County approved equal. Panels for individual mounting shall be surface type mounted in steel cabinets having doors with Plexiglas front covers where needed for safety due to high voltage when doors are opened. Panels shall be built and labeled in accordance with Underwriters’ Laboratories (UL) requirements. Panel boards shall have a minimum of four (4) spare circuit breaker pole spaces; two (2) spare spaces in the operator’s cab. Ground Fault Indicators (GFI) breakers shall be provided for dock level and operator’s cabin convenience outlets.

5.44.3 Lighting panel boards shall be provided in the Main AC Power Control Center (MCC). Essential services shall be supplied from a 480-volt normal source through a 3-phase transformer rated 120/240 volts. The essential services connected to the panel board (s) shall include but not be limited to the following:
   a) All facilities in the operator’s cabin
   b) All convenience outlets and the 120-volt house and walkways,
   c) All exterior convenience outlets,
   d) Aviation obstruction lights,
   e) Control panel heaters and lights,
   f) Motor heaters, and,
   g) Intercom system.

5.44.4 A 480-volt source, electric panel used to power the spreader hydraulic pump drive motors shall be installed in the Drive Room and on the Main Trolley. In addition, a panel will be provided that will include circuit protection for the following:
   a) Main Panel breaker,
   b) Two (2) spare 20-amp 1-pole breakers,
   c) Breakers for cab air conditioner,
   d) Breaker for lights,
   e) Breaker for 120 volt outlets,
   f) Breaker for communication equipment, and,
   g) Breaker for 120 volt spreader control power
5.44.5 All panel boards, junction boxes, pull boxes or cable and wire gutters, etc., exposed to the weather shall be properly sealed from water and weather intrusion under hurricane wind pressure conditions. Access cover seals or gaskets shall comply with these parameters.

5.45 MAINTENANCE MODES – BYPASS AND OVERRIDES

5.45.1 The Cranes shall have the necessary controls and overrides to troubleshoot and operate the cranes when an abnormal operational event occurs such that it renders the Crane in-operable due to a particular breakdown.

5.45.2 This section shall be and contains the governing requirements for any system bypass and overrides.

5.45.3 The following system bypasses and overrides shall be provided at specified location;
   a) Spreader Feeler Pin Bypass
      1) Crane Operator chair – Key switch
      2) Dock Level Control Station
   b) Sill Beam Protection - Dock Level Control Station and CMS
   c) Slack Rope Bypass - Dock Level Control Station and Crane Operator chair
   d) Shore Power Cable Reel
      1) Maintenance Mode -

5.46 TROLLEY POWER AND COMMUNICATION

5.46.1 FESTOON SYSTEM

   a) The Festoon System shall be by Stemmann, Conductix or County approved equal. Festoon hardware, all wiring and supervision of installation shall be supplied by the Festoon System Manufacturer. The festoon system shall be I-Beam type and shall be engineered and installed for ease of replacement of the I-Beam. The system will be designed for container crane application. Festoon design and materials shall consider the stringent container crane operational requirements as well as the harsh environmental conditions of southern Florida. Special attention shall be paid to the rollers and wheels and UV resistance. Details of the rollers, polymers and snap rings to be submitted for review and approval.

   b) All power and control cables shall be run in flexible, insulated, cable conductors from junction boxes on the landside cables and of the main girder crane frame via a festoon system to junction boxes on the trolley. The festoon system shall consist of heavy-duty, high performance trolleys allowing the conductor length to collapse and expand.

   c) The festoon cables shall be Prysmian Cordaflex (K), BIW or County approved equal. The cables supplied shall have at least three (3) spare conductors 8 AWG or larger and ten (10) spare conductors 12 AWG or larger. Spare conductors are required per cable. If the cable provided does not have the required amount of minimum spare conductors, an additional cable shall be provided. (This requirement also applies to spare fiber optic cores/cables in the festoon.)

   d) Fiber optic cable shall be Prysmian Optoflex (K), BIW or approved equal. Festoon trolley wheels shall be changeable in place. The cable saddles shall be arranged for easy side loading of a replacement cable. Steel parts shall be hot-dip galvanized after fabrication. Bolts, wheel axles and fittings shall be stainless steel.

   e) The main support rollers shall be at least 100 mm in diameter. Flanged wheels shall not be used. Side guides rollers and uplift roller shall be used. Wheels for festoon trolleys shall be coated with a durable synthetic material to minimize noise, lasting under South Florida environmental conditions, permanently lubricated and sealed bearings. Side and anti-lift rollers shall be fabricated of steel.
f) All cables shall be blocked in place so as not to overlap or slip on the saddle. Relief drum with Kellems grips shall be used to relieve strains on the cables before they enter the junction boxes. Stainless steel tow cables shall be installed between all festoon trolleys. The number of festoon trolleys, loop length, tow cable organizers tow cables, shock cords, tow cables and bumpers shall be as recommended by the festoon manufacturer for smooth operation.

g) Adequate bumpers shall be provided between each trolley truck. Elastic shock cords will be installed as required to insure smooth acceleration of front and rear trolleys.

h) Fiber-Optical Cable and low power level shielded or twisted pairs shall run in separate UL listed cables and shall terminate at both ends of the festoon system in separate junction boxes from the power and control circuits. The Contractor shall provide a minimum of one (1) six (6) core fiber cable for future communications signals such as video.

i) A service platform shall be provided on the Crane's backreach to permit inspection, repair and/or replacement of the festoon system to include the festoon trolley's rollers and hangers and festoon cable and cable securing components without being required to pull the festoon cable up to the platform level.

5.46.2 CABLE CARRIER AND TRAY (Optional)

a) The Cable Carrier and Tray (aka Energy Chain) System shall be by Igus or County approved equal. The Cable trough, Energy Chain hardware, all wiring and supervision of installation shall be supplied by the System Manufacturer. The system shall be designed for container crane application; engineered and installed for ease of replacement of the cable troughs, links and cables. The system design and materials shall consider the stringent container crane operational requirements as well as the harsh environmental conditions of Southern Florida. Special attention shall be paid to UV resistance.

b) The system shall consist of a cable trough, cable carrier (energy chain) and cables. The trough system must be made 304 stainless steel or other County approved material; resistant to the hot humid South Florida environment. All fasteners shall be stainless steel with all nuts being self-locking.

c) The system must have a trough alignment device installed at the boom and girder hinge point to be designed by the cable carrier supplier. The trough joint joining kits must be heavy duty with reinforced installation support angles and trough must have UHMW glide bars for travel beyond the fixed bracket.

d) The chain radius must be double of the minimum bending radius of the biggest cable. (for example: cable diameter 20mm, minimum bending radius 5x outer diameter =100mm, minimum chain radius 200mm). The chain must not have glide shoes. But, the system must have a floating tow-arm.

e) The side link of the chain and the cross-bar material must be of the same material and must have rollers integrated into the link. The bearings for the rollers must be stainless steel.

f) All power and control cables shall be run in flexible, insulated, cable conductors from junction boxes on the landside cables and of the main girder crane frame via a festoon system to junction boxes on the trolley. The system shall consist of heavy-duty, high performance energy chain allowing the conductor length to collapse and expand.

g) The cables shall be designed for use in a cable carrier and shall be provided by the system manufacturer or County approved equal. The complete energy chain/cable package shall be provided by the system manufacturer. All cables shall be blocked in place so as not to overlap or slip in the links.
h) The cables supplied shall have at least three (3) spare conductors 8 AWG or larger and ten (10) spare conductors 12 AWG or larger. Spare conductors are required per cable. If the cable provided does not have the required amount of minimum spare conductors, an additional cable shall be provided. (This requirement also applies to spare fiber optic cores/cables in the festoon.)

i) Fiber-Optical Cable and low power level shielded or twisted pairs shall run in separate UL listed cables and shall terminate at both ends of the system in separate junction boxes from the power and control circuits. The Contractor shall provide a minimum of one (1) six (6) core fiber cable for future communications signals such as video.

j) Service platforms shall be provided on the Crane to permit inspection, repair and/or replacement of the system components. Access shall be provided to the fixed bracket location on the trolley and on the girder.

5.47 SHIP PROFILING AND LANDING SYSTEM

5.47.1 A profiling and landing control system shall be provided by the control system supplier for the Crane’s main hoist and trolley to reduce spreader/container load collisions and for accurate landing. The system shall be capable of identifying and recording the ship profile for safe trolleying and lowering of load onto and off the ship to include in between stacks and ship cells. The system shall also include a spreader anti-collision for efficient regulation of crane trolley and hoist speeds during landings and lifts.

5.47.2 The system shall be design for on as needed basis where the crane operator and/or maintenance personnel can enable or disable the system. An individual master selector switch for this system shall be provided at the Ground Level Control Station for the maintenance personnel have the capability to disable the system function in the crane operator console and have control of system at ground level. Two (2) separate switches shall be provided: (1) ‘Normal’ and ‘Select’, and (2) ‘On’ and ‘Off’.

5.47.3 The system to be provided must already be in service on ship-to-shore container cranes at a major container handling terminal in the U.S. or Western European seaport for at least three (3) years. A listing of the ports and references are to be provided with the initial bid proposal identifying the current and previous model of the system.

5.47.4 The system shall incorporate several functional controls which requirements are as follows;

a) The system shall measure the profile of containers and other objects within the travel path of the spreader and suspended load. The hoist speed shall be automatically limited to a pre-set value as the spreader and load combination approaches the measured profile to assure smooth and soft landings. This function shall be selected on or off by dynamic operator selection, or permanently via a configuration parameter.

b) The system landing function and trolley motion shall not cause “false slowdowns” due to containers in neighbor stacks or ship’s cells during normal operating conditions. For landings below ship’s deck, the crane operator shall have the capability to lower at “full speed” once in the cell, while the system reduces the speed as required for an optimal and soft landing.

c) To prevent spreader anti-collision the trolley speed shall be limited to a pre-set value as the spreader and load combination approaches the container stack or objects in the measured profile that are in the motion path of the spreader and load. This function is selected on or off by dynamic operator selection, or permanently via a configuration parameter.

d) The protection functions for container Pick-Up and Drop-Off shall work identically for both container operations. The spreader and load collision protection zone size shall be automatically adjusted when a container load is locked on the spreader.
e) The system shall automatically detect and measure hatch covers and adjusts the spreader and load protection zone size accordingly. A hatch cover indication shall be available to the crane control system.

f) The system shall have the capability to identify that a flipper on the spreader is in the down position which system shall provide an automatic stop at a preset height above this deck level to avoid a collision. This function is selected on or off by dynamic operator selection, or permanently via a configuration parameter.

g) The system functions are optionally available at all locations under the crane, over the ship, between the crane legs and in the backreach area and shall be interlocked with the Sill Beam protection controls.

h) The system shall have an Operational Range coverage that measures the stated profile and spreader position working within the maximum limits of the Main Hoist and Trolley functions of the Crane.

i) The system’s hardware and sensors shall be resistant to all types of weather conditions in South Florida’s one-hundred percent (100%) humidity environment to include but not limited to heavy rain, thunder storms, lighting, high wind and rain storms, mist and fog.

j) There shall be no operational restrictions and/or no special operational motion paths that are required for the system to operate properly. All crane motions are made via the conventional cycles and no special “learning pass” is required to generate an initial profile before the first main hoist and/or trolley move. Automatic sway/anti-sway control is not required for proper operation of all features of the system.

k) With the initial proposal, the contractor shall include a detail description and location of all the hardware (to include cameras and lasers) associate with the system.

5.47.5 Technical and Maintainability Requirements

a) The system shall have a diagnostic and recording capability that shall provide its status information and recordings to the CMS interface thru the crane’s drive PLC. It shall record all key parameters and sensor data for each crane operation for a calendar time period which shall be determined by the allotted space in the CMS’ HDD.

b) The system provider shall provide complete instructions for quick and easy field replacement of any failed hardware component by crane maintenance staff.

c) All system hardware components are to be “off the shelf” items, proven in other crane operations and not custom designed for this application which components shall be readily available as required herein.

d) The system shall measure both the profile and spreader sway displacement from centerline using a single sensor or County approved sensor arrangement.

e) The system shall not incorporate any electronic equipment on the head block or spreader.

f) The sensors used shall not emit harmful radiation. All laser sensors shall be rated Laser Class 1 (“eye-safe”).

5.48 COMPLEMENTARY REQUIREMENTS

5.48.1 Anemometer

a) The Anemometer wind sensor with alarm provided shall continuously indicate wind velocities. The wind alarm shall be Lambrent or County approved equal.
b) The wind alarm system shall include a transmitter, receiver and all other necessary electrical components to complete the system. Wind speed indicators are to be provided in the operator’s cab and at all monitoring stations through the CMS. The crane diagnostics shall receive a signal from the anemometer and record wind speeds up-to a minimum of 150 mph.

c) Loss of AC power to the system shall not cause loss of settings.

5.48.2 Electrical Convenience Outlets

a) 120 volt, 20A single phase, outdoors-weatherproof dual convenience outlets shall be provided as follows:

1) One (1) at cable reel platform
2) Two (2) in the operator’s cab
3) Five (5) on the boom and girder (one at backreach, one at the hinge point, two at intermediate positions between hinge and boom tip, and one at boom tip)
4) Two (2) on the Machinery House (one next to the workbench)
5) Four (4) in the electrical house (Two (2) in the Control Room and Two (2) in Drive Room)
6) Four (4) at dock level (one adjacent to each leg)
7) One (1) each at the festoon platforms
8) Two (2) on Main Trolley
9) One (1) at waterside apex

b) Receptacles shall be the grounded type suitable (GFI) for operation of conventional hand power tools.

5.48.3 Auxiliary Power Supply

a) The Cranes shall be furnished with electrical and circuitry equipment to use external auxiliary electrical power to the Crane when the main power is not available. The auxiliary power shall be provided to the Main Hoist, Boom Hoist and Main Trolley auxiliary drives, lighting, motor heaters and critical equipment, air conditioning (see paragraph (f) below), elevator, Drives Room and all emergency systems in the event the main power is not available.

b) The dock/wharf electrical power service is 480 volt, 3 phase, 4 wire with a receptacle fitted with a grounding pole. The Contractor shall provide the total power required calculations with their proposal and at design review for approval.

c) A female connector plug as manufactured by Crouse Hind or approved equal shall be provided. The connector plug shall be mounted on the waterside of the waterside gantry trucks.

d) An automatic transfer switch shall be provided in ACCC (AC Control Center) located in E-house by drive manufacturer. The transfer switch is for the purpose of automatically connecting the Crane AC power services to the external power supply when Crane’s main power is shutdown.

e) When in use, auxiliary power shall at all times be provided to the emergency systems, lighting, air conditioners (as per paragraph (f) below) and one of the main system auxiliary functions. Simultaneously, one of the following system functions shall be able to operate; elevator, auxiliary trolley, auxiliary main hoist, auxiliary boom hoist or maintenance hoist. All auxiliary powered system functions shall only be operable from operator’s cabin, Machinery House Control Station and boom hoist cabin as approved by the County.
f) Under any situation that the Crane is powered by the Auxiliary Power one (1) of the E-House main air conditioning units shall be running to maintain the proper environment and atmosphere for the Cranes’ electronics.

5.48.4 Welding Outlets

a) Eight (8) welding outlets for welding leads shall be provided on the Crane in the proximity of the following locations;

1) Landside gantry truck level and waterside gantry truck level
2) Boom outreach
3) Boom hinge
4) Backreach
5) Machinery House
6) Main Trolley
7) Waterside apex

b) The welding outlet shall be 480 VAC, 3 phase, 4 wire, 60 amp “CROUSE-HINDS ARKTITE” or approved equal. The outlet will be compatible with the power cord provided on the welding machine to be furnished on the Crane.

c) Two (2) copper wire size AWG 00 welding leads will be run in the appropriate size conduit from the welding outlets to the welding machine in the Machinery House. The welding leads will terminate in NEMA 4X hinged cover J-boxes on both ends with insulator stand offs. It is intended that the welder person will attach his ground clamp and rod holder leads to the connection in the J-boxes. The welding outlets shall be the same as on Port Miami cranes 13-16 or County approved equal.

5.48.5 Enclosures

a) Weatherproof and/or watertight enclosures (panels and cabinets) fabricated of stainless steel and utilizing stainless steel hardware shall be provided and used in all exterior locations exposed to the South Florida environment. High grade stainless steel as approved by County must be used.

b) Junction, terminal and outlet boxes, and similar fittings shall be NEMA 4X, high grade stainless steel as approved by County. Cover screws shall not extend into boxes of any watertight enclosures. Enclosure size will be ample to allow easy checking or changing of wire and cable terminations without interference. Ten percent (10%) spare terminal block shall be provided.

c) Enclosures shall be designed and supported to withstand the vibrations and stowed wind forces encountered on the Crane. All enclosures having remote I/O devices shall have shock mounted sub-plates.

d) Panels shall be easily accessible at chest height. Covers of electrical enclosures shall be hinged, capable of being opened to fully expose and easy remove all internal components. Stainless steel hinges and latches shall be provided to secure covers. Covers shall have latches to hold them open.

5.48.6 Nameplates

a) All name plates shall be engraved in English as approved by County. Name Plates shall be provided for Electrical, Hydraulic and Mechanical Equipment.

b) Nameplates shall be provided for devices on switchboards to identify function, and indication, circuit, or purpose. Nameplates for voltage coils or shunt, under-voltage or reverse current shall show voltage rating and value of external resistance, if used.
c) Name plates provided for special precautions, maintenance or operating instructions shall be on a separate plate attached to the equipment.

5.48.7 Circuit Identification

a) All internal and external conductors to panels and inside shall be identified with wire numbers at both ends in accordance with the wiring diagram. Wire markers shall be hot stamped sleeves with machine printed, permanently-legible numbering. Conductors leaving all panels and junction boxes, AC motor control center, cab control panel and operator's console shall be marked with the conduit number or cable in addition to the wire number. Terminal blocks shall have the same markings as the wires connected to them.

b) The spare conductors of each cable shall be marked with the cable number and conductor number as in the interconnection table.

c) Color coding in accordance with NEC of power supply conductors shall be consistent. Where insulation colors are not compatible, colored synthetic tubing or sleeves, no less than six (6) inches long, shall be used at conductor ends with identification of circuit letter and number.

d) Designation on markers and nameplates shall be the same with designation on shop drawings.

