Miami-Dade Water and Sewer Department
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miamidade.gov

August 25, 2015

To: All Prospective P3 Partners

Re: **Design-Build-Finance-Operate-Maintain Services for South Miami Heights Water Treatment Plant Program**

Dear Sir/Madam:

Miami-Dade County, through the Miami-Dade Water and Sewer Department (WASD) hereby solicits public comments in connection with the attached draft RFP Volume III.A: Technical Requirements Document. WASD is currently in the process of implementing a comprehensive Capital Improvement Program (CIP) for numerous water and wastewater projects. One significant project in the CIP is the South Miami Heights Water Treatment Plant (SMHWTP) Project. The SMHWTP seeks to improve WASD's reliability in water service and quality by allowing for the decommissioning of small satellite plants with many years of service. Implementation of the SMHWTP Program will benefit the consumers in the south Miami-Dade area and will bolster water treatment production capacity.

WASD is releasing this Request for Proposals (RFP) Volume III.A draft working document for the SMH WTP Project for the sole purpose of eliciting and gathering industry comment as an important stakeholder in the program. The comments received will be used by WASD in finalizing the RFP. WASD will not be responsible for any cost incurred by the respondents in furnishing the information being requested herein.

All information being submitted is subject to Chapter §119 of the Florida Statues, commonly known as the "Public Records Laws". Accordingly, do not submit any information the respondents consider to be a trade secret, proprietary, confidential or that violates any intellectual rights. WASD may make use of any information, materials, data and concepts disclosed by any recipient without limitation. Respondent's response explicitly entails a waiver of any claim it may have on the use by the County or its agents of any information, materials, data and concepts disclosed.

This is not a procurement solicitation and no award will be issued as a result of the responses received from the industry. WASD is merely soliciting industry comment to a draft working document. A response to this request is not mandatory for future participation on the procurement for the SMH WTP Program. Because this is not a procurement solicitation, the provisions of the County's Cone of Silence do not apply.

Respondents to the RFP Volume III.A draft working document may request written clarifications and/or interpretations from WASD. A response to any request shall be at the sole discretion of WASD and if deemed beneficial to our purpose. WASD shall endeavor to provide copies of any response to a request issued to any proposer requesting in writing to be copied. All submittals, questions and other correspondence to WASD must include a letter of transmittal that identifies a key contact person, address,

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telephone number, fax number and e-mail address. Electronic submittals will be accepted and encouraged.

All submittals shall be made to:

Miami-Dade Water and Sewer Department
Mario Garcia
Senior Program Manager
3071 SW 38 Avenue
Miami, Florida 33146
Email: garcm@miamidade.gov

With copy to:

CDM Smith Inc.
Daniel R. Maher, P.E.
Senior Project Manager
800 Brickell Avenue, Suite 500
Miami, Florida 33131
Email: MaherDR@cdmsmith.com

For purposes only of this informational stage, the submittal deadline of October 23, 2015 has been established to allow the County sufficient time to consider the submittals in preparation of the final RFQ and subsequent RFP. Submittals received after that deadline will be considered only in the County's discretion. No submittal in response to this informational request will be considered following issuance by the County of the formal RFP for the Project.

Very truly yours,

Juan J Arteaga

JC Arteaga, AIA, NCARB, APA, CGC, CBO, LEED ® AP BD+C
Deputy Director
Capital Improvements & Regulatory Compliance

Encl. Draft RFP Volume III
cc: File

REQUEST FOR PROPOSALS (STEP 2)

ISD Project No. 14-DBFO-WASD-01

Design-Build-Finance-Operate-Maintain Services

For

South Miami Heights Water Treatment Plant Program

Volume III.A Technical Requirements

Submittal Deadline: **__________, Local Time, 3:30 P.M.**

Issued: 08/20/2015

Miami-Dade County, Florida

111 NW 1st Street, 17th Floor, Suite 202

Miami, Florida 33128

NOT A PROCUREMENT SOLICITATION

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Volume III.A - Section 1

Program Overview

1.1 General

To improve finished water in the southern area of Miami-Dade County to a quality comparable to that of the lime softened finished waters of the Hialeah-Preston and Alexander Orr distribution systems, it was recommended in the Water Facilities Master Plan (WFMP) prepared by CH2M HILL (2003) that the County construct an 18 million gallons per day (mgd) membrane softening treatment facility to replace the facilities in South Miami-Dade. The proposed water supply improvement for the South Miami-Dade service area included four new supply wellfields: along the Roberta Hunter Linear Park (SW 117th Avenue), at Caribbean Park and Rockpit Wellfield (SW 200th Street between SW 117th Avenue and SW 127th Avenue), and at the Former Plant Wellfield south of 184th Street and east of SW 117th Avenue. Water transmission, storage and distribution improvements in the South Miami-Dade area included approximately five (5) miles of a new raw water transmission pipeline to serve the new membrane softening WTP, 1.5 million gallons (MG) of new elevated water storage and approximately 39 miles of 8-inch diameter to 48-inch diameter of finished water distribution and transmission pipeline. Very few of the improvements were actually implemented.

The 2010 WFMP updated by CDM Smith (formerly Camp Dresser & McKee Inc.) was consolidated into one (1) service area. The water supply, water treatment and water transmission, storage and distribution improvements presented in the 2010 WFMP update included the following:

- Fourteen (14) wells at four sites (Caribbean Park, Former Plant, Roberta Hunter Park and Rockpit Park).
- A new 20 mgd water treatment plant
- A 2 MG storage tank and associated pumps
- South Dade Loop – 25.9 linear miles of 12-inch diameter to 36-inch diameter water mains
- Two water main extensions; (1) approximately 2.1 miles of 12-inch diameter pipeline and (2) approximately 1.0 mile of 16-inch diameter pipeline.

These improvements have, for the most part, not been implemented. This section further discusses the general overview of the proposed South Miami Heights (SMH) WTP Program.

1.2 Project Scope

The current scope of the SMH WTP Program associated with these technical design requirements consists of proposed Biscayne Aquifer (BA) wells, proposed Upper Floridan Aquifer (UFA) wells, the proposed SMH WTP, existing ground storage and high service pump station, a deep injection well to be constructed under Contract W-930, and a redundant deep injection well to be constructed with the WTP. The major components are described below.

1.2.1 Biscayne Aquifer Water Supply

The County's current Water Use Permit (WUP), issued in 2012 by the South Florida Water Management District (SFWMD), limited the raw water withdrawal rate from the BA in the SMH area to 1,095 million gallons per year (MGY), or 3 mgd.

In 2010, CDM Smith completed permitting of BA supply wells in Caribbean Park, the Former Plant site and along Roberta Hunter Park. With the reduction of BA source water, BA wells at Caribbean Park and Former Plant are still being contemplated. A C-905 PVC raw water transmission main with cement lined ductile iron fittings was installed under Contract W-861 for the BA, previously permitting BA wells. This main could be used to convey the water to the WTP. It varies in size from 16-inches to 42-inches in diameter.

1.2.2 Upper Floridan Aquifer Water Supply

Because of the limitation on BA raw water withdrawal rate, the balance of the raw water for the SMH WTP must be withdrawn from the UFA. The current UFA allocation for the SMH area is 8.494 billion gallons per year (BGY) or 23.3 mgd. UFA wells are anticipated at the SMH WTP site, in the Roberta Hunter Park and along the SFWMD's C-1 Canal right-of-way. New raw water transmission mains will supply the WTP with UFA raw water.

1.2.3 Water Treatment Plant

The SMH WTP site is located in south Miami-Dade County at 11800 S.W. 208th Street, Miami, FL 33177, at the northwest side of the intersection of the SFWMD C-1 canal and U.S. 1 (South Dixie Highway).

A membrane treatment process specific to the raw water sources will treat the 3 mgd of raw water allocation from the BA and raw water from the UFA to produce the guaranteed water production volume specified in the Service Contract. The membrane treatment process is anticipated to be nanofiltration (NF) and reverse osmosis (RO).

The UFA water could contain significant concentrations of hydrogen sulfide, while the Biscayne raw water could contain dissolved oxygen, albeit at relatively low concentrations. If these two raw water supplies are mixed prior to treatment, there is a risk that membrane fouling could occur as a result of precipitation of elemental sulfur and/or biofilm formation from sulfur related bacteria. For these reasons, it is anticipated that the UFA raw water supply stream will be kept separated from the BA raw water supply until downstream of the membrane treatment process.

1.2.4 Ground Storage Tank

The existing 5 MG of ground storage and high service pump station were constructed under Contract W-857 at the existing plant site. The tank is connected to an existing high service pump station that discharges into the existing transmission/distribution system.

The Company will be transferring the produced water to the existing County operated ground storage tank; the product water will be sampled and monitored for compliance with Acceptance Standards and metered upstream of the connection to the existing ground storage tank. The existing High Service Pump Station will be operated by the County to convey the produced water into the transmission and distribution system.

1.2.5 Deep Injection Well

The RO reject or concentrate from the treatment process, along with other smaller waste streams, will be disposed of using two deep injection wells. Two wells (one duty and one redundant) will be provided at the SMH WTP site in the eastern portion of the site. One of the proposed injection wells will be constructed by others under a separate contract (W-930), and will have an alternate design with a cement filled annulus for an 18.18-inch outside diameter Fiberglass Reinforced Plastic (FRP) inner (final) casing and 30-inch outside diameter steel casing. The injection well will have a design capacity of approximately 9.44 mgd at the maximum permitted injection rate of 10 feet per second (ft/sec). The injection well will be cased to about 3,000 feet below land surface (ft bls) and will have a total depth of approximately 3,500 ft bls, penetrating through the Boulder Zone. It is anticipated that a total dynamic head of approximately 115 ft, approximately 50 pounds per square inch (psi), will be required at the well head to overcome the artesian pressure of the Boulder Zone, as well as friction and dynamic losses. The deep injection well to be constructed with the WTP may be of similar capacity and construction.

1.3 Finished Water Quality Requirements

Finished water from the SMH WTP will meet all the water quality requirements of the Primary (mandatory for public health) and Secondary (recommended as aesthetic quality) Drinking Water Standards. Primary drinking water standards (PDWS) include Maximum Contaminants Levels (MCLs) for the inorganic-compounds, disinfectant residuals, disinfectant by-products, synthetic and volatile organic-compounds, microbiological parameters and radionuclides. The United States Environmental Protection Agency (EPA) established the MCLs or drinking water standards for constituents in drinking water. EPA has granted primacy to the Florida Department of Environmental Protection (FDEP) for ensuring compliance with the standards. Both PDWS and secondary drinking water standards (SDWS) are mandatory and enforced by the FDEP in Florida. **Table 1-1** presents additional finished water requirements that have been established for the SMH WTP Program. These include compliance with documentation currently on record for the County to comply with the requirements of the Lead and Copper Rule at the point of entry to the distribution system.

Table 1-1 Additional Finished Water Quality Requirements

Parameter	Units	FDEP MCLs	SMH WTP Required Finished Water Limits
Alkalinity	mg/L as $CaCO_3$	-	≥ 50
Calcium	mg/L as $CaCO_3$		≥ 50
pH			<8.74, <9.65
Chloride	mg/L	250	≤ 80
Color	CU	15	≤ 3
LSI	--		<+0.3, >+0.1
Nitrate	mg/L as N	10	<1
Sodium	mg/L	160	≤ 60

In addition, various chapters of the Florida Administrative Code (FAC) address drinking water requirements established by FDEP. Of particular relevance to this RFP is Chapter 62-550, FAC (Drinking Water Standards, Monitoring and Reporting). The Miami-Dade County public water system operated by the County is considered a community water system as defined in Chapter 62-550, FAC. The SMH WTP Program must meet applicable sections of Chapter 62-550, FAC.

1.4 Anticipated Source Water Quality Conditions

The raw water supply for the SMH WTP is the BA and the UFA. The anticipated water quality for the BA and UFA is as identified in the following sections.

1.4.1 Biscayne Aquifer Raw Water Quality

Groundwater in the surficial aquifer system in Miami-Dade County is classified as G-I groundwater as defined in Section 62-520.410 of the FAC. Class G-I groundwater has the potential for use as potable water supply in single source aquifers and has total dissolved solids (TDS) of less than 3,000 mg/l. These aquifers are designated as underground sources of drinking water (USDW). Raw water quality available for the BA wells is presented in Table 4.4 of Volume III.B as background information only.

1.4.2 Upper Floridan Aquifer Raw Water Quality

Groundwater in the Upper Floridan Aquifer System in Miami-Dade County is classified as G-II groundwater as defined in Chapter 62-520.410 of the F.A.C. Class G-II groundwater has the potential for use as potable water supply and has TDS of less than 10,000 mg/l. These aquifers are designated as USDW. Groundwater in the UFA is higher in chloride, total dissolved solids, specific conductance, and hydrogen sulfide than in the BA.

Site-specific water quality is not currently available. Based on water quality information available for other UFA wells in Miami-Dade County, assumptions of the anticipated raw water quality can be developed for an initial conceptual basis of design for the WTP. This information must be updated with the results of the future site specific hydrogeologic testing and groundwater modeling to be conducted by the County during in 2015. It has been assumed the initial anticipated water quality will be degraded by 50% over time. The anticipated water quality for the UFA wells, considering degradation, is provided for informational purposes only in Table 5-2 of Volume III.B. This information should not be used for design purposes and should be supplemented with site-specific water quality when available.

1.5 Permitted Withdrawal and Production Requirements

Permitted withdrawal rates from each aquifer are provided above under Sections 1.2.1 and 1.2.2. The procurement of the SMH WTP Program (discussed in Section 1.6), will require a guaranteed base finished water production rate of 15 mgd, as defined in the Service Contract. The design for the facility, however, should be based on a permitted treatment capacity of 20 mgd max day.

1.6 RFP Volume III Purpose

Through this RFP, the SMH WTP Program is being procured as a Design-Build-Finance-Operate-Maintain (DBFOM) project; as described in RFP Volume I, Instructions and Proposal Evaluation.

Volume III.A of this RFP, Technical Requirements, presents the minimum technical requirements and applicable codes and standards for the various components and disciplines of the SMH WTP Program. The proposed facilities must be in compliance with the Technical Requirements included herein. These requirements, subject to revisions (if any) that are agreeable to the County, will be incorporated into the Service Contract and therefore will apply to the design, construction, operation and maintenance phases of the Project.

Volume III.B of this RFP, Technical Background and Information, includes preliminary engineering documents developed by the County's Technical Advisor. Except to the extent that specific information or specific figures included in Volume III.B are referred to in the main body of this Volume III.A, the contents of Volume III.B are not technical requirements for the purpose of preparing a proposal in response to the RFP. Rather, this Volume III.B is intended to provide background information and to serve as a guideline to Proposers for the County's general expectations for the Technical Proposals and may be used by the County in the evaluation of Proposals. Certain information included in Volume III.B may, <u>at the sole discretion and risk</u> of the Proposer, be used and incorporated into the

Technical Proposal and subsequently into the execution of the Service Contract by the selected Company.

Regardless of the requirements and the information provided in RFP Volumes III.A and III.B, respectively, the Company shall assume full responsibility and liability for the Project's design (including the final construction documents) and permitting, the constructed facilities, achieving Project Acceptance and compliance with the Guaranteed Performance Standards in accordance with the terms and conditions of the Service Contract.

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Volume III.A - Section 2

Project General Requirements

2.1 General

This section sets forth the general requirements for the Project that must be considered for the design, construction, operations, maintenance, and process activities based on the County standards.

2.2 Codes and Standards

The program components (SMH WTP, wellfields and transmission mains) shall be designed in accordance with all applicable Federal, State and Local Codes and Standards including all amendments thereto including, but not necessarily limited to, the following:

- Chapter: 62-521, FAC-Wellhead Protection
- Chapter: 62-532, FAC-Water Well Permitting & Construction Standards
- Chapter: 62-555-FAC-Permitting, Construction, Operation & Maintenance of
- Public Water Systems
- Chapter 62-528, FAC-Underground Injection Control
- Recommended Standards for Waterworks (10 State Standards)
- NSF 61 – Drinking Water System Components-Health Effects

As discussed in Section 1, the Chapter 62-550, FAC dictates the requirements for the Drinking Water Standards, Monitoring and Reporting. Project specific finished water quality requirements are included in Section 13.

2.3 Key Components

The general objective is to allow the different Project facilities to operate effectively and efficiently throughout the required flow capacity range with one or more major process units or major equipment unit out of service and still meet the production requirements of the Service Contract.

2.3.1 Raw Water Wells and Pumping

The Company shall include in the design, one (1) raw water pump for each raw water well in the project. The Company shall conduct an independent evaluation of the findings of the hydrogeologic investigation completed by the County to be able to design the individual wells and wellfields. Sufficient BA wells should be provided for the limited allocation of BA raw water withdrawal, and shall consider adequate redundancy. Sufficient UFA wells should be provided for the ultimate raw water withdrawal required for a future plant production condition of 20 mgd, using UFA raw water.

2.3.2 Raw Water Pipeline

Two separate pipelines that will convey raw water between the well pumps and the WTP: 1) a BA raw water transmission main, and 2) a UFA raw water transmission main.

2.3.3 Water Treatment Plant

The Production Volume specified in the Service Contract as a guaranteed volume of water to be produced dictates the minimum capacity requirement for the water treatment plant. However, the Company should design and permit a facility that would continuously produce 20 mgd (max day) during maintenance activities and scheduled downtimes, which would provide system redundancy for the required production volume with a unit out of service for an extended period. Chemical feed systems shall also be designed to allow continuous operation in accordance with federal, state and local standards. The Company should design and construct the facility with materials for structures and piping with a minimum service life of 50 years or as otherwise indicated herein while demonstrating compliance with the Performance Guarantees included in Section 16. The WTP buildings, structures, and electrical service should be designed to provide space for equipment to produce an ultimate capacity of 20 mgd of finished water based on treating 100% UFA raw water. Section 6 defines the minimum square footage to be provided for the various facilities.

2.3.3.1 Sustainability Goals

Miami-Dade County requires, by County Ordinance 07-65, § 3, 5-8-07, that sustainable practices be used for the design, construction, and maintenance of Miami-Dade County buildings. The Ordinance is titled *The Sustainable Building Program*. The Company shall implement sustainable strategies into the site and building design, evaluating each element of the project for the potential to incorporate "Green" principles. The minimum sustainable green principals incorporated into the facility design shall be equivalent to meeting U.S. Green Building Council's (USGBC's) LEED Silver Certification. Meeting LEED Prerequisites is required.

Sustainable strategies include but are not limited to:

- Sustainable Sites (SS)
- Water Efficiency (WE) Energy and Atmosphere (EA) Materials and Resources (MR)
- Indoor Environmental Quality (IEQ)
  - Innovation in Design (ID)
  - Regional Priority (RP)

Sustainable design elements and "green building materials" should not be added to the project, but rather should be integral to the design.

The Company shall implement an approach to sustainability, carefully balancing initial capital costs with life cycle costs to achieve an optimum cost/benefit ratio.

The Company shall identify and pursue potential incentives and funding sources for specific sustainable strategies.

Green strategies range from simple, common sense "rules of thumb" to complex, high tech systems. Appendix N of Volume III.B includes a LEED Certification Evaluation Memorandum for the South Miami Heights Water Treatment Plant, prepared under LEED 2009. This memorandum is provided for information only. The Company shall provide a checklist of proposed sustainable design strategies to be incorporated into the facility design under the LEED version applicable at the time of bid for review by the County and the County's Technical Advisor. The agreed upon strategies shall be implemented in the design of the facilities to obtain a USGBC's LEED Silver Certification.

2.4 Pilot Testing

Pilot testing is not required.

2.5 Hydrogeologic Investigation

The two major aquifer systems underlying Miami-Dade County from land surface to a depth of approximately 4,000 feet bls are the BA, as part of the surficial aquifer system, and the deeper artesian Floridan Aquifer (FA), starting at about 1,000 feet bls. These two systems are separated by low permeability sediments of the intermediate confining unit. The FA system is generally comprised of an UFA and a Lower Floridan aquifer. Underlying the UFA is the middle confining unit (MCU), which in some locations includes preferential flow paths that may affect the water quality through degradation, if occurring near the proposed well sites.

The County will conduct a Hydrogeologic Test Program for the SMH wellfield. The Hydrogeologic Test Program will provide site specific hydrogeology. The area of interest for this test program evaluation is the UFA, which extends from approximately 950 feet bls to approximately 1,500 feet bls. Following the exploration program, the Company will be responsible for independently evaluating the findings of the Hydrogeologic Test program, which could include groundwater modeling and geotechnical studies as required to complete the final design.

2.6 Minimization of Site Use for Future Needs

In general, the layout of the different Project facilities shall provide for an efficient use of space. The arrangement of the different facility components shall allow for convenient access for operation and maintenance of the facilities, while saving space for future uses.

2.7 Connection Points

The Company will be responsible for the design and construction of the BA and UFA wellfields and their associated transmission and blow off mains, which should connect at appropriate locations at the WTP site.

The water produced by the Company will be metered and transferred to existing 5 MG Ground Storage Tank and High Service Pump Station. The Company shall provide a means of determining compliance with the finished water quality requirements upstream of the connection point.

The existing Ground Storage Tank and High Service Pump Station will connect the proposed SMH WTP to the County's distribution system and will be operated and maintained by the County.

2.8 Safety, Access, and Other General Requirements

All of the facilities shall be designed to facilitate access for Operation and Maintenance (O&M) activities. The facilities shall also be designed to provide safe working conditions in accordance with local, state, and federal (i.e. OSHA) requirements.

In general, a minimum access clearance of 3.5-feet shall be maintained on all sides of mechanical equipment. Refer to Section 11 (Electrical) for the required access clearances at electrical panels, motor control centers (MCCs), and other electrical equipment.

All equipment and valves shall have stainless steel tags with the equipment/valve number. All piping shall be labeled for their service per the requirements outlined herein.

The Company shall provide instrumentation, control, and communication equipment to facilitate supervision of the operation.

- All equipment shall be able to be operated in both a local, manual mode as well as a remote, automatic and manual modes.
- All equipment shall be able to be started and stopped remotely through the SCADA system.
- Closed-circuit video cameras shall be provided outside and inside the different structures that will allow the facilities to be monitored remotely. Operations staff shall be able to pan and zoom the cameras remotely.

- Intrusion detection devices shall be provided outside and inside the different structures to detect the presence of intruders. These requirements are detailed under Section 12 (Security and Personnel Protection Systems).
- Lifting eyes shall be placed over all equipment weighing 100 lbs or more to allow support and lifting during maintenance activities, unless hatches for removing the equipment are to be provided above the equipment.
- Access hatches shall be placed over pumps and other equipment to allow removal.
- Clearance shall be provided around equipment, valve and gate operators, panels and other features to provide adequate space for operation and maintenance including equipment replacement.

2.9 Permits

The new SMH WTP is located west of US-1 in Southeastern Miami-Dade County and may fall within the regulatory jurisdiction of the following entities:

- The Florida Department of Environmental Protection (FDEP),
- The South Florida Water Management District (SFWMD),
- The United States Environmental Protection Agency (USEPA), and
- The Miami-Dade County Department of Regulatory and Economic Resources (DRER), including the Division of Environmental Resources Management (DERM).

These entities comprise the agencies with permitting jurisdiction related to the WTP facility. Following is a description of the permitting requirements for each agency. The Company is responsible for permitting and all permitting fees.

2.9.1 Florida Department of Environmental Protection (FDEP)

There are a number of permits which will need to be obtained from FDEP related to construction and process activities which will take place at the WTP. The individual permits are identified below.

2.9.1.1 Application for a Public Drinking Water Facility Construction Permit

This permit is required for the construction of any public drinking water facility. The proposed project is reviewed for compliance with standards listed in Chapter 62-555, FAC. The review of the permit is conducted by the Miami-Dade County Public Health Unit (MDCPHU) which has been delegated this authority by the FDEP. The current permit expires on August 26th, 2015, however, the changes to the proposed facility will require another permit review. The permit fee is $7,500.

2.9.1.2 Deep Injection Well

An Underground Injection Control permit from the FDEP is required for the construction of a Class I injection well system for UFA concentrate disposal. The permit application form is 62-528.900(1) – Application to Construct/Operate/Abandon Class I, III or V Injection Well Systems. This permit will be regulated under FAC 62-528. DERM may request to receive a courtesy copy of the permit application for their records. The estimated permit fee is $12,500.

2.9.1.3 Air Emission

The WTP process includes degasifiers and scrubbers along with generators on-site. An Air Emissions Construction permit will be required for the operations of the degasifiers/scrubbers and the generators. An air emissions permit is required by FDEP. The estimated permit fee is $100. Air emissions are also regulated by DERM. This permit was previously obtained (Permit No. CAP-002029-

2004/2007). An extension letter identifying any changes to the treatment processes will be required along with an extension approval fee of $70.

2.9.2 South Florida Water Management District (SFWMD)

The SFWMD is the water management district with regulatory jurisdiction over the County. There are four permits that may need to be obtained from the SFWMD for the WTP, UFA and BA wellfields. These are the following: a modification to the Water Use permit (WUP) No. Re-Issue 13-00017-W, a modification to the environmental resource permit (ERP) No. 13-02763-P, a new dewatering permit and a canal right-of-way permit.

2.9.3 United States Environmental Protection Agency

Bulk storage of certain chemical substances, such as sulfuric acid and caustic soda, will likely require an accidental release prevention program (ARPP). Compliance with conditions of the ARPP will have to be demonstrated.

Construction activities can also trigger modifications to the county-wide NPDES permit. NPDES requirements for construction activities greater than an acre in disturbed lands include the preparation of a Stormwater Pollution Prevention Plan (SWPPP) and filing a Notice of Intent (NOI). Since construction will result in a disturbed area of more than an acre, the project is subject to these requirements.

2.9.4 Miami-Dade County Department of Regulatory and Economic Resources (DRER)

Permits from DRER, including DERM, will also be required for construction of the WTP. This permitting process is outlined below.

2.9.4.1 Stormwater Permit Process

Stormwater runoff from the WTP is collected in on-site retention ponds. Assuming that stormwater runoff associated with the site improvements is collected using the retention ponds, the County would permit the drainage plan as part of the DERM review under the building department permit application. A Class VI Permit from DERM will be required in accordance with the approved Site Review Plan. The civil drawings, design calculations, and approvals from both the SFWMD and DERM, as applicable, must be submitted as part of the review. If the retention ponds are modified with overflow capability or if stormwater runoff is piped directly to the canal, a SFWMD stormwater (ERP) permit will be required along with a Class II Permit from DERM.

2.9.4.2 Industrial Facilities Permit Process

An industrial facilities permit will be required for the diesel fuel and waste oil tanks to be stored on-site.

2.9.4.3 Industrial Pretreatment Permit Process

An industrial pretreatment permit will be required for the laboratory waste.

2.9.4.4 Building Permit Process

A building permit for a non-residential structure will need to be obtained from the Miami-Dade DRER for the SMH WTP facilities.

2.9.4.5 Miami-Dade Fire Rescue

The Fire Engineering Bureau of the Miami-Dade Fire Rescue (MDFR) Department is responsible for compliance with the National Fire Protection Association's Life Safety Code in plans review, water supply for new buildings and site plan review for emergency vehicle access. Plan Reviewers will review the drawings of the SMH WTP and process all building plans, including but not limited to construction, fire alarms, automatic sprinklers, hydrant locations, and site plans.

2.9.4.6 Planning and Zoning

The proposed site plan will require an early site plan approval by Planning and Zoning. Subsequently, a landscaping plan must be submitted to the Planning Division of the Department of Planning and Zoning.

2.9.4.7 Miami-Dade Department of Regulatory and Economic Resources (DRER) Permit Summary

Table 2-1 presents a summary list of anticipated permits and reviews from the Miami-Dade DRER. This list may not be all inclusive.

Table 2-1 List of Required Miami-Dade County Permits and Section Reviews for SMH WTP

Department of Regulatory and Economic Resources (DRER)
a. Structural
b. Fire Department
c. Mechanical (HVAC)
d. Plumbing
e. Electrical
Division of Environmental Resources Management (DERM)
a. Air (Generators)
b. Air Section Approval for Asbestos Renovation and Demolition
c. Industrial Facilities Permit
d. Industrial Pretreatment Permit
e. Pollution Remediation - Spill Prevention and Response Plan (Chemical tanks)
f. Chemical Storage Tank Registration: Fuel Storage Tanks
g. Chemical Storage Tank Registration: Chemical Storage Tanks
h. Water Supply Section Approval (Treatment Section)
i. Wastewater Conveyance: Sewer Extension (Sanitary)
j. Wastewater Conveyance: Sewer Extension (Concentrate)
k. Water Control Permit for Drainage
l. Environmental Core Approval
m. Paving and Drainage Approval
n. Flood Plain Section Approval
o. Tree Removal/ Relocation Permit
Planning
Public Works
a. Public Works Concurrency
Zoning
a. Early Site Plan Approval
b. Landscaping Plan

2.10 Training

The Company shall provide training to the County's Operation and Maintenance (O&M) staff on each unit process and piece of equipment for the components of the SMH WTP program (treatment plant and wellfield). The Contractor shall train the County's O&M staff to understand the overall operating strategy of all of the Project facilities, the operation of and performance capabilities of each unit treatment process and the O&M requirements for all mechanical equipment and systems. Training shall also include the emergency operations plan and quality control/quality assurance program. Training shall be performed by knowledgeable, competent personnel who are thoroughly familiar with the theory, design, operation and maintenance of the process and/or equipment. The Company shall provide training by qualified installation and maintenance personnel for a period of not less than two (2) weeks.

Coordination shall be maintained with the County's Technical Advisor in the development of training techniques and materials. Ninety (90) days prior to completion of the project, the Company shall submit for approval a detailed outline of the proposed training schedule, scope of materials and techniques. The Company shall also submit detailed lesson plans with handouts for training.

The Company shall conduct "hands-on" instruction. The training instructor shall present "hands-on" demonstrations of common corrective maintenance repairs for each training class. Hands-on training for O&M staff shall cover proper startup, shutdown, normal and alternative operating strategies.

The Company shall have instruction and training sessions audio/video recorded, in digital format, while they are being given to the County's O&M staff. Audio/video recordings shall be performed by a person or organization experienced in the audio/video production and shall include the entire inspection and training session (including classroom and field) and all question and answer periods. Quality shall not be degraded during the background noises, space, distance or other factors. The video recordings or other electronic media shall be transferred to DVD format or the latest suitable technology and become the property of the County. The Company will provide written release from all claims to the recorded training materials produced.

Training shall not commence until the final operating and maintenance manual has been submitted to the County.

Furnish three (3) copies of a signed acknowledgment that the County's O&M staff have received the specified training.

2.11 Guaranty/Warranty

The Company shall guarantee that all new equipment has the capacity specified and that it will operate without excess noise or vibration.

The Company shall furnish a written guarantee covering all workmanship and materials for a period of one (1) year, from the date of Substantial Completion. This shall include an agreement to repair or replace, at his expense, all defects that may appear in that time, which in the opinion of the County's Technical Advisor, are due to defective workmanship or materials. All items not having a successful five-year operating history shall have the same guarantee as above but extended for five years less their successful operating period.

Copies of factory warranties on all equipment furnished shall be submitted with the above described, written guarantee, and included in maintenance manuals.

2.12 3D/4D Design

The Company shall complete the design of the SMH WTP Program facilities using 3D/4D design tools. The Company shall develop and submit to the County Technical Advisor the proposed 3D/4D Standards and Guidelines for the Project.

Volume III.A - Section 3

Water Supply and Treatment Process Design Components

3.1 General

This section presents the technical requirements for the Water Supply and Treatment Process for the South Miami Heights Water Treatment Plant (SMH WTP).

3.2 Water Supply Process and Pumping Equipment

Design criteria and technical requirements for design, construction and performance for the various components are included below.

3.2.1 Description of Work

The water supply for the SMH WTP will be groundwater from both the Biscayne Aquifer (BA) and the Upper Floridan Aquifer (UFA). The two raw water sources shall not be mixed until after treatment. The SMH WTP shall be designed with a Nanofiltration/Ultra Low Pressure (NF) Membrane System for the BA raw water and Reverse Osmosis (RO) Membrane systems for the UFA raw water in order to produce a finished water that is safe, reliable, and acceptable to the public while complying with all applicable State and Federal water quality regulations. Should the Company's design require other equipment not included below, it shall meet AWWA, ANSI or other Industry standards and be approved by the County's Technical Advisor.

The intent of these technical requirements is to outline the requirements for the various components for the design and construction of the entire infrastructure necessary for complete and functional facilities capable of withdrawing raw water required for the contract water purchase volumes, and treating it to the required water quality standards.

Although minimum requirements are established in this document, the Company shall be fully responsible for the final design and the construction of the Project as described herein and in other related documents. The Company shall have primary responsibility for all work and equipment identified herein. However, the Company shall subcontract with a Membrane System Supplier (MSS) who shall be responsible to the Company for the design, manufacture, oversight of installation, all testing and startup of the NF and RO systems, training of County Staff, and NF and RO equipment warranties.

The MSS shall have a minimum of 10 years of continuous and current experience in the design, fabrication, installation, startup, operation and maintenance of NF and/or RO treatment skids. The MSS shall submit a list of at least five plants with a permeate capacity of greater than or equal to 1 mgd with at least three of these plants having a capacity of 5 mgd or greater, and at least two of these plants having a capacity of 7.5 mgd or greater and one of these plants having a capacity of 10 mgd or greater. At least three of these plants shall have been in successful operation for at least 5 years and at least two plants shall have been placed in operation within the last five years to demonstrate the required experience. The current staff of the MSS shall have a minimum of five (5) years of experience in the design, procurement, installation, supervision and startup of RO and NF membrane systems. The lead process engineer for the MSS shall have a minimum of ten (10) years of experience in the design, procurement, installation supervision and startup of RO and NF membrane systems. The MSS shall provide documentation demonstrating that the stainless steel fabrication for the RO and/or NF installations referenced above included pickling and passivation by full immersion, full penetration welding, and extruded outlets (pulled tees) for the stainless steel piping manifolds in strict conformance with ANSI B31.3. An MSS firm that has been in business for less than 10 years may also qualify provided that the resumes of their core management and project execution team have a minimum of ten (10) years of experience in the design, procurement, installation supervision and startup of RO and NF membrane systems. The resumes of the designated personnel for the roles of principal in charge, project manager, process engineer, site services supervisor for this project shall demonstrate compliance with the MSS experience requirements with respect to the number and capacity of plants outlined above. In addition, resumes for other staff members shall conform with the requirements for current staff outlined above. The resumes of the core project execution team shall also demonstrate experience with stainless steel fabrication and welding requirements specified above.

Allowable MSSs shall include the following:

- Aerex Corporation
- Biwater
- Harn R/O Systems, Inc.
- H2O Innovations
- Doosan Hydro Technology
- Pacific Aqua Technologies
- Approved equal

This Section describes work to be performed by both the MSS and the Company. The MSS shall furnish the equipment items associated with the NF and the RO systems and shall participate in the installation, commissioning, acceptance testing, and training of County Staff in operation of the NF and the RO systems as a whole.

The MSS equipment and services shall generally consist of the following:

- Membrane elements
- Pressure vessels
- Preparation of detailed shop drawings and membrane unit detail design
- Skid or framework supporting the pressure vessels, piping, and instrumentation and controls
- Manifold piping and valves on the membrane units for feedwater, concentrate, permeate, cleaning solutions, and permeate flushing
- Membrane unit instrumentation controls, and sample taps
- Piping, valves and fittings to interconnect the membrane units with plant process piping, including feedwater, concentrate, permeate, cleaning solutions, chemical feed piping, and waste drains
- All instrument sample tubing and valves
- Sample panels
- Supervision of plant startup testing and performance testing
- Recommended spare parts list

The Company shall have overall responsibility for coordination and delivery of the membrane system equipment and services. In addition to having overall responsibility for the MSS's scope of work, the Company shall be responsible for providing:

- Preoperational and start-up testing
- Performance testing
- Operation and maintenance manuals and training

In addition to the MSS supplied equipment, all remaining equipment, piping, controls, and appurtenances shall be designed, supplied, and installed by the Company to provide a fully functional membrane system. The MSS shall provide assistance to the Company and provide the information needed to coordinate the design of the NF and RO systems and the ancillary equipment designed by the Company but not provided by the MSS. The MSS shall oversee and certify the installation of the NF and RO systems by the Company and provide written instruction and verbal direction to ensure proper installation. The MSS shall review installation of equipment prior to startup and commissioning of equipment. The MSS shall perform the startup, debugging and initial field testing of the NF and RO systems including performance guarantee testing.

The physical facility requirements, such as structural, electrical, architectural, security, etc., are included in other sections of Volume III. A.

3.2.2 Basic Requirements

The following are basic requirements for the Water Supply Process and Pumping Equipment.

3.2.2.1 Codes and Standards

The plant process and pumping equipment shall be designed in accordance with all applicable Federal, State and Local Codes and Standards including all amendments thereto including but not necessarily limited to the following:

- American Gear Manufacturer's Association (AGMA)
- Institute of Electrical and Electronics Engineers (IEEE)
- American National Standards Institute (ANSI)
- American Petroleum Institute (API)
- American Society of Civil Engineers (ASCE)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- American Welding Society (AWS)
- American Water Works Association (AWWA)
- United States Environmental Protection Agency (EPA)
- Florida Building Code
- National Bureau of Standards (NBS)
- National Electric Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electric Safety Code (NESC)
- Instrument Society of America (ISA)
- Underwriters Laboratory (UL)

- ASME Boiler and Pressure Vessel Codes
- Hydraulic Institute (HI)
- Occupational Safety and Health Administration (OSHA)
- American Institute of Steel Construction (AISC)
- American Iron and Steel Institute (AISI)
- Society for Protective Coatings (SSPC)
- Compressed Gas Association (CGA)
- American Concrete Institute (ACI)
- National Sanitation Foundation (NSF)
- NSF 61 – Driking Water System Components – Health Effects
- International Society of Automation (ISA)
- National Fire Protection Association (NFPA)
- U.S. Department of Commerce Voluntary Product Standards
- ASTM C 581 – Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures
- ASTM C 582 – Reinforced Plastic Laminates for Self-supporting Structures in a Chemical Environment
- ASTM D 3299 – Filament Wound Reinforced Polyester Chemical-Resistant Tanks
- ASTM D 4097 – Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks
- ASME RTP-1
- ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
- ANSI B16.5 – Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys
- ANSI B46.1 – Surface Texture
- ANSI S12.6 – Method for the Measurement of the Real Ear Attenuation of Hearing Protectors
- ANSI/ASME Bl.20.1 – General Purpose Pipe Threads (Inch)
- ANSI/ASME B31.1 – Power Piping
- ANSI/ASME B31.3 – Process Piping
- ANSI/AWWA D100 – Welded Steel Tanks for Water Storage
- AWWA C206 – Field Welding of Steel Water Pipe
- ASTM A 48 – Specification for Gray Iron Castings
- ASTM A 108 – Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
- ASTM D638 – Standard Test Method for Tensile Properties of Plastics
- ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact
- ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D883 – Standard Definitions of Terms Relating to Plastics
- ASTM D1505 – Density of Plastics by the Density-Gradient Technique
- ASTM D1525 – Vicat Softening Temperature of Plastics

- ASTM D1693 – ESCR Spec. Thickness .125” F50 – 10% Igepal
- ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tank: Section 11.3: Low Temperature Impact Test and Section 11.4: Oxylene-Insoluble Fraction (Gel Test)
- PS 15-69 – National Bureau of standards Voluntary Product Standard "Custom contact molded Reinforced Polyester Chemical Resistant Process Equipment"
- ASTM D-883 – "Definition of Terms Relating to Plastics"
- ASTM D-2583 – "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor"
- ASTM D-2563 – "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts"
- ASTM D-4097-82 – "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks"
- PS 15-69 – National Bureau of standards Voluntary Product Standard "Custom contact molded Reinforced Polyester Chemical Resistant Process Equipment"
- ASTM D-883 – "Definition of Terms Relating to Plastics"
- ASTM D-2563 – "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts"
- ASTM D-2583 – "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor"
- ASTM D-4097-82 – "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks"
- Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers – Recommended Standards for Water Works (i.e. Ten State Standards)
- British Stainless Steel Association (BSS) as it relates to PREN values (pitting resistance equivalent numbers) for stainless steel
- Occupational Safety and Health Administration (OSHA)

Where reference is made to one of the above standards, the revision in effect at the time of Comprehensive (Service) Agreement shall apply, unless otherwise noted

3.2.2.2 Submittals with Initial Bid Package

The Company shall submit at the time of bid the following documentation:

- Design calculations associated with the Company’s Performance Guarantees.
- Membrane performance projections. Company shall provide integrated performance projections for the membranes and the energy recovery units (turbochargers) for initial and degraded water quality and initial and end of life membrane projections.
- Design drawings. Company shall submit a complete drawing set at the preliminary design level (15 to 30 percent) including but not limited to: Process Flow Diagrams (PFDs), site plan, general equipment arrangement of RO building, single line electrical drawings, and P&IDs.
- Equipment Data Sheets
- Energy calculations for feedwater pumps including the use of turbochargers.
- Schedule for design and construction submittals

In addition, MSS qualifications shall be submitted by the Company for the County Technical Advisor’s review prior to authorization to proceed with the design. MSS qualifications are as follows:

- The résumé of experienced membrane process and applications engineer and erection supervisor employed by the MSS who will assist the Company with the detailed shop drawing design, startup, and performance testing.
- Corporate experience and résumés of key technical personnel utilized by the MSS. Corporate experience information shall be sufficient to demonstrate compliance with qualification requirements and shall include a listing of all RO and nanofiltration projects completed by the MSS within the past five (5) calendar years.

3.2.2.3 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor. Documentation shall be provided to the County's Technical Advisor demonstrating compliance with the technical requirements.

The following items as a minimum shall be submitted by the Company for the County Technical Advisor's review prior to finalizing the design:

Design calculations

- Pipelines and process piping sizing calculations, including head loss calculations.
- Membrane projections for initial and degraded water quality for new and 5-year old membrane elements.
- Feed water pump curves for initial and degraded water quality for new and 5-year old membrane elements including operating conditions for the turbochargers.
- Pipe pressure rating calculations.
- Equipment sizing calculations

Design drawings

- Process Flow Diagrams (PFDs) showing the operating conditions of the membrane units for initial and degraded water quality conditions with new and 5 year old membranes. PFDs shall include information on the turbochargers including inlet and outlet flows and pressures for both the turbine and the pump sections of the turbocharger, bypass flow, backpressure requirements and energy recovered under each condition.
- Final plans, sections, and details for all structures.
- Final building plans, sections, elevations, and details.
- Final pipeline plan and profile sheets.
- Pipeline details.
- Site/Civil plans including finished grading.
- Mechanical plan, sections, and details.
- Electrical plans.
- Instrumentation plans and details.
- Control diagrams.
- Specifications.
- Test procedures for equipment and system testing.
- Electronic files of Drawings, Specifications, and test procedures. Each electronic file shall include an index of its content.

Equipment Datasheets and Literature

- Complete equipment datasheets indicating capacity, energy requirements, materials of construction, range of operation,
- Manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard material product data and descriptive data shall be clearly marked to identify pertinent materials, product or models

Energy calculations

MSS Submittals

- Updated Membrane process projection submittals
- Specifications for all MSS supplied/designed equipment
- Schematic Drawings
- P&IDs of the NF and RO systems detailing the equipment supplied by the MSS and showing equipment provided by the Company that will interface with the NF and RO systems. Battery limits of MSS' scope of supply shall be clearly delineated by hatching, line weight, etc.
- The MSS is responsible for establishing the P&ID tag numbering for the system.
- Electrical wiring diagrams including motor horsepower and other electrical load information and identification of external wiring connections and for use by the Company to install and make operational the supplied equipment.
- System Arrangement Drawings – Provide arrangement drawings of the CIP equipment and interconnecting pipe work, valves, supports, and appurtenances for the membrane system.

Component Equipment

- The Company shall submit MSS-prepared technical information for all items of component equipment including:
- Pumps, compressed air equipment, air blower equipment, valves/actuators, CIP equipment, instrumentation, flow meters, and analyzers.

NF and RO Membrane Modules

- Provide element construction details (e.g., active membrane surface area), standard performance parameters, storage, and handling requirements.

Manufacturer's literature

- Illustrations, specifications, weights, pump curves, and engineering data for project engineered equipment including dimensions, materials, sizes, and performance data.

For all pumps with capacities greater than 1.0 hp, provide performance data curves showing the following parameters as defined in the Hydraulic Institute Standards over the full operating range of the pump. Variable speed curves shall be provided showing at least five (5) speeds plotted equally from maximum rpm to minimum rpm. Minimum rpm shall be no less than that required to obtain minimum flow. Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Indicate on the performance curves the point of operation of the pump and the minimum and maximum recommended operating points. Catalog sheets showing a family of curves will not be acceptable.

- Total head in feet.
- Hydraulic capacity in gallons per minute.
- Horsepower demand.

- Pump efficiency.
- Net positive suction head required in feet.

Instrumentation and Control Drawings, including:

- Panel Construction Drawings: Provide construction drawings for all NF and RO system panels.
- Panel Wiring Diagrams: Provide panel-wiring diagrams or I/O Schematics for all NF and RO system panels
- Loop Diagrams: Provide a complete set of control loop diagrams or wiring schematics incorporating similar information for all assigned NF and RO system control loops.
- Operator interface computer stations and PCS submittals.

Design calculations related to sizing of key components, including the overall System, pumps, valves, cartridge filters, membrane units, air compressor system, CIP system, chemical dosing pumps, CIP pumps, and electrical controls and instrumentation supplied by the MSS. Calculations for the piping system shall be sufficient to demonstrate that the system is hydraulically stable (balanced) under normal and backwash operation conditions. Submittals for pump(s) and throttling and modulating valve(s) shall also include calculations to show that cavitation does not occur over the specified operating range(s).

All calculations shall be sealed by a Professional Engineer registered in the State of Florida.

3.2.2.4 Construction Submittals

The Company shall submit construction information on the products and materials related to the work in this Section to the County Technical Advisor. In addition, information shall be furnished to the County Technical Advisor on the following items:

3.2.2.4.1 General Submittal Requirements

Submit complete product data and shop drawings required to establish compliance with these Technical Requirements and Guidelines

Submittals shall include as a minimum:

- Certified drawings showing all important details of construction and dimensions.
- Shop Drawings illustrating materials and equipment which become an integral part of the Project. These drawings shall be complete and detailed. Shop Drawings shall consist of fabrication, erection and setting drawings and schedule drawings, manufacturer's scale drawings, wiring and control diagrams, and bill of materials. Cuts, catalogs, pamphlets, descriptive literature, and performance and test data, shall be considered only as supportive to required Shop Drawings as defined above.
- Manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard material product data and descriptive data shall be clearly marked to identify pertinent materials, product or models.
- The total weight of each item.
- A complete bill of materials.
- Equipment performance data and pump curves.
- As applicable, valve Cv data and head loss characteristics as a function of the entire flow range for both full open and 10, 20, 30, 40, 50, 60, 70, 80, and 90 percent open.
- Actuator torque requirements for normal and maximum pressure operation.
- Recommendations on installation direction with respect to one and two-way flow.

- Additional submittal data, where noted with individual pieces of equipment. For each component to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required hydrostatic tests and certification of proper installation.
- Manufacturer's Installation and Application Data.
- All items required by the Technical Advisor

All construction submittal calculations, as applicable, shall be stamped by a Professional Engineer registered in the State of Florida.

MSS Submittals

- A list of spare parts recommended by the MSS
    - The spare parts shall include but not be limited to retaining rings, port nuts, head seals, permeate port seals, permeate ports, thrust cones, adapter seals, adapter, etc. as applicable to the system.
- Shop drawings and specifications for all purchased equipment
- Name and qualifications of stainless steel fabricator and supplier
- Updated Schematic Drawings
    - P&IDs of the NF and RO systems, including hydraulic and pneumatic schematics detailing the equipment supplied by the MSS and showing equipment provided by the Company that will interface with the NF and RO systems. Battery limits of MSS' scope of supply shall be clearly delineated by hatching, line weight, etc.
    - Electrical wiring diagrams including motor horsepower and other electrical load information and identification of external wiring connections and for use by the Company to install and make operational the supplied equipment.
- System Arrangement Drawings – The Company shall submit MSS-prepared arrangement drawings for the following:
    - Provide general arrangement plan and elevation views of all major components and subsystems, detailing orientation of equipment, piping, fittings and valves (including valve actuators).
    - Provide arrangement drawings of the CIP equipment and interconnecting pipe work, valves, supports, and appurtenances for the membrane system. The arrangement drawings must allow space for electrical conduits, and all associated utilities.
    - A bill of material for all devices, components, and appurtenances supplied with each membrane skid including component original part numbers identifying each furnished component.
    - Provide setting drawings, templates for the installation of anchor bolts and other anchorages for the system.
- Component Equipment – The Company shall submit MSS-prepared technical information for all items of component equipment including:
    - Pumps, compressed air equipment, air blower equipment, valves/actuators, CIP equipment, instrumentation, flow meters, and analyzers, showing all dimensions, materials of construction, performance ratings, set points, component parts, construction details, weight, factory finish system, mechanical and electrical drawings.
- NF Membrane Modules

- Provide element construction details (e.g., active membrane surface area), standard performance parameters, storage, and handling requirements.
- Provide standard commercial part numbers and materials for elastomeric seals.
- Provide standard operating and maintenance data, including storage solutions (concentration and volume) used during shipment and recommended rinsing solution and volume and long and short-term storage protocols.

▪ RO Membrane Modules
  - Provide element construction details (e.g., active membrane surface area), standard performance parameters, storage, and handling requirements.
  - Provide standard commercial part numbers and materials for elastomeric seals.
  - Provide standard operating and maintenance data, including storage solutions (concentration and volume) used during shipment and recommended rinsing solution and volume and long and short-term storage protocols.
▪ Design Calculations
  - Include calculations for equipment anchorage and supports as required herein. Calculations shall be stamped and signed by a professional engineer registered in the State of Florida. The engineer may be employed by either the MSS or the Company.
▪ Manufacturer's literature, illustrations, specifications, weights, pump curves, and engineering data for project engineered equipment including dimensions, materials, sizes, and performance data.
▪ For all pumps with capacities greater than 1.0 hp, provide performance data curves showing the following parameters as defined in the Hydraulic Institute Standards over the full operating range of the pump. Variable speed curves shall be provided showing at least five (5) speeds plotted equally from maximum rpm to minimum rpm. Minimum rpm shall be no less than that required to obtain minimum flow. Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Indicate on the performance curves the point of operation of the pump and the minimum and maximum recommended operating points. Catalog sheets showing a family of curves will not be acceptable.
  - Total head in feet.
  - Hydraulic capacity in gallons per minute.
  - Horsepower demand.
  - Pump efficiency.
  - Net positive suction head required in feet.
▪ Piping Fabrication and Assembly Drawings – For all MSS supplied system piping, provide double-line scaled drawings showing all fittings, valves, instruments and supports.
  - Provide fabrication details for piping and structures elevation views of all major components and subsystems supplied by the MSS, detailing orientation of equipment, piping, fittings and valves (including valve actuators).
  - Identify piping materials and fabrication details as required.
  - Each support shall be identified by catalog number or shop drawing detail number.
▪ Instrumentation and Control Drawings, including:

- Panel Construction Drawings: Provide construction drawings for all NF and RO system panels.
- Panel Wiring Diagrams: Provide panel-wiring diagrams or I/O Schematics for all NF and RO system panels
- Loop Diagrams: Provide a complete set of control loop diagrams or wiring schematics incorporating similar information for all assigned NF and RO system control loops.
- Operator interface computer stations and personal communications service (PCS) submittals.
- Fieldbus Hardware Diagrams showing the following:
  - PLC Identification (rack, drop, slot, etc.)
  - All devices on the serial communications network including the fieldbus cable type and designation.
  - Termination devices.
  - A block depicting the signals generated (input to PCS) and control to (output from the PCS) the individual fieldbus devices.

- Design calculations related to sizing of key components, including the overall System, pumps, valves, cartridge filters, membrane units, air compressor system, clean in place (CIP) system, chemical dosing pumps, CIP pumps, and electrical controls and instrumentation supplied by the MSS. Calculations for the piping system shall be sufficient to demonstrate that the system is hydraulically stable (balanced) under normal and backwash operation conditions. Submittals for pump(s) and throttling and modulating valve(s) shall also include calculations to show that cavitation does not occur over the specified operating range(s).

Maintenance Submittals

- Submit a list of special tools and the manufacturer's standard spare parts being supplied.
- Provide a list of all spare and replacement parts with individual prices and location where they are available.
- Operation and Maintenance (O&M) instructions.

3.2.2.5 Performance Requirements

General performance requirements for the wells and the WTP are outlined in Section 15, and as identified specifically under each component.

The Company and MSS shall design a NF system, to treat BA raw water, and a RO system, to treat UFA raw water, to produce permeate product water. Subsequent to blending of the permeate from the NF and UFA membrane treatment skids and upon the completion of all post-treatment processes, the blended permeate shall meet all finished water quality requirements listed in Table 1-1.

3.2.2.6 Well Construction Requirements

The Contractor shall be familiar with all FDEP, SFWMD and local (Miami-Dade RER, aka DERM) permit conditions of the UFA test well program and shall comply with all requirements of the permit(s) as they relate to the well construction and testing. For all well construction activities, a licensed water well driller in the State of Florida in accordance with Chapter 373, Part III. Florida Statutes, Regulation of Wells shall be required. The drilling contractor shall have experience in working with wells under the high artesian pressures that will be encountered in the wells in South Florida and be experienced drilling in the geologic formations of South Florida, including drilling to depths greater than 2,500 feet below land surface.

Personnel requirements for well construction crew shall include the following:

- Well drilling employees in a supervisory position must be WellCAP trained before mobilization. WellCAP school for all driller's staff to include superintendents, drillers, cementers, and the operations manager
- All driller's employees working on the Project site shall be First Aid and CPR certified
- All driller's superintendents and drillers shall be OSHA Outreach 30-hour and HAZWOPER 24-hour certified

Drill rig(s) Requirements:

- API rated to meet hook load requirements to successfully complete the Project
- Contractor shall provide an Engineer approved flow prevention device to control the artesian head pressures during drilling or coring within the Floridan Aquifer System
- Lifting devices must be suitable for all construction and testing activities (which includes and not limited to drilling, casing and tubing elevators, links and cables)

For work related to mechanical integrity testing on the deep injection wells, the drilling contractor or geophysical logging contractor must hold a license from the Florida HRS Bureau of Radiation Control for the required geophysical logging that will be performed under this Contract; and the logging vehicle used will be licensed ("placcable") by the Florida Department of Transportation for the transportation of radioactive materials; and that the driver of the logging vehicle has a Commercial Driver's License with an "H" endorsement for radioactive materials.

3.2.3 Specific Requirements

The following are specific requirements for the various components of the water supply process and pumping equipment.

3.2.3.1 BA Wells

During drilling and performance testing, management of waste drilling fluids and solids shall be maintained so that there are no adverse impacts to sensitive environmental receptors on or off site properties.

The two well site locations anticipated for the installation of the BA wells are the Former Plant site (FP) and Caribbean Park (CP). The number of BA wells shall be sufficient to supply enough raw water to blend with the UFA raw water supply to meet the design criteria referred to in Section 1.5 and 2.3.1, but not exceed the WUP withdrawal amounts listed in Section 1.2.1.

Test/pilot holes shall be drilled at each well location to sufficient depths to determine casing seat depths, production zones and if the water well can be constructed with an open hole interval or will require a gravel pack and screen.

The BA wells shall be constructed of approximately 30 feet of steel (ASTM A53 API 5L) surface casing set into a hardpan layer. Final casing shall be constructed of approximately 45 feet of Schedule 80 PVC (ASTM 1784, F480) casing. The remainder of the well will be constructed with open borehole. If formation constraints require any of the production wells to be screened, the well screen shall be continuous slot 316L stainless steel. The individual screen may be separated by stainless steel casing blanks depending on formation conditions based on hydrogeologic data collected during test/pilot hole construction. In addition, slot size and gravel pack gradation will be determined from the hydrogeologic data to be consistent with the formation in the production interval. A minimum 5 foot long stainless steel sump shall be installed beneath the screen to collect any fines pulled into the well from the production interval. The screen shall extend up into the PVC final casing with a minimum of

10 feet of overlap. The Company is responsible for all wellhead completion with required piping, valves, appurtenances and instrumentation. Refer to the selected design drawings included in Appendix B of Volume III.B for guidance on specific construction details.

Well acceptance criteria includes development of the wells meeting a minimum criteria of a sand content less than 5 mg/L, turbidity ≤ 1 NTU and a Silt Density Index less than 3.0 while pumping at design flow rates. The development water quality standards apply to final well completion (after all testing is complete and permanent pump installed). Monitoring of parameters shall begin after 5 minutes of pump start up and be in compliance with Well Development of AWWA Standard A 100-06. In addition, the well shall yield shall be sufficient to meet supply demand as stated in Section 1.5, but not cause adverse impacts to the aquifer or other surface water bodies. The water quality of the BA wells shall meet requirements listed in Section 1.4.1.

3.2.3.2 UFA Wells

The UFA contains brackish water under artesian pressure. Drilling and performance testing of all UFA wells requires management of waste drilling fluids and saline formation water. A fluid management system shall be designed, installed and maintained to prevent any potential spills and cross contamination of brackish water into the freshwater aquifer. The fluid management system must be capable of managing a minimum of 2 mgd discharge during UFA drilling and testing.

The conceptual design capacity of the UFA wells estimates 12 wells with an approximate nominal pumping capacity of 2 mgd in order to meet withdrawal production of BA and UFA blended 17.5to produce 20 mgd of finished water. In addition, two wells will be required for redundancy. However, the conceptual design, including the final number of production wells, anticipated well drawdown, well spacing and water quality, must be confirmed by hydrogeologic testing and evaluation, which was not available at the time of these performance specifications. The Hydrogeologic Testing Plan for the UFA wells is provided in Appendix I of Volume III.B. The conceptual UFA wellfield layout is illustrated in on Figures C-2 through C-12 in Appendix B of Volume IIIB. One UFA well is located at the northwest corner of the SMW WTP site (SMH-1), nine UFA wells along the southern bank of the C-1 Canal (SMH-2 through SMH-10) and the remaining four UFA wells are located at the Roberta Hunter Park (RHP) labeled SMH-11 through SMH-14.

Three of the 14 UFA wells, SMH-1, SMH-12 and SMH-6, will be constructed as test wells during the hydrogeologic testing program. Pending acceptable results, these wells shall can be converted to production wells by completing the well head, installation of the pump, plumbing and appurtenances and connecting to the raw water transmission line.

The well site locations were oriented to meet siting and setbacks in accordance with regulatory requirements. However, a variance for well construction permitting (Request for Variance from rule 62-555.312 – Location of Public System Wells) will be required for the wells located along the C-1 Right-of-Way (within 50 feet of surface water body). Compliance with Miami Dade County Noise Ordinance must be maintained. In addition, temporary noise barriers may be required for the C-1 ROW sites due to close proximity of residents.

The UFA well construction shall consists of a pit casing, surface casing, intermediate casing, final casing and open borehole interval. The pit casing shall be a minimum of 40 inch outer diameter, 0.375 inch wall steel set and grouted in place to a depth of the contractor's discretion. The surface casing shall be 34 inch outer diameter, 0.375 inch wall steel casing set and grouted in place through the surficial aquifer system (estimated 160 feet ± bls). An intermediate casing shall be grouted in place through the Hawthorn Group (estimated 950 feet ± bls). The final casing shall be 20 inch inner diameter, 0.63 inch wall fiberglass casing manufactured by Ershigs or equal. The fiberglass casing shall be set and grouted in place into the Upper Floridan aquifer at a depth (estimated 1,100 feet ± bls). Grout shall consist of Type II neat cement. The open hole interval shall be a nominal 18 inches in diameter extending is estimated to extend from approximately 1,100 ± feet to 1,300 ± feet bls. The Company is responsible for all wellhead completion with required piping, valves, appurtenances and instrumentation. Figure M-2 illustrates specific construction details of the UFA wells for guideline reference.