5.48.8 Operating Lights

a) A lighting system matching to the most recent Port Miami cranes shall be provided for all ladders, stairs, walkways, platforms, machinery houses, cabins, electric rooms, and houses which shall, operate on 120 volts, AC power. Floodlights aimed to illuminate large areas of ladders and/or walkways are not acceptable.

b) Minimum levels of illumination shall be Thirty (30) foot candles inside of Machinery, Drives and Control Rooms.

c) All ladders, stairs, access platforms, walkways, control panels, maintenance platforms, and other areas that may require access during Crane operation shall be adequately illuminated. Minimum illumination in these areas shall be five (5) foot candles.

d) Maintenance platforms including, but not limited to, backreach, trolley rope tensioner, cable reel service platforms (spreader and gantry), festoon service, boom tip, window wash platform, and A-frame peak shall have additional illumination sufficient for night-time service/maintenance to provide not less than fifteen (15) foot candles.

e) The lighting fixtures for access systems and maintenance platforms shall be LED type as manufactured by Phoenix with stainless steel housing as approved by the County. Approximately 30% of the fixtures shall be emergency type with battery – minimum 2 hour backup - (or shall be powered by a central UPS system for emergency lighting).

f) The stairs and walkways between ground level, hoist machinery house and operator's cabin shall have three (3) 3-way switches:

1) one (1) located on the interior of the house at the entrance nearest the stair tower,
2) one (1) at the fixed end by leg on the operator cabin walkway, and
3) one (1) located on the gantry frame at ground level near the dock level stairway entrance.

Operators and maintenance personnel shall be able to turn on and off the walkway lights to access the operator’s cabin and machinery house.
g) Lighting for the Boom walkway and stairs shall have three (3) way switches one located inside the boom machinery house at the entrance nearest the stair tower, one at the end of Boom and the other at the hinge gate.

h) The backreach, platforms, stairs, walkway and ladders shall have three (3) switches located inside the boom machinery house at the entrance nearest the stair tower, one at the end of boom and the other at the hinge gate.

i) The Operator’s Cabin shall be equipped with LED lights to maintain thirty (30) foot candles illumination on all operating surfaces. Local switching shall be provided inside the cab within the operator’s reach.

j) All flood light fixtures shall be LED type, as manufactured by Phoenix. Fixtures shall include tilt-up supporting arms and a sealed optical system equal to a system designed for 1,000 watt lamps. Access platforms shall be provided for easy maintenance of each and all lighting fixtures as required.

k) Sufficient light fixtures shall be furnished and installed to provide minimum illumination of thirty (30) foot candles 25 feet on either side of Crane’s Boom and Main Girder centerline, on the dock, directly under the Crane, and, five (5) foot candles on the adjacent dock area within 75 feet from the Crane’s Main Girder centerline.

l) Trolley Ship lighting: Four (4) additional LEDs equivalent to 1000 watt floodlights shall be installed on the Trolley to light the area directly below and into the ships working cell. These fixtures shall not be part of the measured illumination specified above for boom and dock areas. These floodlights will be controlled from the Crane operator cabin and shall be installed at the same location as on Port Miami cranes 13-16 unless otherwise approved by PMCM.

m) The floodlights switches shall be located at the Dock Level Control Station, in the main auxiliary control panel in the E-House, and in Operator’s Cabin seat console.

n) Portal Beam Lighting: Four (4) additional floodlights fixtures shall be mounted on the portal beams; two (2) fixtures on each beam facing the working Dock area under the Crane 25 Feet from each leg. These fixtures will have an independent switch located in the Dock Level Control Station. These fixtures are not part of the measured illumination requirements as specified above. For the Boom and Dock Areas a circuit breaker shall be provided in the E-house MCC.

o) Air Navigation Obstruction Lighting: the Crane(s) shall be equipped with continuously energized lights with red lenses, of the wattage, type and configuration as required by the Federal Aviation Administration. These lighting fixtures shall be located in accordance with and comply with the requirements of FAA Advisory Circular AC 70/7460-1C. Battery backup required. The fixture mounting brackets on the obstruction lights shall be hinged so that the lights can be folded for easy maintenance.

p) The navigational lights shall be installed in three (3) locations; at the highest point of frame (the boom latch platform), boom tip and backreach.

q) The flood lighting fixtures for lighting of the backreach road and terminal area shall be mounted on the LS of the LS legs at the same location as the existing lighting on the newest Port Miami STS gantry cranes. These fixtures shall be easily accessible for maintenance.

5.48.9 Space Heaters

a) Space heaters shall be provided for control panels, festoon junction boxes, enclosed brakes, housings, and motors larger than 5hp; all with provision to energize those heaters when the crane is not in service and on auxiliary power, thereby reducing the possibility of moisture condensation within those units. Heaters shall be powered by
separate, continuously-energized lighting circuit independent of the crane control power. A red warning plate shall be provided at each heater location warning the user of this separate power source. Heaters shall automatically turn off during crane operation and when the particular system component is energized.

5.48.10 Ventilation

a) Power and control shall be provided for ventilation fans in the Machinery Room. Control shall consist of a “manual-off-automatic” switch, and adjustable thermostat, circuit breaker and starter. The thermostat shall control in both “manual” and “automatic”. The crane diagnostics shall indicate fan loss faults but shall not be interlocked with the crane fault.

b) A stainless steel backdraft damper shall be provided on all ventilation fans. The fans shall be located that allows easy access for maintenance.

5.48.11 Intercom System

a) An Intercom System as manufactured by Whelen shall be provided with each Crane. Loudspeakers for the Intercom shall be provided for the operator to have the capability to speak to personnel on the ship or at the wharf level. Two (2) loudspeakers shall be mounted on the aft section of the Operator's Cabin; locations of all speakers shall be as approved by the County. These speakers must be distinctly audible within maximum of 50 meters (50m) from its audible location in the Operator's Cabin. A volume control switch shall be installed in the Operator's Console to adjust the volume of each speaker as required by working conditions. A foot-operated communication system shall be provided on the operator’s chair, with a ceiling mounted microphone. Additionally, the system shall include one (1) synthesizer and a balance assembly.

b) The intercom equipment shall include, but not be limited to, the following:

1) Operator’s Cabin Station:
2) Enclosure
3) Amplifier; integrated or remote
4) Non-Corrosive Speakers for marine environment
5) Speaker Amplifier
6) Selector switching with volume control

c) The location of the Intercom components within the Operator's Cabin shall be pre-approved by the County. Prior to the system initial usage at the Port, the Contractor shall calibrate the system to comply with the standards of OSHA and all other applicable codes. All efforts shall be employed by the Contractor to minimize the loudspeaker noise outside of the designated work area.

5.48.12 Lightning Protection

a) All Crane frame bolted and pinned joints shall have heavy braided copper conductors around the joint.

b) Grounding sliding shoes shall be provided on the Crane rails at the four Corners of the Crane.

c) A lightning protection system is to be provided by the Contractor in accordance with the current issue of NFPA “Lightning Protection Code”. As a minimum, this system shall incorporate air terminals on the boom tip and the top APEX, utilize appropriate down conductors and be equivalent to Erico System 2000 or County approved equal.

d) High Voltage line: Install lightning arrester in High Voltage panel.

e) Control source line: Install surge absorber at secondary or transformer.
f) PLC power source line: Install surge absorber at primary of transformer.

g) Remote I/O power source line: Install surge absorber at exit of the Trolley House, Operator's Cabin, Headblock, signal transmission line between Trolley House and Operator's Cabin.

h) Fiber Optic Lightning protection shall be supplied by an approved manufacturer. The surge protection provided shall be as recommended by the surge protection supplier or approved equal.

5.48.13 Fire Alarm and Warning Light System

a) An NFPA 72 compliant fire detection alarm system (including smoke) shall be provided. The system shall include, but shall not necessarily be limited to: the air conditioning supply and return smoke detectors and heat detectors adjacent to every system. A separate system shall be provided for all electrical panels within the E-house, drives room, control room and air conditioning equipment room. The system shall be provided with means for manual initiation. Signaling shall be provided in all occupied or habitable spaces. Alarm signals shall also be forwarded to a continuously-monitored location via the RCMS.

b) The fire alarm system shall be linked by way of listed relays to a warning light system mounted below the backreacht of the crane easily visible from all directions on the dock and terminal. The system warnings shall be displayed in the CMS and shall also be remotely displayed thru the remote monitoring systems of the different equipment vendors.

c) Warning lighting shall be as follows;
   1) Yellow – Power fault (refer to Crane Control and Fault Diagnostic specifications herein before).
   2) Red – Fire warning
   3) Blue – A/C fault warning (refer to mechanical specifications herein before).

5.48.14 Electrical Start-Up Requirements (Commissioning)

a) The drive and control systems’ manufacturer’s field engineer(s) shall be present for the installation, assembly, start-up, commissioning, testing and acceptance of the Cranes at Contractor’s Facility and thereafter on-site until all problems and issues are resolved. In addition, the field engineer shall be present at Port Miami for all electrical and control’s re-assemblies, re-commissioning, re-testing and certification.

b) Six (6) Channel Chart recordings shall be made available during start-up for analysis of drive performance. As a minimum, these chart recordings shall include for main hoist, trolley, boom and gantry:

   1) Master Switch Speed Command – speed referenced
   2) Tachometer Output – speed feedback
   3) Motor Voltage
   4) Four (4) Load Cell Outputs
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SECTION 6

ADDITIONAL REQUIREMENTS
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SECTION 6 - ADDITIONAL TECHNICAL REQUIREMENTS

6.1 TRAINING OF COUNTY PERSONNEL AT MANUFACTURER’S SITE

6.1.1 The drive and control systems’ manufacturer shall provide comprehensive classroom and hands-on courses of study for a minimum of four (4) Crane Maintenance Technicians and Foreman (the Technicians), covering the trouble shooting, repair, and maintenance of the motor controller, PLC and remote I/O system. The courses will be held at the Contractor’s fabrication facility where Port Miami representatives will have “hands-on” access to the Cranes and the type of hardware provided on the Cranes. The onsite courses schedule shall be finalized prior to arrival of the Technicians to the fabrication facility. All costs of instructions and training aids shall be included in the contract amount. All travel expenses for the Technicians shall be the responsibility of the Port.

6.1.2 Upon the arrival of the Technicians at the fabrication facility the following onsite classroom briefing and training shall be held within the first two (2) calendar days of their arrival and prior to the Technicians commencing their work or leaving the secure confines of their lodging and the office building;

a) Introduction of Contractor’s Fabrication Team, 1 hour
   1) Project Manager,
   2) Trades Supervisors; Electrical, Mechanical, Welders, Fitters
   3) Safety Director
   4) Sub-contractor Supervisors
   5) QA/QC Supervisor
   6) Testing and Inspection Supervisors
b) Introduction to Contractor’s Facilities, 1 hour
c) Safety and Working Procedures, 1 hour
d) Cranes Design criterion; structural, mechanical, electrical, etc., 4 hours
e) Status of the Cranes Fabrication, Erection and on-going Commissioning, 4 hours
f) Additional Fabrication, working, commissioning and testing matters, 4 hours.

6.2 TRAINING OF COUNTY PERSONNEL AT PORT MIAMI

6.2.1 The Contractor shall furnish qualified structural, mechanical, spreader, communications, and electrical Trainers to train Crane Maintenance Technicians and Mechanics at Port Miami in the operation and maintenance of the Cranes. The Contractor shall provide qualified professional personnel for the following minimum periods of accrued training time:

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Training Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>8 hours (1 work day)</td>
</tr>
<tr>
<td>Mechanical</td>
<td>40 hours (5 work days)</td>
</tr>
<tr>
<td>Spreader</td>
<td>16 hours (2 work days)</td>
</tr>
<tr>
<td>Electrical</td>
<td>64 hours (8 work days)</td>
</tr>
<tr>
<td>Control Diagnostics</td>
<td>72 hours (9 work days)</td>
</tr>
<tr>
<td>Remote Monitoring</td>
<td>12 hours (1 work day) (County’s and PMCM Staff)</td>
</tr>
</tbody>
</table>

6.2.2 The times listed above may be extended as determined by the training seminar program submitted by the Contractor.

6.2.3 The training shall be conducted at the Port, in classroom facilities, or as required in the field at the Contractor’s assembly facility or the crane maintenance installation at the Port. The training seminar shall be held prior to the Cranes Substantial Completion issuance by the County.

6.2.4 The training seminar shall cover the following:

a) Operating instructions covering all crane functions and modes.
b) Operations, maintenance and servicing of all mechanical and electrical components of the crane, special servicing of all electrical components special training shall be provided for the electrical controls, crane drive systems, fault diagnostics system, report generation, weighing and communications system.

6.2.5 Port Miami shall be able to reject the use of proposed trainers based on their English speaking abilities.

6.2.6 The majority of the Electrical and Control Diagnostics training shall be conducted by trainers from the Control System Supplier.

6.3 **SUBMITTALS FOR COUNTY REVIEW**

6.3.1 The Contractor shall provide all submittals, documents, drawings and printed manuals, in the English language with no exceptions as required by Project Schedule. Preliminary drawings, shop/fabrication drawings, as-built drawings and manuals shall be provided as required by these Specifications.

6.3.2 The Contractor shall submit “ALL” design drawings, calculations, technical data, purchased component information, shop drawings, etc, pertaining to the Cranes for review.

6.3.3 All communication, drawings, calculations and catalog information shall be in English with no exceptions.

6.3.4 All drawings shall be drawn and made to scale in the proper engineering format. The information shall be clearly presented so the County may review the details for conformance with the contract documents technical requirements. The submittal format and submittal list shall be approved by the County prior to any work commencing.

6.3.5 The following is the Submittals List that includes required drawings, analysis, calculations and technical data that establishes the “minimum” requirements for submittal of information to allow County to perform a thorough technical review of the Work and Cranes which will be supplied. The Notice to Proceed shall not be issued until the below Submittal List with dates and Master Schedule is provided.

<table>
<thead>
<tr>
<th>Submittal</th>
<th>Date</th>
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<tbody>
<tr>
<td>1. <strong>Project Control</strong></td>
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<td>1. <strong>Project Schedule</strong></td>
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<td>2. <strong>QA/ QC Program</strong></td>
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<td>2. <strong>Calculations</strong></td>
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<td>1. <strong>Stability Analysis</strong></td>
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<tr>
<td>a) Factor of safety criteria</td>
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<tr>
<td>b) All component dead weight calculations</td>
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<td>c) Wind loading calculations (wind pressure, surface area, drag coefficients, etc.)</td>
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<tr>
<td>d) Trolley wheel loads</td>
<td></td>
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<tr>
<td>e) Gantry corner and wheel loads for all load cases</td>
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<tr>
<td>f) Lifted load distribution calculations</td>
<td></td>
</tr>
</tbody>
</table>
### 2. Fatigue Calculations

- **a)** Duty cycle calculations
- **b)** Description of design and design code criteria
- **c)** Stress calculations of all members, connections etc.

### 3. Design Criteria

- **a)** Structural: (All structural calculations used to design the crane including governing specs, loads, load combinations with fatigue analysis, gantry frame buckling, plate buckling, and computer output)
- **b)** Mechanical/Electrical: Design life and load criteria calculations shall be for normal and overload conditions. Material specifications for all critical members (Structures, stays, etc.)
- **c)** Electrical
- **d)** Design Code(s)

### 4. Structural Calculations

- **a)** Gantry Components (including articulation mechanisms, trucks, equalizer beams, pins, and bushings, etc.)
- **b)** Frame
- **c)** Main and Catenary Trolleys
- **d)** Boom
- **e)** Machinery House/Support Structure
- **f)** Electrical Room/Support Structure
- **g)** Headblock/Cargo Beam
- **h)** Walks, Platforms, Elevator support, etc.
- **i)** Spreader Components
- **j)** Stays, especially stay end connection details
- **k)** Operator Cab and Support
- **l)** Trolley Rail Bed and Support Web
- **m)** Boom Hinge
- **n)** Main and Secondary Equalizer Pins
- **o)** Tie downs/Stowage pins
- **p)** Natural Frequency
- **q)** FCM design and calculation of joints under tension with stress-relief hole and cover plates
### 5. Mechanical Calculations

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<tbody>
<tr>
<td>a)</td>
<td>Gantry Drive (Wheels, axles, bearings, couplings, reducers, buffers, brakes, articulation bearings, etc.), including material specs</td>
</tr>
<tr>
<td>b)</td>
<td>Main Hoist Components (Gear reducer, brakes, couplings, bearings, ropes, sheaves, shafts, drum, pillow blocks, emergency brake, etc.) including material specs</td>
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<tr>
<td>c)</td>
<td>Trolley Drive Components (Gear reducer, brakes, couplings, bearings, ropes, sheaves, shafts, wheels, axles, etc.) including material specs</td>
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<tr>
<td>d)</td>
<td>Catenary Trolley Drive Components (Gear reducer, brakes, couplings, bearings, ropes, sheaves, shafts, wheels, axles, etc.) including material specifications</td>
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<tr>
<td>e)</td>
<td>Boom Hoist Components (Gear reducer, brake, couplings, bearings, ropes, sheaves, shafts, drum, pillow block, emergency brake, etc.)</td>
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<td>f)</td>
<td>Trim System Components</td>
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<tr>
<td>g)</td>
<td>Snag Protection System Components</td>
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<tr>
<td>h)</td>
<td>All hydraulic systems and schematics</td>
</tr>
<tr>
<td>i)</td>
<td>Machinery House overhead service crane and components.</td>
</tr>
<tr>
<td>j)</td>
<td>Wire Rope(s)</td>
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<tr>
<td>k)</td>
<td>Main Hoist Wire Rope Equalizer Assembly</td>
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</table>

### 6. Electrical Calculations

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<td>a)</td>
<td>Electrical Control System Description/Component Details</td>
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<td>b)</td>
<td>All electrical schematics and wiring diagrams</td>
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<tr>
<td>c)</td>
<td>Wiring/Conduit Sizing, with Voltage Drop and Short Circuit Calculations</td>
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<tr>
<td>d)</td>
<td>Gantry, Main Trolley, Catenary Trolley, Boom &amp; Main Hoist Motors/Controls (Festoon Motorized Trolley)</td>
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<tr>
<td>e)</td>
<td>Motor/Drive Duty Cycle Load Curve/Sizing Calculations (Main Hoist, Main Trolley, Catenary Trolley, Boom, Gantry, T/L/S, Main (Shore) Power Cable Reel, Spreader Cable Reel)</td>
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<td>f)</td>
<td>Power Consumption Calculations</td>
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<td>g)</td>
<td>Safety devices and limit switch(s), proximity(s), etc. operational and interlock description</td>
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<td>h)</td>
<td>Operator’s Console Control/Interface description</td>
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<td>i)</td>
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<td>j)</td>
<td>Load Indicating System</td>
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<tr>
<td>k)</td>
<td>Floodlights/Access Lighting/ Emergency Light Including Illumination Levels</td>
</tr>
<tr>
<td>l)</td>
<td>Switchgear, Transformer, etc.</td>
</tr>
<tr>
<td>m)</td>
<td>Heating and Air Conditioning (Operator’s Cabin, E-house and Dock Level Monitoring Station)</td>
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<tr>
<td>n)</td>
<td>Gantry Cable Reel Trailing Cable</td>
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### 3. General Arrangement Drawings