3.2.3.3 Well Acceptance

Well acceptance criteria includes development of the wells shall meeting minimum criteria of a sand content less than 5 mg/lL, turbidity ≤ 1 NTU and a Silt Density Index less than 3.0 while pumping at design flow rates. The development water quality standards apply to final well completion (after all testing is complete and a permanent pump installed). Monitoring of parameters shall begin after 5 minutes of pump start up and be in compliance with Well Development of AWWA Standard A 100-06. In addition, the well yield shall be sufficient to meet supply demand as stated in Section 1.5, but not cause adverse impacts to the aquifer or other resources. The water quality of the UFA wells shall meet requirements listed in Section 1.4.2.

3.2.3.4 Raw Water Pumps (BA) and Wellhead

3.2.3.4.1 Raw Water Pumps

The Company shall furnish, test and place into satisfactory operation submersible turbine pumps complete with drives and appurtenances necessary to provide a complete installation as specified herein and as shown on Figures in Volume III.B of this RFP.

The equipment described herein shall pump raw water from Biscayne Aquifer wells continuously or intermittently through a raw water transmission main to the South Miami Heights Water Treatment Plant.

The Equipment Supplier shall have unit responsibility for supplying each of the pump units under this specification inclusive of the following components:

- Submersible turbine pump
- Intake screen
- Check valve
- Submersible pump motor
- Motor shroud
- Discharge column assembly
- Surface plate
- Water-tight cable glands
- Submersible power cable
- Riser pipe
- Submersible temperature sensor cable
- Pump safety cables
- All other appurtenances and accessories required for a complete installation of the system

The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

Pump Bowls

Pump bowls shall be nickel aluminum bronze, ASTM B148, Alloy C95800. Castings shall be free from blow holes, sand holes, and all other defects and shall be accurately machined and fitted to close dimensions. All bolts used in bowl assembly shall meet the requirements of ASTM A193, Grade B8M.

Suction and Discharge Cases

Each pump bowl assembly shall have a motor adaptor and a female threaded discharge case of nickel aluminum bronze, ASTM B148, Alloy C95800. The discharge case shall incorporate a factory set shaft upthrust plug.

Impellers

Impellers shall be of the enclosed type as required to meet the specified performance requirements and shall be accurately machined and dynamically balanced. The impellers shall be secured to the shaft with Type 316 stainless steel tapered lock bushing. Impellers shall be nickel aluminum bronze, ASTM B148, Alloy C95800.

Bowl Shaft

The pump shall have a Type 316 stainless steel shaft.

Wear Rings

Impeller wear rings shall be nickel aluminum bronze, ASTM B148, Alloy C95800. Bowl wear rings shall be Type 316 stainless steel. Bowl wear rings shall have a Brinell hardness of 50 units greater than that of the impeller wear rings.

Bearings

Pump shall be furnished with bowl, discharge case and motor adaptor housing bearings. Pump shall be provided with fluted rubber bearings. All bearings shall be water lubricated. The motor adaptor housing bearing shall be equipped with a sand collar to exclude sand from the bearing.

Riser Pipes

The riser pipe shall be Type 316L stainless steel schedule 10S pipe. Pipe shall be furnished in sections not over 20 feet in length and joined with class 150 type 316L stainless steel flanges. The perimeter of flanges shall be notched to accept the electrical cables and level sensor cable and the cables secured to the flanges with 316 stainless steel bands. Schedule 40S Type 316L stainless steel threaded by flanged end adaptor nipples shall be provided as follows:

- Between the threaded riser check valve and the flanged riser pipe
- From the threaded pump discharge case
- From the threaded riser check valve and the flanged end of the pump discharge adapter nipple

Well Discharge Heads and Surface Plates

The surface plate shall be fabricated from Type 316L stainless steel with a flat base flange to match the well casing flange and a Type 316L stainless steel discharge elbow terminating in a flat-faced, class 150 Type 316L stainless steel flange. A 12-inch long Type 316L stainless steel flanged nipple shall extend below the surface plate for connections to the riser pipe. The plate shall be furnished with lifting lugs to support the complete weight of riser pipe, pump and motor. The surface plate shall be provided with penetrations for electrical and instrumentation cables as follows:

- 2-inch FNPT half coupling for power cable gland

- 2-inch FNPT half coupling for over-temperature sensor cable gland
- 1-inch FNPT half coupling for water level sensor cable gland
- 1-1/2 inch FNPT half coupling for well head vent

Bolts

Riser pipe flange bolts shall meet the requirements of ASTM A193, Grade B8M.

Pump Safety Cables

Provide two pump safety cables to support the pump and its appurtenances. The cables shall be anchored to prevent the pump from falling down the well in the event of a drop pipe failure. Each cable shall be capable of supporting the entire weight of the pump and its appurtenances. The cables and their connections shall be sized to carry the pump load and its appurtenances (including drop pipe, cables, etc.) with an ample safety factor. The cables shall be 316 stainless steel.

Cable Glands

The surface plate shall be provided with watertight cable glands to seal cable penetrations. The glands shall be as manufactured by O.Z. Gedney or equal.

Riser Check Valves

The pump(s) shall be equipped with a check valve fitted to the pump discharge casing. The valve shall be of the spring-loaded globe or double leaf type and designed specifically for submerged, deep well service. Provide break away plug to release water in riser pipe when removing pump from the well. Riser Check Valves shall comply with the following:

- Valve body material: 316 stainless steel
- Internals material: 316 stainless steel
- Spring material: 316 stainless steel
- Sealing Elastomers: Buna-N
- Working pressure: 300 psi

Nameplates

Each pump shall be equipped with a stainless steel nameplate indicating rated head in feet, flow in gpm, efficiency at design point, pump speed, pump size and type, impeller size, motor horsepower, and manufacturer's name, model and serial number. Nameplate shall be affixed to the surface plate.

Suction Strainer and Cable Guard

Each pump shall be furnished with a stainless steel suction strainer fitted to the motor adaptor housing and a stainless steel cable protector to protect the submersible cable where it passes alongside the pump. The stainless steel thickness must be equivalent to 14 gauge or thicker.

Flow Shroud

Pump manufacturer shall provide a flow shroud to direct flow past the motor if required cooling water velocity to meet a service factor of 1.15 exceeds 0.5 fps. Shroud shall be fabricated of schedule 80 PVC and be securely attached to pump and motor.

Pumps and Motors

Motor shall be equipped with water lubricated sleeve type radial bearings and Kingsbury type thrust bearing. Thrust bearing capacity must be adequate for all thrust loads imposed by the pump from shut-off through the operating range of the pumps. Provide stainless steel shaft and coupling should be provided.

External wetted metal motor components shall be either stainless steel or coated with an epoxy coating meeting NSF 61 to a DFT of 10 mils. Provide each pump with the required length of heavy-duty power and control cable suited for submerged service. Cables shall be flat jacketed and voltage drop should not exceed 3%. Motor winding insulation shall be suitable for continuous service at a maximum insulation temperature of 75 degree Celsius.

The submersible motors should be protected either via a (1) thermal switch with a 120 V, 10A dry contact output wired to motor overheat trip, or (2) motor winding temperature RTD system. Refer to **Table 3-1** for Pump Data and **Table 3-2** for Motor Data.

Pump Performance Requirements

- Total Number of Units: 3
- Liquid to be Pumped: Biscayne Aquifer Water
- Liquid Temperature (degrees F): 70 - 80

Table 3-1 Pump Data (Raw Water Pumps)

Criteria	Data
Flow(gpm)	2,800
Total Head (feet)	130
Minimum Pump Efficiency	75
Discharge Column Size (inches)	12

Table 3-2 Motor Data (Raw Water Pumps)

Criteria	Data
Maximum Hp (Non-overloading)	120
Maximum Speed (rpm)	3,500
Speed Control	Variable Frequency
Power Supply	460V, 3-Phase, 60 Hz

3.2.3.4.2 Wellhead

The Company shall furnish, test and place into satisfactory operation Biscayne Aquifer wellheads with appurtenances necessary to provide a complete installation as specified herein and as shown on figures in Volume III.B of this RFP.

Wellhead Stainless Steel Pipe

The Company shall install stainless steel pipe and all appurtenant work, complete in place. All pipe should be Schedule 10S, stainless steel, welded seam, annealed after welding, pickled and passivated. Flanges should conform to ANSI B16.5, 150 lb, forged stainless steel, weld-neck or slip-on by flat face, smooth face finish. Gaskets should be 1/8" thick, full face EPDM or fluoroelastomer gaskets rated for 275 psig operating pressure. Pipe components shall be manufactured in accordance with the following data found in **Table 3-3**.

Table 3-3 Pipe Components (Wellhead Stainless Steel Pipe)

Component	Material ASTM	Dimensional ANSI
Pipe	A312, Gr TP 316L	B36.19
Flanges	A182, Gr F 316/316L	B16.5
Gaskets	------	B16.21
Bolts	F593, Grp. 2	B18.2.1
Nuts	F594, Grp. 2	B18.2.2
Bolt Length	------	B16.5
Bolt and Nut Threads	------	B1.20.1

Valves (General)

All valves shall have a minimum design pressure rating of 150 psi and capable of a test pressure of 300 psi. For service applications with pressures in excess of 150 psi, valves shall have a minimum pressure rating in excess of the service application working pressure. All above grade, interior valves with a nominal pipe size of 3 inches and larger shall have flanged ends unless otherwise noted. All above grade, interior valves less than 3 inch size shall be threaded ends. Buried service valves shall have mechanical joint pipe ends. Buried service valves shall be provided with AWWA operating nuts, extension stems and cast iron valve boxes. Extended valve stems, stem guides and operating nuts shall be provided as indicated or required.

Ball Valves

In a stainless steel piping application, ball valves shall be end entry type with type 316 stainless steel body and trim, Teflon seats and seals and flanged or threaded connections as indicated on the Drawings. Valve body shall be either two or three piece design; no internal ring for the ball shall be acceptable. All stainless steel ball valves shall be flanged in conformance with ANSI B16.5 Class 150, unless otherwise shown on the Drawings. For flanged valves, the manufacturer shall select gasket material which is suitable for the intended service.

Valves shall be supplied with stainless steel manual lever or "T" handle. Valves used as moisture drain valves shall be installed at low points of the line and piped to drain.

Butterfly Valves

Butterfly valves shall have ANSI 150 wafer bodies. Valves shall meet ANSI/FCI 70-2 Class IV requirements for bi-directional shutoff and be suitable for 275 psi, CWP. Valve disc shall be of the double-offset type and the seat ring shall be contained in the body. Valve shall be suitable for continuous throttling or modulating service. All manual actuators for this valve type shall be geared. Valve bodies and discs shall be ASTM A351 gr. CF8M and shafts should be AINSI 316. Valve seats and packing should be Polytetrafluoroethylene (PTFE).

Air and Vacuum Pressure Relief Valves

Combination air and vacuum relief valves shall exhaust large quantities of air during the filling of a pipeline or vessel. The valve shall be capable of venting air without blowing shut; closing only after all the air has been vented. The valve shall continue to release small quantities of air under pressure as often as needed to keep the system free of accumulated air. The valve shall automatically open to allow air to re-enter during draining or whenever a negative pressure occurs.

The air release valves shall be provided with a ¼-inch diameter orifice, 1-inch inlet and ½- inch outlet. The vacuum relief valves shall be spring-loaded poppet type set to crack at 0.25 psi vacuum. The vacuum relief valve shall be provided with a 2-inch inlet and shall be equipped with a hood and screen assembly on the outlet.

All vacuum relief and air release valves shall be provided with cast CF8M stainless steel bodies, 316 stainless steel trim and replaceable seats of Buna-N. Plastic or bronze components are not acceptable. Combination air and vacuum relief valves shall conform to the requirements of AWWA C512. Valves shall be rated for a 150 PSIG working pressure.

All connection piping and valves between the air vacuum and air release valves shall be 316 stainless steel materials. All air release valves shall be provided with a gooseneck on the air release vent connection using 1/2-inch diameter 316 stainless steel piping and fittings for exhausting the vented air downward. All combination air and vacuum relief valves shall be supplied with a stainless steel ball valve for isolation. The ball valve shall be equal in size to the inlet of the vacuum relief valve.

Pressure Relief Valves

The valve body and cover shall be of 316 stainless steel. All main valve components (valve seat, valve stem, and valve trim) and all pilot system components (tubing and fittings) shall be 316 stainless steel. The main valve shall be a hydraulically operated, single diaphragm actuated, globe pattern valve. Y-pattern valves shall not be permitted.

The exposed portion of the seat disc shall contact the valve seat and seal drip-tight. The disc and diaphragm assembly must be guided by two separate bearings, one installed in the valve cover and one concentrically located in the valve seat, to avoid deflection and assure positive disc-to-seat contact. Center guided valves will not be permitted. All necessary repairs shall be made from the top of the valve while the body remains in line.

The disc and diaphragm assembly shall contain a EPDM synthetic rubber disc with a rectangular cross-section that is securely retained on 3-1/2 sides by a disc retainer and disc guide. Diaphragm assemblies utilizing bolts or cap screws for component retention will not be permitted.

The main valve seat the stem bearing in the valve cover shall be removable. The cover bearing and seat shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem the valve body and cover shall be machined with a locating lip. No “pinned” covers to the valve body shall be permitted. Cover bearing, disc guide, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

The pilot control system shall contain Single Limit Switch, 3-way Accelerator Pilot with integral orifice. Backpressure Pilot, Adjustable Closing Speed Controls, (2) Check Valves, an external Y-Strainer and Isolation Ball Valves on all body connections. The pilot control system shall utilize 316 stainless steel tubing and fittings. The adjustment range of the pressure sustaining pilot shall be 20-200 psi.

The valve pilot system shall have isolation valves to isolate the pilot system from line pressure to facilitate pilot control maintenance. Also, the valve pilot system shall have a “Y” strainer. The “Y” strainer shall have an appropriately sized ball valve installed on it which can be used to flush out to atmosphere any debris that the strainer screen collects.

An adjustable limit switch assembly shall be mounted on the main valve connected to the main valve stem. It shall be actuated by opening or closing of the valve an easily adjusted to operate at any point of the valve’s travel. The limit switch will be used to remotely indicate the valve position (open or closed). The limit switch shall be rated for 120 Volt 3 Amp, and the contacts configuration shall be SPDT. The limit switch shall be 316 stainless steel.

3.2.3.5 Raw Water Pumps (UFA) and Wellhead

3.2.3.5.1 Raw Water Pumps

The Company shall design, furnish, test and place into satisfactory operation submersible turbine pumps complete with drives and appurtenances necessary to provide a complete installation as specified herein and as shown on Figures in Volume III.B of this RFP.

The equipment described herein will pump raw water from brackish Upper Floridan Aquifer wells continuously or intermittently through a raw water transmission main to the South Miami Heights Water Treatment Plant.

The Equipment Supplier shall have unit responsibility for supplying each of the pump units under this specification inclusive of the following components:

- Submersible turbine pump
- Intake screen
- Check valve
- Submersible pump motor
- Motor shroud
- Discharge column assembly
- Surface plate
- Water-tight cable glands
- Submersible power cable
- Riser pipe
- Submersible temperature sensor cable
- Pump safety cables
- All other appurtenances and accessories required for a complete installation of the system

The materials covered by these requirements are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

Pumps and Motors

All submersible well pumps and motors under this contract shall be provided by one manufacturer. The pumps shall be capable of pumping the design flows at the pressures required to supply the RO skids. The pumps shall be equipped with variable frequency drives, and have a minimum efficiency of 70%.

Pump and Discharge Column Assembly

The pump shall be a submersible turbine pump, multistage, deep well pump suspended in well from pump discharge column and surface plate. Pump bowls shall be of Duplex 2205 stainless steel free from blowholes, sandholes, or other defects; accurately machined and fitted

Each intermediate bowl shall be constructed with a Teflon bearing to support the impeller shaft. The bowl unit shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at the rate capacity of 1.5 times the shutoff head, whichever is greater.

Bowl

Unit shall include a bearing to carry the momentary upthrust encountered at start-up. The bowl unit shall include a metal guard to protect the motor cable from abrasion during installation.

Interconnector

The interconnector shall be made of Duplex 2205 stainless steel and shall couple the bowl unit to the motor. The interconnector shall include a Teflon sleeve bearing with a length to shaft diameter ratio of at least 3:1 to protect the motor from radial loads. This bearing shall be protected from sand and grit by a labyrinth-type sand slinger. The interconnector shall be open type to allow abrasives to be flushed from the coupling and motor seal area. The interconnector shall include a suction screen which has a net open area at least four times the area of the eye of the impeller. The screen shall be made of 2205 Duplex stainless steel.

Impeller Shaft

The impeller shaft should be of 2205 Duplex stainless steel and adequately supported by composite carbon bearings in top and suction bowls and by bearings in intermediate bowls.

Impellers

Impellers enclosed type, Duplex 2205 stainless steel, finished all over, accurately fitted, perfectly balanced mechanically and dynamically, and securely locked to shaft.

Column Pipe

The column pipe shall be Duplex 2205 stainless steel, with stainless steel flanges meeting AWWA dimensional requirements. Bolts and Nuts to be 316 stainless steel. Each 20 foot section of column shall be fitted with stainless steel centralizer. The flanges shall be notched to allow the level transmitter and control cables to pass down the column. The column pipe shall be connected to the pump and pump column surface plate using stainless steel Type 316 adaptors. The adaptors and column pipe shall be furnished by the pump manufacturer and expressly designed with adequate strength to support in operational, stationary and maintenance modes the electric motors, pumps, column pipe and appurtenances.

Pump Column Surface Plate

The plates shall be provided with bottom flange to be bolted to the top of a well casing and a top flange to be bolted to elbow plate. Elbow shall be pressure rated for 250 psi. Surface plates shall be fabricated of Duplex 2205 stainless steel.

Surface plates shall be furnished expressly designed with adequate strength to support electric motors, pumps, and column pipe. Surface plates shall be furnished with suitable lifting lugs to support complete weight of column, pump, and motor assembly. Surface plates shall rigidly support the total weight of the motor, bowl assembly, column pipe, cable and column of water. The cable outlet shall be designed to prevent entry of foreign matter into the well and shall be equipped with a cable seal.

The surface plate shall be provided with water tight cable glands to seal all cable penetration. Coordinate with all supplies as needed to determine proper sizing requirements for the cable penetrations. Cable penetrations shall be coordinated with the surface plate detail shown on the Drawings and the requirements of the each equipment supplier.

Pump Check Valve

The company should provide in-line check valves to be mounted directly above the raw water pumps. Check valves shall be of the in-line column type, specifically designed for submersible pump installations and manufactured by a submersible pump manufacturing company. All internal working parts shall be constructed of Duplex 2205 stainless steel, and the valve seal shall be of a durable nitrile to provide a positive shut-off. Valves shall be of the spring loaded design which will open immediately and automatically with flow and close silently upon cessation of flow. Valves shall be maintenance free and capable of providing long, dependable life under repeated daily operation. Valve body shall be constructed of Duplex 2205 stainless steel and shall have sufficient strength to support the full weight of the submersible pump, motor and column pipe filled with water. Valve body shall be of sufficient thickness to be drilled and tapped and provided with a break-off plug to drain the column of water for pulling of the submersible pump. Valve shall be rated at 425 psi maximum working pressure. The valve shall be manufactured from materials which have been classified by U. L. under ANSI/NSF 61. Valves shall be spring loaded globe type.

Pump Cable

Provide a pump cable to support the pump and its appurtenances. The cable shall be anchored to prevent the pump from falling down the well in the event of a drop pipe failure. The cable and its connections shall be sized to carry the pump load and its appurtenances (including drop pipe, cables, etc.) with an ample safety factor. The cable shall be 316 stainless steel or other material as approved by the Technical Advisor.

Motors and Power Cables

Motors shall conform to the latest National Electrical Manufacturers Association (NEMA) specifications for submersible motors. The motor thrust bearing shall be sized to carry the weight of all rotating parts plus the hydraulic thrust of the pump regardless of the direction of rotation. The thrust bearing shall have sufficient capacity to permit the pump to operate for short periods with the discharge valve closed.

The motor shall be of the squirrel cage induction type, inverter duty rated suitable for variable frequency drive operations. Motors shall be 3-phase, 60 Hz, 460 V, 3,500 RPM. The motor shall be capable of continuous operation underwater at the conditions specified. The power output shaft shall be Type 17-4 PH stainless steel or equivalent. All fastenings exposed to well water shall be of Duplex 2205 stainless steel or corrosion resistant material as approved by the Technical Advisor. Motor shall have a service factor of 1.15. Any oil used shall be FDA approved for contact with potable water. Motor shell shall be 316 stainless steel.

The Pump Motor Coupling shall be of Duplex 2205 stainless steel and shall be capable of transmitting the total torque of the unit, regardless of the direction of rotation. Submersible Cable shall be sized to limit the voltage drop to 2% at the motor's terminals. Three separate conductors shall be furnished. Each conductor shall be jacketed or the conductors may be included in a single jacketed assembly. The conductor insulation shall be water and oil resistant, suitable for continuous immersion.

The length of the cable to be furnished shall be the sum of total pump setting, including bowl unit plus two feet for each 50 feet of setting to compensate for possible twist or sag during installation, plus 40 feet to extend from the surface plate to the well control panel. Cable shall be provided as one continuous length without any splicing. The cable will be suitably supported from the column. All cable fittings and terminals shall be water tight at the pressure encountered in the application. All supports provided shall be Duplex 2205 stainless steel, PVC or other corrosion resistant materials as approved by the Technical Advisor.

A flow shroud shall be provided to direct the flow past the motor if required cooling water velocity to meet a service factor of 1.15 exceeds 0.5 feet per second. Shroud shall be fabricated of Schedule 40 PVC pipe and be securely attached to pump and motor.

Cable Glands

The surface plate shall be provided with water tight cable glands to seal all cable penetration. Coordinate with all supplies as needed to determine proper sizing requirements for the cable penetrations. The glands shall be as manufactured by O.Z. Gedney, or equal. Refer to **Table 3-4** for Pump Data and **Table 3-5** for Motor Data.

Pump Performance Requirements

- Total Number of Units: 14
- Liquid to be Pumped: Upper Floridan Aquifer Water
- Liquid Temperature (degrees F): 70 – 80

Table 3-4 Pump Data (Raw Water Pumps - UFA)

Criteria	Data
Flow(gpm)	1,400
Total Head (feet)	400
Minimum Pump Efficiency	75
Discharge Column Size (inches)	8

Table 3-5 Motor Data (Raw Water Pumps - UFA)

Criteria	Data
Maximum Hp (Non-overloading)	200
Maximum Speed (rpm)	3,500
Speed Control	Variable Frequency
Power Supply	460V, 3-Phase, 60 Hz

3.2.3.5.2 UFA Wellhead

The Company shall furnish, test and place into satisfactory operation Upper Floridan Aquifer wellheads with appurtenances necessary to provide a complete installation as specified herein and as shown on figures in Volume III.B of this RFP.

Wellhead Stainless Steel Pipe

The Company shall install stainless steel pipe and all appurtenant work, complete in place. All pipe should be Schedule 10S, stainless steel, welded seam, annealed after welding, pickled and passivated. Flanges should be of Duplex 2205 stainless steel, weld-neck or slip-on by flat face, smooth face finish. Gaskets should be 1/8" thick, full face EPDM or fluoroelastomer gaskets rated for 275 psig operating pressure. Pipe components shall be manufactured in accordance with the following.

Valves (General)

All valves shall have a minimum design pressure rating of 150 psi and capable of a test pressure of 300 psi. For service applications with pressures in excess of 150 psi, valves shall have a minimum pressure rating in excess of the service application working pressure. All above grade, interior valves with a nominal pipe size of 3 inches and larger shall have flanged ends unless otherwise noted. All above grade, interior valves less than 3 inch size shall be threaded ends. Buried service valves shall have mechanical joint pipe ends. Buried service valves shall be provided with AWWA operating nuts, extension stems and cast iron valve boxes. Extended valve stems, stem guides and operating nuts shall be provided as indicated or required.

Ball Valves

In a stainless steel piping application, ball valves shall be end entry type with type Duplex 2205 stainless steel body and trim, Teflon seats and seals and flanged or threaded connections as indicated on the Drawings. Valve body shall be either two or three piece design; no internal ring for the ball shall be acceptable. All stainless steel ball valves shall be flanged. For flanged valves, the manufacturer shall select gasket material which is suitable for the intended service.

Valves shall be supplied with stainless steel manual lever or "T" handle. Valves used as moisture drain valves shall be installed at low points of the line and piped to drain.

Air and Vacuum Pressure Relief Valves

Combination air and vacuum relief valves shall exhaust large quantities of air during the filling of a pipeline or vessel. The valve shall be capable of venting air without blowing shut; closing only after all the air has been vented. The valve shall continue to release small quantities of air under pressure as often as needed to keep the system free of accumulated air. The valve shall automatically open to allow air to re-enter during draining or whenever a negative pressure occurs.

The air release valves shall be provided with a ¼-inch diameter orifice, 1-inch inlet and ½- inch outlet. The vacuum relief valves shall be spring-loaded poppet type set to crack at 0.25 psi vacuum. The vacuum relief valve shall be provided with a 2-inch inlet and shall be equipped with a hood and screen assembly on the outlet.

All vacuum relief and air release valves shall be provided with cast CF8M stainless steel bodies, 316 stainless steel trim and replaceable seats of Buna-N. Plastic or bronze components are not acceptable. Combination air and vacuum relief valves shall conform to the requirements of AWWA C512. Valves shall be rated for a 150 PSIG working pressure.

All connection piping and valves between the air vacuum and air release valves shall be 316 stainless steel materials. All air release valves shall be provided with a gooseneck on the air release vent connection using 1/2-inch diameter 316 stainless steel piping and fittings for exhausting the vented air downward. All combination air and vacuum relief valves shall be supplied with a stainless steel ball valve for isolation. The ball valve shall be equal in size to the inlet of the vacuum relief valve.

Pressure Relief Valves

The valve body and cover shall be of 316 stainless steel. All main valve components (valve seat, valve stem, and valve trim) and all pilot system components (tubing and fittings) shall be 316 stainless steel. The main valve shall be a hydraulically operated, single diaphragm actuated, globe pattern valve. Y-pattern valves shall not be permitted.

The exposed portion of the seat disc shall contact the valve seat and seal drip-tight. The disc and diaphragm assembly must be guided by two separate bearings, one installed in the valve cover and one concentrically located in the valve seat, to avoid deflection and assure positive disc-to-seat contact. Center guided valves will not be permitted. All necessary repairs shall be made from the top of the valve while the body remains in line.

The disc and diaphragm assembly shall contain a EPDM synthetic rubber disc with a rectangular cross-section that is securely retained on 3-1/2 sides by a disc retainer and disc guide. Diaphragm assemblies utilizing bolts or cap screws for component retention will not be permitted.

The main valve seat the stem bearing in the valve cover shall be removable. The cover bearing and seat shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc guide, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

The pilot control system shall contain Single Limit Switch, 3-way Accelerator Pilot with integral orifice. Backpressure Pilot, Adjustable Closing Speed Controls, (2) Check Valves, an external Y-Strainer and Isolation Ball Valves on all body connections. The pilot control system shall utilize 316 stainless steel tubing and fittings. The adjustment range of the pressure sustaining pilot shall be 20-200 psi.

The valve pilot system shall have isolation valves to isolate the pilot system from line pressure to facilitate pilot control maintenance. Also, the valve pilot system shall have a "Y" strainer. The "Y" strainer shall have an appropriately sized ball valve installed on it which can be used to flush out to atmosphere any debris that the strainer screen collects.

An adjustable limit switch assembly shall be mounted on the main valve connected to the main valve stem. It shall be actuated by opening or closing of the valve an easily adjusted to operate at any point of the valve's travel. The limit switch will be used to remotely indicate the valve position (open or closed). The limit switch shall be rated for 120 Volt 3 Amp, and the contacts configuration shall be SPDT. The limit switch shall be 316 stainless steel.

3.2.3.6 Strainers

The strainers at the WTP shall be vertical pressure units used for the removal of sand, silt and other particulate matter that may be present in the raw water immediately following withdrawal from the supply wells. The strainer system shall be designed to maintain separate streams for the BA and UFA raw water supplies in order to minimize the risk of oxidation as a result of the presence of hydrogen sulfide in the UFA raw water and oxygen in the BA raw water.

The strainers shall be automatic self-cleaning strainers and shall have all required equipment, including motors. The strainers shall have a recovery rate of 97% to 98%. Strainers for the BA raw water shall be sized to treat a maximum of 3.0 mgd of BA raw water. Strainers for the UFA raw water shall be sized for the raw water flow required for purchase water volume, with consideration given to the ultimate future capacity of the plant of 20 mgd of UFA permeate. The number of units provided shall consider adequate redundancy, but should not be less than 1 for the BA raw water stream and 3 for the UFA raw water. Pressure loss across the duty units with clean straining elements shall not be more than 1.00 psig.

The body and cover shall be fabricated (stainless steel) designed, manufactured and tested generally to ASME Section VIII Standards, using qualified ASME Section IX welders. Strainers for BA raw water service shall be of 316 Stainless Steel. The straining element shall be manufactured from 316 Stainless Steel reverse rolled slotted wedge wire screen designed with 150 mesh openings capable of screening particles to 105 microns. The straining media shall be free of pockets, tubes, collector bars, etc., that accumulate and trap debris permanently.

Strainers for UFA raw water service shall be of duplex stainless steel , with a PREN of 32 or greater. The straining element will be manufactured from duplex stainless steel reverse rolled slotted wedge wire screen designed with 150 mesh openings capable of screening particles to 105 microns. The straining media shall be free of pockets, tubes, collector bars, etc., that accumulate and trap debris permanently

The strainer housing design pressure shall be suitable for the designed hydraulic conditions for each raw water transmission system, but should not be any less than 150 psig. Inlet and outlet connections shall be flanged and conform to ANSI B16.5 standards. The strainer shall have a single backwash connection and large drain connections located in vessel bottom. Unit shall be complete with factory supplied steel support legs for bolting to concrete or steel base.

The strainer shall be provided with drive shaft and hollow port assembly fitted with all necessary bearings and seals. The drive arm and hollow port assembly will be free running at a maximum speed of two (2) rpm and not contact with screen surface. Port assembly shall be factory and field adjustable for positive effective cleaning and shear capability. The drive shaft will be supported at the top with roller bearings located in a double reduction gear reducer and at the bottom with a water lubricated guide bearing. The gear reducer shall be driven by an appropriately sized motor.

Drive shaft/backwash arm assembly shall be fitted with an external source spray nozzle assembly. The external source spray assembly shall be mounted either internally or externally to the strainer element and attached to the hollow drive shaft/backwash assembly. Design of the spray assembly shall be in accordance with strainer design furnished.

The Strainer System shall be controlled by a control panel for each raw water stream that will interlock the operation of the strainers together, based on the raw water stream, so that only one strainer backwashes at a time in full "AUTOMATIC" mode. System shall include the following control package:

- A backwash control package shall be provided for continuous or intermittent operation of the backwash cycle.
- Control panel
  - NEMA 4X 316 stainless steel enclosure with an adjustable timer, relays, drive motor starter, selector switch Hands-Off-Auto (H-O-A) and "Power On","Backwash Operating", and "High Differential" indicating lights. Provide run relays for remote monitoring.
- Backwash valve with electric operator
  - Provide an open/close auto handswitch, open/close limit switches and indicating lights at the control panel.
- Controls shall be designed to accept a maintained "inhibit backwash" signal from the plant SCADA system. Strainers shall not backwash during the duration of this signal.
- Dual element differential pressure switch to override the timed backwash sequence while also providing for customer alarm.
  - NEMA 4X Enclosure
  - 460 V Power Supply with 460/120 V Transformer
  - Inlet and Outlet Pressure Gauges and Differential Pressure Indicating Gauge
  - Disconnect Switch
  - Circuit Breaker
  - PLC Interface

Provide required drain connections and lifting lugs. Provide an easy to read, corrosion resistant nameplate containing the manufacturers name, serial number, year fabricated, design pressure and temperature and ASME code stamp (if applicable).

3.2.3.7 Static Mixers

The raw water from BA and the UFA will be treated with acid to reduce the potential for calcium carbonate scale formation and with an antiscalant to reduce the potential for the precipitation of sparingly soluble salts. Static mixing shall be provided to ensure adequate mixing of pretreatment chemicals with the raw water. Two static mixers shall be provided for each raw water stream (BA and UFA), one for the injection of the acid, which shall be suitable for use with 93 percent sulfuric acid, and one for the injection of the antiscalant, which shall be suitable for use with 100 percent antiscalant (or alternate RO feedwater pretreatment chemicals as deemed appropriate by the Contractor). The BA static mixers shall capable of mixing the pretreatment chemicals with a maximum of 2.94 mgd of BA raw water. The UFA static mixers shall capable of mixing the pretreatment chemicals with a maximum of 27.2 mgd of UFA raw water.

Each static mixer shall be a standard product of proven ability as offered by a reputable static mixer manufacturer having long experience in the manufacture of such products. All static mixers provided shall be supplied by a single manufacturer to ensure uniformity. The static mixers for the BA raw water shall be constructed 316L stainless steel. The static mixers for the UFA raw water shall be constructed of duplex stainless steel (Duplex SS) with a PREN value of 32 or greater. The term “Duplex SS” shall include alloy numbers UNS S31803, SAF 2205, and S32205 and the cast equivalent alloy CD4MCuN, UNS J93372 specified as Grade 1B in ASTM A890 and A995. All the static mixers shall be of the continuous mixing design wherein the elemental geometry divides and rotates the influent flow while approaching a plug flow condition. The configuration for each static mixer shall consist of full elements which rotate the flow radially in opposing directions as the flow moves axially through the static mixer. Each static mixer shall provide complete mixing over the entire operational flow range. The minimum cross-sectional flow area for each static mixer shall be at least 98 percent of the open pipe area to minimize obstruction of flow and plugging. Each static mixer element shall be constructed so as to eliminate material hangup and to impart a uniform shear to process fluids. Each static mixer shall be provided with dual (redundant) chemical injection assemblies for each chemical to be injected into the static mixer. Each chemical injection assembly shall consist of a flanged chemical injection nozzle which shall be welded to the body of the static mixer, a solid Teflon chemical injection quill which shall be inserted into the flanged chemical injection nozzle, and a Teflon ball valve through which the Teflon chemical injection quill shall be inserted and which shall be bolted directly to the flanged chemical injection nozzle. Each chemical injection assembly shall be designed to allow for the isolation, insertion, and removal of the chemical injection quill while the static mixer is in service. The chemical injector shall be of sufficient strength and stiffness to insure flexural rigidity against the process flow. All materials that come into contact with the water stream shall be NSF approved. Static mixers shall be manufactured by Aerex Industries Inc., Chemineer Inc., Koch Glitsch Inc., Komax Systems Inc., or approved equal.

3.2.3.8 Cartridge Filters

Cartridge filtration shall be provided prior to both the BA and UFA membrane treatment units for the filtration of the feedwater to remove sand, grit, silt and other suspended material that may damage the membranes. In order to maintain the BA and UFA raw water supplies separate, a dedicated cartridge filter vessel shall be provided for the BA feedwater independent from the cartridge filter system to be provided for the UFA feedwater.

The BA cartridge filter vessel shall have a capacity sufficient to hold the required number and size of cartridge filter elements to filter a minimum of 2.94 mgd at loading rates of not more than 3.0 gpm per 10-inches of cartridge filter length. The UFA cartridge filter vessels shall have a capacity sufficient to hold the required number and size of cartridge filter elements to filter a minimum of 23.31 mgd at loading rates of not more than 3.5 gpm per 10-inches of cartridge filter length when all cartridge filter vessels are in service and not more than 4.0 gpm per 10-inches of cartridge filter length when one cartridge filter vessel is out of service.

3.2.3.8.1 Cartridge Filter Vessels

All cartridge filter vessels shall be horizontally mounted and shall be standard product of proven ability as offered by a reputable cartridge filter vessel manufacturer having long experience in the manufacture of such products. Vessels shall be suitable for potable water use. All cartridge filter vessels provided shall be supplied by a single manufacturer to ensure uniformity.

Each cartridge filter vessel shall be designed, fabricated, and stamped in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII, Division II. Each cartridge filter vessel, cover, internals, and all wetted parts shall be fabricated of Duplex stainless steel with a PREN value of 32 or greater. The term “Duplex SS” shall include alloy numbers UNS S31803, SAF 2205, and S32205 and the cast equivalent alloy CD4MCuN, UNS J93372 specified as Grade 1B in ASTM A890 and A995. Cartridge filter vessels shall have a minimum pressure rating of 150 psi.

The vessel supports, clevis brackets, and davit arm assembly for each cartridge filter vessel shall be manufactured of 316L stainless steel. Each vessel shall have Type 316 stainless steel swing closure bolts. Swing bolts shall be 1-¼ inch diameter hex head cap screw design with a 316 stainless steel, LDX2101 or aluminum bronze clevis pin. After all fabrication is completed, each cartridge filter vessel shall be cleaned, pickled and passivated. Following the pickling and passivation, all surfaces of each cartridge filter vessel shall be glass bead blasted. The inlet connection shall be on the side and outlet connection shall be at the end of the vessels. Inlet and outlet connections shall be provided with RFSO 150 psi flanges, Class D in accordance with AWWA C207. Each vessel shall have two guide pins to align the cover to the shell and two handles made from Duplex SS bar stock welded to the cover to allow for opening the cover. Each horizontal cartridge filter vessel shall include an alignment system that does not require removal during cartridge replacement, but can be removed for maintenance, if necessary. The system shall include a plate manufactured of Duplex SS with a hole pattern matching and aligning to the seat cup arrangement. The plate shall be bolted to four brackets welded to the interior of each horizontal cartridge filter vessel. Each cartridge filter vessel shall have an inlet diffuser plate fabricated of Duplex SS and be of a size at least 1.5 times the area of the inlet nozzle. The inlet diffuser plate shall be welded to the interior of each cartridge filter vessel at a minimum of four locations and shall have gussets in at least two other locations to provide stiffening of the plate. Each cartridge filter vessel shall be provided with a one piece machined separator plate with dual purpose seat cups suitable for double o-ring single open ended cartridge filter elements or double open ended cartridge filter elements utilizing a knife-edge sale. The separator plate shall be welded to the vessel shell on both the clean and dirty sides of the vessel. Separator plates with rolled in place seat cups shall not be used. Each cartridge filter vessel shall be welded by American Welding Society (AWS) certified welders. All pressure retaining welds shall be crevice free.

The vessels shall be provided with both clean and dirty water drain nozzles, as well as a 1/2inch air vent at the top. A 2-inch 3,000 lb NPT coupling will be used for clean and dirty drains for all vessels. A 4-inch, 150 lb flanged inspection port will be installed on clean side plenum at 90° from inlet and outlet centerline and shall be provided with a Duplex SS blind flange and type 316 stainless A193B8M bolts and nuts.

Cartridge filter vessels shall be manufactured by Aerex Industries Inc., the Process Filtration Division of Parker Hannifin Corporation, Cuno, or approved equal.

3.2.3.8.2 Cartridge Filter Elements

Each cartridge filter element shall be a standard product of proven ability as offered by a reputable cartridge filter element manufacturer having long experience in the manufacture of such products. All cartridge filter elements provided shall be supplied by a single manufacturer to ensure uniformity. Each cartridge filter element shall have a 5-micron (nominal), or less, rating. Each cartridge filter element shall be of the single open ended type with double o-rings (size 222) on the sealing end and a polypropylene flex-fin or spring on the closed end. Each cartridge filter element shall be self-supporting with no reinforcing structures of resin. Each cartridge filter element shall be of sufficient length to traverse the entire length of the cartridge filter vessel shell (from the dual purpose seat cups to the cover) with one element. Each cartridge filter element shall be of polypropylene construction and shall be continuously wound. The polypropylene material shall be 100 percent Food and Drug Administration (FDA) grade material with no binders or resins and shall be National Sanitary Foundation (NSF) certified for Standard 61, Drinking Water System Components – Health Effects.

Cartridge filter elements shall be manufactured by the Process Filtration Division of Parker Hannifin Corporation, Cuno, or approved equal.

The Contractor shall provide no less than three sets of cartridge filter elements for each cartridge filter vessel beyond those cartridge filter elements sets required for startup and testing.

3.2.3.9 Membrane Feed Pumps

The BA membrane treatment system shall be capable of producing not less than 2.5 mgd of permeate on a MDF basis from raw water of water quality characteristics from the BA at a recovery rate of 85 percent. Anticipated water quality for the BA wells is presented in Table 4-4 of Volume III.B for informational purposes only, design shall be modified as appropriate based on water quality results obtained from site-specific hydrogeological testing and groundwater modeling. The UFA membrane treatment system shall be capable of producing not less than 17.5 mgd of permeate on a MDF basis from raw water of both initial and degraded water quality characteristics from the UFA with all units in service over a system recovery range of 75 to 80 percent. Anticipated water quality for the UFA wells is presented in Table 5-2 of Volume III.B for informational purposes only, design shall be modified as appropriate based on water quality results obtained from site-specific hydrogeological testing and groundwater modeling. The membrane feed pumping units shall be selected to accommodate the operating conditions at both initial and degraded raw water quality conditions.

Each membrane feed pumping unit shall be of the multistage vertical turbine can type design and shall be a standard product of proven ability as offered by a reputable pump manufacturer having long experience in the manufacture of such products. All membrane feed pumping units provided shall be supplied by a single manufacturer to ensure uniformity. The maximum speed of all membrane feed pumps shall be 1,800 rpm. The membrane feed pumping unit for the BA membrane skid shall be of 316L stainless steel construction and shall include a Duplex SS (PREN > 32) can. The membrane feed pumping units for the UFA membrane skids shall be of Duplex SS (PREN > 32) construction and shall include a Duplex SS (PREN > 32) can. The Company shall coordinate with the pump manufacturer the size of the can for the BA membrane feed pumping unit to also be able to accommodate a pump similar to the membrane feed pumping units supplied for the UFA membrane skids in case UFA is used as water source in the future. Each membrane feed pumping unit shall be capable of variable speed operation and shall be provided with a variable frequency drive (VFD). Each membrane feed pumping unit shall be designed and constructed for 24-hour per day, 365 days per year continuous service at any and all points within the previously described range of operation without overheating or cavitating and without excessive vibration or strain. Each membrane feed pumping unit and its drive equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to backflow through the pump. The maximum reverse run-away speed shall not exceed 180 percent of the design pump maximum operating speed. All working parts of each membrane feed pumping unit shall be of standard dimensions such that parts can be interchanged between like units. All rotating parts of each membrane feed pumping unit shall be mechanically and hydraulically balanced so as to operate throughout the previously described range of operation without excessive thrust, vibration, or noise. The maximum allowable vibration measured at the top motor bearing shall not exceed the maximum peak to peak amplitude as set forth in the Hydraulic Institute Standards, latest edition. The natural frequency of each assembled membrane feed pumping unit and its supporting structure shall be at least 25 percent higher than the maximum pump speed.

Each membrane feed pumping unit shall be of the vertical turbine multistage type designed to pump pretreated raw water (feedwater) to the corresponding membrane skid. Each membrane feed pumping unit shall be self-lubricated, completely equipped with motor support of one piece construction, and shall conform to ANSI/AWWA E101, Vertical Turbine Pumps.

The discharge head for the membrane feed pumping unit of the BA skid shall be a one piece fabrication of 316L stainless steel ASTM A312, 3/8-inch minimum thickness with raised face ANSI B16.5 flange connections. The discharge head shall be thermally stress relieved after fabrication. The discharge head shall include a 316L stainless steel stuffing box with extra large openings for pump adjustment and seal maintenance. The membrane feed pumping unit for the BA skid shall include a 316 stainless steel John Crane Type 1 or A. W. Chesterton Type 880 self-aligning single inside mounted cartridge mechanical seal equipped with ceramic stationary and carbon rotating seal faces.

The discharge heads for the membrane feed pumping units of the UFA skids shall be a one piece fabrication of Duplex SS (PREN > 32) and shall be thermally stress relieved after fabrication. The discharge head shall include a Duplex SS (PREN > 32) stuffing box with extra-large openings for pump adjustment and seal maintenance. The membrane feed pumping unit for the UFA skids shall include a John Crane Type 1 or A. W. Chesterton Type 880 self-aligning single inside mounted cartridge mechanical seal with Inconel springs and Hastelloy metal parts equipped with ceramic stationary and carbon rotating seal faces.

Each discharge head shall be pickled and passivated after all welding is complete and shall be grit blasted to an even matte finish. The base of each discharge head shall be machined to match the drilling of the top of the suction can flange. The top of each discharge head shall have a registered fit for mounting the drive motor. The opening for the coupling shall be covered with a 316 stainless steel expanded metal mesh guard and fastened with 316 stainless steel screws.

The diameter of each pump shaft shall be determined from ANSI/AWWA E101, Vertical Turbine Pumps, Section A 4.1.5. Impeller shafts and couplings for the membrane feed pumping unit for the BA skid shall be of 316 stainless steel construction. Impeller shafts and couplings for the membrane feed pumping unit for the UFA skids shall be of Nitronic 50 or Duplex SS (PREN > 32) construction. Circular keys to carry thrust load and longitudinal keys to transmit torque shall be provided. The shaft for the BA skid membrane feed pumping unit shall be of 316L stainless steel construction, of one piece construction, and field replaceable. The shaft for the UFA skids membrane feed pumping unit shall be of Nitronic 50 or Duplex SS (PREN > 32) construction, of one piece construction, and field replaceable.

Each pump shall be equipped with a four piece rigid adjustable spacer coupling between the motor shaft and pump shaft to allow the replacement of the mechanical seal without disturbing the motor. The pump and motor shaft sections for each membrane feed pumping unit shall be joined with a shaft coupling, which shall be easily removed through the discharge head opening.

The pump bowl and suction bell for the membrane feed pumping unit for the BA skid shall be of 316 stainless steel, ASTM A351, Grade CF8M, flanged and bolted construction. All bowl hardware shall be 316 stainless steel. The impeller for the BA membrane feed pumping unit shall be of the enclosed type and of 316 stainless steel, ASTM A351, Grade CF8M construction. Each impeller shall be statically and dynamically balanced.

The discharge column shall be constructed of 316L SS for the BA unit and Duplex SS (PREN > 32) for the UFA units of flanged and bolted construction in lengths not exceeding 5-ft .

The pump bowl and suction bell for each membrane feed pumping unit for the UFA skids shall be of Duplex SS (PREN > 32), flanged and bolted construction. All bowl hardware shall be Duplex SS (PREN > 32). The impeller for the each UFA membrane feed pumping unit shall be of the enclosed type and of Duplex SS (PREN > 32) construction. Each impeller shall be statically and dynamically balanced.

The suction can for each membrane feed pumping unit shall be designed and supplied by the membrane feed pumping unit manufacturer. The suction can, flanges, and all accessories for each membrane feed pumping unit shall be constructed of super duplex stainless steel (PREN > 40) in accordance with the requirements of the manufacturer. The length and diameter of the can shall be determined by the membrane feed pumping unit manufacturer to meet the requirements of the specific application and installation. The can for the membrane feed pumping unit for the BA skid shall be sized to also accommodate an UFA membrane feed pumping unit with minor or no modifications. The annular flow velocity shall not exceed five feet per second for any operating point on the pump curve. The suction can shall meet all requirements of the Hydraulic Institute Standard for Pump Intake Design, ANSI/HI 9.8 (latest version). An internally mounted, stainless steel vertical flow splitter shall be installed within the suction can for each membrane feed pumping unit to prevent the possibility of fluid circulation around the pump bowl assembly.

After the manufacture and welding of all fabricated components for each membrane feed pumping unit, including each pump discharge head and each suction can, all stainless steel surfaces, including pump bowls, discharge column, and impellers shall be pickled and passivated in accordance with ASTM A380.

The natural frequency of the assembled pump and its supporting structure, shall be at least 25 percent higher than the maximum pump speed.

Each membrane feed pumping unit shall be equipped with suction and discharge pressure gauges. Each pressure gauge shall be of super duplex stainless steel construction with a super duplex stainless steel bourdon tube, glycerin-filled, and 2-½ inches in diameter. Each pressure gauge shall be furnished with an isolation valve, a diaphragm seal, and a pressure snubber. Each membrane feed pumping unit shall also be equipped with suction and discharge pressure switches. Each pressure switch shall be diaphragm actuated, single pole double throw, enclosed in a NEMA 4X housing, have Duplex SS (PREN > 32) wetted parts, and have a range and setpoint as recommended by the pump manufacturer.

Each membrane feed pump shall be driven by a vertical, inverter duty rated for variable speed, solid shaft, squirrel cage induction motor with a totally enclosed fan cooled (TEFC) enclosure which shall be provided by the membrane feed pumping unit manufacturer. Each motor shall be furnished with thrust bearings having ample capacity to carry the full weight of all rotating parts and hydraulic forces developed by continuous pump operation. Each motor shall have ball type centrifugal non reverse ratchets. Additional requirements of the membrane feed pumping unit drive motors are presented in Section 11.3.

Membrane feed pumping units shall be manufactured by Flowserve, Peerless Pumps, Sulzer, Fairbanks Morse, Goulds-ITT, or approved equal.

3.2.3.10 Turbochargers

An energy recovery device (ERD) shall be provided for each of the proposed RO membrane treatment skids. The system shall not expose any of the water streams (feed water, interstage or concentrate) to atmosphere to minimize corrosion. The ERDs shall be an integral turbine driven pressure booster type with a single stage radial inflow turbine and removable/replaceable nozzle. ERDs shall be properly sized turbochargers as manufactured by Energy Recovery, Inc (ERI), Fluid Equipment Development Company (Fedco), or approved equal.

Material of construction for the casing and rotors shall be super duplex stainless steel (PREN > 40). External bolting shall be 316L stainless steel, external tubing shall be super duplex stainless steel (PREN > 40), and retaining rings shall be passivated 316L stainless steel. Bearings shall be of non-metallic material that is compatible with concentrate water up to 30,000 mg/L TDS.

Pressure gauges shall be provided on the inlet and outlet to both the turbine and pump ends of the device. Flow control shall be achieved via an auxiliary nozzle with valve.

3.2.3.11 Membrane Treatment Systems

The Contractor shall be fully responsible for the design and construction of the membrane treatment system, including the membrane elements, the membrane feed pumps, the membrane skids, and the clean-in-place (CIP)/permeate flush system. The membrane treatment system for the UFA raw water shall consist of RO membrane skids capable of producing not less than 17.5 mgd of permeate on a MDF basis from raw water of both initial and degraded water quality characteristics from the UFA. The membrane treatment system for the BA raw water shall consist of one (1) NF membrane skid capable of producing not less than 2.5 mgd of permeate on a MDF basis from raw water of water quality characteristics from the BA. Subsequent to blending of the permeate from the UFA and BA skids and upon the completion of all post-treatment processes, the blended permeate shall meet all finished water quality requirements for both the initial and degraded raw water quality conditions. A general description and minimum requirements for the membrane treatment system are presented below.

3.2.3.11.1 Membrane Elements

The NF membrane elements for the BA skid shall be capable of producing not less than 2.5 mgd of permeate from raw water from the BA. The RO membrane elements for the UFA skids shall be capable of producing not less than 17.5 mgd of permeate from raw water of both initial and degraded water quality characteristics from the UFA. The NF and RO membrane elements shall be selected such that subsequent to blending of the permeate from the two systems and upon the completion of all post-treatment processes, the blended permeate shall meet all finished water quality requirements for both initial and degraded raw water quality conditions.

Each NF and RO membrane element shall be a standard product of proven ability as offered by a pre-qualified membrane element manufacturer (MEM) having significant experience in the manufacture of such products. All membrane elements (NF and RO) provided shall be supplied by a single MEM to ensure uniformity. Each NF and RO membrane element shall be a non-cellulosic, polyamide derivative, spiral-wound, thin film composite membrane, 8 inches in diameter, and a maximum of 40 inches in length (nominal). Each NF and RO membrane element shall contain 400 (nominal) square feet of active membrane area. The MEM shall perform an integrity test and a wet test for each NF and RO membrane element provided. These tests shall be consistent with the MEM's standard testing protocol for the specific NF or RO membrane element model. Membrane elements shall be manufactured by Osmonics (GE Power and Water), Hydranautics, A Nitto Denko Company; Toray Membrane USA; or Dow/FilmTec.

3.2.3.11.2 Membrane Skids

The BA membrane treatment system shall be capable of producing not less than 2.5 mgd of permeate on a MDF basis from raw water from the BA. The UFA membrane treatment system shall be capable of producing not less than 17.5 mgd of permeate on a MDF basis from raw water of both initial and degraded water quality characteristics from the UFA with all skids in service. The membrane skids shall be designed and constructed to accommodate the operating conditions at both initial and degraded raw water quality conditions for the respective feedwater. The BA membrane skid shall be designed for a maximum average flux of 12.5 gal/ft^2-day (gfd) at a maximum system recovery of 85 percent. The UFA membrane skids shall be designed for a maximum average flux of 15 gfd and a system recovery range of 75 percent to 80 percent. The membrane skids shall be designed with no more than 9 pressure vessels stacked in the vertical direction and shall have enough space to add pressure vessels corresponding to 10 percent of the initial number of vessels. The maximum height of the membrane skids shall be sixteen feet (16').

Each membrane skid, either NF or RO, shall be the complete product of a reputable membrane system supplier (MSS) having long experience in the manufacture of such products. All membrane skids provided shall be supplied by a single MSS to ensure uniformity. Each membrane skid shall be designed and constructed for 24-hour per day, 365 days per year continuous service. The NF membrane skid of the BA membrane treatment system shall be isolated from the UFA membrane treatment system. Each RO membrane skid of the UFA membrane treatment system shall be capable of being isolated from the other RO membrane skids for maintenance without affecting the other RO membrane skids. Each RO membrane skid shall be directly connected to a CIP/permeate flush system via hard piping and manual isolation valves. The NF membrane skid shall also be directly connected to the CIP/permeate flush system via hard piping and manual isolation valves.

Each membrane skid (NF or RO) shall, at a minimum, include: membrane elements (previously described in Section 3.2.3.6.1); pressure vessels; membrane skid and support structure; process piping; modulating butterfly feed control valve; modulating vee-port ball concentrate control valve; concentrate discharge check valve; permeate discharge check valve; total permeate isolation butterfly valve; concentrate discharge vacuum check valve breaker; permeate discharge vacuum check valve breaker; feed water check valve; membrane skid instrumentation panel; membrane skid sample panel; membrane skid power and instrumentation junction boxes; permeate rupture disks; total and second stage permeate flowmeters; concentrate flowmeter; instrumentation for monitoring and control; cleaning solution supply, cleaning solution return, permeate fill, and permeate return isolation valves and associated spool pieces; a brine driven interstage booster pump; and feed, interstage, and concentrate piping vent valves. The NF skid shall include a modulating vee-port ball valve on the first stage permeate header. Feed, permeate and concentrate piping shall be provided with a vent valve at the highest point for clearing air during membrane unit startup. The vent line shall be routed to a floor drain or trench. The vent valve shall be located at 5 feet elevation above finished floor elevation.

Pressure Vessels

All pressure vessels provided shall be supplied by a single manufacturer to ensure uniformity. Each pressure vessel shall have a diameter and length designed specifically to contain a quantity of seven (7) standard 8-inch diameter by 40-inch long spiral wound membrane elements. Pressure vessels shall have a maximum working pressure of 450 psi at a temperature of 120 degrees F. Vessels shall be designed, constructed, inspected and stamped in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code - Section X, Fiberglass - Reinforced Plastic Pressure Vessels. Each pressure vessel shall be of the side ported or mega side ported type. Side ports shall be a minimum of 1-1/2" diameter designed for a flexible groove coupling. Permeate ports on the permeate manifold end shall be 1½-inch diameter with pressure rating of 125 psig. Permeate ports on the other end shall be 1-inch FPT. The Contractor shall provide all necessary 316 SS fittings to connect a ½ –inch 316 SS ball valve to be provided on each vessel for probing. Each pressure vessel shall be complete with end closures, mounting hardware, and membrane element end adapters. Each feed side port or mega side port shall be constructed of Duplex SS pipe (PREN > 32) and shall be designed to interface with a flexible grooved coupling. Each interstage/concentrate side port or mega side port shall be constructed of super duplex stainless steel pipe (PREN > 40) and shall be designed to interface with a flexible grooved coupling. Each pressure vessel head shall be designed for removal by hand under normal operating conditions. Each head seal gland shall be designed to eliminate dead space and to allow the seal surface to be exposed for flushing of the seal. Each permeate port shall be designed with an anti-rotation mechanism. Each head shall be retained by a single retaining mechanism that provides ASME required redundancy and is constructed of stainless steel. Each mechanism shall be able to be removed by hand. Each head shall contain an integral secondary interlock that shall require a simple, yet specific sequence of events to remove the end closure and shall not require the use of separate components that may become separated from the vessel. Each pressure vessel shall be constructed of materials approved by the ASME Boiler and Pressure Vessel Code for use in the construction of pressure vessels. These materials shall be code certified and lot traceable. The shell of each pressure vessel shall be fabricated of filament –wound fiberglass reinforced plastic using continuous glass roving, impregnated with an elevated temperature cure epoxy resin system to provide superior dimensional stability and long term service life. The shell bore of each pressure vessel shall be fabricated from a resin-rich epoxy barrier that has been cured to allow for superior corrosion resistance, minimal extractables, and improved service life. The shell of each pressure vessel shall have a smooth exterior surface that has been coated with a two-part urethane enamel for superior gloss retention, abrasion resistance, and to block all light that may promote biological growth. All pressure vessels shall be made from non-corrosive materials. Metal parts in contact with the feed water shall be Duplex SS (PREN > 32). Metal parts in contact with intertage or concentrate streams shall be super duplex stainless steel (PREN > 40). Pressure vessels shall be manufactured by CodeLine – Pentair Water, Protec Arisawa, or approved equal.

Structural Steel Frame

Each membrane skid shall be assembled on a powder coated structural steel frame or stainless steel frame. The frame shall be designed to withstand shipping and handling forces as well as the operating loads. Each membrane skid shall be designed as a complete factory assembled unit. The frame shall be designed, signed, and sealed by a currently registered professional structural engineer in the state of Florida. Each pressure vessel assembly shall be adequately supported on the frame by plastic, contoured saddles or cradles and stainless steel retaining clamps. All mounting hardware and bolting shall be 316L stainless steel.

Process Piping

Permeate water process piping on each membrane skid shall be 316L stainless steel. All feedwater piping on each membrane skid shall be Duplex SS (PREN > 32). Interstage, and concentrate piping on each membrane skid shall be super duplex stainless steel (PREN>40). All process piping shall be seamless or welded seam, annealed after welding, and pickled and passivated per ASTM-A312 TP. Fittings shall be ASTM-A403, WPW manufactured to ANSI B16.9.

Flanges shall be manufactured to ANSI B16.5. Stainless steel piping assemblies shall be fabricated by an ASME Code Certified fabrication facility with in-house facilities to pickle and passivate all completed assemblies by an immersion process. Each piping manifold shall be designed to distribute and/or collect flow while minimizing headloss on the process fluid and flow imbalances. Fluid velocities in all stainless piping shall be maintained within the range of five (5) to eleven (11) feet per second, but not to preclude the use of straight manifold sections where applicable. Stainless steel piping connections shall be welded, except as required for connection to valves and equipment or to avoid pipe spools longer than 20 feet, in which case, the joints shall have flanged joints, split couplings, or Dependolock couplings. With the exception of instrumentation or sample fittings, threaded fittings shall not be allowed. All process piping shall be designed to accommodate straight runs of piping as required for each flow meter. All welding shall be in accordance with the latest applicable codes of the American Welding Society and ASME Boiler Code. No field welding of stainless steel process pipe or mild steel will be allowed. All welders shall be certified by AWS.