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<td>Operator’s Cabin and Consoles</td>
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<td>3</td>
<td>Main Hoist Arrangement</td>
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<td>4</td>
<td>Boom Hoist Arrangement</td>
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<td>5</td>
<td>Trolley/Trolley Drive Arrangement</td>
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<td>Gantry Drive/Arrangement</td>
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<td>7</td>
<td>Headblock and Cargo Beam</td>
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<td>Drives and Control Room</td>
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<td>Catenary Trolley</td>
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<td>Machinery House (Machinery Room, E-House)</td>
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<td>Telescopic Spreader</td>
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<td>Walks, Ladders, Platforms, Elevator</td>
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<td>Trim System</td>
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<td>Machinery House Overhead Service Crane</td>
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### 4. Detailed Structural Drawings

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<td>2</td>
<td>Complete Frame and Boom</td>
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<tr>
<td>3</td>
<td>Main Trolley Frame</td>
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<tr>
<td>4</td>
<td>Machinery House and Support Structure</td>
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<tr>
<td>5</td>
<td>Catenary Trolley Frame</td>
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<tr>
<td>6</td>
<td>Electrical House Enclosure/Support Structure (Control and Drives Room)</td>
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<td>7</td>
<td>Headblock and Cargo Beam</td>
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<td>8</td>
<td>Boom Latch System</td>
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<td>9</td>
<td>Spreader</td>
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<td>10</td>
<td>Trolley Rail, Stops, etc.</td>
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</tbody>
</table>
### 5. Detailed Mechanical Drawings

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1)</td>
<td>Gantry Drive/Wheel Assembly</td>
</tr>
<tr>
<td>2)</td>
<td>Gantry Pins</td>
</tr>
<tr>
<td>3)</td>
<td>Boom Hoist Drive Components</td>
</tr>
<tr>
<td>4)</td>
<td>Main and Catenary Trolley Drive Components</td>
</tr>
<tr>
<td>5)</td>
<td>Main and Catenary Trolley Wheels/Axles/Bearings</td>
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<tr>
<td>6)</td>
<td>Main Hoist Drive Components</td>
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<tr>
<td>7)</td>
<td>Main Hoist Sheaves/Bearings</td>
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<tr>
<td>8)</td>
<td>Headblock Components</td>
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<tr>
<td>9)</td>
<td>Boom Hinge Assembly and Lower/Heel Pin</td>
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<tr>
<td>10)</td>
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### 6. Detailed Electrical Drawings

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15) Trolley Festoon System
16) Cable Tray and Carrier Chain (optional item)
17) Overload Protection system
18) Load Indicating system
19) Lightning Protection System
20) Trim System
21) PLC Logic
22) CMS Logic
23) Communication System
24) Gantry/Shore Power and Spreader Cable Reels
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8. Operation and Maintenance Manuals

1) Operation Instructions
2) Recommended Spare Parts List and Delivery Times
3) Maintenance Manuals
4) On-Site Training Procedure/Class Outline
5) (Contractor and Control System Supplier)

9. As-Built(s)

1) All component weights, dimensions, materials, etc.
2) All As-built drawings and calculations of items submitted in the design review.
3) Final “As Commissioned”
   a. PLC Logic
   b. CMS Software including all licenses
   c. Drive Firmware for all programmable drivers
4) Electrical Cable inter-connection Table
5) AutoCAD Drawings

6.3.6 All information submitted for review, (including drawings and other submittals via email), shall have a cover letter listing all items submitted for review including submittal and drawing number and revision. The drawings shall be in the English language only and include a description and notation of items revised from revision to revision.

6.3.7 Drawings and calculations shall be submitted in a logical order and grouped by assemblies so that the review process can be expedited and all submittal data checked against previous information submitted.

6.3.8 Submittals for design review shall include two (2) hard copies and an electronic copy in PDF format, as approved by the County.

6.3.9 Prior to the beginning of project fabrication, a complete set of full size hard copy project drawings shall be provided to the County for review.

6.3.10 After the County’s approval and concurrence of the Crane design, systems equipment, components and accessories for fabrication, the Contractor shall furnish one (1) complete set of said approved drawings in full size format drawings 24” x 36” and one (1) set in 11” x 17” format and one (1) electronic copy in ‘pdf’ format.

6.4 AS-BUILT DRAWINGS AND MANUALS

6.4.1 General

a) All manuals shall be submitted in English language and in a format that allows the customer to make copies of the manual for its own use. Contractor shall provide six (6) copies of each set of manuals with the first Crane and one (1) additional copy of each
set with each additional Crane in hard binder format, indexed, cross referenced for easy reading and appropriately bound.

b) Digital versions of each manual shall be provided on separate DVD+R media. All manuals shall be included in the electronic version and appropriately cross referenced and indexed and easily accessed Microsoft Office software. The CMS computers shall be capable of supporting the electronic manuals should the County decide to install the files on those computers.

c) Contractor shall furnish operating and maintenance manuals (O&M) which shall include the operation, lubrication, maintenance and inspection of the Crane including routine and major maintenance and troubleshooting of mechanical and electrical components/systems on the Crane as well as systems such as the Spreaders. The manuals shall include all software manuals and documentation. The structure manual shall cover routine and major/periodic inspections of the structure.

6.4.2 Operating and Maintenance Manuals

a) Crane operator’s instructions shall cover in detail every step necessary to place the Crane into operation, to maintain and to operate the crane. A laminated set of crane operation instructions shall be placed on each operators cab.

b) Separately printed lubrication schedules and diagrams showing recommended lubrication for all parts and requiring periodic lubrication shall be furnished.

c) The service manuals shall provide instructions for typical maintenance, repairs and overhaul operations of trouble-shooting, adjustment procedures, minor and major repairs and overhaul, removal and replacement of units, assemblies and subassemblies and complete instructions for disassembly and re-assembly of components. Repair and overhaul instructions shall be factual, specific, concise and clearly worded as to be readily understood by a qualified mechanic, electrician, technician with no previous experience on the equipment. Also, the procedures and instructions shall include data listing tolerances, specifications, capacities and preventive maintenance directions. Illustrations, wiring diagrams and exploded views shall be used to clarify texts and should appear as close to the related text as possible. Special tools required for the repair and overhaul of the equipment shall be listed and illustrated.

d) Electrical Schematics and instruction books shall be included in each O&M manual.

e) A separate section dedicated to PLC programming manuals, diagnostic and maintenance programming manuals, software and hardware troubleshooting manuals, network administration and maintenance manuals and drive operations and troubleshooting manuals shall be furnished.

f) A separate manual dedicated to structural maintenance and inspection shall be furnished by the Contractor. The manual shall cover periodic structural inspections in order to discover cracks, loose bolts, dents, broken members, corrosion and any other examples of structural distress that might have developed through the use of the Crane. This manual shall cover every weld on the Crane structure including the trolley, it shall also include inspection intervals, locations and procedures. All inspection intervals shall have a rational basis utilizing fracture mechanics principles.

g) All Operation and maintenance manuals shall be certified as complete and approved by the responsible Contractor Mechanical Engineer and the responsible Contractor Electrical Engineer. All structural related manuals shall be certified as complete and approved by the responsible Contractor Structural Engineer.

h) All manuals shall be approved by the County for acceptance.
6.4.3  As-Built Drawings

a) Upon the Cranes delivery to Port Miami, the Contractor shall furnish two (2) complete certified sets of as-built 11”x17” design drawings per Crane and an electronic copy of all as-built drawings to include all structural, mechanical and electrical detail, shop and assembly drawings revise to show changes made during construction process and accurately reflect “as-built” conditions, complete with bills of materials stored on a DVD+R media.

b) Additionally, the Contractor shall furnish at the time of the Crane(s) delivery, two (2) sets of the as-built 11”x17” of all electrical single line diagrams drawings per Crane, each page individually plastic laminated and in the format as approved for fabrication and construction of the Crane(s). The drawings shall include electrical components drawings, wiring diagrams and inter-connection drawings to accurately reflect the “as-built” conditions.

c) The Contractor shall additionally provide all Crane arrangement drawings in an Auto CAD 2016 “dwg” drawing format. The following individual arrangements of the front, side, back and top (plan view) shall additionally be provided:

1) Overall crane arrangements
2) Electric House
3) Machinery House
4) Trolley arrangement
5) Main Hoist/Boom Hoist/Trolley/Gantry Drives

6.4.4  Oil And Lubrication Chart

a) The Contractor shall furnish with the delivery of the Crane a list of oil and grease lubricants suitable for the ambient temperatures and humidity conditions at Port Miami. The Contractor shall also supply a cross-reference to those oils and lubricants used by the Port from those supplied with the Crane.

b) The Contractor shall provide two (2) plastic laminated 11”x17” sets per Crane of each lubrication schedules and diagrams showing recommended lubrication for all parts requiring periodic lubrication; one to be mounted on the inside wall of the Machinery House adjacent to the work desk and the other at an approved location at the gantry level.

6.5  PERSONNEL ELEVATOR

6.5.1 Provide a three (3) person (350 Kg, 770 Lbs minimum capacity) elevator to be installed on the right landside leg, looking from the backreach toward the water. The elevator shall provide access to the Main Power Cable Reel landing, Operator’s Cabin and Machinery House/Electric House. No part of the elevator structure shall extend beyond the width of the sill beam, at elevations below the bottom edge of the portal beam, unless specifically approved by the County.

6.5.2 The elevator controls shall be fully automatic with automatically controlled “soft start”, slow down and stop at the selected station. Provide means for safe manual lowering of the elevator. An elevator call button shall be provided at all levels adjacent to the access doors. An elevator overtravel by-pass keyed switch shall be provided inside the cab. Electrical provisions shall be in compliance with Section 5 including NEMA 4X stainless enclosures and stations. A suitable fire extinguisher shall be provided in the elevator car.

6.5.3 The elevator must traverse from the ground level to the upper most station in less than one minute. It shall have the capability to travel from the ground landing to the Electric House level with intermediate stations at the Operator’s Cabin and portal beam landing. The elevator shall have the capability to travel to all landing without limitations. Landing platforms shall be
sized for emergency egress with stretcher. The lower landing shall be as close to the ground as possible to minimize stair height access to the lower landing.

6.5.4 The complete elevator system shall be stainless steel and hot dipped galvanized, including the mast runway, as approved by County. Elevator components may be primed and painted in accordance with the paint specification, Section 7.7 and 7.9. All fasteners used must be of stainless steel or as approved by County. Elevator electrical components are required to be UL listed and available for the US market – including the governor/fall protection device.

6.5.5 The elevator structure and all components to include access doors shall be designed to comply with wind load conditions. Under storm wind conditions, the elevator personnel cage shall be stowed at the ground landing and have the capability to be secured in place.

6.5.6 The Contractor must provide an elevator service representative to supervise the installation and commissioning of the elevator. Installation and commissioning of the elevator must be performed prior to Crane commissioning and delivery to Port Miami.

6.5.7 The elevator is not to be used prior to the delivery of the Crane to Port Miami. It shall not be used until such time as the elevator supplier and the regulating agency have certified it for use at the Port.

6.5.8 If the elevator manufacturer uses software to program the elevator PLC or drives, this software shall be provided to Port Miami with all the appropriate interface cables prior to any commissioning at the Contractors facility.

6.5.9 The Contractor is responsible to obtain the required Miami-Dade County elevator and State of Florida certifications and any other applicable documentation and requirements.

6.5.10 Fittings for Cables and Conduits shall be located at the bottom of the limit switch enclosure. No electrical or mechanical actuator for door functions shall be used.

6.6 STRETCHERS

6.6.1 One (1) industrial type, metal basket “Stokes” – type stretcher shall be provided with each Crane. The stretcher shall be mounted on the inside wall of the Machinery House adjacent to a principle access door.

6.6.2 The exact location of each stretcher shall be as required by the applicable safety regulations and the additional requirements and as approved by the County.

6.7 FIRE extinguishers

6.7.1 All aspects of safety and occupational health shall be in full compliance with all applicable OSHA regulations.

6.7.2 Each Crane shall be equipped with wall mounted, hand type UL listed carbon dioxide fire extinguishers sized and located as follows:

   a) 5 lb. CO₂ fire extinguishers

      1) One (1) in the operator’s cab
      2) One (1) at dock level adjacent to the access stairway

   b) 10 lb. CO-2 fire extinguishers

      1) Two (2) in the Machinery House
      2) Two (2) in the electric house
      3) One (1) in the Ground Level Monitoring Station
6.7.3 All fire extinguishers shall be mounted in plain sight and shall be easily accessible.

6.7.4 The requested fire extinguishers locations above are the minimum required by the County. However, the Contractor shall provide and install additional fire extinguishers as required by the applicable safety regulations. Signs and indicators denoting the locations of these extinguishers shall be installed in accordance with all applicable State and Local fire prevention regulations.

6.7.5 The exact location of each fire extinguisher shall be as required by the applicable safety regulations and additional requirements as approved by the County.

6.8 MAINTENANCE AIR COMPRESSOR

6.8.1 A three (3) phase, AC motor driven air compressor as manufactured by Ingersoll Rand or County approved equal, shall be furnished and installed in the Machinery House. The compressor shall be equipped with a 20 gallon minimum ASME receiver and an automatic pressure switch, pressure gauge, pressure relief valve, drain valve, automatic-manual reloader, intake filter, instruments, controls and fitted with an air dryer.

6.8.2 The air compressor shall automatically start when receiver pressure drops to 100PSI, and stop when the receiver pressure reaches 150 psi. The air receiver shall be equipped with a manual valve at the bottom for draining, and a suitable pressure gauge.

6.8.3 A hose reel shall be installed above the compressor, provided with 3/8 inch I.D., 250 psi pressure rated rubber air hose having sufficient length to reach any part of the boom machinery house and/or electrical house. Rigid pipe shall be installed from the compressor to the trolley girder to provide service connections at the boom hinge and in the back reach. Additional service connections shall be provided on the Crane at landside sill beam and at the compressor. All service connections shall be spring loaded quick disconnects and be easily accessible by service personnel. The compressor and associated equipment shall be sized to maintain a pressure of 250 psig/5 CFM at each service connection.

6.8.4 A quick-connect fitting equipped, pistol grip blowgun shall also be provided. All piping, fittings and valves shall be high grade stainless as approved by the County.

6.9 CRANE NAME PLATES AND SIGNS

6.9.1 Separate Nameplates clearly indicating the safe working load of the Crane in long tons shall be attached to the gantry frame in conspicuous locations on portal beam. The lettering on the nameplates shall be readily legible when viewed from the dock. The size of each nameplate, lettering and location shall be subject to approval by the County.

6.9.2 Nameplates indicating safe working load (SWL) shall read as follows:

   a) SWL UNDER SINGLE-LIFT SPREADER 50 LT
   b) SWL UNDER TWIN-LIFT SPREADER 65 LT
   c) SWL UNDER CARGO BEAM 100 LT

6.9.3 A separate nameplate shall be attached to each Crane indicating the Crane Manufacture's name, address, trademark, the Crane serial number, and the year that the Crane was placed into service.

6.9.4 The Cranes shall be numbered in the same form as the existing cranes at the Port. The number shall be of the same size, color and location as existing cranes using specified painting requirements.

6.9.5 A Port Miami logo shall be painted on the Crane Machinery House as approved by the County. The logo shall be approximately 2 meters (6.5 ft) high and shall be the same as currently used on Port Miami Cranes.
6.10 WELDING MACHINE

6.10.1 A rectifier-type welding machine shall be supplied with each Crane. The machine shall be a Miller “Trailblazer” or as approved by County. It shall be installed in the Machinery House as approved by County, and shall be equipped with a cord and plug to match the welding receptacles specified in Section 5.42.4. The welding machine shall be permanently fixed in the specified house and wired into the welding system outlets.

6.11 WASTE LUBE OIL DRAIN SYSTEM

6.11.1 A waste lube oil drain system shall be provided to collect and drain used oil in the Machinery House. The Trolley reducer fluids shall drain via a pipe with shutoff valve onto the Trolley when positioned under the Machinery House. The system shall consist of black iron pipe with socket welded connections, running down the Landside Crane leg on the stair and attached to the stair structure with shop-welded pipe supports. It shall be possible to drain used oil and hydraulic fluids via valves and fittings into the drain system for collection at dock level. A shutoff valve and hose connection shall be provided at dock level.

6.12 TOOLS AND WORK BENCH

6.12.1 The Contractor shall furnish for each Crane, in a lockable, steel tool box or locker, lubricant guns, oilers and all tools required for the adjustment of non-standard equipment and for any required maintenance of the Crane. All of this equipment shall be new and unused. The tools and box shall be provided with the Crane’s delivery.

6.12.2 Each Crane shall be equipped with a 36” wide by 60” long metal frame, wood topped workbench in the boom hoist house. The workbench shall include sliding storage drawers, a 6” jaw width bench vise and shall be firmly attached to the house floor.

6.13 STORAGE LOCKERS

6.13.1 Two (2) metal storage lockers with dimensions of 36” wide by 80” high by 18” deep shall be provided with each Crane. The lockers shall be equipped with doors, shelves and bins suitable for the storage of spare parts and supplies, and shall have common-keyed locks in the door latches. All lockers will be rated for storage of flammable material.

6.13.2 One locker shall be placed in the Machinery House and one (1) in the Electrical House. All lockers shall be securely fastened to the walls of the houses.

6.14 BOOM HOIST OPERATOR’S CABIN

6.14.1 An enclosed cabin shall be provided for operating the boom. The cabin shall be located in a safe assessable area with clear visibility of all boom operations, including latches. Said cabin shall be fixed at waterside top sill beam as approved by County.

6.14.2 The cabin shall be fabricated of hot rolled steel, thermally insulated. It shall have safety glass windows on all sides to include the door. Proper ventilation shall be provided in accordance with applicable regulations.

6.14.3 All boom controls shall be located in this cabin in a waist-high console. The control console shall be constructed of stainless steel in accordance with the applicable codes and Section 5 of these specifications. Normal lighting and night lighting shall be provided as approved by County. See reference Boom Console Layout drawing included in Section 9 of these Specifications.
6.15  **VIDEO CAMERA AND OPERATIONS MONITORING**

6.15.1 A digital video camera display and recording system shall be provided on the Crane with two (2) dedicated display monitors in the Operator's Cabin to permit the operator to observe the operation below the trolley and in the ship's/vessel cells', and, in the backreach roadway. Another dedicated display monitor shall be provided in the Crane Control Room which with a desktop computer shall be the master video camera control recording station. The display monitors shall be a of 24” (minimum) HD type and mounted on antishock and vibration dampers as approved by the County.