Instrumentation Panel

Each RO membrane skid shall include a factory supplied, skid mounted local instrumentation panel. All indicating transmitters for each membrane skid shall be mounted on this skid mounted local instrumentation panel. All instruments shall be front accessible and shall, at a minimum, include: a second stage permeate flow transmitter; a total permeate flow transmitter; a concentrate flow transmitter; a first stage permeate conductivity transmitter; a total permeate conductivity transmitter; a first stage feed pressure transmitter; a first stage concentrate (interstage) pressure transmitter (upstream of the brine driven turbocharger); a second stage feed (interstage) pressure transmitter (downstream of the brine driven turbocharger); a concentrate pressure transmitter (upstream of the brine driven turbocharger); a concentrate pressure transmitter (downstream of the brine driven turbocharger); a total permeate pressure transmitter; a pressure gauge with a seven-way selector valve for feed, interstage (upstream of the brine driven turbocharger), interstage (downstream of the brine driven turbocharger), concentrate (upstream of the brine driven turbocharger), and concentrate (downstream of the brine driven turbocharger) pressures; and a pressure gauge for the total permeate pressure. Manual isolation valves shall be provided as necessary to isolate all instruments from the process fluid such that instruments can be removed from service for calibration, service, or replacement without removing the entire membrane skid from service. Each skid mounted local instrumentation panel shall be mounted on the membrane skid such that unobstructed access is available to all valves and mechanical equipment and all instruments can be easily read, removed, calibrated, serviced, and installed.

Electrical Control Panel

Each membrane skid shall include a factory supplied, skid mounted local electrical control panel. Each electrical control panel shall be NEMA 4X and shall provide all necessary power for all instruments, control valves, and other related skid mounted devices that require power.

Sample Panel

Each membrane skid shall include a factory supplied, skid mounted local sample panel. Each sample panel shall be of white fiberglass, white PVC, or 316L stainless steel construction. Each sample panel shall have a minimum six-inch wide trough under the sample cocks and a drain pipe routed to the nearest drain. Sample tubing shall be black nylon tubing and sample cocks shall be ¼ inch stainless steel sample cocks. All sample tubing shall be neatly bundled and enclosed in Schedule 40 PVC piping from the areas near the sampling points to the sample panel. The bundled sample lines shall enter and exit the Schedule 40 PVC through machined openings and all pipe ends shall be capped. Samples of the following process streams from each membrane skid shall be available at each local sample panel: feedwater, concentrate, total permeate, permeate from each individual pressure vessel, first stage permeate, second stage permeate, and interstage.

Valves

All permeate water stream valves installed on each membrane skid shall be of 316L stainless steel construction. All feedwater, interstage, and concentrate water stream valves installed on each membrane skid shall be of super duplex stainless steel (PREN > 40) construction. All valves installed on each membrane skid shall be mounted in such a position that the valve position indicators are plainly visible when standing on the floor. All valves installed on each membrane skid of the same type shall be from one manufacturer.

RO membrane skids shall be manufactured and supplied by only pre-qualified membrane system suppliers.

3.2.3.11.3 Clean-In-Place/Permeate Flush System

The CIP/permeate flush system shall, at a minimum, consist of three storage tanks: one insulated cleaning solution storage tank, one cleaning solution neutralization tank, and a permeate flush storage tank; one variable speed cleaning pump; one variable speed permeate flushing pump; one cartridge filter vessel (with cartridge filter elements); and associated piping, valves, and instruments (flowmeter, temperature indicators, pH indicators, pressure switches, pressure indicators, differential pressure indicators, etc.) necessary to provide a fully functional CIP/permeate flush system. A local NEMA 4X control panel including all required motor starters and controls shall also be provided. The CIP/permeate flush system shall be capable of cleaning or flushing a complete membrane skid in no more than three batches. Operation of the CIP/permeate flush system shall be manual. The cleaning solution storage tank shall be supplied with an adjustable tank heater capable of heating the contents of the tank to a maximum of 45 degrees Centigrade within one hour, a temperature indicator, a mechanical mixer, high and low level switches, and a sight glass. The cleaning solution neutralization tank shall be supplied with a mechanical mixer, high and low level switches, and a sight glass. The permeate flush storage tank shall be supplied with high and low level switches, and a sight glass.

Fiberglass Reinforced Plastic Tanks

The cleaning system tanks shall be standard products of proven ability as offered by a reputable FRP tank manufacturer having long experience in the manufacture of such products. Company shall perform capacity and hydraulic analysis calculations for the sizing of the cleaning tank and to determine cleaning pump capacity and head requirements based on MSS and MEM membrane cleaning guidelines and recommendations. Each FRP tank shall be complete with a hinged FRP cover and FRP conically gusseted flanged nozzles. Each FRP tank shall be manufactured in accordance with ASTM Designation D3299 (latest version), "Filament-Wound Glass Fiber Reinforced Polyester Chemical Resistant Tanks." The resin used in the fabrication of each FRP tank shall not degrade when in contact with the process fluid contained within each FRP tank and only one resin shall be used. The resin shall not contain any pigments, dyes, or colorants. The manufacturer of the resin shall provide a written statement recommending the use of the proposed resin for storage of acids, bases, and detergents used to prepare the membrane cleaning solutions at a maximum temperature of 50 degrees Centigrade.

Each FRP tank shall have a resin-rich interior surface, a corrosion barrier, a structural laminate, and a gel coat exterior layer. The interior of each FRP tank shall have a resin-rich (minimum 90 percent by weight) surface with a minimum thickness of 10 to 20 mils. The corrosion barrier shall consist of an interior layer of randomly oriented chopped glass and resin (minimum 68 percent by weight) and shall be of sufficient thickness to provide a corrosion barrier. The structural layer shall consist of a continuous-strand roving of Type E glass fiber sized for compatibility with the proposed resin. The maximum glass content of the structural layer shall be 65 percent plus/minus 5 percent by weight. The exterior layer of the tank shall consist of a white pigmented gel coat (minimum 65 percent resin by weight) to a minimum thickness of 10 mils for non-insulated tanks and 100 mils for insulted tanks. The tank interior shall be post cured at 180 degrees Fahrenheit for a minimum of 12 hours.

The cylindrical shell for each FRP tank shall not contain any longitudinal joints. The entire thickness of each cylindrical shell (inner surface, interior layer, and exterior layer) shall be built up prior to removing the shell from the mandrel. Each FRP tank shall have an externalflat bottom which shall be constructed with the bottom molded as an integral part of the cylindrical shell. The internal bottom of the each tank shall be sloped to drain to allow the tanks to be completely drained. The FRP tanks shall not contain a cylindrical shell-bottom joint.

All surfaces of each FRP tank shall be finished so as to obtain complete cure of the resin without air inhibition. Surface cure shall be determined by means of the Barcol Hardness Test for the proposed resin. The area on the back of each flange around each bolt hole shall be the diameter of a standard washer and shall be flat and parallel to the flange face. Each nozzle shall be conically gusseted. Each nozzle on the top of each FRP tank shall have flange faces perpendicular to the centerline of the tank. Each nozzle on the side wall of each FRP tank shall have flanged faces perpendicular to radial centerlines. Each nozzle attached to the tank wall shall conform to Figures 3 and 5, ASTM D3299 (latest version) and shall be hand laid up. Compression molded fittings and nozzles shall not be used. Each FRP tank shall be provided with suitable lifting lugs for use in transporting and placing each FRP tank. Lifting lugs shall be of 316 stainless steel or FRP construction.

The FRP cleaning system tanks shall be manufactured by Justin Tanks, Xerxes Corporation, Raven Industries, Warner Fiberglass Products, Industrial Plastic Systems, or Augusta Fiberglass, or approved equal. All FRP tanks provided shall be supplied by a single manufacturer to ensure uniformity.

Cleaning Pump

The cleaning pump shall be a standard product of proven ability as offered by a reputable pump manufacturer having significant experience in the manufacture of such products. The cleaning pump shall be of 316L stainless steel construction and shall be an end-suction, ANSI B73.1, centrifugal pump. The cleaning pump shall be designed to pump cleaning solution (acids, bases, and detergents) from the cleaning solution storage tank to each membrane skid during a CIP event. The cleaning pump shall be designed to clean 50 percent of the first stage membrane elements at a minimum flow rate of 40 gpm/vessel. The cleaning pump shall be capable of variable speed operation. The cleaning pump shall be designed and constructed for continuous and intermittent service for at all points on the pump curve without overheating or cavitation and without excessive vibration or strain.

The cleaning pump shall be driven by an inverter duty rated for variable speed, solid shaft, squirrel cage induction motor with a TEFC enclosure. The cleaning pump and motor shall be mounted on a common baseplate.

Permeate Flush Pump

The permeate flush pump shall be a standard product of proven ability as offered by a reputable pump manufacturer having significant experience in the manufacture of such products. The permeate flush pump shall be of 316L stainless steel construction and shall be an end-suction, ANSI B73.1, centrifugal pump. The permeate flush pump shall be designed to pump permeate from the permeate flush storage tank to each membrane skid during a permeate flush event. The permeate flush pump shall be designed to flush 100 percent of the first stage membrane elements at a minimum flow rate of 20 gpm/vessel. The permeate flush pump shall be capable of variable speed operation. The permeate flush pump shall be designed and constructed for continuous and intermittent service for at all points on the pump curve without overheating or cavitation and without excessive vibration or strain.

The permeate flush pump shall be driven by an inverter duty rated for variable speed, solid shaft, squirrel cage induction motor with a TEFC enclosure. The permeate flush pump and motor shall be mounted on a common baseplate.

CIP System Cartridge Filter Vessels

The CIP system cartridge filter vessel shall be horizontally mounted and shall be a standard product of proven ability as offered by a reputable cartridge filter vessel manufacturer having long experience in the manufacture of such products. The cartridge filter vessel shall be designed, fabricated, and stamped in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII, Division I. The cartridge filter vessel, cover, internals, and all wetted parts shall be fabricated of Type 316L stainless steel. The vessel supports, clevis brackets, and davit arm assembly for the cartridge filter vessel shall be manufactured of Type 316 stainless steel. Each vessel shall have Type 316 stainless steel swing closure bolts. Swing bolts shall be 1-1/4 inch diameter, hex head cap screw design with a 316 stainless steel or aluminum bronze clevis pin.

After all fabrication is completed, the cartridge filter vessel shall be pickled and passivated. Following the pickling and passivation, all surfaces of the cartridge filter vessel shall be glass bead blasted. The inlet connection shall be on the side and outlet connection shall be at the end of the vessels. Inlet and outlet connections shall be provided with RFSO 150 psi flanges, Class D in accordance with AWWA C207. The cartridge filter vessel shall have two guide pins to align the cover to the shell and two handles made from 316L stainless steel bar stock welded to the cover to allow for opening the cover. The horizontal cartridge filter vessel shall include an alignment system that does not require removal during cartridge replacement, but can be removed for maintenance, if necessary. The system shall include a plate manufactured of 316L stainless steel with a hole pattern matching and aligning to the seat cup arrangement. The plate shall be bolted to four brackets welded to the interior of the horizontal cartridge filter vessel. The cartridge filter vessel shall have an inlet diffuser plate fabricated of 316L stainless steel and be of a size at least 1.5 times the area of the inlet nozzle. The inlet diffuser plate shall be welded to the interior of the cartridge filter vessel at a minimum of four locations and shall have gussets in at least two other locations to provide stiffening of the plate. The cartridge filter vessel shall be provided with a one piece machined separator plate with dual purpose seat cups suitable for double o-ring single open ended cartridge filter elements or double open ended cartridge filter elements utilizing a knife-edge sale. The separator plate shall be welded to the vessel shell on both the clean and dirty sides of the vessel. Separator plates with rolled in place seat cups shall not be used. The cartridge filter vessel shall be welded by American Welding Society (AWS) certified welders. All pressure retaining welds shall be crevice free.

The vessels shall be provided with both clean and dirty water drain nozzles, as well as a 1/2inch air vent at the top. A 2-inch 3,000 lb NPT coupling will be used for clean and dirty drains for all vessels. A 4-inch, 150 lb flanged inspection port will be installed on clean side plenum at 90° from inlet and outlet centerline and shall be provided with a super duplex blind flange and type 316 stainless A193B8M bolts and nuts.
Cartridge filter vessels shall be manufactured by Aerex Industries Inc., the Process Filtration Division of Parker Hannifin Corporation, Cuno, or approved equal.

CIP System Cartridge Filter Elements

Each cartridge filter element shall be a standard product of proven ability as offered by a reputable cartridge filter element manufacturer having long experience in the manufacture of such products. All cartridge filter elements provided shall be supplied by a single manufacturer to ensure uniformity. Each cartridge filter element shall have a 5-micron (nominal), or less, rating. Each cartridge filters element shall be of the single open ended type with double o-rings (size 222) on the sealing end and a polypropylene flex-fin or spring on the closed end. Each cartridge filter element shall be self-supporting with no reinforcing structures of resin. Each cartridge filter element shall be of sufficient length to traverse the entire length of the cartridge filter vessel shell (from the dual purpose seat cups to the cover) with one element. Each cartridge filter element shall be of polypropylene construction and shall be continuously wound. The polypropylene material shall be 100 percent Food and Drug Administration (FDA) grade material with no binders or resins and shall be National Sanitary Foundation (NSF) certified for Standard 61, Drinking Water System Components – Health Effects. Cartridge filter elements shall be manufactured by the Process Filtration Division of Parker Hannifin Corporation, Cuno, or approved equal.

The Contractor shall provide no less than three sets of cartridge filter elements for the CIP system cartridge filter vessel beyond those cartridge filter elements sets required for startup and testing.

3.2.3.12 Chemical Feed Systems

The Company shall furnish, install, test and place in operation all chemical feed systems, accessories and appurtenances as specified herein and as shown in the Figures presented in Volume III.B of the project Technical Requirements for a complete and operable system.

The basic chemicals, and corresponding feed systems, that are required to achieve water treatment objectives include:

- Sulfuric Acid
- Antiscalant
- Hydrated Lime
- Sodium Hypochlorite
- Sodium Hydroxide
- Aqueous Ammonia
- Zinc Orthophosphate
- Fluorosilicic Acid

The general physical properties of the above listed chemicals are presented in **Table 3-6**.

Table 3-6 General Chemical Properties

Chemical	CAS Number	Storage Concentration	pH	Boiling Point °F	Specific Gravity
Sulfuric Acid	7664-93-9	93-98%	1 (1% Sol.)	535 to 586	1.84
Antiscalant	N.A.	100%	3 – 4	287	1.2
Hydrated Lime	1305-62-0	30%	>11	1,076	2.3
Sodium Hydroxide	1310-73-2	50%	>13	287	1.52
Aqueous Ammonia	1336-21-6	18.5 – 19.5%	>13	120	0.92
Zinc Orthophosphate	7779-90-0	36%	<1	>212	1.12
Fluorosilicic Acid	16961-83-4	25%	1.2	222.5	1.27

N.A. – Data Not Available

3.2.3.12.1 Chemical Transfer Pumps

The Company shall furnish, install, test and place in operation all chemical transfer pumps and accessories for the transfer of chemicals from the bulk storage tanks to the day tanks. All chemical transfer pumps shall be supplied by the same manufacturer.

The manufacturer shall specialize in manufacture, assembly, and field performance of chemical transfer pumps with minimum five years' experience in the industry. The pumps shall be manufactured by ANSI-Mag – Transfer Pumps, Finish Thompson, Inc., IWAKI-Walchem – Transfer Pump, or approved equal.

Pumped Fluid Physical Properties

The manufacturer of the chemical transfer pumps and accessories shall be knowledgeable of the characteristics of the chemical solution(s) to be handled by these pumps and guarantee the suitability of the materials used in manufacturing of the pumps and accessories. The pump supplier is responsible for coordination of corrosion resistant materials for the chemical solutions specified below.

Anticipated chemical properties are as given above in Table 3-6. Company shall verify chemical properties and provide pump materials that are acceptable for use with such chemicals.

General Requirements

Pumps shall be magnetic drive type, closed impeller design, flanged suction and discharge connections, and close-coupled drivers. Pumps shall conform to the requirements of the Chemical Transfer Pump Schedule as shown in **Table 3-7**.

Pumps shall comply with applicable sections of Hydraulic Institute, the latest NEMA, IEEE and ANSI Standards unless otherwise noted.

Pumps, drivers and accessories shall be suitable for continuous operation at the specified operating conditions, and at flows ranging from the specified minimum flow to end of curve conditions. Pump head-capacity curve characteristics shall rise continuously from rated capacity to specified minimum flow. Pump rated capacity shall not exceed capacity at the best efficiency point. Pump design and selection shall permit a 5% head increase at rated flow by installing a new impeller unless otherwise noted.

Required Net Positive Suction Head (NPSHr) shall be based on the pumped fluid described in this section. Available NPSHa shall exceed required NPSHr by a minimum of two feet. Any electrical drives or accessories shall be suitable for the specified electrical area classification and the environment of

Table 3-7 Chemical Transfer Pump Schedule

Location	Pre Treatment Chemical Facility	Pre Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility
Service	Sulfuric Acid Transfer Pumps	Antiscalant Transfer Pumps	Corrosion Inhibitor Transfer Pumps	Sodium Hypochlorite Transfer Pumps	Aqueous Ammonia Transfer Pumps	Hydrated Lime Transfer Pumps	Sodium Hydroxide Transfer Pumps	Fluoride
No. of Pumps	2	2	2	2	2	4	2	2
Liquid Pumped	Sulfuric Acid (93%)	Antiscalant	Corrosion Inhibitor	Sodium Hypochlorite	Aqueous Ammonia	Hydrated Lime	Sodium Hydroxide	Sulfuric Acid (93%)
Chemical Working Temp.	90° F	90° F	90° F	90° F	90° F	90° F	90° F	90° F
Type of Pump	Metallic, lined,seal-less centrifugal	Nonmetallic, seal-less centrifugal	Nonmetallic, seal-less centrifugal	Nonmetallic, seal-less centrifugal	Nonmetallic, seal-less centrifugal	Nonmetallic, seal-less centrifugal	Nonmetallic, seal-less centrifugal	Nonmetallic, seal-less centrifugal
Minimum Capacity (gpm)	70	10	10	110	10	80	80	10
Head Required (ft)	25	25	25	25	25	25	25	25
Motor Horsepower (hp)	2	1/2	1/2	3	1/2	3	3	½
Max. Pump Speec (rpm)	3450	3450	3450	3450	3450	3450	3450	3450
Available NPSH (ft)	15	20	20	20	20	20	20	20
Suction Size (in)	2	1	1	2	1	2	2	1
Discharge Size (in)	1	3/4	3/4	2	3/4	2	2	3/4

the installation. Equipment and accessories shall be designed for weather resistance in accordance with the NEMA 4X standard. Noise Emission shall not exceed 85 dBA, 3 ft from equipment surfaces.

Drive Motor

The pump motor shall be designed for the proper area designation and approved by the Technical Advisor. Power supply will be three phase, 480 volt, 60 Hz power. Motor enclosures shall be rated TEFC "corrosive duty". Furnish motors with integral temperature switch in each winding.

Driver nameplate horsepower, not including the service factor, shall be equal to, or exceed the required pump horsepower over the entire performance curve for the design impeller. Required pump brake horsepower (BHP) will include corrections for product specific gravity. All magnetic drives shall have torque ratings greater than or equal to the maximum motor torque the drive is rated for. Drive shall not "decouple" at any point on the pump operating curve.

Magnetic coupling shall be neodymium iron boron for maximum strength. The coupling shall be properly sized to effectively transmit the required torque over the full range of specified pump performance without slipping or decoupling. Pump systems shall be cooled by internal circulation of process fluid through the coupling minimizing heat rise and providing bearing lubrication. O-rings shall be constructed of materials completely resistant to corrosion for the specified chemical service. Shafting shall be one piece, solid construction, sintered silicon carbide. All conduit, couplings, fittings, and fasteners furnished by the equipment manufacturer shall be PVDC coated rigid galvanized steel and liquid tight, flexible metal conduit.

Pressure gauges

These should be provided on discharge of transfer pumps as shown in the Figures in Volume III.B of this RFP. Each gauge shall have a range in psi as recommended by the manufacturer. Each gauge shall be provided with a diaphragm seal and isolation valve, which are constructed of materials completely resistant to corrosion by the chemicals referred to in this section.

Valves

Provide type of valves on suction and discharge of each transfer pump as indicated on Figures in Volume III.B of this RFP or in valve schedules. Valves shall be removable without disturbing piping. Material of the valves shall be entirely suitable for the chemical solution the transfer pumps process.
Mounting and Connections

All pipe connections to the transfer pumps shall be firmly supported from a floor-mounted, stainless, structural steel frame, to avoid any stress on the pump or on the piping system.

Safety Equipment

Where required by Code, all chemical unloading, storage, and pumping equipment shall be furnished with all necessary safety devices and clearly visible warning signs.

3.2.3.12.2 Chemical Metering Pumps

The Company shall furnish, install, test and place in operation mechanically and hydraulically actuated diaphragm chemical metering pumps, accessories and appurtenances as specified herein and as shown on the Figures in Volume III.B of this RFP for a complete and operable system.

The manufacturer shall be a company specializing in the manufacture, assembly, and field performance of chemical metering pumps with a minimum of five years' experience. All chemical metering pumps shall be supplied by the same manufacturer. Chemical metering pump manufacturing shall be Prominent Fluid Controls; or approved equal.

The Company shall furnish the services of a qualified manufacturer's technical representative for a period of not less than seven (7) days to perform the tasks as follows for each set of chemical metering pumps:

- Witness and check installation.
- Assist the Company in conducting field tests and preparing a written report as specified below.
- Witness and check start-up of the system.
- Assist Company in making adjustments and modifications as necessary to optimize operation of the system components and to minimize surge pressures.
- Troubleshoot and correct any mechanical or control problems with the metering pumps and accessories that are noted during tests and start-up.
- Submit written certification that the system has been properly installed, tested, and adjusted; that the system operates as specified or as required; and that all controls and protective devices operate properly, including date of final acceptance test, as well as a listing of all persons present during the tests.
- Investigate and supervise correction of any operating problems that may arise up to the end of the guarantee period of the pumps.
- Instruct Department in the operation and maintenance of equipment.

The Company shall be fully informed and shall be responsible to ensure that all Company's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with the chemical(s) described in this section.

The manufacturer shall provide a minimum two (2) year warranty on the pump drive and a one year warranty on the pump liquid end, including diaphragm and O-rings.

Pumped Fluid Physical Properties

The manufacturer of the chemical metering pumps and accessories shall confirm the characteristics of the chemical solution(s) to be handled by these pumps and guarantee the suitability of the materials used in manufacturing and sizing of the pumps and accessories. The pump supplier is responsible for coordination of corrosion resistant materials for the chemical solution(s) specified herein. Anticipated physical properties for chemicals are as shown in Table 3-6.

Stroke Adjustment

Manual stroke adjustment shall be controlled by a stroke adjustment knob that is turned to adjust the pump from 0 to 100% in increments of 1% or smaller. The adjustment control shall be marked with a graduated scale to provide a visual, numerical indication of the stroke setting. Stroke adjustment shall be the mechanical lost-motion type.

Valve cartridges

Cartridges shall be of the single ball type and be externally removable from the liquid level end. Valve cartridges shall compression seal to the pipe connectors.

Diaphragms

These shall be composite type with a PTFE-faced fluid contact surface and reinforced elastomer backing. Diaphragm leak detection shall be provided as specified for mechanical pumps.

Motor Driven Mechanically Actuated Diaphragm Metering Pumps

Metering pumps shall be of the simplex, motor-driven, reciprocating mechanically actuated diaphragm type with diaphragm physically attached to the reciprocating actuation shaft. The liquid end shall be physically separated from the drive unit by an air gap. A shaft wiper seal shall be provided to exclude the pumped liquid from the drive end if the primary diaphragm fails.

An AC inverter shall be integral to the microprocessor control and function of the pump. While 115VAC, 1 phase may be used to power the pump, the inverter shall drive a 120VAC, 1 phase motor. Stroke frequency shall be accomplished through microprocessor control with proportional start/stop of the motor, from 0% to 33% of stroke rate. Stroke rate shall be accomplished through variable speed of the motor from 34% to 100% of stroke rate. Stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the LCD. The pump shall be capable of receiving a pulse input via optional external control cable such that one pulse gives one pump stroke rate. Metering pumps shall be fitted with a diaphragm leak detection system. The system shall provide a dry contact alarm output.

Solenoid Driven Mechanically Actuated Diaphragm Metering Pumps

Metering pumps shall be microprocessor-controlled, simplex, solenoid driven, reciprocating, mechanically actuated diaphragm type. The power supply shall be 115 VAC, 60 Hz, single phase. The microprocessor is to automatically compensate for supply voltage variations within 15% of the rated voltage such that the frequency of the pump remains constant.

The liquid end shall be physically separated from the drive unit by a backplate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the solenoid if the primary diaphragm fails. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE-faced fluid contact surface. The liquid end shall be glass-filled polypropylene with ((EPDM/Viton®)) seals, with built-in coarse valve and needle valve for air bleed, manually adjusted for continuous degassing of process fluid and self-priming against pressure. The suction and discharge valves shall be of the double ball check design.

Programing and Control

The metering pump shall be microprocessor-controlled. All pumping functions shall be set by membrane-switch keypad and status shall be displayed on an illuminated LCD, which is readable at an offset of 45 degrees. Keypad will allow for simple scrolling of programmed parameters.

Stroke length control shall be adjustable manually by means of a stroke length, in increments of 0.5%, from 0 to 100% of stroke length. The LCD shall digitally display stroke length in 1% increments in the full range between 100% and 0%.

Programming shall allow pump to be calibrated so as to display pump output in gallons/hour or liters/hour. Calibration shall be maintained when stroke length is altered up to +/-10% on the stroke length knob. If stroke length is altered by more than +/-10%, a yellow warning light will light and a flashing message “calib” will appear.

The pump shall be equipped with the programmable function of electronic interlocking of the keypad by access code to prevent unauthorized adjustments to the pump. The keypad shall allow for scrolling and display on LCD such parameters as stroke frequency, stroke length, stroke counter, pump output in gals/hr or l/hr, dosing quantity, mA input being received by pump, and indication of external mode.

The pump shall be capable of remote ON-OFF operation using the pause function via a voltage free contact relay through an optional control cable. In addition, the pump shall be configured with analog input functionality. The pump shall accept an analog signal such that stroke frequency is proportional to 4-20mA. The pump shall allow the setting of a maximum stroke rate, which corresponds to the maximum analog signal, with stroke rate proportional to signal strength below that rate. Programming for curve processing shall also be possible, in which any stroke frequency ratio in proportion to the electrical signal can be configured. Analog to digital converters external to the pump shall not be acceptable.

Each controller shall be provided with a Local-Off-Remote switch, and Running, Off, and Fail indicating lights. An auxiliary contact shall be provided on the L-O-R switch for remote indication of switch position. When in Remote, the controller shall be designed to accept an isolated, maintained closed contact, for remote on/off control. Each controller shall provide isolated contact outputs for motor run, motor fail (overload and diaphragm fail). Each contact shall be rated 120 volts, 5 amps, minimum.

Metering Pump Skid Assembly

Each pump shall have the ability to function as an isolated pump (i.e., independent of piping and operation of the other pump mounted on the skid assembly). Pumps shall be provided as skid mounted chemical metering pump systems complete with the skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:

- Skid with drip lip
- Metering pumps with manual stroke length adjustment
- Spray safety shields
- Pump motors

- Calibration columns
- Pulsation dampeners
- Pressure gauges with diaphragm seals
- Ball valves
- Pressure relief valves
- Backpressure valve
- Basket strainer
- Remote mounted control panel
- Controls
- All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. Electrical cables shall terminate in the control panel.

Each chemical feed system shall be completely assembled by pump manufacturer, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid shall include, but not be limited to, the metering pumps, calibration column, piping, valves, piping accessories (pulsation dampeners, etc.), and wiring integral to the skid. The chemical feed system supplier shall be responsible for providing all equipment, valves and piping within the skid boundary.

The skids shall be constructed of fusion welded polypropylene sheets with adequate supports for all equipment and piping. Fork lift truck cut outs and anchor bolt holes shall also be provided. All components of the skid mounted system (pumps, piping and controls) shall be tested prior to shipment.

Safety spray shields shall be provided on all metering pumps for all services. The spray shield shall consist of an adhesive bonded extruded FRP frame with removable cover. Removable cover shall be 1/4" clear acrylic on the top and side panels. Back shall remain open.

Provide one, clear plastic calibration chamber with vent for use in calibrating the metering pumps. The chamber shall be sized to give adequate capacity for a minimum 30 second draw down test. The scale shall give direct readings in GPH without the need for calculations. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pumps. The top of the chamber shall have a threaded fitting to allow for piping to a common vent.

Pulsation Dampeners shall be of the single diaphragm design, capable of arresting water hammer in the pump discharge lines created by the metering pumps. Pulsation dampener shall dampen flow a minimum of 95 percent. Pulsation dampeners shall be provided with valves, gauges and fittings necessary for maintaining required air pressure in the air chamber. Materials of construction of diaphragm and body shall be corrosion resistant to the chemical fluid pumped. Provide one dampener on the discharge side of each metering pump. Each pulsation dampener shall include an integral pressure gauge. Pulsation dampeners shall be sized appropriately for each pump to remove a minimum of 95% of the pulsations. The manufacturer shall provide calculations to verify sizing if requested by the Technical Advisor.

Each skid shall be supplied with its own control panel suitable for remote mounting. Each pump shall have its own disconnect switch mounted in the control panel. A common terminal strip shall be utilized for electrical connections at the control panel. Terminals shall be provided for a single control panel 120 volt, single phase power input. All wiring on the skid shall be performed prior to shipping and shall terminate in a NEMA 4X junction box located on the skid. Terminals shall be provided in the junction box for all connections between the remote control panel and the junction box.

Company shall provide metering pumps according to the Chemical Metering Pump Schedule below in **Table 3-8**.

3.2.3.12.3 Chemical Pumps for the Odor Control

The Company shall furnish, install, test and place in service skid mounted chemical pump systems complete with skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories.

Provide eight (4) chemical feed/metering pumps. A single chemical metering pump manufacturer shall be responsible for supplying all components, assembly, and testing of the skid mounted chemical metering system.

Pumps should be skid-mounted with all motors, valves, gages, piping, wiring and controls to provide a complete unit to pump/meter either sodium hypochlorite (12.5% NaOCL) or sodium hydroxide (50% NaOH) from storage tanks into odor control unit processes.

Sodium Hydroxide Chemical Feed Pumps

The 50% sodium hydroxide chemical feed system shall take 50% sodium hydroxide from chemical storage tank and deliver the chemical to 1st and 2nd stages of the odor control vessel sumps. pH probe/meter at each vessel will shall be used to control the chemical feed pumps. The technical requirements of these pumps are as follows:

- Manufacturer: Pulsafeeder or Equal
- Series: Pulsar Series M
- Model: L6S4
- Number: 4
- Type: Mechanically actuated diaphragm
- Wetted Parts Chemical Service: 50% NaOH
  - Balls: Hastelloy C
  - Gaskets: Telfon
  - Diaphragm: TFE Faced Hypalon
  - Voltage/Hz/Phase: 115-206/230/60/1
  - Reagent Head, Valve Seat & Valve Cap &Guide: PVC
  - Rated Flow/Pressure: 29.7 gph/150 psi
  - Stoke Adjustment: Manual
  - Motor: Type [hp/Voltage/Hz/Phase] TEFC [¾ /115-206/230 / 60 /1]
  - Back Pressure and Pressure Relief Valves
    - Adjustable diaphragm backpressure sustaining valve
      - Install on pump discharge odor control units.
      - Material shall be CPVC body, Telfon diaphragms & viton gaskets.
      - Pressure rating 150 psi.

Table 3-8 Chemical Metering Pump Schedule

Location	Pre Treatment Chemical Facility	Pre Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility	Post Treatment Chemical Facility
Service	Sulfuric Acid Metering Pumps	Antiscalant Metering Pumps	Corrosion Inhibitor Metering Pumps	Sodium Hypochlorite Metering Pumps	Aqueous Ammonia Metering Pumps	Hydrated Lime Metering Pumps	Sodium Hydroxide Metering Pumps	Fluoride Metering Pumps
No. of Pumps	2	2	2	4	2	2	2	2
Liquid Pumped	Sulfuric Acid (93%)	Scale Inhibitor	Zinc Orthophosphate (36%)	Sodium Hypochlorite (12.5%)	Aqueous Ammonia (18%)	Hydrated Lime (15%)	Sodium Hydroxide (50%)	Hydrofluorosilicic Acid (18%)
Capacity Range (gph)	0 - 100	0 - 5	0 - 5	0 - 100	0 - 10	0 - 250	0 - 50	0-5
Turndown Ratio	20:1	10:1	10:1	20:1	10:1	30:1	20:1	10:1
Max. Stroke/Minute	100	120	120	100	120	100	100	120
Design Discharge Pressure (psig)	50	100	50	50	100	50	100	50
Pump Head Type	Simplex	Simplex	Simplex	Simplex	Simplex	Simplex	Simplex	Simplex
Diaphragm Head	Alloy 20	PVC	PVC	PVC	316 SST	316 SST	316 SST	316 SST
Valve Cartridge	Alloy 20	PVC	PVC	PVC	316 SST	316 SST	316 SST	PVC
Ball Check	Ceramic	Ceramic	Ceramic	Ceramic	316 SST	316 SST	316 SST	Hastelloy C
Diaphragm	PTFE/ Elastomer	PTFE/ Elastomer	PTFE/ Elastomer	PTFE/ Elastomer	PTFE/ Elastomer	PTFE/ Elastomer	PTFE/ Elastomer	PTFE/Elastomer
Back Pressure Spring	Hastelloy C	Hastelloy C	Hastelloy C	Hastelloy C	316 SST	Hastelloy C	316 SST	Hastelloy C
Max. Motor Speed (rpm)	1725	1725	1725	1725	1725	1725	1725	1725
Motor Horsepower	3/4	1/4	1/4	3/4	1/4	2	3/4	1/4
Drive Type	DC, variable speed, constant torque	DC, variable speed, constant torque	DC, variable speed, constant torque	DC, variable speed, constant torque	DC, variable speed, constant torque	DC, variable speed, constant torque	DC, variable speed, constant torque	DC, variable speed, constant torque
Motor Enclosure	TENV	TENV	TENV	TENV	TENV	TENV	TENV	TENV

- Adjustable diaphragm external pressure relief valve /3-way
  - Install on pump discharge within pump skid.
  - Material shall be CPVC body, Telfon diaphragms & viton gaskets.
- Pulsation Dampeners
  - Single diaphragm type mounted on pump discharged for pneumatic-hydraulic pulsation dampening.
  - 1200 ml minimum capacity
- Material of construction: PVC body and Teflon diaphragm& viton gaskets

▪ Control: Each pump shall be automatically shut off if a low level is sensed in the appropriate chemical tank and shall be activated when pH level of solution in the odor control vessel sump rises above set point established by odor control manufacturer and shall de activate when the

- pH level of solution falls below this set point.Sodium Hypochlorite Chemical Feed Pumps. The 12.5% sodium hypochlorite chemical feed system shall take 12.5% sodium hypochlorite from chemical storage tanks and deliver the chemical to 2nd stage of the odor control vessel sump. ORP probe/meter shall be used to control the chemical feed pumps.

NaOCl Chemical Metering Pumps with Controller

- Manufacturer: Pulsafeeder or equal
- Series: Pulsar Series M
- Model: L6T2
- Number: 4
- Type: Mechanically actuated diaphragm
- Wetted Parts Chemical Service: 12% NaOCl
  - Balls: Hastelloy C
  - Gaskets: Telfon
  - Diaphragm: TFE Faced Hypalon
  - Voltage/Hz/Phase   115-206/230/60/1
  - Reagent Head, Valve Seat & Valve Cap &Guide PVC
  - Rated Flow/Pressure: 65 gph/150 psi
  - Motor: Type [hp/Voltage/Hz/Phase]   TEFC [¾ /115-206/230 / 60 /1]
  - Back Pressure and Pressure Relief Valves:
    - Adjustable diaphragm backpressure sustaining valve
      - Install on pump discharge odor control units.
      - Material shall be CPVC body, Telfon diaphragms & viton gaskets.
      - Pressure rating 150 psi.
    - Adjustable diaphragm external pressure relief valve /3way
      - Install on pump discharge within pump skid.
      - Material shall be CPVC body, Telfon diaphragms & viton gaskets.
  - Pulsation Dampeners
    - Single diaphragm type mounted on pump discharged for pneumatic-hydraulic pulsation dampening.
    - 1200 ml minimum capacity
  - Material of construction: CPVC body and Teflon diaphragm& viton gaskets
- Control: Each pump shall be automatically shut off if a low level is sensed in the appropriate chemical tank and shall be activated when ORP level of solution in the odor control vessel sump rises above a set point established by odor control manufacturer and shall de activate when the ORP level of solution falls below this set point.

Pump Skids

Construct and provide pump skids with the frame construction from fiberglass tubes with fours sides covered with clear lexan covers and the top with opaque lexan covers. The sides shall have access doors installed with stainless steel hinges and stainless steel closer latch in a two-door allow arrangement which allows a 180 degree swing to provide easy access to the pumps. Sufficient number of rain proof vents shall be provided on the sides to limit moisture and heat buildup. Pumps shall be installed on a fiberglass deck. Each skid shall be secured to the concrete slab with a removable stainless steel fastening system.

3.2.3.12.4 Polyethylene Tanks

The Company shall furnish, deliver, install, test and place in satisfactory operation polyethylene storage tanks, complete with all necessary accessories at the locations shown on the Figures in Volume III.B of this RFP and as specified herein.

Storage tanks shall be furnished complete with all associated appurtenances such as hardware, anchorage, piping, ultrasonic level indicators, etc., as shown on the Figures in Volume III.B of this RFP and as specified herein or as otherwise required.

It is the intent of this Specification to obtain an installation complete in every necessary detail whether or not covered by the Specification. Any omission of required equipment from the Specification shall not relieve the manufacturer of his responsibility to satisfy this intent.

General

Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, drains, overflows, and anchoring system. Covered tanks shall be vented, and where indicated, tanks shall be provided with entrance manways, level indicators and exterior coating. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, and capacity. Tanks shall meet the requirements of ASTM D1998 unless otherwise indicated.

The tank capacity (volume) specified shall include only that volume in the straight shell below the overflow pipe invert elevation and above the pump suction connection. At least 4 inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.

Tank Materials and Construction

Material used for polyethylene storage tanks shall be virgin cross linked polyethylene resin as compound and certified by the manufacturer. Resin shall be Marlex CL-200 YJN as manufactured by Phillips Petroleum Company or Paxon 7004 as manufactured by Paxon, Inc. or of resins of equal physical and chemical properties.

Polyethylene shall meet or exceed the following presented in **Table 3-9.**

Table 3-9 Polyethylene Materials

Parameter	ASTM	Value
Density (Resin)	D1505	0.938-0.944
Tensile (Yield Stress 2”/min)	D638	2600 PSI
Elongation at Break (2’/min)	D638	400%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1,000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1,000 hours
Vicat Softening Temperature, Degrees	FD1525	248
Flexural Modulus	D790	100,000 PSI

Manways

A top mounted manway shall be provided for each tank. Manway shall be at least 19 inches inside diameter.

Threaded Bulk Head Fittings

These fittings should be provided for below liquid installation for fittings up to two inches in diameter. Tank wall thickness shall be considered for bulkhead fitting placement and the maximum wall thickness for each fitting size is shown in **Table 3-10**.

Table 3-10 Wall Thickness

Fitting Size	Maximum Wall Thickness (inches)
1/2 inch	0.750
3/4 inches	0.875
1 inch	0.875
1 1/4 inches	0.875
1 1/2 inches	0.875
2 inches	1.0

Bulkhead fittings shall be constructed of PVC, polypropylene for other specified material. Gaskets shall be a minimum of 1/4-inch thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton, as appropriate for tank service.

Bolted Double Flange Fittings

These are required for below liquid level installation for sizes over 2 inches in diameter depending on tank diameter. Refer to **Table 3-11.** Fittings must be placed away from tank knuckle radius and flange lines. Allowable fitting sizes based on tank diameter for curved surfaces are shown below. Bolted double flange fittings shall allow tank wall thickness up to 2-1/2 inches.

Table 3-11 Bolted Double Flanged Fitting Requirements

Tank Diameter	Maximum Bolted Fitting Size Allowable for Non-Stainless Steel Construction
48 inches	3 inches
48 inches – 86 inches	3 inches
64 inches to 142 inches	4 inches
90 inches – 102 inches	6 inches
120 inches – 142 inches	8 inches

The bolted double flange fittings(non stainless steel construction) shall be constructed with two each 150 lb flanges, 2 each 150 lb flange gaskets, and the correct number and size of all thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I. Gaskets shall be a minimum of ¼" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton or other specified material. There shall be a minimum of four each full thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of ¼" of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material. Each encapsulated bold shall have a gasket to provide a bolt sealing surface against the inner flange.

Bolted stainless steel fittings shall be constructed with a minimum of four fully threaded 3/8 inch studs. Each fitting shall have two gaskets with two flanges. One gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The other gasket shall be compressed between the outside tank wall surface and the outside flange of the fitting. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of ¼" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton as appropriate for fluid service.

Fill Lines

Tank fill lines shall be as shown on the Figures in Volume III.B of this RFP. All pipe supports, hardware, accessories, etc., shall be provided. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.

Pipe Supports and Piping

All pipe supports, hardware, accessories, etc. shall be provided. Vertical piping into the tanks shall be supported every five feet with flexible connections to account for flexing of tank walls and shall be parallel to the tank wall and not less than 6 inches from the tank wall. Manufacturer shall provide anti-siphon suction connections for outlet pipes leading to pump suction.

Expansion Joints

Suction connections for outlet pipes leading to pump suction shall be provided with flanged reinforced rubber expansion joints. Expansion joints shall have full-face integral flanges drilled to mate with ANSI Class 125 bolt patterns. Stainless steel retaining rings shall be provided. Expansion joints shall be double arched. The inner layer of the joint shall be constructed of EPDM and the outer layer shall be neoprene. Expansion joints shall have a minimum pressure rating of 25 psi.

Vent Lines

Vent lines shall be top mounted. Vent lines shall be as specified herein and as indicated on the Figures in Volume III.B of this RFP.

Overflow and Drain Lines

The tanks shall be provided with overflow and drain pipes as specified and as indicated on the Figures in Volume III.B of this RFP. Drain line shall be as indicated on the Contact Drawings. Drain connection shall be siphon drain connection.

Pipe Supports and Accessories

Pipe supports, hardware, and accessories on tanks shall be provided by the tank manufacturer. Vertical piping from the tanks shall be supported every 5 feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.

Level Sensor

The tanks shall be provided with a level sensor. The mounting and connecting requirements shall be coordinated with the instrument supplier.

Sight Level Gauge

Each tank shall be equipped with a visual liquid level.

Access Ladder

The storage tank shall be equipped with an exterior access ladder for access to the manway. The ladder shall be constructed of FRP or stainless steel. Ladder shall meet OSHA requirements. Ladders shall be furnished with all required mounting hardware, accessories, anchor bolts, bands, base brackets, etc. for a complete installation. Mounting hardware shall be Type 316L stainless steel. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad. Ladders shall be furnished with gooseneck handrails at the top. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto. The tank ladder shall be equipped with a safety cage for tanks above 15 feet in height.

Lifting Lugs

Tanks shall have a minimum of three lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

Tie Down Lugs, Tie Down Cables and Anchor Bolts

Tie down lugs, tie down cables and anchor bolts shall be Type 316 stainless steel. Lugs shall be integrally molded into the tank walls or bases or reinforced with FRP winding around the tank shell. Anchor bolts shall be anchored into concrete foundations using methods designed to transfer the full ultimate strength of the anchor bolt to the concrete foundation. Tank restraint system shall be adequate to meet 140 mph wind load requirements.

Signage

The tank shall be provided with signs to identify contents. Signs shall be attached to the tank at locations that are clearly visible or as directed by the Engineer. Sign layout and location shall be submitted to the Engineer for approval.

Refer to **Table 3-12** for the HDPE Tank Schedule for Chemical Storage.

Table 3-12 HDPE Tank Schedule for Chemical Storage

Liquid Contained	Type	Tank Capacity (gal)
Antiscalant	Bulk Storage Tank Day tank	3,000 90
Zinc Orthophosphate	Bulk Storage Tank Day tank	6,500 90
Sodium Hypochlorite	Bulk Storage Tank Day tank	3 x 11,230 760
Hydrated Line	Bulk Storage Tank	3 x 20,000
Sodium Hydroxide	Bulk Storage Tank Day tank	2 x 5,900 760
Fluoride	Bulk Storage Tank Day tank	6,500 90

3.2.3.12.5 Steel Tanks for Chemical Storage

The Company shall furnish, deliver, install, test and place in satisfactory operation carbon steel storage tanks for sodium hydroxide and sulfuric acid storage complete with all necessary accessories as specified and as shown on the Figures in Volume III.B of this RFP.

All chemical storage tanks shall be furnished complete with all associated appurtenances such as hardware, anchorage, piping, ultrasonic level indicators, etc., as shown on the Figures in Volume III.B of this RFP and as specified herein or as otherwise required. The Company is responsible for the coordination and selection of corrosion chemically compatible materials for the chemicals specified below. The chemical storage tank manufacturer shall become familiar with the characteristics of the specified chemical and guarantee the suitability of the materials used in manufacturing of the equipment and accessories. The Company and manufacturer shall include all features as necessary for satisfactory operation of the systems for the specified chemical.

All tank capacities (volumes) specified shall include only that volume below the overflow pipe invert elevation and above the pump suction connection. At least 4 inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.

General

The Company is responsible for the coordination and selection of corrosion chemically compatible materials for the chemicals specified below. The chemical storage tank manufacturer shall become familiar with the characteristics of the specified chemical and guarantee the suitability of the materials used in manufacturing of the equipment and accessories. The Company and manufacturer shall include all features as necessary for satisfactory operation of the systems for the specified chemical.

All tank capacities (volumes) specified shall include only that volume below the overflow pipe invert elevation and above the pump suction connection. At least 4 inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.

Bulk storage tanks shall be made of materials that can withstand the maximum delivery temperature, if specified. Chemical properties are as follows:

The Company and tank manufacturer shall be responsible for the structural design and integrity and water-tightness of the tanks, including anchorages and connections.

Storage Tanks Capacity and Design Requirements

The storage tank shall be designed for storing up chemicals as shown in **Table 3-13**. Capacity and design requirement conditions shall be as noted.

Table 3-13 Carbon Steel Tanks Schedule for Chemical Storage

Liquid Contained	Sulfuric Acid	Sulfuric Acid	Aqueous Ammonia	Aqueous Ammonia
Type	Bulk Storage Tank	Day Tank	Bulk Storage Tank	Day Tank
Tank Capacity (gal)	Two 13,000 gallon tanks	Two 635 gallon tanks	One 9,000 gallon tank	One 90 gallon tank
Tank Diameter (ft)	10’-0”	4’-0”	10’-0”	2’-0”
Sidewall Length/ Height (ft)	22’-0”	6’-5”	15’-6"”	4’-0”
Total Length/ Height (ft)	23’-4”	7’-10”	16’-10”	5’-4”
Tank Type Bottom/ Top or Ends	Horizontal, Saddle Mounted Dished/Dished*	Vertical, Leg Mounted Dished/ Dished*	Horizontal, Saddle Mounted Dished/Dished	Vertical, Leg Mounted Dished/ Dished*

*Bulk tanks to be shallow dished heads; Day tanks to be standard dished heads.

The Company shall coordinate with tank manufacturer the dimension and location of concrete pier for tank plate saddles.

Tank Materials and Construction

All materials shall be new and both workmanship and material shall be of the very best quality, entirely suitable for the service to which they are to be subjected.

Tanks, anchors, and anchor bolts shall be designed per the Florida Building Code requirements for the intended service under full and operating conditions.

Fabrication shall be in accordance with applicable provisions of the ASME Boiler and Pressure Vessel Code, Section VIII; code stamp not required. Tanks shall be of ASTM A-36 carbon steel. All connections shall be flanged.

Company shall coordinate the number of nozzles required to meet the requirements of the installation in accordance with the Contract Documents. The outlet nozzle of the sulfuric acid bulk storage tank shall be Schedule 40S Type 316L stainless steel with a Class 150 Type 316L stainless steel welding neck flange.

Fabrication

The tanks shall be fabricated of carbon steel. The minimum plate thickness for all tanks except those for sulfuric acid service shall be 3/8-inch. Sulfuric acid tank plates shall be the thickness required for structural strength plus a corrosion allowance of 0.25-inch, for a total thickness of not less than 7/16-inch. Plate materials shall be flange quality steel conforming to ASTM A-36. All joints shall be of butt weld construction using single plate ring design.

The tank tops shall be as indicated on the Figures in Volume III.B of this RFP with openings and connections as shown on the Figures in Volume III.B of this RFP and as specified herein. The bulk tank tops shall be able to support a 250-lb load on a 4-inch by 4-inch area.

The design of the tanks shall be the responsibility of the tank manufacturer. All welds shall be ground smooth, and all interior corner welds shall be ground to a minimum 1/4-inch radius. All corners and sharp edges shall be rounded and ground smooth.

Protective Coatings

The tank interior and exterior shall be cleaned of all oil, grease, dirt, rust, loose and tight mill scale, by cleaning in accordance with SSPC-SP-5, Blast Cleaning for the interior and SSPC-SP-6 Commercial Blast Cleaning for the exterior.

The exterior shell, top, and bottom of the tank shall be provided with two coats (8 mils total) of epoxy polyamide primer and a polyurethane top coat to be applied in the shop. The Company shall repair damaged tank coatings on site to match manufacturer's coating system.

Safety Requirements

The Company shall furnish and install all precautionary labeling as recommended by the Manufacturing Chemists' Association for storage of the designated chemical.

Anchor Bolts and Saddles

Anchor bolts and nuts shall be Type 316 stainless steel. Bolts shall conform to ASTM A 193, Grade B8M. Nuts shall conform to ASTM B 194, Grade 8M. Provide washer for each nut of the same material as the nut.

All supports on tanks shall be supplied by tank manufacturers.

Tank saddles shall be supported along the full length of the base. Space shall be 12-inches high, from bottom of tank to concrete pier.

Tanks shall be saddle mounted as shown on the Figures in Volume III.B of this RFP.

Flanged Nozzles

Nozzles shall be designed for a minimum torque of 2,000 ft-pounds and a minimum bending moment of 1,500 ft-pounds. Nozzles shall be flanged, as shown on Figures in Volume III.B of this RFP. Flange dimensions shall conform to ANSI B16.5 Class 150.

Bolts and Nuts for Flanged Nozzles and Manways

Bolts and nuts shall be Type 316 stainless steel. Bolts shall conform to ASTM A 193, Grade B8M. Nuts shall conform to ASTM A 194, Grade 8M. Provide washer for each nut and bolthead. Washers shall be of the same material as the nuts.

Fill Pipes

The fill pipes shall extend from the fill connection to 12-inches above the tank bottom. The end of the pipe shall be mitered at a 45 degree angle.

Vent Pipes

The vents for the sulfuric acid bulk tanks and day tanks shall be fitted with desiccant breathers, with two-way vent valve to allow air intake through the desiccant breather and vapor exhaust to atmosphere. Each vent line shall be provided with its own BR-10 unit as shown on the Contract Documents. Provide one BR-10 as a spare and a 110 volt, 1 phase, 60 Hz Lectrodryer (or equal) reactivator sized to service the specified desiccants when they have become saturated with moisture.

The vent valve assembly shall be constructed of Type 316L stainless steel. Tank breathers shall have an indicator to show when units are wet and require reactivation. Indicators shall be mounted such that they can be readily visible from the elevated walkway. Tank breathers shall be manually removable for reactivation.

Transfer Pump Connections

The bulk storage tanks shall each be fitted with a steel nipple projecting above the tank bottom at each of the connection location.

Access Ladders and Platforms

The tank supplier shall furnish stainless steel Type 316 ladders and access platforms at each tank to allow access from the floor to the top of the tank as shown on the Figures in Volume III.B of this RFP. A platform shall be furnished atop each tank to allow ease of access to the fill connection, vent lines and instruments. The Supplier shall submit its proposed design to the Engineer for review and comment. Design shall meet all applicable regulatory requirements. Tanks above 15 feet in height shall have safety cages provided with ladders.

Certification Label

Each tank shall bear a stainless steel nameplate. The tanks shall be provided with a permanently attached label providing the following information:

- Type of material stored
- Concentration of material stored
- Specific gravity
- Maximum temperature
- Tank capacity
- Manufacturer
- Date of manufacture

Level Sensor

Each tank shall be provided with level sensors. The mounting and connecting requirements shall be coordinated with the instrument supplier.

Sight Indicators

Each bulk storage tank and day tank shall be equipped with a visual liquid level indicator. Housings and floats shall be Type 316 stainless steel.

Length of visual liquid level indicators shall be in accordance with the Contract Documents and shall be coordinated by the tank manufacturer.

Visual liquid level indicators shall be mounted such that they are readily visible from outside of the bulk chemical containment area for bulk storage or from the door of the chemical rooms for the day tanks.

Overflow and Drain Lines

The tanks shall be provided with an overflow and drain pipe as specified and as indicated on the Figures in Volume III.B of this RFP. All pipe supports, hardware, accessories, etc., shall be provided by the Company. Vertical piping from the tanks shall be supported every 5 feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.

Flange Insert Check Valves (FIV)

The tank manufacturer shall provide FIVs for the storage tanks as shown on the Figures in Volume III.B of this RFP. The FIVs shall be installed on the overflow lines as indicated in the Contract Drawings. The valves shall be flanged check valves inserted between two mating flanges. The valves shall be the same diameter as the overflow line. The material of the valves shall be Teflon with Teflon O-ring seats. Each valve shall have a cracking pressure of 1/2 psi. The springs shall be Type 316 stainless steel completely encapsulated in Teflon. FIV shall be as manufactured by Check-All Valve Manufacturing Company or equal.

Signage

Each storage tank shall be provided with signs to identify chemicals stored and location of fill connections. Signs shall be attached to the tank at locations that are clearly visible or as directed by the Engineer.

Quick Connect Couplings

Each bulk storage tank fill line shall be provided with a quick connect coupling with a check valve as indicated on the Figures in Volume III.B of this RFP. The materials shall be suitable for the specified chemical. The quick connections shall be provided complete with fittings, quick lock coupling and dust cap and chain.

3.2.3.12.6 Chemical Handling Safety Equipment

The Company shall furnish and install chemical handling safety equipment as required by all applicable laws and codes. Certain equipment items will be field located by Owner, if not otherwise specified.

The materials covered by these technical requirements \ are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Figures in Volume III.B of this RFP and operated per manufacturers' recommendations.

Safety Equipment

Chemical Handling Safety Equipment shall include dust masks, chemical splash goggles, and chemical resistant work aprons, gloves and boots and safety clothing. The type and quantity of equipment listed below shall be supplied.

Dust Masks

Masks shall be Pyramex N-95 DM-2 (or equal) conforming to 42 CFR Part 84, N95 Class. Five (5) boxes with 20 masks per box shall be provided.

Chemical splash goggles

Goggles shall be Pyramex Model G304 (or equal) with fog-free coating. Three (3) splash goggles shall be provided.

Aprons and gloves

Chemical resistant work aprons and gloves shall be cloth with a double coating of abrasion resistant and chemical resistant elastomer. Sizes of gloves and boots shall be selected by the Owner. Three (3) complete sets of aprons and gloves shall be provided.

Chemical Handling Safety Equipment shall be stored in a wall mounted double door steel cabinet of approved size to prevent cramping of equipment specified. Cabinet shall be field located as directed by the Engineer. One (1) cabinet shall be provided.

The Company shall furnish a total of three sets (one each, small, medium, large and extra large) of safety clothing to protect personnel handling sodium hydroxide and 98 percent sulfuric acid. The clothing shall protect the body against splashes.

First Aid Kits

First aid kits shall be wall mounted metal cabinets and shall conform to OSHA standards. The kits shall be approved for industrial applications, serving 50 people. Stainless steel mounting brackets for masonry wall shall be provided. Kits shall be mounted at locations as directed by the ENGINEER. Three kits shall be provided and will be located within the following areas:

- One in the Pretreatment Building
- Two in the Membrane Building (one on main floor and one in the utilidor)

Ear Protectors

Three pairs of ear protectors shall be furnished. Two pairs shall be mounted in wall cabinets in the Generator Room. They shall be the over the head style for regular use with an adjustable padded head band. They shall be Bausch and Lomb, Inc. (Model 5N 85), Welsh Corporation or equal.

3.2.3.13 Clearwell Transfer Pumps

The Company shall furnish and install vertical turbine transfer pumps including but not limited to pumps, motors, variable frequency drives, pump bases and all other necessary mounting appurtenances provided by the pump manufacturer, tools, supplies in accordance with the Contract and as required for a complete and operable system. Furnish all labor, materials, equipment and incidentals required and install, place in operation, and field test four vertical turbine water transfer pumps including their respective motors and variable frequency drives as specified herein and as shown on Figures in Volume III.B of this RFP.

All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.

3.2.3.13.1 General

All equipment for the pumps, including motors, cans and bases, shall be provided as a complete unit by the pump Manufacturer. All pumps for same pumping application shall be provided by one manufacturer Guards should be in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.

All equipment shall be suitable for water treatment, continuous operation (24 hours per day, 365 days per year). Access to couplings and oil drains should be provided. All anchor and assembly bolts, nuts, washers, and fasteners shall be Type 316 stainless steel.

3.2.3.13.2 Manufacturers

Manufacturer shall have a minimum of 10 years of experience of producing substantially similar equipment and shall be able to show evidence of at least 5 installations in satisfactory operation for at least 5 years in the continental United States.

3.2.3.13.3 Performance Requirements

When operating at the maximum output speed each pump shall have a characteristic performance curve which meets all the minimum conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full-range of speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency as defined herein shall include all losses from the pump intake suction bell to the pump discharge flange. Losses through blank bowls (if any) for initial conditions shall also be considered.

The impeller diameter required for the specified operating conditions shall not exceed 95% of the maximum impeller diameter for the pump provided to provide flexibility in meeting specified head within required tolerance and allow increased duty for future conditions.

Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to backflow through the pump with the primary TDH specified available at the pump discharge flange. Maximum reverse run-away speed shall not exceed 130 percent of the design operating speed. Design operating capacity shall be between 85% and 100% of best efficiency point. Refer to **Table 3-14**.

Table 3-14 Pump Operating Conditions

No.	Description	Transfer Pumps
1	Number of Pumps	4
2	Maximum Pump Operating Speed (rpm) Minimum Pump Operating Speed (rpm)	590 or 710* 50% of full speed
3	Number of Stages	1
4	Operating Point No. 1 (Guarantee Point) (at maximum pump speed): ▪ Flow (gpm) ▪ Total Head (feet) ▪ Minimum Pump Efficiency (%)	 4,630 17.3 72
5	Operating Point No. 2 (at maximum pump speed): ▪ Flow (gpm) ▪ Total Head (feet) ▪ Minimum Pump Efficiency (%)	 >5,300 9.0 65
6	Maximum NPSH Required (Operating Point No. 1/2)	12.4/16.5
7	Maximum Shut Off Head (feet) (at maximum pump speed)	39
8	Motor Horsepower (hp) RPM Type	Direct Coupled 30 600 or 720 * TEFC
9	Motor Speed Control	VFD

* Flowway pumps operate at 590 rpm and Peerless pumps operate at 710 rpm.