6.15.2 One (1) fixed angle camera with zoom capability shall be located beneath the Trolley centered on the spreader to provide clear visibility for the operator directly under the trolley and into the ship’s cell to observe the hoisting and/or lowering of the spreader, and/or of containers there and into. The camera shall be easily accessible for ease of maintenance from on top the trolley frame grading. The camera provided shall be resistant to vibrations in an industrial application.

6.15.3 Another camera (with PTZ capability) shall be located on the back-reach for visibility of the roadway while the gantrying of the Crane and of the lay-down area for ship hatches. The camera shall be easily installed and accessible for ease of maintenance from the backreach platform. It shall clear and unobstructed viewing 360 degree from horizontal to vertical view on dock and roadway.

6.15.4 The video system shall consist of all required cameras, anchoring enclosures, wiring, cabling, display monitors, computer, and display software controls. The PC shall incorporate the latest PC hardware as required herein for other Crane PC systems. The main (Master) camera controls shall be located in the Controls Room of the E-House adjacent to the CMS.

6.15.5 The system shall be capable of continuous operation without degradation in performance under the operating environment described in these specifications.

6.15.6 The system shall be capable of recording a minimum of 5TB of data and shall be fitted with a separated fiber converter to allow communication with the cameras. The system shall have a separate dedicated fiber optic for this purpose.

6.15.7 System details and arrangement shall be provided to County for review and approval.

6.16  **CABLE RE-REEVING MACHINE AND TRAILER**

6.16.1 With the initial order of the contract the Contractor shall furnish a wire cable re-reeving machine and heavy duty towed trailer to transport the machine and cable reels.

6.16.2 The design, materials, fabrication, assembly, commissioning and testing shall me all the requirements of these technical specifications and any other application US codes and standards.

6.16.3 The wire cable re-reeving machine shall be as manufactured by Reel-o-matic model NK8 or County approved equal which shall comply with the following requirements;

- a) Handle cable reels from 38” to 84” diameter x 60” wide x 8,000 lbs. lift capacity and 10,000 lbs. pulling capacity.
- b) Minimum 15 HP Hydraulic Variable Speed Drive, 230 Volt, 3 Phase, 0-70 RPM
- c) Heavy duty structural steel frame.
- d) Forward/Reverse feature.
- e) Automatically raise and lower the reel.
- f) Manual Slide Traverse to more easily achieve an even lay of material onto the take-up reel.
- g) Slide Drive to quickly and easily load and unload the reel.
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h) Rear floor locks.
i) Wire roller and Push Handle
j) Elongated shaft pocket with cam roller to prevent reel and shaft escape.
k) Safety shaft latch.
l) Removable drive pin.
m) Shaft storage brackets.
n) ½” dia. shaft with bushings for 3” and 4” arbor holes.
o) 3/8” dia. shaft for use with smaller reels with cone bushings and regular bushings.

6.16.4 A metal fabricated vehicle towed trailer shall be provided which trailer has the capacity to transport the re-reeving machine with the largest cable reel that can be handled by the machine.

6.17 CRANE MODELS

6.17.1 The wind test model as noted in Section 3.28 shall be painted, signs installed on its frame and incased in an approved protective clear viewing case on a wooden varnished base with a County approved name plate with the basic crane specifications. The name plate shall be mounted on the base inside of the clear case.

6.17.2 Four (4) 1/500 scale detailed crane models shall be furnished to the County with the initial order. The models shall be provided in an approved protective clear viewing case on a wooden varnished base with a County approved name plate with the basic crane specifications. The name plate shall be mounted on the base inside of the clear case.

6.18 SPARE PARTS

6.18.1 The Contractor shall provide at a minimum the following Crane and Spreader spare parts with the initial order of three (3) Cranes’ delivery:

a) Cranes

1) Two (2) of each and every printed circuit board in the drive and crane PLC including remote I/O boards
2) Two (2) complete PLC units with flash card if it is in use but not included in above item
3) Six (6) each of every type of low voltage fuse installed on the crane
4) Six (6) of every type of low voltage circuit breaker installed on the crane
5) Four (4) spare gantry motors
6) Two (2) each of Main Hoist, Main Trolley, and Boom motors including cooling fan
7) Two (2) of each complete hydraulic cylinder and valve assembly for anti-snag system if installed on the crane
8) Two (2) load-cells and modules as used on the crane
9) Two (2) of each type power supply in control and drive system
10) Two (2) of each type Master switch (complete)
11) Four (4) additional Master switch encoders
12) Two (2) complete drive modules interchangeable with all of the drives used on the cranes
13) Two (2) of each type of pulse tachometer used on the cranes (Main Hoist, Main Trolley, Boom, Gantry, High Voltage cable reel and spreader cable reel) or four (4) pulse tachometers if Main Hoist, Main Trolley, Boom, Gantry are interchangeable and two (2) each for High Voltage cable reel and spreader cable reel
14) Two (2) each type over-speed switch used on Main Hoist
15) Two (2) each type over-speed switch used on Boom Hoist
16) Two (2) complete brake assemblies of the Main Hoist brake
17) Four (4) sets of each type of brake pads for the Main Hoist brake
18) Two (2) complete brake assemblies for the Main Trolley
19) Four (4) sets of each type of brake pads for the Main Trolley brake
20) Two (2) complete brake assemblies for the Boom Hoist
21) Four (4) sets of each type of brake pads for the Boom Hoist brakes
22) Two (2) complete brake assemblies for Gantry motor
23) Four (4) sets of each type of brake pads for the Gantry motor brakes
24) Two (2) complete brake assemblies of the Gantry Storm/Wheel brakes
25) Four (4) set of each type of brake pads for the Gantry Storm/Wheel brakes
26) Two (2) complete high speed couplings for the Main Hoist
27) Two (2) complete High Voltage Cable reel drives,
28) Two (2) complete Spreader Cable reel drives
29) “Not used”
30) Two (2) wind speed sensors
31) Eight (8) boom LED flood light fixtures
32) Two (2) each trolley gearboxes
33) Four (4) complete sets of gear parts for trolley gearbox
34) Four (4) each type of gantry gearbox
35) Four (4) complete sets of gear parts for gantry gearbox
36) Eight (8) sets of Main Trolley wheel bearings
37) Eight (8) Main Trolley guide roller wheels with bearings
38) Eight (8) sets of Catenary Trolley wheel bearings
39) Eight (8) sets of Catenary Trolley guide roller wheels with bearings
40) Two (2) sets of gantry wheel bearings for each type of wheel
41) Two (2) each Boom Hoist rotary Cam switches or absolute encoders
42) Two (2) each Main Hoist rotary Cam switches or absolute encoders
43) Two (2) each High Voltage cable reel rotary Cam switches
44) Two (2) each Spreader cable reel rotary Cam switches
45) Two (2) each special application limit switches such as for over-travel
46) Two (2) each complete Festoon Cable Carrier trucks as used on the cranes
47) Two (2) sets of all parts necessary for the Festoon Cable Carrier truck
48) Eight (8) Main Trolley wheels
49) Eight (8) Catenary Trolley wheels
50) Two (2) each of the gantry driven and non-driven wheels
51) Two (2) sets of each type of hoist sheave block
52) Two (2) sets of Spreader Power and Control cables
53) Two (2) rolls, full length of Fiber Optic cables used in the festoon
54) Four (4) sets of Main Hoist wire ropes, tape measured
55) Two (2) complete Spreader Cable reel slip rings with brushes
56) Any other spare parts and tools recommended by the Contractor and component suppliers.

b) Spreaders

1) Two (2) each hydraulic pump electrical motor used on the spreaders
2) Two (2) each hydraulic pump used on the spreaders
3) Two (2) each of each type of hydraulic valve set used on the spreaders
4) Sixteen (16) complete sets of twist-lock assemblies used on the spreaders (to include but not limited to twistlocks, sleeve, nut, guide, mechanical interlock, spherical washers, feeler pin, blockading key, springs, nuts, washers, keys, etc.)
5) Twenty-four (24) flippers as used on the spreaders
6) Sixteen (16) flipper actuators as used on the spreaders
7) Twelve (12) of each type relay used on the spreaders
8) Eight (8) of each hydraulic cylinder used on the spreaders
9) Four (4) of Expand/Retract Hydraulic motor
10) Four (4) of Expand/Retract gear reducers with sprockets
11) Four (4) of Expand/Retract chain idler sprockets
12) Four (4) sets of driven chain for Expand/Retract installed on the spreaders
13) Four (4) sets of each hydraulic hose with high pressure fittings installed on the spreaders
14) Eight (8) cable and hose carrier chains
15) Forty (40) of each type of proximity switch used on the spreader
16) Eight (8) Spreader expand/retract chain Tightener Assemblies/devices
17) Forty (40) proximity switches (IFM) – 24VDC
18) Two (2) Spreader PLC – (IFM)
19) Four (4) Spreader CAN I/O module (IFM)
20) Two (2) Spreader DP Gateway (IFM)
21) Ten (10) Solenoid Valve connectors
22) Four (4) each type of proximity switch and solenoid valve connector cables
23) Four (4) TTDS limit switches (SUN)
24) Two (2) Height Detecting Limit Switches (P&F)
25) Two (2) 24VDC Special Power Supplies

6.18.2 Each spare part shall be supplied with an item number with matching cross-reference to the schematic diagrams, a description of the part, and a unit price value.

6.18.3 All parts and components must be identifiable commencing with the number or designation of the particular part, and trace the part back to the schematics, and the parts list in the bill of materials. All parts in assembly shall be individually listed.

6.18.4 Additionally, the drive supplier shall supply 180 days prior to shipment of the Crane a recommended spare parts list for the drive system. The spare parts list shall include all critical spare parts not readily available in the local Miami market.

6.18.5 In addition to the above spare parts to be provided with the initial Crane order delivery, the Contractor shall also provide at that time, a recommended spare parts list for the first five years of each Cranes operation.
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SECTION 7

MANUFACTURING
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SECTION 7 - MANUFACTURING

7.1 GENERAL

7.1.1 The Contractor shall manufacture the Crane as herein specified and in accordance with all applicable codes, rules and regulations. The manufacturing shall be performed at the Contractor’s facility unless otherwise approved by the County.

7.1.2 The manufacturing shall be performed in accordance with the approved drawings and Submittals. Any Work performed by the Contractor which is not approved by the County, the County reserves the right not to accept said Work. The Contractor shall be responsible for any Work and its cost not approved by County to include all corrective Work.

7.1.3 For any and all Work performed under a Contract, the Contractor shall submit for the County’s approval a written Quality Control/Quality Assurance (QC/QA) Program plan. No Work shall be performed until the County reviews and approves the QA/QC program.

7.1.4 All Work shall be performed in a thorough workmanlike manner and shall follow the best modern practice in the manufacture of high grade machinery. Work shall be performed by workmen suitably skilled and certified in their particular trades.

7.1.5 Carbon steel material shall not be used on this project that at the moment to be abrasively blasted, cut or formed, exhibits the appearance of SSPC Rust Condition B thru G. Only SSPC-VIS 1 Rust Condition A material is acceptable to be used.

7.1.6 No procurement of parts and components, materials, fabrication and manufacturing shall commence until the County provides written approval of the Cranes’ design, calculations and specific submittals.

7.1.7 Any modifications or changes required during fabrication, manufacturing, installation, startup, testing and commissioning of the Cranes shall be formally submitted directly to the Crane Engineer or the County for review and approval. No modifications or changes are authorized to be approved by the County’s Crane Consulting Engineer or its third party independent inspector(s), or any other representative. No on-site and/or field changes or modifications are permitted without proper submittal as noted herein this sub-section 7.1.5.

7.1.8 All aspects of welded construction shall be performed in accordance with AWS D1.1, Structural Welding Code – Steel (D1.1/D1.1M:2015). The 2015 Edition shall be the governing edition.

7.2 QUALITY CONTROL/QUALITY ASSURANCE

7.2.1 It shall be the responsibility of the Contractor to maintain a Quality Control/Quality Assurance (QC/QA) Program (the “Program”). This program shall follow the guidelines established hereinafter. The Program is to include, but is not limited to providing, a qualified supervisor, qualified inspectors, required inspections, and records. This program shall assure the County that all materials and work are supplied and/or conducted in accordance with the applicable codes, approved shop drawings, this Specification, and proper work practices for the various trades.

7.2.2 The Contractor must implement the written QC/QA program that is appropriate for this Contract and shall submit it to the County within sixty (60) days prior to commencement of any manufacturing Work for review and approval. This QC/QA Program shall include approach, schedule, and personnel resumes. Resumes are to include name, title, specialty, and experience. Acceptance of quality assurance inspectors will be pending the review of resumes. Inspection of multiple trades will be allowed only if these qualifications are reflected in the resume.

7.2.3 The QC/QA Program shall include, but is not limited to, the following:
Appendix A, Attachment A - Technical Specifications

7.2.4 At least one of the Contractor's quality control employees shall be assigned full time to each location where components are fabricated. Components such as electrical motors and gear reducers should be tested and accepted by the Contractor at the manufacturer's plant.

7.2.5 With respect to welded construction, the responsibilities of the Contractor shall be as specified in AWS D1.1, Clause 6.6.

7.2.6 All quality assurance shall be conducted at the Contractor's expense.

7.3 INSPECTIONS

7.3.1 All inspections of the Work shall be performed in accordance with these Specifications, Scope of Work and all applicable rules, regulations and codes.

7.3.2 The type and extent of inspection of welded construction shall be as specified in AWS D1.1, Clauses 6.1, 6.2, 6.3, 6.4, and 6.5.

7.3.3 The County reserves the right to retain independent inspection laboratories and/or Engineers and inspectors to insure strict compliance with the terms of the Contract. The Contractor shall keep the County fully informed as to the general progress of the work and shall notify the County, three (3) weeks in advance, when any item of equipment, component, or subassembly is ready for testing. If any subassembly should be assembled by the Contractor without such notification, or without allowing the County reasonable opportunity to inspect all of its components, the County will have the right to require the Contractor to remove or disassemble the assembly in whole or in part, so that proper inspection of its components can be made. The Contractor shall bear the cost of such removal or disassembly and no extension of time to the Contract completion date for this work will be allowed.

7.3.4 All non-destructive testing, materials testing, and bolt torque testing shall be conducted by an independent testing firm (Subcontractor), as approved by the County. The Contractor is permitted the option of utilizing a Subcontractor for the entire QC/QA Program. Acceptance of Subcontractors will be subject to the same criteria stated above.

7.3.5 The County shall have free access to the mills or shops of the Contractor and its subcontractors or vendors, and shall be supplied with all drawings and specifications required to carry out the inspection. This independent inspection does not relieve the Contractor of his responsibility to carry out his own quality control.

7.3.6 Any Work, materials, or equipment not conforming to these specifications will be considered defective, whether in place or not, and will be rejected by the County or representative. Work performed from drawings or revisions thereto which have not been signed or initialed by the Contractor's responsible Structural Engineer will not be inspected and will be considered rejected. Refusal of the County to exercise such authority shall not impose any responsibility on him, and the Contractor shall remain fully responsible for the completion of his Work as specified. Defective Work shall be repaired using approved procedures.

7.3.7 No inspector is authorized to change any provision of the Specification without written authorization of the County, nor shall the inspection and approval by the County's
representative, or lack of inspection and approval, relieves the Contractor from any requirements of the Contract. Inspection by the County’s representative will be performed in such a manner as not to unnecessarily delay the Work.

7.4 RECORD KEEPING

7.4.1 The Contractor shall maintain a record of all Work performed in accordance with these Specifications and all applicable rules, regulations and codes. Written record of inspections shall be submitted to the County as required by this Section. Typewritten copies of each required inspection record or report shall be submitted to the County bi-weekly. All inspection forms and reports shall identify job title, contract number, Crane number, type of test or inspection, location, comments, date of inspection, and the inspector’s signature. Subcontractor’s standardized forms will be accepted, if the above stated information is included on the forms.

7.4.2 The Contractor shall be required to submit all manufacturer’s certificates and welder certificates in accordance with these Specifications.

7.4.3 All radiographic film shall be submitted to the County for review.

7.4.4 Digital progress photographs shall be taken and submitted to the County for the duration of the project. The photographs shall reflect the work being conducted in that particular week. All photographs shall be mounted in a binder, dated and labeled and forwarded via e-mail to the County at least bi-weekly. Two (2) bound copies of each submittal shall be required by the County.

7.5 CERTIFICATION OF WELDERS, OPERATORS AND PROCEDURES

7.5.1 Welders, welding operators and tackers (the "Welder") shall have been certified as qualified for the materials, processes and type of welding being performed, by an independent testing laboratory within 6 months prior to performing such work. Proof of certification of all Fitters, Tackers and Welders on this Project are to be submitted to the County for approval prior to commencement of any Work. No Work shall be performed until the County has had ample time to review and approve the submitted Welder certifications. Welder certification shall be in accordance with AWS D1.1, Clause 4 – Part C.

7.6 INSPECTION AND TESTING METHODS

7.6.1 The inspection methods described in this Section are acceptable to the County for this project but are not limited to those noted herein. If any additional method(s) are required but not included in this Section, the Contractor shall comply with US approved standard methods of inspection(s).

7.6.2 All weld inspections and acceptance criteria shall be in accordance with AWS requirements for cyclically loaded structures.

7.6.3 Visual Inspection

a) This type of inspection shall be conducted with the human eye, hand held magnifier and measuring devices. Verification of proper dimensions, sizes, and work practices shall be accomplished by this type of inspection. This inspection shall be in accordance with AWS D1.1, Clause 6.5.