3.2.3.13.4 Pump Components

Suction and Discharge Head

The discharge head shall have bolted register or rabbet-fit connections for the motor. Discharge head shall have connections for the pump column and shall support the loadings that it imposes as well as hydrostatic and hydrodynamic heads. Design columns and discharge heads for 100% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff. Hydrostatically test columns and discharge heads at 130% of design pressure. Access to the stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes or windows with stainless steel, expanded metal guards in stainless steel frames to protect the exposed shaft and coupling. The discharge head outlet pipe shall be Class 150 flanges, complying with ANSI B16.5. If cast iron discharge heads are specified, flange shall be Class 125.

Packing with Lantern Ring

The discharge head shall include a cast iron lineshaft stuffing box. Lineshaft stuffing box housing shall contain a bronze bearing, bypass water passage to the bearing terminating in a lantern ring or an annular port for relieving pressure on the stuffing box. The lantern ring shall be opposite a grease fitting for lubricating the packing. The bypass line shall contain a throttling valve for adjusting the leakage rate at the gland. The stuffing box shall be equipped with a minimum of four (4) rings of packing. Packing shall be interface braided synthetic impregnated with PTFE or graphite to maximize lubricity. Packing gland shall be Type 316 Stainless Steel, split type secured using at least two stainless steel bolts.

Shafts

Shafting shall be polished over its full length. Support the shafting by bearings at intervals so that the first natural frequency complies with general pump requirements. Calculate the shaft diameter using the formulas given in AWWA E103 for the pump shutoff head.

Shafts shall be supported by no fewer than three bearings (not including stuffing box bushing). Lineshaft bearings shall be supported by bearing retainers and clamped between column pipe flanges for open lineshaft pumps. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design.

The pump shaft shall be coupled to the motor shaft by a four piece adjustable spacer coupling that allows axial adjustment and removal of the complete seal assembly without disturbing the driver. An adjusting plate shall be part of the coupling.]

Bowl Assembly

Each bowl assembly shall consist of the discharge bowl, impeller, impeller shafting, and a bearing above the impeller. A bearing below the first stage impeller shall be located in the suction case or bell. Pump bowls shall be of the material listed under the subsection on “Pump Materials of Construction”. Refer to **Table 3-15** for details. Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment and to maintain the running clearances of seal rings. Bowls shall be flanged with male and female rabbets for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips. Provide the bowls with a renewable wear ring adjacent to the impeller, made of materials as indicated under “Pump Materials of Construction”. Cast iron bowls shall be internally lined with vitreous enamel or coated with 12 mils of fusion bonded epoxy. All fusio6n bonded epoxy shall be heat-cured.

Suction Bell

The suction bell shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance velocity shall not exceed 5 fps based on the outside diameter of the suction bell. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

Impellers

Pump impellers shall be of the enclosed type, cast in one piece of the material listed in the subsection on “Pump Materials of Construction”. Impellers shall incorporate a close fitting annular clearance with the case at the suction eye and be equipped with replaceable wearing rings. Impellers shall be positively secured to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation or torque. For pumps having bowl diameters greater than 15 inches and all pumps with stainless steel impellers and shafts, impellers shall be keyed to the shaft and positively secured against axial movement. Dynamically balance impellers to the tolerances specified by ISO 1940-1, grade G-6.3. Provide for adjustment of the axial position of the impellers at the pump shaft connection to the motor shaft to obtain proper clearance between bowls and impellers.

Vibration

The maximum vibration level measured on the top of the discharge head for any speed and operating point within the Preferred Operating Region shall not exceed that shown in Figure 9.6.4.2.5.16 of the Hydraulic Institute Standards as measured on the installed pump during field testing.

Table 3-15 Pump Materials for Construction

Component	Material Required
Pump shafts and line shafts	Stainless steel, Type 416
Bowl wear rings	Bronze
Bowl Impellers	“G” Bronze
Pump bowls, discharge case, and suction bell	Cast Iron, fusion bonded epoxy coated internally
Impeller keys and thrust rings	Stainless Steel, Type 416
Pump columns	Steel pipe, ASTM A53, Sch 30*
All parts made of fabricated steel	Steel, ASTM A36, ASTM A53
Mounting plate and Flanges	Steel
Bolts and nuts	Bolts shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M. Nuts shall be Type 316 stainless steel conforming to ASTM A 914, Grade 8M
Discharge heads	Cast Iron
Sole plate	Carbon Steel, ASTM A36
Sleeve bearings	Bronze
Lineshaft bearings	Rubber
Bearing Retainers	Bronze

* or higher schedule if required to meet vibration criteria.

The pump and motor assembly shall be designed so that its lateral critical speed avoids the operating speed range by a margin of 25 percent above and below the maximum and minimum speeds, respectively, assuming a rigid foundation. Manufacturer calculations that show compliance with this requirement shall be furnished with the shop drawing submittal. The Company shall coordinate pump installation requirements with the pump supplier to ensure a vibration free and stable installation.

The pump supplier shall have unit responsibility for coordinating and fabricating the proper pump mounting design for the layout shown on the Figures in Volume III.B of this RFP. If, in the opinion of the pump supplier, the openings or other aspects of the pump mounting design must be revised to allow for vibration free, stable pump operation, the Company shall submit said revisions to the Technical Advisor for review, comment and acceptance.

Discharge Head and Column Fabrication

Welding shall conform to the following Welding procedures and performance qualifications shall be in accordance with AWWA Standards with written certification from the manufacturer. The minimum number of passes for welded joints is shown in **Table 3-16**.

Table 3-16 Number of Passes for Welded Joints

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

Welds shall be full circumferential.

Beveled ends for butt welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. Test the seams by the dye-penetrant method per ASTM E 165, Method B. Welded stainless steel components shall be pickled and passivated following fabrication. All surfaces shall be free of heat tint, scale and slag. Manufacturer shall provide written certification that passivation has been completed prior to shipment of equipment.

Motors and Drives

The motor for the pump shall be of the weather protected vertical solid shaft WP-1 squirrel cage induction type. The motor shall be designed to accept all upthrust loads imposed by the pump during starting and running. The maximum speed and horsepower of each motor shall be as specified. The rated horsepower shall be such that the motors will not be overloaded nor the motor nameplate horsepower exceeded when the pumps are operated at any point on the pump performance curve. Motors shall be specifically designed for operation with variable frequency drive speed controls. Refer to **Table 3-17**.

Table 3-17 Pump Motor Data

Criteria	Data
Type	Direct coupled - vertical
Horsepower (hp)	30
Voltage (V)	460
Phase	3
Frequency (Hz)	60
Speed (rpm)	600 or 720*
Speed Range (%)	50 – 100 *
Minimal Efficiency at Full Load	92%
Minimum Power Factor	0.78
Enclosure Type	WP-1 **
Rating	Inverter Duty
Thermal Protection	Thermostats in Winding
Motor Speed Control	VFD
Non-reverse ratchet	Yes
Maximum Sound at 3 feet (dBA)	85
Space Heater	120V 1Ø
Miscellaneous	Provide Oversized Terminal Box

* Floway pumps operate at 590 rpm and Peerless pumps operate at 710 rpm.

** The outdoor rated auxiliary cooling shall be provided if recommended by pump manufacturer for speed range.

Thrust bearings shall be oil or grease lubricated. Provide thrust bearing cooling water piping if required for specified bearing life. Guide bearings shall be product lubricated. The motor shall be equipped with a nonreverse ratchet type mechanism to prevent reverse rotation. The motors shall be capable to turndown to at least 50 percent of full (100%) speed for extended periods of time.

3.2.3.14 Contact Basin

The Company shall design and construct one (1) contact basin/clearwell to achieve required disinfection prior to distribution. The Contact Basin is an enclosed concrete structure which shall be designed to provide a chlorine contact time sufficient for 99.99% (4-log) inactivation of viruses at a temperature of 22°C with a minimum free chlorine residual of 3.0 mg/L.

The required CT value for targeted virus inactivation and temperature between a pH of 6.5 and 7 is 2.6 mg/L-min. The minimum requirements for the Contact Bain are presented in **Table 3-18**. The contact basin should have required baffling factor to achieve the required CT.

Table 3-18 Contact Basin

Criteria	Data
Design Flow (mgd)	20
Water Depth (ft)	8
Effective Surface Area (ft^2)	5,000
Effective Volume (ft^3)	40,000
Contact Basin/Clearwell Volume (gal)	300,000
Hydraulic Retention Time (min)	22

The values presented above shall be confirmed during the detailed design. The contact basin shall be designed to all applicable industry standards, including the Hydraulic Institute Standard ANSI/HI 9.8 Pump Intake Design. All post-treatment chemical injection shall take place in the contact basin and achieve required effluent quality.

3.2.3.15 Degasification and Odor Control

3.2.3.15.1 Degasification

The Company shall furnish all labor, materials, equipment and incidentals required to install and test, complete, and ready for operation degasifier system specified herein.

The degasifier system shall include, but not be limited to, the de¬gasifier towers, ductwork, filter housings complete with motors and con¬trols, distribution headers and laterals, weir trough distribution system spray nozzles, mist eliminator, packing, packing support structures, manways and connections, lifting lugs, ladders, platforms, and grating as specified herein. The entire degasifier system shall be supplied and guaranteed by one (1) degasifier system supplier.

Supplier

The degasifier supplier shall also furnish the FRP centrifugal fan equipment to ensure unit responsibility for proper system installation and operation.

The degasifier system supplier must have demonstrated successful experience fabricating dual laminate vessels and should have at least five successes with PVC/FRP degasifiers in the State of Florida. FRP vessels will not be allowed.

Service Conditions

The degasifier units shall be designed to remove hydrogen sulfide from the product stream of a reverse osmosis (RO) process The units shall conform to the criteria presented in **Table 3-19**.

Table 3-19 Degasifier Unit Criteria

Criteria	Data
Number of units	TBD
Type	PTA/Forced Air
Ambient air temperature, degrees Fahrenheit	30-100
Relative humidity, %	Up to 100
Design flow rate, MGD (gpm)	TBD[1]
Water pH, SU	TBD
Hydraulic loading, gpm/ft2	<38
Air flow rate per unit at ultimate flow, scfm	scfm/gpm of permeate
Available H2S concentration in inlet, mg/L	5[2]
Minimum H2S removal efficiency @ 60 ºF water temperature and @ 70 ºF air temperatures, %	98
Fan motor horsepower, hp	TBD
Minimum Safety Factor on calculated packing height	1.3
Minimum packing depth, ft.	TBD
Packing Diameter, inches	TBD
Maximum vessel pressure drop, inches W.C.	TBD
Vessel Diameter, ft.	TBD

[1]To be Determined during detailed design

[2]Available H2S concentration to be confirmed based on results of hydrogeologic test program

Materials of Construction

The degasifier units shall be constructed of the materials listed in **Table 3-20**.

Table 3-20 Degasifier Construction Materials

Criteria	Data
Vessel	PVC overlaid with FRP NSF-61 certified
Exhaust Stack	PVC overlaidwith FRP
Exterior Coating	White Parafinated w/ UV screener
Liquid Distribution	PVC Weir Trough w/ Notches and Distribution Holes
Cleaning Header	Schedule 80 PVC
Gaskets	Sika-flex NSF 61 certified
Packing Supports	Polypropylene Gratings, PVC Support Rings, PVC I Beams, PVC Pipe Stands
Flange & Anchor Bolts	Stainless steel, Type 316 hardware
External Hardware	316 Stainless Steel
Internal Hardware	Titanium

PVC vessel overlaid with fiberglass-reinforced plastic (FRP) Vessels shall be fabricated from a composite material consisting of a polyvinyl chloride (PVC) vessel overlaid with fiber-reinforced plastic (FRP). The PVC vessel thickness shall be no less than 1/4-inch to avoid inducing structural stresses. Minimum thickness of the overlay shall be that created by application of 3 layers of 1-1/2 ounce chopped strand glass mat; with greater thickness as required to satisfy structural requirements of the application. Chopper gun application of laminate is permitted.

Vessels shall be fully constructed from rigid PVC sheet. PVC material shall conform to ASTM D 1784-69. It shall be hot gas welded at all seals and joints. Welds in areas subject to hydrostatic pressure shall be tested by non-destructive spark test, and weld integrity shall be demonstrated before application of the FRP overlay.

Fiberglass shall be applied by hand lay-up or chopped spray techniques in accordance with Voluntary Product Standard PS15-69. The resin shall be general purpose resin such as Composite One 1001-1, or equal. A pigmented exterior topcoat containing UV inhibitors and sufficient paraffin wax to give an air inhibited cure is required. This exterior topcoat must not soften or become tacky when subjected to an acetone sensitivity test as described in ASME/ANSI RTP-1-1989. Surface hardness shall be determined in accordance with ASTM D 2583. Random Barcol hardness test will be taken and 80% of the readings shall exceed 90% of the manufacturer's published minimum cured hardness value. Failure to meet these tests shall be considered a non-conformance and corrections must be made by the fabricator.

Vessel Construction

The loading conditions for the design of the degasifier and attachment to the concrete slab shall include, but not be limited to, a roof load of 20 pounds per square foot, materials dead loads, forces imposed by the liquid splashing downward, forces imposed by the air moving upward, and design degasifier vessels to supports connecting ductwork.

- Vessel Tops
  - The degasifier vessels shall have top air outlets and conical covers. All vessel internal components, except the media, shall be factory installed.
- Vessel Bases
  - The degasifier vessel base shall be flat and shall contain the necessary lugs for anchoring to the concrete base. The base shall include a degasified bottom outlet and drain.

Air Inlet

The Company shall design, furnish and install a transition air duct from each fan to the inlet flange of each degasifier (air stripping) unit. Duct shall have flanged inlet and outlet connections. Construct the duct in the same manner and thickness as the air stripper shell.

Attachment Bolts, Nuts, Washers

Vessel (FRP/PVC) element to concrete structure with Type 316 stainless-steel bolts anchors and nuts. Bolts shall conform to ASTM A 193, Grade B8M. Nuts shall conform to ASTM A 194, Grade 8m. Provide washer under each nut and bolt head. Design bolts and washers to prevent bolt pull out due to uniform and non-uniform vertical, horizontal, torsional, fatigue and cyclical loading of the FRP and bolts.

Air Stripper Air Inlet Filter Housing

Each degasifier (air stripping) unit shall be supplied with a filter housing/inlet silencers integrally attached to filter out 95 percent of 10 micron size and larger particles.

FRP Centrifugal Fan

Furnish one fan per degasifier. Each fan shall be furnished with an air inlet filter housing. Fans shall be sized to overcome the sum of the pressure losses through the inlet filter and the degasifier. In addition provisions should be made to allow the fan to operate under an additional 7-inch W.C. headloss as specified below. Components (including motors) shall be sized to handle this condition.

The Company shall furnish and install all tools, supplies, materials, equipment, and labor necessary for the installation, testing, and placing into operation of all fiberglass reinforced plastic (FRP) centrifugal fans and appurtenances, complete and operable, all in accordance with the requirements of the Contract Documents. This equipment shall be furnished by the air stripper (degasifier) supplier to ensure unit responsibility for the operability of the air stripper system.

The supplier(s) of the degasifiers shall be responsible for coordinating the selection of the centrifugal fans. Fan Enclosure

Each fan and motor shall be enclosed by a drop over, easily removable, non-corrosive sound attenuation enclosure which incorporates the air intake filter housing. The noise level measured 5 ft from the air intake shall not exceed 70 dBA with the fan in operation. Sound absorption material shall be a nominal 2-inch thick resilient sheet capable of returning to its original form after compression.

The material shall be faced with an oil-resistant layer to protect its integrity. Absorption material shall be fitted to all interior surfaces of the enclosure. Material shall be held in place by corrosion resistant fasteners and adhesive.

Each fan inlet shall have an enclosure which also incorporates the air intake filter housing. The inlet enclosures shall be fabricated from aluminum sheet, type T-5051 checker plate. All structural framing shall be of aluminum construction. Fasteners shall be of a corrosion resistant, self-locking type.

The inlet enclosures shall be equipped with an air intake designed to suppress sound propagation and filter the incoming air. The replaceable filters shall have a nominal rating of 10-microns and operate at an air face velocity of less than 625 fpm. The air intake filter housing shall be made of aluminum with Type 316 stainless steel. Retaining screens shall be Type 316 stainless steel and be hinged front and back for easy maintenance.

The inlet enclosures shall be structurally designed and constructed to withstand the maximum pressure differential produced by the fan, assuming complete blockage of the air intake. Installation around the fan shall be essentially air-tight except for the air intake. The enclosure shall be secured to the concrete slab with 316 stainless steel fasteners.

Centrifugal Fan Materials

Fans including housing and impellers shall be FRP, centrifugal type, with backwardly curved blades and non-overloading characteristics. Fan housings shall be grounded to the support bases. Provide integral inlet damper control as required. Fan housings shall be of a curved scroll design with a 3/4 inch flanged drain outlet at the lowest point of the scroll. Fan inlet and outlet nozzles shall be flanged.

The fan should include gasketed FRP access door bolted to the wheel housing, and Viton shaft seals with FRP backup plate bolted to the housing. FRP construction should be of two laminate layers: one for the inner surface. Glass content in the inner surface layer shall not exceed 23-percent by weight. The structural layer shall be composed of chopped strand mat having a minimum glass content of 30-percent by weight. The overall glass content of the finished laminate shall be at least 30-percent by weight. Laminate thickness shall be at least ¼-inch.

Resin shall be corrosion resistant as defined by ASTM C 581. Medium shall be air containing 0 to 10 ppm of hydrogen sulfide gas and saturated with water vapor. Resin layers in contact with the airstream shall contain carbon to allow for control of static electricity.

Fiberglass construction shall comply with ASTM D 2563, Level II, except as modified herein. Wall hardness shall be at least 90% of the resin manufacturer's recommended Barcol hardness, with a minimum Barcol hardness of 30, with the resin fully cured. Maximum strain in the laminate shall be 0.001 inch/inch. Maximum air bubble size in the laminate shall be 1/16 inch. Maximum frequency of air bubbles in the liner portion of the laminate shall be 10 per square inch of laminate. B. Construction shall comply with NBS Voluntary Product Standard PS 15 69. Fan shall be rated and tested per AMCA 210.

Fan shafts shall be Type 316 stainless steel. Fan shall have self-aligning grease packed bearings with neoprene shaft seals. Provide OSHA approved weatherproof FRP or PVC cover for the motor and drive.

Provide two antifriction bearing assemblies. Locate bearings outside the fan housing. One assembly shall be free to float to carry radial thrust only. The other assembly shall carry both radial and axial thrust. Bearings shall be either spherical or tapered roller type. Bearings subject to radial thrust only shall be single row or double row. Bearings subject to both radial and axial thrust shall be double row.

Minimum bearing life per the AFBMA B 10 rating shall be 50,000 hours. Bearings shall be grease lubricated. Provide external Type 316 stainless steel ZERK fittings for grease lubrication.

Vibration

The vibration in any plane measured on the bearing housings shall not exceed 1 mils peak to peak.

Fan Drive

Provide V belt drive with a rating at least 50% greater than the rated motor horsepower. Provide belt guard conforming to OSHA requirements.

Motor

Install the motor on an adjustable base. Motor shall operate on 460 volts, 3 phases and 60 hertz. Motors shall be equipped with 120 Volt space heaters and winding thermostat. Motors shall have TEFC enclosures and shall be rated for belt drive.

FRP Centrifugal Operating Conditions

Fan performance and operating conditions shall be as shown below. Ratings shall conform with AMCA 210 as shown in **Table 3-21**.

Table 3-21 FRP Centrifugal Operating Conditions

Criteria	Data
Number of Units	3
Minimum rated capacity	18,000 scfm
Differential pressure	As required by air stripper/degasifier supplier including future off-gas treatment
Minimum efficiency at rated capacity	68 %
Motor horsepower	50
Maximum fan speed	2250 rpm
Maximum noise level (5' from fan)	83 decibels (without sound enclosure)

3.2.3.15.2 Odor Control

The work specified herein shall include design, furnishing and installing all equipment and materials necessary to provide the Owner with two (2) completely operational Odor Control (wet scrubber) Systems. The systems shall be a completely package two-stage absorption system. The Contractor shall be responsible for providing complete Odor Control (wet scrubber) Systems which shall include, but not limited to with PVC/FRP vessels, demister, nozzles, internal media, and control system (recirculation pumps, chemical pumps and acid transfer pump, makeup water, etc.) recirculation pump, pipes, valves, ducting, dampers, pipe & duct supports, hydrogen sulfide analyzers/recorders (inlet/outlet), NaOCl analyzer kit, pH and ORP probes and all necessary accessories. Additionally, the contractor shall coordinate the ducting, dampers, chemical feed pumping system, acid pump, chemical storage tanks, piping, valving RO degasifier units and to provide a complete operating system.

Two (2) two-stage odor control systems are required with eight (8) recirculation pumps.

General Information and Description

All Odor Control (Wet Scrubber) equipment shall be supplied by one manufacturer in order to achieve standardization for appearance, testing of a complete system performance, operation, maintenance, spare parts and service. It is the intent of this specification to obtain an installation complete in every necessary detail whether or not covered by the specifications, and any omission of required equipment from the specifications shall not relieve the manufacturer of its responsibility for the satisfactory installation and operation of all the required equipment specified in this section.

The Contractor shall provide two-stage odor control (wet scrubber) systems specified which shall treat hydrogen sulfide and carbon dioxide air generated from the degasifier units. Each system shall be designed for continuous and automatic operation with automatic chemical injection and also be capable of manual operation. The wet scrubber blowdown stream shall be discharged into a chemical drain. Access manways shall be provided to allow access to the internals of the scrubber. The scrubber system shall be designed to withstand a temperature up to 150ºF.

The Contractor shall have unit responsibility for coordination of all structures, metals, controls and piping with all interrelated equipment as may be specified elsewhere in these documents to provide a complete and operable system.

Operating Conditions

The odor control (wet scrubber) systems shall be designed to remove hydrogen sulfide from the air discharge stream from the degasifier units. The units shall conform to the criteria presented in **Table 3-22**.

PVC Vessel Overlaid with Fiberglass-Reinforced Plastic (FRP)

Vessels shall be fabricated from a composite material consisting of a polyvinyl chloride (PVC) vessel overlaid with fiber-reinforced plastic (FRP). The PVC inner vessel thickness shall be no less than 1/4-inch to avoid inducing structural stresses. Minimum thickness of the overlay shall be that created by application of 3 layers of 1-1/2 ounce chopped strand glass mat; with greater thickness as required to satisfy structural requirements of the application. Application of laminate shall be by chopper gun.

Vessels shall be fully constructed from rigid PVC sheet. PVC material shall be NSF approved and shall conform to ASTM D 1784. It shall be hot gas welded at all seals and joints. Welds in areas subject to hydrostatic pressure shall be tested by non-destructive spark test, and weld integrity shall be demonstrated before application of the FRP overlay.

Table 3-22 Odor Control (Wet Scrubber) System Design Criteria

Criteria	Data
Number of units	2
Number of stages per unit	2
Type	Wet Scrubber Packed Column
Ambient air temperature, degrees Fahrenheit	30-100
Relative humidity, %	Up to 100
Average influent H2S Concentration, ppm	122
Total Minimum H2S removal efficiency @ 90°F water temperature and @ 90°F air temperature, %	99
Stage 1	
Unit max. air flow rate, scfm	54,000
Air velocity (Vessel), fps	6.8
Vessel Diameter, ft	13
Overall Height, ft	26
Minimum packing depth, ft	7
Packing Diameter, inches	2
Chemical Addition	NaOH
Number of Recirculation Pumps	2
Recirculation Pumping, gmp/TDH, ft	1,100/58
Pumping motor horsepower	25
Stage 2	
Unit max. air flow rate, scfm	54,000
Air velocity (Vessel), fps	6.8
Vessel Diameter, ft	13
Overall Height, ft	26
Minimum packing depth, ft	7
Packing Diameter, inches	2
Chemical Additions	NaOH/NaOCl
Number of recirculation pumps per stage	2
Recirculation Pumping, gpm/TDH, ft	1,100/58
Pumping motor horsepower	25

Fiberglass shall be applied by hand lay-up or chopped spray techniques in accordance with Voluntary Product Standard PS15-69. The resin shall be isophthalic resin such as Aropol 7242, or equal. If fire retardancy is required the resin shall be Hetron 99P with 3% antimony trioxide or equal. A pigmented exterior topcoat containing UV inhibitors and sufficient paraffin wax to give an air inhibited cure is required. This exterior topcoat must not soften or become tacky when subjected to an acetone sensitivity test as described in ASME/ANSI RTP-1-1989. Surface hardness shall be determined in accordance with ASTM D 2583. Random Barcol hardness test will be taken and 80% of the readings shall exceed 90% of the manufacturer's published minimum cured hardness value. Failure to meet these tests shall be considered a non-conformance and corrections must be made by the fabricator.

Vessel Construction

The Company shall assign to the odor control system equipment supplier full responsibility for the complete structural design of each scrubber vessel. Duct, flanged joints, field wrapped joints, supports and packaged tower scrubber vessel shells located outdoors shall be designed in accordance with the latest edition of the Florida Building Code.

The treated gases from the packed tower scrubber vessel discharge from free standing vertical stacks above the top flange of the vessels. The scrubber vessel manufacturer shall consider in the design of the vessels, stacks, flanges and hold-down brackets the dead loads and previously specified wind loads imposed by the stacks. The specified thickness for the scrubber vessel wall, heads and outlet flange are minimums and the manufacturer shall increase the thickness or provide additional reinforcement required to meet the above stated conditions. Guy wire type support systems are not acceptable.

The odor control (air stripping) vessels shall be round in cross section with a top air outlet and dome cover. All vessel internal components, except the media, shall be factory installed. Suitable Type 316 stainless steel lifting lugs shall be provided for use in transporting and placing scrubber vessels.

The vessel base shall be flat and shall be provided with Type 316 stainless steel hold down lugs for anchoring to the concrete base. The base shall include odor control vessel recirculation pump feed outlet drain outlet as shown on the Figures in Volume III.B of this RFP. Refer to **Table 3-23** for details.

The minimum wall thickness shall be 1/4 inch. Maximum wall deflection under any combination of loading conditions shall not exceed 1/360.

Cleaning (Wash) System

A liquid distributor with nozzles shall be provided to spray cleaning solution over mist eliminator packing and scrubbing packing to wash and clean packing. Piping and valving shall be provided to use the recirculation pumps to pump cleaning solution from the sump to above mist eliminator packing to wash and clean packing systems.

A high efficiency, demister (mist eliminator) shall be provided at the discharge of the system. The mist eliminator shall remove 99% of all mist particles 40 microns and larger and 90% of all mist particles 10 microns and larger.

Neoprene Pad

A 1/4" thick, 60 durometer neoprene rubber sheet must be placed underneath the odor control scrubber vessels.

Support Brackets

Support brackets shall be provided for all piping. Support brackets shall be constructed of Type 316 stainless steel.

Recirculation Pumps

Each stage for each odor control system shall have two recirculation pumps with alternating service, chemical recycle piping and valving, make-up water and drain piping, and blowdown,.

The recirculation pumps shall comply with the criteria presented in **Table 3-24**.

Table 3-23 Materials of Construction

Criteria	Data
Vessel	PVC overlaid with FRP
Exhaust Stack	PVC overlaid with FRP
Exterior Coating	Paraffinated gel coat with UV light inhibitors
Packing	Polypropylene, random, Jaeger Tri-Pak or approved equal.
Water Distribution Weir Trough	Schedule 80 PVC
Spray system	Schedule 80 PVC
Recirculation pump suction and discharge piping	Schedule 80 PVC
Chemical recycle piping, make-up water and drain piping, and blowdown	Schedule 80 PVC
Demister	PVC or FRP
Gaskets	EPDM, NSF 61 certified (caulking not acceptable)
Packing Supports	PVC or FRP – Company shall submit calculations that demonstrate the packing support can satisfy a loading rate of 90 psf.
Flange & Anchor Bolts	Stainless steel, Type 316 hardware over PVC/FRP construction
External Hardware	316 Stainless Steel
Internal Hardware	Titanium/PVC

Table 3-24 Recirculation Pump Design Criteria

Criteria	Data
Quantity Required	8
Quantity Required per Vessel	2
Pump Type	Vertical Centrifugal
Fluid Service	NaOH, Chlorine Solution, Sodium Hydroxide
Fluid pH Range	0 to 14
Fluid Temperature, ºF	85
Design Flow Rate, gpm	1,100 gpm
Design Flow Pump Head (TDH), feet	90
Pump Speed Maximum, rpm	1200
Drive Type	Direct Drive
Motor Type	TEFC
Motor Size, hp	25
Electrical Requirements	460 volt, 3 phase, 60 Hertz, one thermostat in each motor winding for motor thermal protection
Material of wetted parts	FRP
Material of shaft	316 Stainless Steel

Furnish at a minimum, for each recirculation pump.