7.6.4 Non-Destructive Testing

a) The extent of NDT performed by the Contractor shall be at a minimum the following, and shall comply with any more stringent requirements indicated elsewhere within this specification.
b) The County reserves the right to both witness these examinations as well as perform independent testing at any time.

c) All welds – 100% VT – Acceptance criteria – AWS D1.1, Table 6.1 – Cyclically Loaded Nontubular Connections.

d) Tension, complete penetration welds – 100% UT – Acceptance criteria – AWS D1.1 Table 6.3. Tension shall be determined by stress levels due to operating loads.

e) Compression; complete penetration welds – 25% UT. 25% shall be considered 25% of the length of each weld, selected randomly. Acceptance criteria – AWS D1.1, Table 6.2.
   1) Rejection on any portion of a weld length shall require that 100% of the weld length be inspected.

f) Fillet welds on FCM – 100% MT – Acceptance criteria – AWS D1.1, Table 6.1 – Cyclically Loaded Nontubular Connections.

g) Fillet welds on NFCM – 10% MT – Acceptance criteria – AWS D1.1, Table 6.1 – Cyclically Loaded Nontubular Connections.
   1) Rejection on any portion of a weld length shall require that 100% of the weld length be inspected.

h) This type of testing will be used to test welds and material for defects. Acceptable methods of non-destructive testing are as follows:
   1) MT - Magnetic Particle Testing
   2) PT Penetrant Testing
   3) UT - Ultrasonic Testing
   4) RT - Radiographic Testing (x-ray)

7.6.5 Electrical Testing

a) The acceptable instruments for testing electrical installations are as follows:
   1) Calibrated Voltmeter
   2) "Ground Resistance" Test Meter
   3) Light Meter calibrated in foot-candles or Lux.
   4) Ammeter
   5) Oscilloscope
   6) Control Diagnostic Instrument with Print Out

7.6.6 Air Test

a) This test is a pressure test to determine the air and/or watertight integrity of a specified structural member or tank. This test is accomplished by filling a member or tank with air to a pressure of 0.105 kgf/cm² (1.50 psi gage). Upon pressurization, a soap solution is applied to all welded joints, fittings and bolted covers. These joints shall then be visually inspected for evidence of leakage, (soap bubbles). If leaks are discovered in screwed or bolted joints, leakage shall be corrected by tightening until all evidence of soap bubbles disappears. If leaks are discovered in welded joints, the pressure shall be released before repair is initiated. Leaking welds shall be corrected by removing the defective portion of the weld by air arc gouging and re-welding. Peening shall not be accepted as a means to correct leakage in welded joints. After the weld has been repaired, the member or tank shall again be pressurized and testing shall be repeated.

b) The testing rig shall include a calibrated pressure gauge, a positive closing valve to shut off the air supply, and a relief valve set at a pressure not to exceed the specified test pressure (0.105 kgf/cm²). A calculated head of water to maintain the test pressure is recommended in lieu of a mechanical relief valve.
7.6.7 Water Hose Test

a) This test is used to determine the air and/or watertight integrity of welded joints and fittings in structures which cannot be air tested.

b) This test is accomplished by subjecting the test areas to a spray of water from a 38 mm (1.50 inch) diameter hose at a pressure of 3.45 bar (50 psi gage). The nozzle of this hose is to be held a maximum of 3 m from the test area.

c) While the test areas are being subjected to the spray of water, the inspector shall visually inspect the opposite side for evidence of leakage. If leakage is discovered, these shall be corrected by the methods specified under "Air Test" and the test repeated.

7.6.8 Air Hose Test

a) This test is to serve as an alternative to the "Water Hose Test". Test areas are to be subjected to an air flow from a 10 mm (3/8 inch) nozzle at 6.2 bar (90 psi gage). The nozzle is to be held as close as possible to the test area.

b) A soap solution is to be supplied to the test areas opposite the areas subject to the air flow. The inspector shall then inspect for evidence of leakage, (air bubbles). If leakage is discovered, these shall be corrected by the methods specified under "Air Test" and the test repeated.

7.6.9 Chalk Test

a) This test is to serve as an alternative for testing manhole covers for watertight integrity. This test is to be used on manhole covers where only the covers are required to be tested.

b) Chalk is applied to the entire sealing flange edge opposite the gasket. The manhole cover will then be closed and then opened. Upon opening, the inspector shall visually inspect the gasket for a continuous chalk mark. A break in the chalk mark indicates an improper seal. This defect is to be corrected by adjustment.

7.6.10 Hydrostatic Test (Piping)

a) This test is to determine the tightness of piping systems. The piping shall be pressurized with water to one hundred fifty percent (150%) of the working pressure. Pumps and miscellaneous equipment in the system which are unable to withstand the test pressure are to be isolated using blanks.

b) Upon attaining the specified test pressure, all joints in the system are to be visually inspected for evidence of leakage. If leakage is discovered, pressure shall be released from the system, and leakage shall be corrected by the methods specified under "Air Test" and the test repeated.

7.6.11 Bolt Torque Test

a) The Contractor is to utilize the services of an independent testing firm as approved by the County to perform this test. This test is to assure the proper torques of structural and mechanical fasteners.

b) Ten percent (10%) of all critical structural and equipment mounting fasteners, but not less than two (2) fasteners per critical connection, are to be randomly checked for proper torque values. This test must be conducted using a calibrated torque wrench. The County will require submittal of the torque records upon completion of the test for review.
7.6.12 **Blueing of Mounting Surfaces**

a) This test is to verify that adjoining mounting surfaces are in proper contact.

b) The test shall be conducted by applying a thin film of blue machinist's dye to one (1) of the adjoining surfaces. The two (2) surfaces shall be joined and separated. The surface which was not coated with dye shall be visually inspected. If this surface is not fully coated, there is improper contact. This defect shall be corrected by approved re-machining or shimming.

7.6.13 **Mechanical Property Testing of Critical Structural and Mechanical Fasteners**

a) The Contractor is to submit all manufacturers’ fastener certificates to the County. As a double check, the Contractor shall be required to randomly test the fastener system to verify mechanical properties. This testing shall be performed by an independent testing firm, as approved by the County, commissioned by the Contractor. The sample fastener system shall be tested for proof load, tensile strength (wedge test), and hardness. Samples are to be selected at random from each shipping lot. These samples shall include the entire fastener system. Included in the system are the bolt, nut, and washer. The quantity of samples to be tested per shipping lot are to be determined as follows:

<table>
<thead>
<tr>
<th>Number of Pieces In Shipping Lot</th>
<th>Number of Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 or less</td>
<td>1</td>
</tr>
<tr>
<td>151 to 280</td>
<td>2</td>
</tr>
<tr>
<td>281 to 500</td>
<td>3</td>
</tr>
<tr>
<td>501 to 1,200</td>
<td>5</td>
</tr>
<tr>
<td>1,201 to 3,200</td>
<td>8</td>
</tr>
<tr>
<td>3,201 to 10,000</td>
<td>13</td>
</tr>
<tr>
<td>10,001 or more</td>
<td>20</td>
</tr>
</tbody>
</table>

b) If any fastener in a shipping lot is found to be defective, the entire lot is to be rejected. Records of these tests shall be required by the County for review.

7.6.14 **Supplemental Hardness Testing of Critical Structural and Mechanical Fastener Systems**

a) In addition to the test specified by Part K of this Section, the hardness of one random fastener per connection shall be checked. If the hardness is below tolerance for size and grade, hardness tests on the other fastener system in the connection shall be checked. If others are found to be below tolerance, proof loading tests shall be conducted on the "suspect" fastener systems. If any fails the proof loading, the connection fasteners shall be considered rejected.

7.6.15 **Hydrostatic Testing (Tank)**

a) This test is to determine the watertight or oil tight integrity of a tank.

b) The tank shall be filled with clean, fresh water until it overflows thru the overflow pipe. This will simulate a full tank. The inspector shall inspect all welded joints of the tank for
evidence of leakage. If leaks are discovered, these shall be corrected by the methods specified under "Air Test" and the test repeated. Prior to correcting any welded joint, the tank shall be completely drained of all water.

7.6.16 HVAC Test and Balance

a) The Operator's Cabin air conditioning system, and the Dock Level Monitoring Station air conditioning system shall all be tested before delivery. The following procedures shall be followed and the following shall be measured, recorded and adjusted as/if necessary:

1) Mechanically check controls and make available to operate under design conditions. Calibrate and set all thermostats.
2) Install clean filters.
3) Test air volumes and velocities for each fan (maximum and minimum air quantities).
4) Test voltage and motor load Amperes under working conditions. Current must not exceed full load Amperes nameplate rating.
5) Test and adjust systems for design supply, return, outside and exhaust air CFM.
6) Entering and leaving air dry bulb and wet bulb temperatures for each cooling and heating coil.

b) The Control and Drives Rooms' air conditioning systems shall all be tested before delivery. The following shall be measured, recorded and adjusted as/if necessary:

1) Mechanically check fans, blowers and air handling equipment and make available to operate under design conditions.
2) Set splitters, volume dampers, and vanes in their neutral positions.
3) Set grilles, diffusers, etc., installed with vanes, blades in their neutral positions.
4) Mechanically check controls and make available to operate under design conditions. Calibrate and set all thermostats.
5) Install clean filters.
6) Check all safety and operating controls of electric strip heaters and verify that heaters operate at minimum air flow conditions.
7) Make pitot tube transverse of main supply, auxiliary and exhaust ducts.
8) Test air volumes and velocities for each fan (maximum and minimum air quantities).
9) Test voltage and motor load Amperes under working conditions. Current must not exceed full load Amperes nameplate rating.
10) Test static pressures of all systems, suction and discharge.
11) Test and adjust systems for design supply, return, outside and exhaust air CFM.
12) During balancing and testing period all supply and exhaust fans shall have speeds adjusted and drives changed where necessary so that fan delivers design CFM at actual static pressure developed by installed system. Increasing static pressure by dampening at fan will not be permitted.
13) Entering and leaving air dry bulb and wet bulb temperatures for each cooling and heating coil.
14) Test and adjust each diffuser, grille and register with + or - 10% of design requirements.
15) Automatically operated dampers shall operate as specified or indicated.
16) The completed conditioned envelope shall be tested and the air leakage rate of the complete conditioned volume shall not exceed 0.04 cfm per square foot of wall and roof envelope area (excluding doors) at a pressure differential of 0.3 inches water gauge (0.2 liters per second per square meter at 75 Pascals) in accordance with American Society for Testing and Materials (ASTM) E 779. Maximum door infiltration rates shall be 0.2 cfm per square foot of door area at a pressure differential of 0.3 inches water gauge (1.0 liter per second per square meter at 75 Pascals) in accordance with American Architectural Manufacturers Association (AAMA) A440.
7.7 FABRICATION AND WORKMANSHIP

7.7.1 Work shall conform to the requirements of the AISC Specification, Allowable Stress Design, and the cyclically loaded structures requirements of AWS D1.1. Welding procedures and electrodes shall be noted on the drawings.

7.7.2 All welding shall be done in accordance with AWS D1.1. All Clauses shall be applicable to govern design, qualification, fabrication, and inspection.

7.7.3 In addition to these Specifications, all welding, inspection, and weld repair on fracture critical members shall comply with AWS D1.5, Section 12, “AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members.”

7.7.4 Welding procedures shall be qualified in accordance with AWS D1.1 Clause 3 (prequalified) or Clause 4 (qualified by testing), with the required testing performed by an approved testing laboratory. The County shall have the option to approve the Welder testing and certification laboratory.

7.7.5 Written procedures for all welded joints shall be identified on the drawings and shall be made available to the County and all appropriate manufacturing shop personnel so they can understand and use them without referencing the applicable codes.

7.7.6 All welders and welding operators shall be qualified in accordance with AWS D1.1, Clause 4, Part C.

7.7.7 Written procedures for all welded joints shall be submitted to the County for approval. Procedures shall delineate every work step and identify all required inspections that may be critical to the specific welds. Procedures shall be identified on the drawings and shall be made available to all appropriate shop personnel. Procedures shall be prepared in a manner such that shop personnel can understand and use them without referencing to and reading the applicable codes and standards manuals.

7.7.8 Welds installed using unqualified procedures or welding performed by noncertified welders shall be subject to removal by the Contractor at his expense, at the discretion of the Chief Engineer.

7.7.9 These requirements shall apply to all welding, burning, cutting and grinding on the crane structure. This includes welds for erection attachments, whether or not they are removed, and electrical clips and conduit supports. All welds shall be shown on the drawings and shall be approved by the Contractor's responsible Structural Engineer before the welds are made.

7.7.10 All Work shall be performed in a thorough and neat professional workmanlike manner that shall follow all modern practice in the fabrication and manufacture of high grade machinery. All Work shall be performed by skilled tradesmen qualified in their particular trade.

7.7.11 Bolts that are 7/8" (22 mm) in diameter or less may be tightened to the required tension, torque and/or torsion as enumerated in the AISC manual.

7.7.12 A325 and A490 bolts greater than 7/8" (22 mm) diameter shall be tightened to the required tension by the calibrated wrench method only. Sizing and installation of the bolts shall comply with the requirements of Research Council on Structural Connections (RCSC) “Specification for Structural Joints Using High-Strength Bolts” for slip critical joints:

   a) Pre-installation verification procedures using a tension calibrator to calibrate the torque wrench used in the installation shall be performed for each fastener assembly lot in accordance with requirements of pre-installation verification requirements of RCSC’s specification. Records of the pre-installation verification procedures shall be submitted for review by the County and included in as built quality assurance documentation.
b) Pre-installation verification procedures shall be performed for each torque wrench used in the installation.

c) Frequency of pre-installation verification shall be daily in accordance with RCSC requirements and (1) when the lot of any component of the fastener assembly is changed, (2) when the lot of any component of the fastener assembly is re-lubricated, (3) when significant differences are noted in the surface condition of the bolt, thread, nuts, or washers, and (4) when any major component of the torque wrench including lubrication, hose, and air supply are altered.

d) The minimum pretension used in pre-installation verification shall be 1.05 times the required minimum installed bolt pretension as specified by RCSC

e) Hardened washers shall be placed under the both the head and the nut.

f) The tension calibrator shall be calibrated at least annually.

g) The Contractor shall notify the County if the highest and lowest torques measured during wrench calibration varies by more than 10 percent (10%) of the lowest torque, so the County can develop the appropriate solution.

h) The "snug tight" tension/torque shall be within 15–45 percent (15% to 45%) of the specified tension and shall be achieved using a calibrated wrench or an impact wrench as approved by the County.

i) The sequence of bolt torque and/or tensioning shall be shown on the drawings.

j) After the "snug tight" condition is achieved, an initial tension of 75 percent (75%) of the final tension shall be developed in all the bolts. Only then shall the final tension be developed.

k) The minimum installed bolt tension shall be at least 70 percent (70%) of the specified tensile strength of the bolt as specified by RCSC.

l) The final tension shall be verified by testing 10 percent (10%) of the bolts after all the bolts are tensioned. If the verification indicates loss of tension in any bolt, the Contractor shall notify the County and submit a proposed correction plan for review and approval.

7.7.13 Fitting and Welding

a) All welds must be continuous and in accordance with AWS requirements.

b) No slag or inclusions is permitted.

c) Where field burning, grinding, or welding is unavoidable, any structure, mechanism and/or electrical equipment that is adjacent to or underneath the repair area shall be protected against contamination or damage from burn splatter, weld splatter and grinding particles.

7.7.14 Weld Repairs

a) Repair of defects detected during fabrication or inspection shall be corrected in accordance with AWS D1.1, Clause 5.25 and the County requirements herein.

7.7.15 Crane Erection and Disassembly

a) The Contractor shall submit all of its subcontractors credentials for the County’s approval prior to any assembly, erection or disassembly of the Cranes.

b) All structural members and components must fully fabricated and fitted in accordance with the requirements herein prior to any commissioning, testing and shipping.
c) Damage to the factory applied paint system is to be minimized. Paint repairs shall comply with the requirements herein. Contamination or paint repair to areas with grating will require removal of the grating for an acceptable decontamination and paint repair.

7.8 FABRICATION INSPECTIONS AND TESTS
(To be carried out by Contractor at Contractor’s facility)

7.8.1 Structural Materials

a) All work shall conform to the requirements of the latest edition of AWS D1.1 requirements for dynamically loaded structures, and the workmanship requirements of sub-sections of this specification. Welding procedures and electrodes shall be as required and shall conform to the applicable fabrication codes.

b) All structural materials are to be visually inspected for any apparent defects. Size of materials is to be inspected as required.

c) All critical structural fasteners are to be visually inspected upon receipt. In addition to visual inspection, the Contractor shall be required to test fastener systems to verify their mechanical properties as specified under "Inspection Methods".

d) All welding electrode and flux container labels are to be inspected to verify compliance with the Specifications.

7.8.2 Structural Fabrication

a) Structural members are to be continuously visually inspected throughout fabrication. As the fabrication of individual members is completed, the Contractor shall conduct a final inspection, before releasing that member to be painted. This inspection shall include visual inspection and non-destructive testing (NDT).

b) All groove welds in butt joints subject to tension and/or reverse loadings, including flanges of members in bending, shall be inspected by either radiographic or ultrasonic testing, as applicable, for 100% of the weld length. All complete joint penetration groove welds loaded in compression shall be ultrasonically tested for 25% of their length. In the event welding defects are discovered, the amount of radiographic examination may be increased at the County's direction to 100% of the length of the welds. Testing shall be done by or under the direct supervision of properly qualified personnel. All fillet welds in members subjected to a fatigue stress range exceeding 70% of the allowable stress range shall be inspected by magnetic particle testing. In areas that cannot be reached properly with magnetic particle testing equipment, penetration testing shall be used.

c) Plates subject to through plate tension shall be 100% UT tested for lamination in the area of through plate tension. If lamination is found, it will be reported to the County and the plate shall be rejected or the Contractor shall submit a repair scheme which shall be accepted or rejected by the County.

d) If a structural member is to be hermetically sealed, it shall first be air tested in accordance with the "Air Test" requirements prior to applying any coating to the exterior of this structure. Contractor shall maintain and submit to the County for review and approval, records of air tests.

e) All primary structural members that are not hermetically sealed and tested by the "Air Test" method are to be either "Water Hose" or Air Hose tested prior to applying any coating to the interior or exterior of the structure. This testing shall be conducted as specified under "Inspection Methods." Contractor shall maintain and submit to the County for review and approval records of this testing.
f) If any critical structural fastener systems are permanently installed during fabrication, torque values shall be checked in accordance with "Torque Test" requirements. Contractor shall maintain and submit to the County for review and approval records of this testing.

g) Supplemental hardness testing of critical structural connection fastener systems permanently installed in the shop shall be tested in accordance with "Supplemental Hardness Testing of Critical Structural and Mechanical Fastener Systems". Contractor shall maintain and submit to the County for review and approval records of this testing.

h) Rejected welds must be gouged and re-welded in accordance with AWS requirements.

7.8.3 Welding Inspection

a) Welds shall meet the requirements of AWS D1.1. The specific method of weld inspection shall be shown on the drawings.

b) Testing of tension butt splices shall be done by or under the direct supervision of a certified technician from a testing lab, as approved.

c) Defective welds shall be corrected in accordance with Section 9.4 of AASHTO "Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members".

d) Mill test certificates for all materials shall be supplied to the County and shall identify the component or assembly that the material is intended for.

7.8.4 Mechanical Materials Inspections

a) Certificates for mechanical stock and wire rope proof loads shall be submitted to the County for review.

b) Purchased machinery is to be visually inspected for apparent defects or damage upon receipt.

c) All castings, forgings, pins, and axles shall be non-destructively tested (NDT) by an independent testing firm. Acceptable test methods are "Ultrasonic Testing" (U.T.) and "Radiographic Testing" (x-ray). Contractor shall maintain and submit to the County for review and approval records of these tests.

d) Mechanical property testing shall be conducted on all critical mechanical fastener systems. These tests shall be conducted in accordance with the mechanical property test requirements. Contractor shall maintain and submit to the County for review and approval records of this testing.

7.8.5 Mechanical Fabrication Inspections

a) All fabricated machinery parts shall be inspected for compliance with the approved shop drawings, applicable codes, and proper machinist practices.

b) Measurements of critical machined surfaces shall be required to verify compliance with the approved shop drawings. Contractor shall maintain and submit to the County for review and approval Records of these measurement inspections shall be submitted to the County for review and concurrence.

c) Installation of all major machinery shall be inspected to verify proper mounting and alignment. Contractor shall maintain and submit to the County for review and approval records of machinery installation inspections.

d) Critical mechanical fasteners shall be torque tested in accordance with "Torque Testing" requirements, after machinery installation. Contractor shall maintain and submit to the County for review and approval records of the Torque Testing.
e) Supplemental hardness testing of critical mechanical connection fastener systems permanently installed in the shop shall be tested in accordance with "Supplemental Hardness Testing of Critical Structural and Mechanical Fastener Systems". Contractor shall maintain and submit to the County for review and approval records of this testing.

f) Prior to shipping, all major mechanical components and machinery shall be shop tested to demonstrate proper working order. Shop testing is to include, but is not limited, to all travel assemblies and all hoist drives. Equipment will be allowed to be tested without the full reeving of drums and sheaves. All sheaves are to be moved by hand to determine proper free-movement. Rope clearances shall be inspected in the shop. Contractor shall maintain and submit to the County for review and approval records of all shop testing shall be required by the County.

7.8.6 Painting Materials Inspections

a) The Contractor’s Inspector shall verify that all paint complies with the Specifications upon receipt from the manufacturer.

7.8.7 Paint Application Inspections

a) All blasted surfaces are to be visually inspected and approved by the County prior to any coating applications.

b) Each coat of a paint system shall be visually inspected and approved by the County and paint supplier/vendor representative to verify application in accordance with the Cleaning and Coating Section.

c) Dry film thickness readings shall be taken for each coat of a paint system. These readings shall be taken every two square meters. Ten percent (10%) of all readings shall be taken on surfaces not easily accessible, such as inside stiffener angles. Records of these readings shall be required by the County. These records shall indicate the Crane number, member, type of paint, and color.

d) All painted surfaces are to be inspected prior to shipping. If any damaged coatings are found, they shall be repaired prior to shipping.

7.8.8 Electrical and Components Inspections

a) Electrical components, such as wiring, conduit, motors, transformers, and generators, shall be inspected for damage and defects upon receipt from the manufacturer.

b) Shop wiring shall be visually inspected for compliance with the electrical specifications, approved wiring diagrams, applicable codes, and proper wiring practices.

c) All motors are to be checked for proper rotation and wiring prior to shop testing. Equipment shall be subjected to applicable vibration tests and records shall be submitted to the County for review and concurrence. Lighting shall be shop tested prior to shipping for verification of proper working order.

7.9 SURFACE PREPARATION AND PAINTING

7.9.1 This Section shall govern the procedures the Contractor shall follow in surface preparation and painting of the Crane from initial component fabrication, assembly, erection and on-site installation as specified herein. The Contractor shall be responsible for all Work described in this Section.
7.9.2 General

a) All surfaces of the Crane shall be painted except machinery and electrical equipment that have been completely finished by the manufacturer or equipment supplier, wire rope, power cable, bearing surfaces, non-ferrous surfaces and other areas as may be designated and approved by the County. Mating surfaces of high-strength slip critical bolted connections shall be coated only with coatings qualified to provide the slip coefficient required by the connection design in accordance with Research Council on Structural Connections “Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints”. The Contractor shall provide supporting documentation if faying surfaces of slip critical connections are coated. Non Ferrous metals, machine surfaces and surfaces in sliding or rubbing contact will not be coated, unless otherwise specified by County.

b) Paint shall be furnished in the paint manufacturer’s original unopened and clearly identifiable containers with the expiration date (shelf life) clearly labeled. No mixing of different paints shall be permitted.

c) The paint shall be handled, mixed, thinned (only if necessary and recommended by the paint manufacturer), and applied in accordance with the paint manufacturer’s recommendations. All painting shall conform to the Steel Structures Painting Council (SSPC) and National Association of Corrosion Engineers (NACE) Specifications and to the applicable portions of these Specifications.

d) The paint manufacturer shall maintain a full time SSPC/NACE certified technician at the coating facility to assure the material surfaces to be primed and/or paint is prepared correctly for the coating and the coating is applied correctly in a timely manner as required herein these specifications. The paint manufacturer shall provide the County a separate warranty certificate upon Final Acceptance of the Cranes.

e) After fabrication, all structural steel and unfinished surfaces of castings and forgings shall be thoroughly cleaned and painted. Shop painting shall consist of surface preparation and the application of the primer coats.

7.9.3 Surface Preparation

a) All Crane material surfaces must be properly cleaned in accordance with these requirements or the material, part or component will be rejected. No Exceptions.

b) Prior to steel plate cutting, machining and/or fabricating, all material surfaces shall be blasted and cleaned by sand and/or grit blasting to SSPC-SP5/NACE No. 1 White Metal Blast Cleaning standard.

c) All materials surfaces will have ¾ to 1 mil of inorganic zinc rich pre-construction weldable primer (shop primer) applied for protection during fabrication and shall not to be considered a part of the Paint System. As determined by the paint manufacturer and approved by the County, all pre-construction priming must be completed within four (4) of blast cleaning completion prior to any corrosive film building. No deterioration of the blasted surface will be acceptable.

d) All surfaces and welds, after fabrication, will be cleaned by sand and/or grit blasting to provide a clean, oil free surface for paint application as required herein these specifications to SSPC-SP5/NACE No. 1 White Metal Blast Clean condition.

e) All surfaces that are to be coated shall be cleaned as required herein these specifications to SSPC-SP5/NACE No. 1 White Metal Blast Clean condition to remove all oil, grease, dirt, dust, grit, and/or other contaminants that will impair the coating system.

f) Prior to sandblasting or centrifugal blasting, welds shall be given special attention for removal of welding flux in crevices. Welding spatter, sliver, scabs, and underlying mill scale not removed during fabrication and exposed before and during the cleaning
operation shall be removed by the best mechanical means. Exposed edges shall be rounded to assure proper adhesion and build-up of paint.

g) The primer shall be applied simultaneously after the surface preparation and cleaning is performed. The intermediate paint coat will be applied as recommended by paint manufacturer and must comply with the painting requirements as set forth by these specifications.

h) All mil thickness references are minimum dry film thickness. Testing shall be performed with a wet film gauge during application and rechecked after drying with a dry film gauge.

i) Minimum and maximum drying time shall be in accordance with manufacturer’s recommendations for all coatings.

7.9.4 Galvanizing

a) The components that are to be hot dip galvanized shall be clean of welding spatters, welding slag and grounded smooth prior to galvanizing which shall be checked by the Owner’s Quality Inspector.

b) After complete fabrication and cleaning the specific component shall be hot dipped zinc coated to not less than two ounces per square foot. All work shall comply with the requirements of the American Galvanizing Association. Galvanizing shall conform to ASTM A 123 for fabricated items and to ASTM A 153 for hardware or to equivalent Owner-approved international standards. Damaged areas shall be recoated by melting into the prepared surface a continuous film of zinc-lead alloy bar solder such as Metalloy Products Co. “Galvalloy” or County approved equivalent.

c) Damaged areas, cut, and/or welded components that are galvanized shall be repaired in strict accordance with the manufacturer’s recommendations in compliance with the regulating standards and those of the County.

d) The Contractor shall warrantee all galvanizing work for a minimum of ten (10) years.

e) Galvanized parts, to be painted, shall be degreased, washed, provided with an etched surface (by light sanding or seep blast), primed with a suitable Epoxy Primer of 2.0 mils maximum thickeners, and top coated with 2.0 mils of suitable Aliphatic Polyurethane.

7.9.5 Paint Coating Application

a) No surfaces shall be coated unless the County and paint vendor inspects the individual surfaces and approves of the cleaned condition. Surfaces coated without the approval of the County shall not be accepted and shall be re-cleaned in accordance with the County procedures herein, inspected and approved by the County prior to coating, and, coated at the Contractors expense.

b) Primer Coat: Shop applied primer coating shall not be included as part of this primer. Immediately after cleaning (maximum of six (6) hours), apply one coat of primer paint to all blasted and cleaned surfaces including all surfaces prepared for painting, 2.0 mil dry film thickness. Interior surfaces of box girders shall be painted with two (2) coats of paint; a primer coat and an intermediate coat. Total dry film thickness of both coats shall be not less than 3.5 mils. Faying surfaces shall be primed but shall not be over-coated. The paint/coating shall be allowed to dry fully before additional coats are applied; the minimum drying time shall be at least that recommended by the paint manufacturer.

c) Intermediate Coat: Shall be applied on the primed clean surfaces. The intermediate coat shall be applied as soon as possible at the crane fabrication plant as much as feasible to comply with painting requirements after the prime coat is applied. Areas with prime coat application only that are left unpainted with the Intermediate Coat for more
than the acceptable drying time shall be clean and recoated as required by paint manufacturer.

d) **Final Coats:** Shall be applied at the fabrication plant with UV protection during erection and after completion as approved by County.

e) Painting of components and joints not assembled at the crane fabrication plant may have the painting applied in the field (Port Miami) only as required herein and approved by the County.

f) Painting shall be performed by qualified and skilled paint technicians in a neat and good workmanlike manner as required herein and recommended by the paint manufacturer. Each coat of paint shall be applied uniformly without running, streaking, sagging, wrinkling, or incurring any other defects. Each coat of freshly applied paint shall present an appearance of uniform coverage, proper gloss and good masking characteristics. Each coat of paint shall be dry before the succeeding coat is applied. The paint shall be well worked into all joints, open spaces, laps, seams, bolts, nuts and edges.

g) Shop application of paint may be done by spray, brush or roller in accordance with the paint manufacturer’s explicit instructions and approved by the County.

h) Field application of paint and Touch-up may be performed upon proper cleaning as required herein by brush or roller, either on the dock or when completely erected.

i) Paint to include pre-construction/shop primer shall not be applied when the air temperature is below 40°F and relative humidity is not within the acceptable level as established by the paint manufacturer, when the air is misty, or when in the opinion of the County, conditions are otherwise unsatisfactory for the work. Paint shall not be applied upon damp, frosted or dusty surfaces. If these conditions occur, the surface(s) to be painted must be cleaned and prepared again.

j) Each coat is to be applied uniformly and completely over the entire surface. Skims, skips, sags and drips will be rejected, and will require re-preparation of the surface and repainting to the County’s satisfaction.

k) All joints, crevices, and cavities that have not become sealed in a watertight manner by the first coat of paint shall be filled with a County approved metal filler that is compatible with the paint system. A brush or spatula shall used to apply the filler before the field coat (s) are applied. Every location where filler material is to be applied shall be individually submitted to the County for review and approval.

l) A touch-up coat (or full coat, as the case may be) of primer paint shall be applied to all surfaces that do not have a full coat of the herein required primer coat. This includes such as welds, bolts, splice plates, surfaces where damaged shop paint has been removed by cleaning, and any other surfaces where low mil film thickness have been detected. This coat of primer shall have a minimum of 3.0 mils dry film thickness.

m) The Contractor shall exercise extreme care in the protection of all equipment specifically electrical to include but not limited to the following parts of the Cranes. These parts shall not be painted. If any deviation from this requirement is desired by the Contractor, the Contractor shall submit the request to the County for review and consideration:

1) Windows and light fixtures
2) Machined surfaces that rub or bear. This includes bushings, equalizer pins, screw threads, brakes, and brake drums.
3) Wire ropes.
4) Electrical equipment and accessories, including motors, generators, festoon cable, umbilical and controls.
5) Anti-friction bearings, bearing seals, reducers, chain drives and belt drives.
6) Breathers, vents and air filter.
7) Seals and Gaskets
8) Nameplates, builder’s plaque and other labels.
9) Hydraulic equipment.
10) Switches, lights, sensors, etc.

n) The above items shall be properly covered/masked or otherwise suitably protected during blasting and painting of adjacent areas. Extreme care shall be taken to guard against damage to moving parts of machinery by mill scale, brittle paint film, or other materials of a generally abrasive nature when removed from the Crane by cleaning.

o) The materials used in the coating system will be supplied by one of the listed manufacturers as approved by the County. The Contractor shall provide a ten (10) year warranty underwritten by the paint manufacturer for labor and materials. The Contractor shall submit the proposed warranty for County’s review 90 days before start of paint application. The system will be as specified herein. The finish colors shall be semi-gloss type with the paint scheme as currently used on Port Miami’s gantry cranes. See attached drawings for paint scheme specifics.

p) Representatives of the paint supplier shall be on site to qualify the Contractor’s personnel qualifications, procedures and application of the paint system. A sufficient number of the paint supplier’s properly trained representatives/inspectors shall be on site full time to monitor and inspect all application of the coating system. These inspectors shall witness and inspect all paint application Work at the Contractor and any/all subcontractor sites. No paint Work shall be performed at either the Contractor’s or the subcontractor(s)’s site(s) without the paint supplier’s inspector(s) present to confirm full compliance with the coating system application requirements. The paint supplier shall submit regular inspection reports to County stating the results of the paint application, and shall certify that all application has been performed in accordance with their requirements.

q) Use of Lead Based coatings are not acceptable and shall not be used.

r) Exterior exposed surfaces shall be painted according to the table below.

<table>
<thead>
<tr>
<th>Coat</th>
<th>Product</th>
<th>Color</th>
<th>Min Dry Film Thickness (MILS)</th>
<th>Min Dry Film Thickness (Microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weldable Shop Primer</td>
<td>Pre-Construction Primer</td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Primer Coat</td>
<td>Suitable Inorganic Zinc Primer</td>
<td>Green</td>
<td>3.0 – 4.0</td>
<td>75 - 100</td>
</tr>
<tr>
<td>Intermediate Coat</td>
<td>Suitable High Build Epoxy</td>
<td>Contrasting Color</td>
<td>4.0</td>
<td>100</td>
</tr>
<tr>
<td>Final Coat</td>
<td>Suitable Aliphatic Polyurethane</td>
<td>See Crane Color Scheme in Section 7.9.8</td>
<td>3.0 – 4.0</td>
<td>75 – 100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>11.0 – 13.0</strong></td>
<td><strong>250 - 300</strong></td>
</tr>
</tbody>
</table>

7.9.6 **Paint Supplier and System**

a) The paint shall be produced by an experienced manufacturer with prior experience in manufacturing paint of this type. The paint shall have a satisfactory service history for similar applications and the maritime industry. Lead content of paint shall not exceed levels allowed by applicable US codes and standards. The materials entering into the composition of paints shall conform to the requirements of the Steel Structures Painting
Council (SSPC) Paint and National Association of Corrosion Engineers (NACE) Specifications. The paint shall be shipped in strong, new commercial containers of not larger than five (5) gallons capacity. All containers shall be plainly marked with the name of the material, color, expiration date, quality contained therein, and the name and address of the manufacturer. Any package or container not so marked will not be accepted for use under these Specifications. The date and manufacturer’s lot number shall be stamped or stenciled on every package.

b) Paint manufacturer and paint materials shall be approved by the County prior to any primer or painting being applied.

7.9.7 Qualified Paint Manufacturers

a) The Contractor shall use one of the following industrial marine Paint Manufacturer's/Suppliers which have been Pre-Qualified by the County to supply the coating products and oversee surface and paint preparation and application.

1) Carboline
2) International Paint, LLC
3) Sherwin Williams
4) ICI Devoe Coatings
5) Jotun

b) The above Paint Manufacturers/Suppliers have been pre-qualified and shall recommend surface preparation methods, paint system, and procedures and equipment to be used by the Contractor.

7.9.8 Painting System

a) Finish coat colors and Logo details shall be as specified below and as in attachment drawings.

<table>
<thead>
<tr>
<th>RAL COLOR CARD NO.</th>
<th>COLOR NAME</th>
<th>AREA(S) TO BE PAINTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAL5018</td>
<td>Turquoise Blue (T. Blue)</td>
<td>Boom Trolley Girder, Trolley Support Structure, Trolley Motors, Reducers and Covers, Walkways appurtenances and Handrails at Trolley Motor Level.</td>
</tr>
<tr>
<td>RAL9010</td>
<td>Off White</td>
<td>Crane Structure, Pylons, Stays, Beams, Cabins, House Walls and Roof only, etc.</td>
</tr>
<tr>
<td>RAL1003</td>
<td>Signal Yellow</td>
<td>Boggies, Lower Equalizer Beams, Gantry Motors, Reducers, Shaft Covers and Appurtenances, Guard Rails and Stairs at ground level up to same level as Lower Equalizer Beams, and Head Block.</td>
</tr>
<tr>
<td>RAL7030</td>
<td>Stone Gray Anti-Slip/Sanded</td>
<td>Flat Walking surfaces on top of boom, girders, portal beam, machinery houses, cabins, etc.</td>
</tr>
<tr>
<td>RAL 5017</td>
<td>Traffic Blue</td>
<td>Shadow for ‘Port Miami’ sign on Boom Trolley Girder.</td>
</tr>
<tr>
<td>RAL 4003</td>
<td>Heather Violet</td>
<td>Exterior of Operator Cabin</td>
</tr>
</tbody>
</table>

b) One mil is equal to 0.001 inch (0.0254 mm) or 25.4 microns.
c) All walking surfaces with the exception of open grating and County approved "Diamond" plating shall have the final coat applied to be an Anti-Slip/Sanded coating, typical.

d) **Paint Warranty**

1) The Manufacturer shall warranty a minimum paint life of ten (10) years. The paint warranty for the manufacturer purchased components and accessories shall be the warranty provided as required by this contract of the individual part or component. If the Contractor paints any of the painted components, the paint coating shall be warranty the same for ten (10) years.

2) The conditions of painting system warranty are as follows:
   
i. Warranty shall cover the main structure, including walkways, handrails, stairs, etc.

   ii. Failure is defined as corrosion of substrata in excess of ASTM-D610/SSPC-VIS 2 Grade 8, 0.03% Rusted of the total crane area, or, SSPC-VIS 2 Grade 8, 0.03% Rusted of a ten (10) square meters area.

   iii. Corrosion caused by physical and mechanical abuse or damage by the owner shall be excluded from warranty. Also, deterioration caused by fire, explosion, welding or other related acts shall be excluded.

   iv. The Owner shall notify the Manufacturer, in writing, giving details and pictures of the nature of the claim immediately upon discovery and Manufacturer will give prompt attention. Repairs falling within this warranty shall be made only after consultation with the paint manufacturer, the Contractor and the County.

   v. The warranty repairs and painting shall follow and be performed in accordance with the herein enumerated procedures and required standards.

   vi. All warranty work shall cover all costs and include all materials, equipment, labor, travel and lodging required by the Contractor to perform all the warranty repairs and work.

   vii. Repairs and painting performed under this Manufacturer’s warranty shall have the same warranty requirements upon completion of repairs and the painting.

e) Consumable parts which have a normal life expectancy of less than the warranty period shall not normally be the subject of a warranty claim.

**7.9.9 Touch Up and Repairs**

a) The Contractor shall touch-up all scratches and/or marred areas after the erection of the Crane and installation of components. The damaged and repaired areas shall be cleaned to SSPC –SP5/NACE 1 as required to “White Metal” finish, overlapping slightly onto the intact coating, creating an anchor pattern that will lend itself to the proper adhesion of the new application of the coatings. If blast cleaning is used, it shall be used with extreme caution to avoid damaging the existing surface coating and installed equipment which shall be protected (properly covered) so that no component is damaged from the blast medium.

b) The Contractor shall properly blast, power brush, grind and polish the damaged metals surfaces (repaired areas) to "White Metal" and clean with an SSPC and County approved solvent cleaner prior to applying the primer coat. The County shall approve and accept each of the “touch-up” painting areas.
c) Touch up areas shall have a full paint system as specified and required herein to match original finish.

d) Any damage to the finish coat subsequent to application shall be touched up prior to loading of Crane on to transportation vessel and prior to Final Acceptance.

e) A minimum of 5 gallons per Crane of each color and type of paint used shall be furnished to the County upon Final Acceptance.

f) During the progress of the work, the Contractor shall provide the County the means of ready access to all parts of the work such as scaffold, ladders or any required aids to facilitate the work of inspection. Safe Access to the repair areas shall be provided in accordance with OSHA requirements.

g) The specified dry film thickness of each coat of each kind of paint shall be checked by the County using film thickness gauges of the Nordson or other types. Any damage caused by the tests shall be repaired by the contractor at the contractor’s expense.

h) The representative of the paint manufacturer shall be allowed access to the site(s) at any time to inspect and/or consult with the painting personnel or sub-contractor in order to insure that the paint is being properly applied. Safe Access to the repair areas shall be provided in accordance with OSHA requirements.

i) The Contractor shall perform Touch-up Painting work of an area or on an item and complete all including cleaning, primer application during the same day: abrasive blast, power tool brush, grind, polish, solvent cleaned and paint. No area or item shall be cleaned and left unprotected overnight. If so, the complete process must be performed from the beginning (clean to “white” finish) and completed the same day without the area being affected by weather. The only time delay acceptable is for the minimum time permitted by paint supplier, for the specific paint coat to dry.

j) Touch up of scratches and/or marred areas and repairs shall be performed as soon as practical in accordance with the requirements above and prior to Final Acceptance. A reputable paint contractor shall be chosen prior to substantial completion if the Contractor does not have qualified painting personnel at site.

7.9.10 County Inspection

a) All work is subject to inspection by County or Representative at any time.

b) The Contractor shall submit for County review, the individual Product Data Sheets for each product used to confirm correct application, dry film thickness, thinning, mixing, handling and cleaning instructions.

c) The Contractor is required to provide County access to equipment necessary for inspection (i.e. elevated work platforms, staging, climbers and etc.), including final inspection.

d) If County or Representative becomes aware of work being performed in conflict with the requirements of this specification, the County reserves the right to order all work to be stopped. The Contractor will be allowed to resume work only after existing deficiencies have been corrected to the satisfaction of the County.

e) Any work found to be deficient, damaged or otherwise unacceptable shall be repaired in accordance with the paint manufacturer’s written recommendations at Contractor’s expense.

f) The Contractor is required to observe inspection hold points to allow County or its Representative adequate time for inspection prior to continuation of cleaning and/or painting operations.
g) Inspection hold points shall be as follows; however, all cases shall be agreed upon at a pre-Work conference or prior to the beginning of any Work specified herein:
   1) Completion of surface preparation prior to prime coat application.
   2) Completion of prime coat application prior to intermediate coat application.
   3) Completion of intermediate coat application prior to finish coat application.
   4) Completion of finish coat application prior to repair of defects and prior to final acceptance of work by the County.

h) The County or its Representative will make every attempt to minimize damage to newly painted areas during inspection activities, but any damage caused shall be repaired by the Contractor in accordance with these Specifications.

i) Inspection and/or acceptance of Contractor's work by County and/or its Representative in no way releases Contractor from any terms and conditions of the Contract Agreement.

j) All dry film thickness (dft) measurements shall be made in accordance with Steel Structures Painting Council SSPC-PA2.

k) The Contractor shall submit for the County’s review the individual Product Data Sheets for each product used to confirm correct application, dry film thickness, thinning, mixing, handling and cleaning instructions.

7.10 COMMISSIONING AND PERFORMANCE TESTS

7.10.1 The Contractor shall perform commissioning, testing and certification of all the equipment, component and certification as reasonably possible, of the Crane(s), at its manufacturing facility(s) prior to loading on the transportation vessel. Prior to commissioning and testing, all systems must be completely installed, started, made operational and completely functional.

7.10.2 The Contractor shall prepare the formal Test and Check-out Procedures Manual for all required tests and submit the manual to the County for approval, ninety (90) days prior to the first scheduled tests. These test procedures results will prove the compliance of the Crane to the technical requirements and these Specifications herein enumerated. The Contractor shall successfully complete all performance tests as reasonably possible and provide the test reports to the County for review, acceptance and concurrence.

7.10.3 The Cranes will NOT be accepted until all tests are properly documented and accepted by the County.

7.10.4 The Contractor shall coordinate and schedule the inspection to determine and document all deficiencies on the Project’s Deficiencies Punch List. All deficiencies on this Punch List shall be repaired in compliance with the Specifications prior to loading of the Cranes on to the transportation vessel.

7.10.5 Upon successful completion of the Crane erection, installation and start-up, the County will conduct inspections to document all deficiencies. This inspection will identify remaining Work, non-compliance, missing parts and defects. The Contractor’s Inspector(s) will accompany the County during this inspection.

7.10.6 A Punch List will be compiled by the County indicating items found during the inspection. This list will be distributed to the County, its representatives and the Contractor. Acceptance will not be considered until all items noted in the Punch List have been supplied or corrected to the County’s satisfaction. The Contractor’s Inspector shall verify correction of all Punch List items before requesting the County for a subsequent inspection.
7.10.7 Painting and Touch-up Painting

a) Any areas requiring painting (touch-up) shall be cleaned, coated and painted in accordance with SSPC requirements and those of Section 7.8. No deviation shall be accepted. It is a requirement of these Specifications to properly grind, solvent cleaned and polish the metals surfaces (repaired areas) to “White Metal” and clean with a County approved solvent cleaner prior to applying the primer coat. The County shall inspect to approve and accept all “touch-up” painting.

b) After the application of any touch-up coat, an inspection of this coating shall be conducted. Total dry film thicknesses shall be taken and recorded as specified in this Section. Thicknesses are to comply with those specified in the coating Section of this Specification. Records of the readings shall be submitted to the County for review and concurrence.

7.10.8 Safety Test

a) The Contractor shall operate the Crane without load in each mode at full rated speeds to establish integrity of all limit switches, back up limit switches, interlocks lights, and controls to the satisfaction to the County.

7.10.9 As-Built Testing and Verification

a) The Contractor shall verify that the Crane as-built wheel loads comply with the specified maximum dock/rail loads prior to final load certification. This shall be accomplished by jacking all wheels (together) on the waterside corners until they are clear of the rails and determining the wheel loads by means of load cells or calibrated hydraulic pressure gages on the jacking system. This procedure will be repeated for the landside wheels, jacking all wheels together. The Contractor shall submit a written test procedure for the County’s review and concurrence at least six weeks prior to testing and a written report of the results.

b) If the results of this testing reveal that the as-built condition of the Crane do not comply with the specified structural, mechanical or electrical standards as set forth by these Specifications, or if the maximum dock/rail loadings are exceeded, it shall be the responsibility of the Contractor to make any necessary changes to the Crane to bring it back into compliance. Any proposed corrective action must be approved in writing by the County prior to implementation.

7.10.10 Speed and Power Test

a) The Contractor shall complete the following operations and record the measurements of voltage, amperage of the drive motors, and the operational speeds of the functions during these operations.

1) Raise and lower the boom at normal speed. Operate all boom latches and check the operation of all limit switches.

2) With an empty telescoping spreader, run all motions at full speeds to the limits of their travel. Slowdown and end limit switches are to be checked by running each motion at full speed into its extremes of travel, depending solely on the limit switches to slow and stop that particular motion.

3) In accordance with US OSHA requirements, perform certification load tests as required for the rated capacities of the Crane. Perform any other proof or overload tests as required by applicable local codes and regulations for rated capacities.

4) With loads of fifty (50) and sixty-five (65) long tons under the spreader, repeat operation (2) above at full speed and measure the acceleration forces for the most severe conditions.
7.10.11 Cycle Time Test

a) The Crane shall hoist a certified weight of 50 long tons simulating as closely as possible the theoretical duty cycle as defined in Section 2.7. Duration of this test shall be no less than one (1) hour. Should downtime occur during this test, the test will be repeated until the one (1) hour duration is completed successfully without downtime.

7.10.12 65LT Thermal Capacity Test

a) The Crane shall hoist a certified weight of 65 long tons simulating as closely as possible the theoretical duty cycle as defined in Section 2.7. Duration of this test shall be no less than four (4) hours. Should downtime occur during this test, the test will be repeated until the four (4) hours duration is completed successfully without downtime.

7.10.13 Endurance Test

a) The Crane shall be operated through cycles of placing and removing fully loaded containers. The Crane shall be demonstrated to be able to hoist, lower, hold in any position, and transport the container at rated speed and accelerations. With a fifty (50) long ton test load, position and lower telescoping spreader to container position on dock, lock spreader to container, hoist approximately ten (10) meters, travel trolley to position over a barge (may be substituted or waived), lower load to barge and unlock. Lift empty spreader to clear container, lower to container, lock and carry load back to dock. Unlock and lift empty spreader to clear container. This cycle is to be repeated continuously for twelve (12) hours, the last eight (8) hours of which are to be trouble free. The Contractor shall correct all malfunctions that develop and these corrections shall be made to the satisfaction of the County and without affecting the guarantee.

b) The testing and adjustments specified shall be made by the Contractor in accordance with this Specification.

c) During the full load and overload testing, measurements are to be taken of speed, voltage and amperage at the drive motors as follows: (A report of these readings shall be furnished to the County.)

1) Main Hoist Motor
   i. Raise spreader only.
   ii. Lower spreader only.
   iii. Raise at 100% load.
   iv. Lower at 100% load.
   v. Raise at overload.
   vi. Lower at overload.

2) Main Trolley Motor(s)
   i. Travel inboard-spreaders only.
   ii. Travel outboard-spreaders only.
   iii. Travel inboard at 100% load.
   iv. Travel outboard at 100% load.
   v. Travel inboard at overload.
   vi. Travel outboard at overload.

3) Gantry Motors
   i. Travel right-spreaders only.
   ii. Travel left-spreaders only.
   iii. Travel right at 100% load.
   iv. Travel left with 100% load.
   v. Travel right with overload.
   vi. Travel left with overload.
4) Boom Motor(s)
   i. Raise boom.
   ii. Lower boom.

d) Wind velocity and direction of the wind, as well as the mean temperature, shall be taken and recorded at the time of test.

e) In addition, strip charts of master switch reference, motor current, motor voltage, motor torque and speed shall be made with a chart recorder supplied by the Contractor. The readings and chart recordings shall be submitted to the County in a clear and easy to comprehend format prior to acceptance of the Crane.

f) During the endurance test, a chart recording of motor current, motor voltage, and motor speed at a chart speed of 5mm/second for one complete cycle shall be made for the main hoist and another for the trolley motor. The portion of the cycle shall be logged on the chart recording.

g) Note: For all tests, the Contractor will provide all necessary test loads including test container, barge, and test loads. The Contractor shall also furnish test load frames, operators, and labor required for the tests.

7.10.14 Electrical Systems Operational Test

a) Prior to the Acceptance/Performance Test, the following systems or equipment shall be tested and reported as herein specified.
   
   1) Verify that the taps on all transformers are set to deliver voltage indicated in the Contract Documents with the system in full operation. This test shall be conducted with a calibrated voltmeter.

   2) Each grounding point shall be tested after all connection to ground points are made but before grounding conductor connection is made to the frame. Ground point installations shall be tested by "fall of potential" measuring method using ground resistance test meter.

   3) All electrical systems shall be tested for compliance with the Specifications. The Contractor shall provide personnel and equipment required to assist the County or its representative in conducting the tests.

   4) Equipment covers such as panel boards, trims, motor control covers, device plates and junction box covers shall be removed for inspection of internal wiring. All circuits throughout the project shall be energized and tested for operation and equipment connections tested for in compliance with Contract Documents.

   5) Additional Acceptance Tests
      
      i. **Illumination Tests:** Illumination readings shall be taken and recorded in the work areas specified in the Lighting Section. These readings shall be taken with all machinery in operation and during the night time hours.

      ii. **Climate Control Tests:** All climate controls shall be demonstrated to verify proper operation. Temperature in climatically controlled spaces shall be measured and recorded.

      iii. **Vibration tests:** All mechanical and electrical rotating and moving structures and components shall be tested and shall comply with the vibration standards herein. All test results shall be documented and submitted to the County for review. Special emphasis shall be place on
the vibration testing of the MH, TH and BH electric motors and mechanical drives.

7.10.15 Functional Tests

a) The following equipment shall be tested to demonstrate proper operation.

1) Maintenance Lockouts
2) Communication Equipment
3) Signals, alarms, and bypasses
4) Gantry Stowage Pins, Tie Downs and other Stowing Devices
5) Boom Latching System
6) Manlift (personnel elevator)
7) Interface of Gantry Bumpers with other Cranes and Dock Bumper
8) Safety systems (anti-collision, overload, etc.) and bypasses

7.10.16 Crane Weight - Corner Load Requirement

a) The completed Crane shall be weighed at the Contractor’s manufacturing facility prior to loading of the Crane on to the transportation vessel and the center of gravity of the Crane shall be established with the boom in the up and down position. As verification of contractor wheel load and stability calculations, the Contractor shall also measure, at manufacturing facility the wheel loads at all four (4) corners for each of the following conditions:

1) With boom stowed and trolley in normal stowed park position.
2) With boom stowed/raised with empty trolley at maximum operating outreach.
3) With boom stowed/raised with empty trolley at park position between land side and water side rails.
4) With boom stowed/raised with empty trolley at maximum operating back reach.
5) With boom in the normal lowered operating position and with empty trolley at maximum operating outreach.
6) With boom in the normal lowered operating position and with empty trolley at park position between land side and water side rails.
7) With boom in the normal lowered operating position and with empty trolley at maximum operating back reach.

b) At completion of Crane weight measurements at the Contractors manufacturing facility, an “As Built” set of wheel load calculations shall be submitted for the County’s review based on Crane weights and center of gravity determined by the wheel load measurements. The “As Built” wheel loads based on measured weights and center of gravity shall not exceed the wheel load allowable of Section 2.6.3. The Contractor shall provide a detailed analysis to the County to explain any differences between the calculated wheel loads and weighed wheel loads when the difference is greater than 3%.

c) The complete weight of Main Trolley with Operator’s Cabin and all equipment required for normal operation shall be determined by measurements before installing the Trolley on the Trolley rails.

7.10.17 Boom Tip, Trolley Rail and Gantry Gage Measurements

a) Boom tip elevation and levelness measurements shall be made prior to shipment.

b) Rail trolley gage and trolley rail alignment measurements shall be verified prior to shipment.

c) Gantry wheel gage (of trucks) and alignment shall be verified prior to shipment.
d) The Contractor shall establish the method of measuring the deflections under “No Load” and “Rated Load” conditions and shall submit the method to County for review during the design review of the Cranes.

7.10.18 Crane Structure, Boom and Girder Deflection and Torsion

a) The Contractor shall establish the method of measuring the deflections under “No Load” and “Rated Load” conditions as required in Section 3.4 (Structural Deflection, Torsion and Stiffness) and shall submit the method to County for review during the design review of the Cranes. The actual results of the test performed at the manufactures facility during commissioning shall be submitted to the County for review.

b) The Contractor shall establish the method of measuring the natural frequency under the conditions required in Section 3.4 (Structural Deflection, Torsion and Stiffness) and shall submit the method to County for review during the design review of the Cranes. The actual results of the test performed at the manufactures facility during commissioning shall be submitted to the County for review.

7.10.19 Elevator Function Testing and Certification

a) The Contractor shall perform commissioning and testing of crane elevators as required by the manufacturer and the County at the Contractors Crane Fabrication site and shall be fully operational upon delivery of cranes to Port Miami.

b) All elevators shall be fully operational and pass inspections to obtain required certifications from the County. Miami-Dade County’s Elevator Inspector or its designee will perform these inspections and issue elevator certifications, which shall be posted on all cabins prior to Substantial Completion, as required by code.
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SECTION 8

SHIPPING AND DELIVERY
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SECTION 8 - SHIPPING AND DELIVERY

8.1 GENERAL

8.1.1 The Crane shall be fully fabricated, assembled and all components made operational at the Contractor’s Manufacturing Facility. This work may be performed at separate Fabrication Sites as selected by the Contractor and approved of by the County.

8.1.2 The Contractor shall obtain all necessary permits required to unload, install and test the Cranes. Unless otherwise agreed to by the County, the Contractor shall also obtain all contract laborers, stevedores, security guard services, fire watches, telephone, utilities, and all supplies needed for the unloading, installation, testing, certification and delivery of the Cranes.

8.1.3 All coordination with the shipping agent and US Customs clearances as well as all contracts with all the required sub-contractors, sub-consultants, stevedores and testing laboratory must be executed and submitted to the County’s contract representative for review and approval prior to delivery ship departure from the fabrication site. No ship dockage will be permitted without conformance with this requirement.

8.1.4 The Contractor shall provide, a full time, qualified Shipping Engineer approved by the County who shall insure that the loading on to ship, transportation, off load and installation of the Cranes is performed in accordance with manufacturer’s recommendations and the requirements of these Specifications.

8.1.5 A qualified start-up Commissioning Engineer from the Contractor or control system manufacturer and the Contractor's engineer(s) as approved of by the County, shall be provided at the delivery site during delivery, installation, re-commissioning, acceptance testing, certification and initial crane (commercial) service to assure that all Crane systems to include the control system is set up and adjusted in accordance with the manufacturer's requirements and these specifications for optimum performance.

8.2 CONTRACTOR SUBMITTALS

8.2.1 Sixty (60) days prior to shipment, the Contractor shall submit for the County’s review, the preliminary shipping and delivery schedule, plans and calculations for loading the Cranes on the vessel, securing the Cranes on the vessel, and off-loading the Cranes at Port Miami. The Contractor’s Shipping Engineer shall prepare, review, and sign all calculations for shipping and erection. The loading, securing and shipping plan shall be submitted and approved by the County prior to loading of the Cranes on to the transportation vessel.

8.2.2 Prior to vessel departure from the fabrication site, the Contractor must submit to the County for concurrence the contracts with all US vendors that will be contracted for all work performed under this Contract at Port Miami.

8.2.3 Should the Contractor decide to partially disassemble the commissioned Crane(s) to be loaded and transported, the Contractor shall submit all disassembly plans, procedures, packaging, loading, stowage plans, securing and shipping plans for review and approval by the County.

8.3 LOADING AND SHIPPING

8.3.1 The Contractor shall not load a fully erected Crane onto the transportation vessel until the loading, securing and shipping plans have been submitted and approved by the County.

8.3.2 The Contractor shall load the fully erected or partially disassembled Crane(s) onto the transportation vessel at Contractor’s Manufacturing Facility, stow the Crane and/or components on the vessel, restrain and secure to the vessel, and, transport the Crane(s) to Port Miami Lummus Island gantry wharf, the Delivery Site. The Crane(s) shall be secured on the vessel to prevent any undue stresses that would affect the Cranes and its expected life.
The allowable stresses in the Crane(s) and sea fastening under maximum wind and wave conditions during the sea voyage shall not exceed those allowed by FEM 1.001, 3rd Edition, revised 1998.10.01 for load Case II (Working with Wind). Other recognized International Shipping Standards for Sea Transportation, such as DNV, may be used as approved by the County.

8.3.3 All mechanical and electrical equipment shall be properly packaged, covered, water sealed/proof and secured to prevent damage from movement, rain, rogue waves, moisture, etc. Component and motor heaters shall be installed as required and shall be powered along with those on the Crane during the entire time on the vessel and voyage.

8.4 PRE-SHIPMENT CERTIFICATE

8.4.1 The Crane shall not be removed and transported from the Manufacturing Facility until the Contractor has completed all possible and commissioning work and functional/acceptance testing as required by these Specifications. The Contractor shall provide the required transportation insurance certificates to the County prior to loading of the Crane onto the vessel.

8.5 DELIVERY AND UNLOADING

8.5.1 The Contractor shall be responsible for the transportation of the Crane from the Manufacturing Facility to the Delivery Site at Port Miami. The Contractor is directly responsible for all coordination and access approvals for entrance of the transportation vessel into US waters and Port Miami harbor. The Contractor transportation vessel access to the Port shall be coordinated with the Project Manager, Port’s Berthing office, Biscayne Bay Pilots and all appropriate organizations to include USCG and USCBP.

8.5.2 Upon the County’s receipt of the Contractor’s submittals for the on Port Miami onsite subcontractor(s), ship arrival and offloading timelines, procedures and calculations, a pre-delivery meeting shall be held at Port Miami with the Contractor’s shipping, offloading and site management personnel along with the prime subcontractor to discuss all crane delivery and commissioning matters. This meeting shall be held at least one (1) month prior to the scheduled arrival of the vessel/ship to Port Miami, preferably prior to departure of the vessel from the fabrication site.

8.5.3 The transportation vessel shall berth as instructed by the Port’s Berthing office and the unloading work shall be performed so as to not impede the Port’s ongoing vessel unloading and loading operations and any other ongoing stevedoring operations or Port work. The Port’s operation shall take first priority. The County shall not be responsible for any damages and delays to the Contractor or shipper.

8.5.4 The Contractor and/or its prime subcontractor shall hire a Port Miami licensed stevedore to assist with the unloading and loading of the delivery vessel as required by the local collective bargaining agreement.

8.5.5 For fully erected Cranes on a single ship the Contractor shall be allotted a maximum of ten (10) calendar days of continuous berth usage for the delivery ship at Port Miami Lummus Island Container Terminal gantry berth for the delivery and unloading of Crane(s) on to the Delivery Site on the gantry wharf.

8.5.6 For dis-assembled Cranes individually delivered (three (3) Cranes, three (3) shipments) the Contractor shall be allotted a maximum of fifteen (15) calendar days (five (5) calendar days per shipment) of berth usage for the delivery ship at Port Miami Lummus Island Container Terminal gantry berth for the delivery and unloading of Crane(s) on to the Delivery Site on the gantry wharf and to transport to the Staging Area.

8.5.7 The delivery wharf area shall consist of an area of approximately 100 meters (328 feet) long/parallel to the rails x 42 meters (138 feet) deep/perpendicular from the waterside face of
the concrete sea wall/bulkhead to the landside of the landside gantry rails. Any additional unloading time required and space required shall be requested by the Contractor and approved by the Port Engineer prior to ship arrival.

8.5.8 The Contractor shall unload the Cranes’ and/or components on to the wharf area, the Delivery Site, designated by the County by roll-off or other approved methods. A fully erected and commissioned Crane shall be placed on the gantry rails. A partially disassembled commissioned crane shall be placed in the Crane Staging Area. All of the Crane’s components and materials shall be unloaded, transported by the Contractor and placed in the pre-determined Crane Staging Area which is to be used for Onsite Re-erection and Re-assembly.

8.5.9 The Unloading Plan and Dock Loadings shall be submitted to the County for approval at least sixty (60) days prior to shipment. No Crane unloading Work shall be performed until the Unloading Plan and Dock Loadings is submitted, reviewed and approved by the County.

8.5.10 There shall be no field erection or re-assembly at the Delivery Site (the wharf area). Re-erection and re-assemblies shall be performed in the Crane Staging Area. Only limited final commissioning and certification as approved by the County shall be performed on the wharf’s gantry rails. This consists of placing the fully erected, assembled and commissioned Cranes on the gantry rails, removing all necessary bracing, etc., used for the shipment, making necessary repairs and adjustments for operations, limited commissioning, final testing and certification.

8.5.11 On-the-wharf time is of the essence as it is needed for container ship operations. For shipment of fully erected, all three (3) Cranes shall be ready for hand over for commercial service within sixty three (63) calendars days after the delivery vessel berths at Port of Miami wharf 5; i.e., period of interference with normal vessel operations shall not exceed sixty three (63) calendar days in total for delivery, commissioning, certification and hand-over of all three (3) Cranes. Penalties (Liquidated Damages) will be assessed for exceeding the permissible number of calendar days.

8.5.12 Except for County approved re-assemblies, repair of damage items such as anchoring points, field welding and painting will not be allowed. Prior to repair of damage to any of the components and structural members of the Cranes, the Contractor shall submit his methods of repair for review by the County. These repairs may be performed after the Crane has been accepted for commercial service (Substantial Completion).

8.5.13 The vessel shall remain in Port for the time required herein as approved by the County to enable it to unload the Crane(s) but no longer than ten (10) calendar days. The vessel shall depart the Port as required by regulating authorities.

8.6 ONSITE RE-ERECTION AND REASSEMBLY

8.6.1 For onsite re-erection and reassembly, on-the-wharf time is of the essence as it is needed for container ship operations. Unloading of all three (3) Cranes, components and required materials from the transportation vessels for onsite re-erection and reassembly shall be performed as quickly as possible so the delivery ship has the shortest stay at Port Miami and leaves the berth as soon as possible so that Port Miami customer’s container vessels are able to berth and unload/load their cargo.

8.6.2 The Contractor shall be provided with a Crane Staging Area to store, laydown, re-erect, reassemble, re-install, commission and make operational the Cranes at Port Miami. The Crane Staging Area to be provided by Port Miami shall be adjacent too or near the wharf Delivery Site where the Cranes will be placed into commercial service. The Staging Area shall be no greater in size than 100 meters (328 feet) x 110 meters (361 feet).

8.6.3 The Crane Staging Area provided is the responsibility of the Contractor to maintain its security, cleanliness and accountability. The Contractor shall have use of the Staging Area for no longer than one-hundred twenty (120) calendar days for each Crane unless specifically approved by the County.
8.6.4 Should the Contractor deliver the Cranes in the form requiring re-erection and reassembly, after unloading of Cranes and ship departure, the Contractor will only be permitted to use the Staging Area for the Work to make the cranes operational prior to placing the Cranes on the gantry rails.

8.6.5 Should the Contractor chose the option to deliver the Cranes to Port Miami disassembled and reassemble them in the Staging Area in lieu of shipment fully erected, the Contractor will be responsible for providing all labor, materials, tools, equipment, services, engineering, temporary power, and other miscellaneous costs associated with offloading the disassembled cranes at Port Miami wharf, transporting the disassembled cranes from the offloading site on the wharf to the staging area, reassembly of the cranes in the staging area, completion of all necessary commissioning and acceptance testing, transport of the reassembled cranes from the staging area to the final delivery site on the wharf, certification, delivery, and handing the Cranes over in place at Port Miami ready for commercial service.

8.6.6 The crane staging area is an existing area at Port Miami. Permissible ground bearing pressure (for temporary foundations, erection cranes, transport equipment, etc.) in the staging area and on the path to move assembled cranes to the final delivery site on the wharf is 1,000 pounds per square foot. The Contractor shall provide drawings and calculations showing compliance with permissible ground bearing pressures in all affected areas.

8.6.7 The Contractor will be responsible for all devices/features (temporary tie downs, stowage pins, etc.) required in the staging area to secure the Crane(s) against high winds including stowed/hurricane winds.

8.6.8 The Contractor shall be provided with a suitable path from the wharf Delivery area across the road behind the wharf to the Crane Staging Area to allow transportation of all Cranes, parts, components and materials to Staging Area.

8.6.9 The finalized Onsite Re-erection and Reassembly Plan and Procedures with schedule shall be submitted to the County for approval at least sixty (60) days prior to the Crane's shipment from Contractor facility. No Crane unloading Work shall be performed until this plan is submitted, reviewed and approved by the County. The initial Onsite Re-erection and Reassembly Plan and Procedures with schedule shall be submitted with initial Base Proposal to the County during the RFP phase of County procurement.

8.6.10 The Staging Area shall have an air conditioned office with access to restrooms and electrical power to include power required by contractor for commissioning of the Cranes. Wifi Hotspot will be provided for internet access. Storage containers that can be locked shall be provided to the Contractor as needed. However, the Contractor shall submit request for the required container and items along with the Onsite Re-erection and Reassembly Plan and Procedures at least sixty (60) days prior to the Crane's shipment from Contractor facility.

8.6.11 The County shall not be responsible for providing any additional areas, services, utilities or modifications to any County facility or structure unless stated herein and agreed too. It is the responsibility of the Contractor to repair any damages created as a result of any Work under any Contract issued by the County.

8.7 **FINAL INSTALLATION, COMMISSIONING AND TESTING**

8.7.1 Initial start-up, commissioning and testing shall be accomplished at the Contractor's Manufacturing/Erection Site to minimize the amount of time required at Port Miami for reassembly, commissioning and testing.

8.7.2 Prior to commencing the final commissioning and functional/acceptance testing at Port Miami, the Crane(s) shall be inspected for deficiencies which shall be listed in a 'Punch List' and shall be lubricated in accordance with the lubrication charts. The Contractor's field engineers shall inspect and certify that all areas, including bearings and motors, are properly lubricated and that the Crane is ready for startup and testing.
8.7.3 The County shall provide the necessary electrical power and test weight required by the Contractor for the final commissioning, testing and certification of the Cranes at Port Miami.

8.7.4 The Contractor shall have qualified field project engineer along with the drives vendor electrical startup field engineer at the job site at all times, when the work is in progress. The field engineer shall ensure that all field work is in accordance with the approved designs and that all tests are in compliance with the approved procedures and the original equipment manufacturer's recommendations. The Contractor's field project engineer and the electrical vendor electrical startup field engineer shall be fluent in the English language; verbal and written. They shall have demonstrated their qualifications by each successfully completing five (5) similar crane projects within the past five (5) years.

8.7.5 The Contractor shall make the necessary final installations, repairs, adjustments and calibrations prior to commencement of the Cranes' final start-up and commissioning, including verification of proper operation of all safety devices and interlocks.

8.7.6 For fully erected Crane(s), the Contractor shall perform and successfully complete any remaining and required commissioning, testing and certification of all the equipment, component and certification in accordance with these specifications to include Section 7.10. Prior to final commissioning and testing, all systems must be complete and functional. The Contractor shall use the same previously approved and used Test and Check-out Procedures manual as used at the Manufacturing Facility. An eight (8) hour, trouble free endurance test shall be performed prior to handing over the Crane to the County for commercial service (Substantial Completion). Upon completion of tests the Contractor shall provide the test results reports to the County for review and concurrence.

8.7.7 For onsite re-erection and reassembly, all commissioning and testing required at the manufacturing facility for the fully erected shipment option shall be performed at the Crane Staging Area as described in Section 7.10. Final testing and commissioning shall then be completed after moving from the Crane Staging area to the delivery area on the wharf. The Contractor shall use the same previously approved and used Test and Check-out Procedures manual used at the Manufacturing Facility. The Contractor shall successfully complete remaining final tests and commissioning at the final delivery area on the wharf. An eight (8) hour, trouble free endurance test shall be performed on the wharf. Upon completion of tests the Contractor shall provide the test results reports to the County for review and concurrence.

8.7.8 Any testing related to safety performed at the Manufacturing Facility or at the Crane Staging area shall be repeated at the final delivery site on the wharf.

8.7.9 Each Crane shall be readied for handover for commercial service (Substantial Completion) within twenty one (21) calendar days after relocation from the Staging Area to the delivery area on the wharf; i.e. period of interference with normal vessel operations shall not exceed twenty one (21) calendar days for the delivery of each Crane and sixty three (63) calendar days in total for all three (3) Cranes. No extended period of time obstructing cargo operations is permitted. The Contractor shall take the necessary actions and procedures to minimize non-utilization of the gantry wharves. Penalties (Liquidated Damages) will be assessed for exceeding the permissible number of calendar days for handover after moving the Cranes from the staging area to the wharf.

8.8 **FINAL INSPECTION AND PUNCH LIST**

8.8.1 Upon successful completion of the operational tests, an inspection shall be conducted by the County. This inspection shall identify remaining work, missing parts and defects which shall be document on a 'punch list’. The Contractor's Inspector is to accompany the County representatives and engineers during this inspection.

8.8.2 The Contractor shall coordinate and schedule a final inspection to determine and document all deficiencies on the Project’s Deficiencies Punch List. All deficiencies on this Punch List shall be repaired in compliance with the Specifications prior to Final Acceptance.
8.8.3 A punch list will be compiled by the County indicating items found during the inspection. This list will be distributed to both the County and the Contractor. Final acceptance will not be considered until all items noted in the punch list have been supplied or corrected to the County’s satisfaction. The Contractor’s Inspector shall verify correction of all punch list items before requesting the County for a subsequent inspection.

8.8.4 **Structural**

Upon delivery of the Cranes to Port Miami, the structure and machinery shall be inspected for any damage incurred during shipping. These inspections shall be conducted in the presence of the County. Contractor shall maintain and submit to the County for review and approval reports of these inspections.

8.8.5 **Electrical**

All electrical equipment and wiring is to be inspected prior to the start of the operational tests.

8.8.6 **Painting**

a) Any areas requiring painting (touch-up) shall be coated and painted in accordance with SSPC requirements herein established. No deviation shall be accepted. Proper grinding and polishing of metals to “White Metal” and cleaning with solvent prior to applying the primer coat is a requirement of these Specifications. The County shall approve and accept all “touch-up” painting.

b) After the application of any touch-up coat, an inspection of this coating shall be conducted by the County. Total dry film thicknesses shall be taken and recorded as specified in this Section. Thicknesses are to comply with those specified in the coating Section of this Specification. Contractor shall maintain and submit to the County for review and approval records of the readings.

8.9 **CERTIFICATIONS**

8.9.1 The Contractor shall perform all actions necessary to obtain the certifications required by the Regulatory organizations in order to place the Crane and crane elevators in service as required herein.

8.9.2 The Crane shall be certified in accordance with regulations of the local governing agencies and OSHA. It shall be the responsibility of the Contractor to have this certification made by the accredited individual or organization that is currently utilized by Port Miami for certification of Port Miami’s existing STS cranes. Testing and certification vendors from outside Miami Dade County shall not be considered and used for Port Miami onsite final certifications.

8.9.3 The tests and inspection made by the accredited individual or organization shall be combined with the above acceptance tests. The Contractor shall furnish to the accredited individual or organization a copy of the test procedure at least two (2) weeks prior to the tests.

8.9.4 The Cranes’ elevator certification will comply with County and State of Florida requirements.

8.9.5 The Contractor shall furnish the County with a copy of the certificate on the wire ropes, compressed air tank or air compressor.

8.9.6 The Contractor must provide material certifications for all structural, mechanical and electrical components as applicable, to the County for review and concurrence. The certifications shall be provided to the County prior to acceptance of the part and/or component as specified in but not limited to Section.
8.10 **ACCEPTANCE PROCEDURES**

8.10.1 Before Substantial Completion (Commercial Service) is made as stipulated in the contract, the Contractor shall complete all contract work, all County inspections, all testing and certification of the cranes as specified, the Crane(s) are operational and the Punch List Items have been agreed and documented between the Contractor and the County.

8.10.2 Before final payment is made as stipulated in the Contract, the Contractor shall repair any malfunctioning equipment, replace any defective parts or components, make good on any defects, flaws, and deficiencies revealed and/or noted in the Punch List by the inspection and tests, and demonstrate the acceptability of all repaired or replaced equipment under new tests.

8.11 **CLEAN UP AND FINAL ACCEPTANCE**

8.11.1 The Contractor shall repair any damage occurring as a result of the shipping and delivery activities of the Crane and related equipment. This includes damage to fender systems, curbs, dock surface, pavement, and utilities. All debris resulting from his activities shall be removed and disposed of off-site. All wrapping and shipping material shall be removed from the Crane, to include lubricants and glue residue from windows and paint. A final inspection by the County and the Contractor shall include the cleanup of the Delivery Site by the Contractor. Prior to final acceptance, all "Punch List" items for the Crane and the clean-up of the Delivery Site shall be satisfactorily completed as reasonably acceptable by the County.
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SECTION 9
TECHNICAL ATTACHMENTS

Attached Technical Drawings, sketches and Schematics follow.
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