Provide rebuilding kit as recommended by the manufacturer and include at minimum of:

- Impeller, shaft and bearing assemblies.
- 1 check valve
- 1 butterfly valve
- 1 flexible reducing coupling

Instrumentation and Control System

Panels

Provide the following panels:

- Quantity: 2
- Enclosure Rating: NEMA 4X
- Enclosure Material: Fiberglass
- Power Requirements: 480 Vac, 3-phase
- Operator Controls and Indications:
  - System ON status light
  - ON status light for each, Stage 1 Recirculation Pump
  - Low level light, Stage 1 Sump
  - Low level light, Stage 2 Sump
  - ON status light for each, Stage 2 Recirculation Pump
  - ON status light, NaOH Stage 1 Feed Pump
  - ON status, NaOH Feed Stage 2 Pump
  - Low level light, Caustic Soda Storage Tank
  - ON status, Hypochlorite Feed Stage 2 Pump
  - Low level light, Hypochlorite Storage Tank
  - ON status, Acid Pump (H2SO4)
  - Flow totalizer for Acid Pump
- Stage 1 pH Controller
- Hand/Off/Auto selector switch, Stage 1 Recirculation Pump
- Hand/Off/Auto selector switch, Stage 1 NaOH Feed Pump
- Stage 2 ORP Controller
- Stage 2 pH Controller
- Hand/Off/Auto selector switch, Stage 2 Recirculation Pump
- Hand/Off/Auto selector switch, Stage 2 NaOH Feed Pump
- Hand/Off/Auto selector switch, Stage 2 Sodium Hypochlorite Feed Pump
- Hand/Off Selector switch, Acid Pump
- Hand/Auto Selector Switch, System

External Interfaces:

- Provide the following external interfaces with the Plant I&C System:
  - Discrete Inputs:
    - Low level NaOH storage tank (Disable NaOH Feed Pumps).
    - Low level NaOCl storage tank (Disable NaOCl Feed Pump).
  - Discrete Outputs:
    - Abnormal Level Alarm.
    - Abnormal pH Alarm.
- Functional Requirements:

- Provide system master Hand/Auto switch.

Hydrogen Sulfide Gas Monitoring System

H2S gas monitoring system shall be furnished complete with sensors, modules, enclosures, and appurtenant devices suitable for detecting H2S as indicated in this section. Provide one hydrogen sulfide gas detection system network unit, and two individual gas detection systems and transmitters.

The sensor assembly shall be a diffusion-type device requiring a minimal d-c excitation current to provide automatic temperature control to eliminate zero drift and false alarms from ambient temperature changes. Sensors shall be rated explosion proof and shall be suitable for the environment in which they will be located. Sensors shall not require any addition of chemical reagents and shall require no routine maintenance other than calibration checks. Sensor shall be equipped for a minimum of a one-year full replacement warranty.

Each gas detection system sensor shall be equipped with a receiver module for each sensor. The receiver module shall be housed in a weatherproof NEMA 4X enclosure suitable for an operating temperature of -4°F to 122°F, with a relative humidity of 5 to 95 percent. Each receiver module shall have an LCD readout with units of the corresponding sensor engraved on the module face. Each module shall have a digital output to the network module.

The monitoring level in ppmv shall range from 1-10 ppmv at ambient temperatures and 100% relative humidity. The recording shall be in 0.1 ppm increments. The monitoring systems shall have an automatic purging system to purge sample lines and analyzer between readings.

Monitoring and analyzers shall be provided with adjustable sampling time ranging from 15 to 30 minutes. The network display module shall be capable of viewing the information from each of the three receiver modules as well as change parameters, alarm levels, and view dates of the last calibrations. The network display module shall be housed in a weatherproof NEMA 4X enclosure suitable for an operating temperature of -4°F to 122°F, with a relative humidity of 5 to 95 percent. Each network display module shall have LCD readout with units of the sensors engraved on the module face. The network display module shall have connections with the three gas receiver modules and one relay module. The relay module shall provide three alarm relay outputs to receiver module. The relay module shall be housed in a weatherproof NEMA 4X enclosure suitable for an operating temperature of -4°F to 122°F, with a relative humidity of 5 to 95 percent. The relay module shall be equipped with alarm, status, and fault LED indications.

One spare sensor shall be provided for each sensor installed. Spare sensors shall be provided in addition to any replacement sensors required during the warranty period, even if the warranty period exceeds the normal expected life of the sensor. Delivery schedule for the spare sensors shall be as recommended by the manufacturer.

Odor Control Accessories

Make-up Water systems shall be provided for each stage of each odor control system.

- Continuous feed System: The direct reading rotameter shall be a variable area type with a Teflon float, EPR "O" rings, and PVC fittings. Size and flow rate shall be design by the odor control manufacturer. The rotameter shall be of the same size as the pipe in which it is installed. The rotameter shall have a direct reading scale UV resistant.
- Level Activated System: Float level shall activate a solenoid valve when the liquid level in the sump reach a manufacturer determined level.

Scrubber Recirculation Sump Blowdown and Level Controls

The scrubber shall be operated with a manual blowdown. The rate of blowdown shall be controlled by overflow to the scrubber tower drain line proportional to the makeup water added.

Differential Pressure Gauges

Two magnehelic type pressure gauges shall be provided to monitor pressure drop across the scrubber and the mist eliminator. Transparent overlays will be included.

Pressure Gauges

A pressure gauge complete with all plastic activator/isolator shall be provided for installation in the pump discharge piping. The gauge shall have a minimum dial size of 3½ inches, indicate the units of measurement on the dial face, and be complete with isolation valve. The gauge range shall be such that the normal operating reading shall be near the midpoint of the range

Piping and Valving

All recirculation piping, make-up water piping and drain piping, and blowdown piping shall be SCH 80 PVC with carbon black. All recirculation piping shall be flanged. All recirculation valving, make-up water valving, drain valving and blowdown valving shall be PVC with carbon black. All gaskets, seals, o-rings, & seats shall be viton. All cleaner and glue shall be industrial grade, pressure rated, silica free and approved for use with NaOCl and NaOH

Identification

All piping shall have colored code labels, flow arrows and descriptive naming.

3.2.3.16 Concentrate Pumps and Pump Station

The Company shall provide all materials, equipment, motors, anchorage systems, and incidentals necessary for the installation, testing, and placing into operation the concentrate pump station at the South Miami Heights Water Treatment Plant as illustrated in Volume III.B of this RFP.

The concentrate pump station wet well and pumping units shall be designed utilizing the following criteria presented in **Table 3-25**.

Table 3-25 Wet Well and Pumping Unit Basis of Design

Criteria	Data
Concentrate Pump Station Wet Well Design Flows	
Strainer Backwash (mgd)	0.54
RO Concentrate (mgd)	8.33
RO Flush Flow (mgd)	0.55
Scavenger Tank Pump Station (mgd)	0.06
Concentrate Pumping Units	
Number of Pumps	3
Design Flow (gpm)	2525
TDH (ft)	145
Horsepower	250
Control	Variable Frequency Drive
Minimum Efficiency	75%

The technical requirements of the pump station are described below.

3.2.3.16.1 Concentrate Pumps

The Company shall furnish and install vertical turbine transfer pumps including but not limited to pumps, motors, variable frequency drives, pump bases and all other necessary mounting appurtenances provided by the pump manufacturer, tools, supplies in accordance with the Contract and as required for a complete and operable system. Furnish all labor, materials, equipment and incidentals required and install, place in operation, and field test four vertical turbine water transfer pumps including their respective motors and variable frequency drives as specified herein and as shown on Figures in Volume III.B of this RFP.

All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.

General

All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump Manufacturer. All pumps for same pumping application shall be provided by one manufacturer Guards should be in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.

All equipment shall be suitable for water treatment, continuous operation (24 hours per day, 365 days per year). Access to couplings and oil drains should be provided. All anchor and assembly bolts, nuts, washers, and fasteners shall be of super duplex stainless steel (PREN > 40).

Manufacturers

Manufacturer shall have a minimum of 10 years of experience of producing substantially similar equipment and shall be able to show evidence of at least 5 installations in satisfactory operation for at least 5 years in the continental United States.

Performance Requirements

When operating at the maximum output speed each pump shall have a characteristic performance curve which meets all the minimum conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full-range of speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency as defined herein shall include all losses from the pump intake suction bell to the pump discharge flange. Losses through blank bowls (if any) for initial conditions shall also be considered.

The impeller diameter required for the specified operating conditions shall not exceed 95% of the maximum impeller diameter for the pump provided to provide flexibility in meeting specified head within required tolerance and allow increased duty for future conditions.

Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to backflow through the pump with the primary TDH specified available at the pump discharge flange. Maximum reverse run-away speed shall not exceed 130 percent of the design operating speed. Design operating capacity shall be between 85% and 100% of best efficiency point.

3.2.3.16.2 Pump Components

Suction and Discharge Head

The discharge head shall be super duplex stainless steel (PREN > 40). It shall have bolted register or rabbet-fit connections for the motor. Discharge head shall have connections for the pump column and shall support the loadings that it imposes as well as hydrostatic and hydrodynamic heads. Design columns and discharge heads for 100% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff. Hydrostatically test columns and discharge heads at 130% of design pressure. Access to the stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes or windows with stainless steel, expanded metal guards in stainless steel frames to protect the exposed shaft and coupling. The discharge head outlet pipe shall be Super Duplex Stainless Steel.

Packing with Lantern Ring

The discharge head shall include a super duplex stainless steel (PREN > 40) lineshaft stuffing box. Lineshaft stuffing box housing shall contain a bearing, bypass water passage to the bearing terminating in a lantern ring or an annular port for relieving pressure on the stuffing box. The lantern ring shall be opposite a grease fitting for lubricating the packing. The bypass line shall contain a throttling valve for adjusting the leakage rate at the gland. The stuffing box shall be equipped with a minimum of four (4) rings of packing. Packing shall be interface braided synthetic impregnated with PTFE or graphite to maximize lubricity. Packing gland shall besuper duplex stainless steel (PREN > 40), split type secured using at least two stainless steel bolts.

Shafts

Shafting shall be of super duplex stainless steel (PREN > 40). Support the shafting by bearings at intervals so that the first natural frequency complies with general pump requirements. Calculate the shaft diameter using the formulas given in AWWA E103 for the pump shutoff head.

Shafts shall be supported by no fewer than three bearings (not including stuffing box bushing). Lineshaft bearings shall be supported by bearing retainers and clamped between column pipe flanges for open lineshaft pumps. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design.

The pump shaft shall be coupled to the motor shaft by a four piece adjustable spacer coupling that allows axial adjustment and removal of the complete seal assembly without disturbing the driver. An adjusting plate shall be part of the coupling.]

Bowl Assembly

Each bowl assembly shall consist of the discharge bowl, impeller, impeller shafting, and a bearing above the impeller. The assembly shall be of super duplex stainless steel (PREN > 40). A bearing below the first stage impeller shall be located in the suction case or bell. Pump bowls shall be of the material listed under the subsection on "Pump Materials of Construction". Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment and to maintain the running clearances of seal rings. Bowls shall be flanged with male and female rabbets for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips.

Suction Bell

The suction bell shall be super duplex stainless steel (PREN > 40) and shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance velocity shall not exceed 5 fps based on the outside diameter of the suction bell. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

Impellers

Pump impellers shall be of the enclosed type, cast in one piece of super duplex stainless steel (PREN > 40). Impellers shall incorporate a close fitting annular clearance with the case at the suction eye and be equipped with replaceable wearing rings. Impellers shall be positively secured to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation or torque. For pumps having bowl diameters greater than 15 inches and all pumps with stainless steel impellers and shafts, impellers shall be keyed to the shaft and positively secured against axial movement. Dynamically balance impellers to the tolerances specified by ISO 1940-1, grade G-6.3. Provide for adjustment of the axial position of the impellers at the pump shaft connection to the motor shaft to obtain proper clearance between bowls and impellers.

Vibration

The maximum vibration level measured on the top of the discharge head for any speed and operating point within the Preferred Operating Region shall not exceed that shown in Figure 9.6.4.2.5.16 of the Hydraulic Institute Standards as measured on the installed pump during field testing.

The pump and motor assembly shall be designed so that its lateral critical speed avoids the operating speed range by a margin of 25 percent above and below the maximum and minimum speeds, respectively, assuming a rigid foundation. Manufacturer calculations that show compliance with this requirement shall be furnished with the shop drawing submittal. The Company shall coordinate pump installation requirements with the pump supplier to ensure a vibration free and stable installation.

The pump supplier shall have unit responsibility for coordinating and fabricating the proper pump mounting design for the layout shown on the Figures in Volume III.B of this RFP. If, in the opinion of the pump supplier, the openings or other aspects of the pump mounting design must be revised to allow for vibration free, stable pump operation, the Company shall submit said revisions to the Technical Advisor for review, comment and acceptance.

Discharge Head and Column Fabrication

The discharge heads for the concentrate pumping units shall be a one piece fabrication of super duplex stainless steel (PREN > 40). The discharge head shall include a super duplex stainless steel (PREN > 40) stuffing box with extra-large openings for pump adjustment and seal maintenance.

Welding shall conform to the following Welding procedures and performance qualifications shall be in accordance with AWWA Standards with written certification from the manufacturer, Each discharge head shall be pickled and passivated after all welding is complete and shall be grit blasted to an even matte finish.

Motors and Drives

The motor for the pump shall be of the weather protected vertical solid shaft WP-1 squirrel cage induction type. The motor shall be designed to accept all upthrust loads imposed by the pump during starting and running. The maximum speed and horsepower of each motor shall be as specified. The rated horsepower shall be such that the motors will not be overloaded nor the motor nameplate horsepower exceeded when the pumps are operated at any point on the pump performance curve. Motors shall be specifically designed for operation with variable frequency drive speed controls. Refer to **Table 3-26**.

Table 3-26 Pump Components Motor Data

Criteria	Data
Type	Direct coupled - vertical
Horsepower (hp)	30
Voltage (V)	460
Phase	3
Frequency (Hz)	60
Speed (rpm)	600-720
Speed Range (%)	50 – 100
Minimal Efficiency at Full Load	92%
Minimum Power Factor	0.78
Enclosure Type	WP-1
Rating	Inverter Duty
Thermal Protection	Thermostats in Winding
Motor Speed Control	VFD
Non-reverse ratchet	Yes
Maximum Sound at 3 feet (dBA)	85
Space Heater	120V 1Ø
Miscellaneous	Provide Oversized Terminal Box

Thrust bearings shall be oil or grease lubricated. Provide thrust bearing cooling water piping if required for specified bearing life. Guide bearings shall be product lubricated. The motor shall be equipped with a nonreverse ratchet type mechanism to prevent reverse rotation. The motors shall be capable to turndown to at least 50 percent of full (100%) speed for extended periods of time.

Pump Station Odor Control System.

The concentrate pump station odor control system should be comprised of a 3-stage chemical scrubber packaged system (LO/PRO® or equal). The manufacturer will be responsible for the system design. The Company shall be responsible for furnishing, and installing the system per manufacturer specifications.

Hydrogen sulfide laden air passes through ductwork to the LO/PRO® odor control scrubber. The system utilizes Sodium Hydroxide (NaOH) and Sodium Hypochlorite (NaOCl) to react with and remove the odorous compounds present in the airstream. The odor control system confiruigation should be such that it maximizes the amount of liquid to gas contact in the system, thereby maximizing the removal efficiency of the system and minimizing chemical consumption. The minimum hydrogen sulfide removal efficiency shall be 99%.

3.2.3.17 Sample Pumps

The Company shall furnish and install all sample pumps as specified herein and as shown on Figures in Volume III.B of this RFP. The sample pumps shall be provided by one manufacturer with sole responsibility for the satisfactory manufacture and performance of the systems.

Horizontal, close-coupled or frame mounted, single-stage turbine pump. The pump shall be of all-bronze construction with Type 416 stainless steel shaft and mechanical seal.

Motor

The pump motor shall be TEFC "corrosive duty", designed for 480 volt, 60 hertz, 3 phase electrical power and. Motors shall operate at 1,750 rpm.

All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards. Motors shall be fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

Pump Bypass

Each pump shall be equipped with a bypass such that flow from the discharge of the pump may be recirculated to the pump suction as shown on Figures in Volume III.B of this RFP. A globe needle valve shall be placed on the bypass to control the amount of flow that is recirculated.

Suction and Discharge Connections

Suitable fittings to facilitate the connections shall be provided by the sample pump manufacturer.

Spares

Provide one shelf spare pump identical to provided pumps.

3.2.3.18 Deep Injection Wells

Two wells (one duty and one redundant) will be provided at the SMH WTP site in the eastern portion of the site. One of the proposed injection wells (SMH IIW-1) and a dual-zone monitoring well (SMH DZMW-1) will be constructed by others under a separate contract (W-930), but will require permitting from a Class V exploratory well to a Class I Industrial injection well. The construction and operation of the redundant injection well shall meet all permitting, hydrogeologic testing and well construction requirements of Chapter 62-528, F.A.C. Both the injection wells and dual zone monitoring wellheads will need to be completed with piping, valves, appurtenances and instrumentation by the Company.

The injection wells will penetrate into aquifers containing high saline water under pressure. At the injection well site location, the Surficial Aquifer contains potable water and therefore it is required that high saline water produced from the deep aquifer be contained so there is no contamination to the Surficial Aquifer. A fluid management system shall be designed, installed and maintained to prevent any potential spills and cross contamination of saline water into the freshwater aquifer.

The injection wells shall have an alternate design with cement filled annulus for the Fiberglass Reinforced Plastic (FRP) injection casing (final) and 0.50 inch wall steel casing. The well shall be designed so that it is of sufficient size and capacity capable of handling maximum daily waste discharge of permeate from the SMH WTP and not exceed the maximum permissible injection rate of 10 feet per second (ft/sec).

The injection well construction is dependent on site-specific hydrogeological conditions and that the anticipated depths are approximate. Final well depths shall be determined by Florida licensed engineer or geologist based on field data collected during well construction. Hydrogeologic testing including coring, geophysical logging, packer tests, water quality sampling, and injection tests must be adequate to define the Base of the Underground Source of Drinking Water (USDW), confining units and the injection zone (Boulder Zone).

The injection well shall be constructed with multiple strings of casing to protect against cross contamination of the multiple aquifers penetrated by the well and be in compliance with well construction requirements of Chapter 40C-3 and 62-528 of the F.A.C. The USDW shall be cased off prior to continuing on with well construction to deeper depths. Final casing is anticipated to about

3,000 feet below land surface (ft bls). The total depth of the injection well shall be approximately 3,500 ft bls, penetrating through the Boulder Zone. It is anticipated that a total dynamic head of approximately 115 ft, approximately 50 pounds per square inch (psi), will be required at the well head to overcome the artesian pressure of the Boulder Zone, as well as friction and dynamic losses. The design plans for injection well SMH IIW-1 and the dual zone monitoring well SMH DZMW-1 are included in Appendix B of Volume IIIB for guideline reference.

3.3 Plant Processing Piping

3.3.1 Description of Work

This Section contains the detailed Technical Requirements for the process piping for the WTP and wellfield. This section includes the requirements for pipe and fittings expected to be used on the project. Should the Company's design require other types of pipe or fittings, such pipe and fittings shall meet AWWA, ANSI or other Industry standards and be approved by the County Technical Advisor.

3.3.2 General Requirements

3.3.2.1 Codes and Standards

The plant process piping shall comply with the following:

Miami-Dade County Water and Sewer Department (MDWASD) Construction Standards and Specifications

American Society of Mechanical Engineers (ASME)

- ASME B1.10.1 – Pipe Threads, General Purpose (Inch)
- ASME B1.1 – Unified Inch Screw Threads (UN and UNR form)
- ASME B16.5 – Pipe Flanges and Flanged Fittings
- ASME B16.9 – Factor-Made Wrought Buttwelding Fittings
- ASME B16.11 – Forged Fittings, Socket-Welding and Threaded
- ASME B16.10M – Welded and Seamless Wrought Steel Pipe
- ASME B16.47 – Large Diameter Steel Flanges NPS 26 through NPS 60
- ASME B18.2.1 – Square and Hex Bolts and Screws: Inch Series
- ASME B18.2.2 – Square and Hex Nuts
- ASME B36.10M – Welded and Seamless Wrought Steel Pipe
- ASME B31.3 – Process Piping
- ASME B46.1 – Surface Texture (Surface Roughness, Waviness, and Lay)
- ASME Boiler and Pressure Vessel Code Section V – Nondestructive Examination
- ASME Boiler and Pressure Vessel Code Section IX – Welding and Brazing Qualifications

American Society for Testing and Materials (ASTM)

- ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel
- Stainless Steel Plate, Sheets and Strip for Pressure Vessels
- ASTM A312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
- ASTM A530 - Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
- ASTM A536 - Standard Specification for Ductile Iron Castings

- ASTM A774 - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
- ASTM A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
- ASTM A790 – Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
- ASTM A815 – Standard Specification for Wrought Ferritic, Ferritic/Autenitic, and Martensitic Stainless Steel Piping Fittings
- ASTM A967 – Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
- ASTM A1032 – Standard Test Method for Radiographic Examination of Welds
- ASTM B462 – Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06200, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675 & UNS R20033 Alloy Pipe Flanges, Forged Fittings & Valves & Parts for Corrosive
- ASTM B464 – Standard Specification for Welded UNS N08020 Alloy Pipe
- ASTM B675 – Standard Specification for UNS N08367 Welded Pipe
- ASTM B690 – Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Seamless Pipe and Tube
- ASTM B729 – Standard Specification for Seamless UNS N08020, UNS N08026, UNS N08024 Nickel-Alloy Pipe and Tube
- ASTM A377 - Standard Index for Specifications for Ductile-Iron Pressure Pipe
- ASTM C150 - Standard Specification for Portland Cement
- ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
- ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
- ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- ASTM D2467 - Standard Specification for Socket - Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
- ASTM E94 – Standard Guide for Radiographic Examination
- ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

- ASTM F438 - Standard Specification for Socket - Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
- ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- ASTM F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
- ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
- ASTM F594 - Standard Specification for Stainless Steel Nuts
- ASTM F1674 – Standard Test for Joint Restraint Products for Use with PVC Pipe
- ASTM A182 - Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheets and Strip for Pressure Vessels
- ASTM A262, Practice A - Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
- ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- ASTM A276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- ASTM A312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe
- ASTM A530 - Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
- ASTM A774 - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
- ASTM A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
- ASTM B32 - Standard Specification for Solder Metal
- ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes
- ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
- ASTM B75 - Standard Specification for Seamless Copper Tube
- ASTM B88 - Standard Specification for Seamless Copper Water Tube
- ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- ASTM B306 - Standard Specification for Copper Drainage Tube (DWV)
- ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings
- ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A105 - Standard Specification for Carbon Steel Forgings, for Piping Applications.
- ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

- ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength
- ASTM A714 - Standard Specification for High-Strength Low-Alloy Welded and Seamless Steel Pipe
- ASTM C33 - Standard Specification for Concrete Aggregates
- ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections or Tile
- ASTM C33 - Standard Specification for Concrete Aggregates
- ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
- ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
- ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
- ASTM E329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- ASTM A139 - Standard Specification for Electric-Fusion (ARC) welded Steel Pipe
- ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- ASTM A570- Standard Specification for Steel, Sheet and Strip, Carbon Hot Rolled, Structural Quality
- ASTM A572- Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- ASTM A36 - Standard Specification for Carbon Structural Steel
- ASTM A53 - Standard Specification for Pipe, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A1011- Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium, Vanadium, and High-Strength Low-Alloy with Improved Formability

American National Standards Institute (ANSI)

- ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250
- ANSI B16.9 - Factory-Made Wrought Steel Buttwelding Fittings
- ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws
- ANSI B31.3 Process Piping
- ANSI B36.19 - Stainless Steel Pipe
- ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form)

- ANSI B31.1, Paragraph 127.5 - Power Piping
- ANSI B36.19 - Stainless Steel Pipe
- ANSI/ASME B16.15 - Cast Bronze Threaded Fittings
- ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
- ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV)
- ANSI/ASME B16.24 - Bronze Pipe Flanges and Flanged Fittings Class 150 and 300
- ANSI/ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes
- ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings (DWV)

American Water Works Association (AWWA)

- AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1219mm) for Water
- AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- AWWA C150 - Thickness Design of Ductile-Iron Pipe
- AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast for Water
- AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances
- AWWA C606 - Grooved and Shouldered Joints
- AWWA C651 - Disinfecting Water Mains
- AWWA C200 - Steel Water Pipe - 6-in (150 mm) and Larger
- AWWA M9 - Concrete Pressure Pipe
- AWWA M11 - Steel Pipe - A Guide for Design and Installation
- AWWA C205 - Cement-Mortar Lining and Coating for Steel Water Pipe 4-in and Larger- Shop Applied
- AWWA C206 - Field Welding of Steel Water Pipe
- AWWA C207 - Steel Pipe Flanges for Waterworks Service- sizes 4-in Through 144-in
- AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings
- AWWA C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
- AWWA C214 - Tape Coatings for the exterior of Steel Water Pipelines
- AWWA C216 - Standard for Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
- AWWA C222 - Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings
- AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
- AWWA M11 - Steel pipe- A Guide for Design and Installation

American Society of Mechanical Engineers (ASME)

- ASME B31.1 - Power Piping.

American Welding Society (AWS)

State of Florida Department of Environmental Protection (FDEP)

- Rules and Regulations Pertaining to Public Drinking Water, Chapter 62 of the Florida Administrative Code (FAC)

Manufacturer's Standardization Society (MSS)

- MSS SP 43 – Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications
- MSS SP-79 – Socket Welding Reducer Inserts
- MSS SP-83 – Class 3000 Steel Pipe Unions Socket Welding and Threaded
- MSS SP-97 – Integrally Reinforced Forged Branch Outlet Fittings – Socket Welded, Threaded, and Buttwelding Ends
- MSS SP-114 – Corrosion Resistant Pipe Fittings Threaded and Socket Welding Class 150 and 1000.

Compressed Gas Association (CGA)

- CGA G-4.4 – Oxygen Pipeline Systems

NSF International (NSF)

- NSF Standard 61 Drinking Water System Components

National Fluid Power Association (NFLPA)

- NFLPA B93.19M – Particulate Contamination Analysis – Extraction of Fluid Samples from Lines of an Operating System

Society of Automotive Engineers (SAE)

- SAE ARP598 – Aerospace Microscopic Sizing and Counting of Particulate Contamination for Fluid Power Systems
- SAE J514 – Hydraulic Tube Fittings
- SAE J518 – Hydraulic Fanged Tube, Pipe and Hose Connections, Four Bolt Split-Flange Type
- SAE J1165 – Reporting Cleanliness of Hydraulic Fluids

Where reference is made to one of the above standards, the revision in effect at the time of Service Contract applies.

3.3.2.2 Design Submittal

The Company shall submit Design Submittals and Documentation to the County Technical Advisor as required. In addition, the following items shall be submitted by the Company for the County Technical Advisor's review prior to finalizing the design:

- Design pressure (operational, surge and test) for all piping components indicating the process fluid, reach, and size.
- External loads.
- Sizing calculations.
- Proposed materials for all piping components and coatings or linings.
- Bedding and backfill requirements and materials.

Calculations shall be provided to the County Technical Advisor and shall be stamped by a Professional Engineer registered in the State of Florida.

3.3.2.3 Construction Submittal

The Company shall submit construction information on the products and materials related to the work in this Section to the County Technical Advisor. In addition, information shall be furnished to the County Technical Advisor on the following items:

- Piping materials, layouts and schedules, including locations of valves and appurtenances, joint details, methods of supports, and all other pertinent technical information for all piping to be furnished demonstrating compliance with the Technical Requirements and Guidelines.
- All data and information required for the complete piping systems, and shall include dynamic calculations. Operational and test pressure assumptions shall also be included.
- All dimensions shall be based on the actual equipment to be furnished. Types and locations of restrains, pipe hangers and/or supports shall be shown on the piping layouts for each pipe submittal. Pipe hanger design shall include all static and dynamic loads.

All construction submittal calculations shall be stamped by a Professional Engineer registered in the State of Florida.

3.3.2.4 Performance Requirements

The Company's design and construction of the process piping systems shall meet the following performance requirements:

- All piping systems shall be appropriately designed for the Company's proposed operating, surge and test pressures, temperature ranges, pH ranges, chemicals or fluids (service) carried, earth loads, traffic loads, and local environmental conditions.
- Pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last ten (10) years in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the applicable codes, manufacturer's recommendations, water industry practices and methods, and shall comply with this Section.

3.3.3 Specific Requirements

Where AWWA, ANSI and ASTM standards are used to identify the type of pipe, these references shall provide requirements for the piping system. However, certain modifications to the standard requirements specified herein shall apply.

3.3.3.1 Ductile Iron (DI)

DI pipe shall conform to ANSI/AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water. All pipe and fittings for water applications shall be in full compliance with ANSI/NSF 61, "Drinking Water System Components-Health Effects. Manufacturers shall maintain their NSF certification for the duration of the Contract and any extensions thereof. If not specified otherwise, provide flanged joints for exposed piping, and mechanical or push-on joints for buried piping.

The pipe thickness and outside diameter shall conform to Tables 1 and 2 (for push-on and mechanical joint pipe, respectively) of ANSI/AWWA Standard C151/A21.51-02 for the sized below and the pressure class specified in the minimum permitted.

Table 3-27 Pipe Requirements

Size	Pressure Class
4-inch through 12-inch	350
14-inch through 20-inch	250
24-inch	200
30-inch through 54-inch	150

The ductile iron pipe design shall be per ANSI/AWWA C150 – Thickness Design for Ductile-Iron Pipe, including the additional allowances made for service allowance and casting tolerance and AWWA M41. The safety factor of 2.0 shall be used. Fittings shall be ductile iron of the same pressure rating, at a minimum, as the adjoining pipe.

Deflection shall be controlled and kept within the limits contained in AWWA Manual M41 or as required by the pipe manufacturer's written recommendations, whichever is more restrictive. In determining the vertical loads on the pipe, the trench condition shall normally apply unless an actual embankment condition exists or the trench width exceeds the transition width in which case the embankment condition shall apply. Yard piping shall always be designed for an embankment condition. For depths of cover of 10-feet or greater, the earth load shall be computed assuming the trench/embankment condition, as applicable. For depths of cover of less than 10-feet, H20 live load shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges".

Refer to the MDWASD Design and Construction Standard Specifications and Details for detail specification on ductile iron pipe and fittings.

3.3.3.2 Polyvinyl Chloride (PVC) Pressure Pipe, Rubber Joints

PVC pipe shall be AWWA C900 or C905, cast iron pipe size outside diameter, conforming to ANSI ANSI/AWWA C900, "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In., for Water Transmission and Distribution", and ANSI/AWWAC905, "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In", respectively.

The dimensions and pressure classes shall be for Dimension Ratios 14, 18 and 25 (DR's 14, 18 and 25) for C900 PVC pipe and DR's of 14,18, 21,25, 26, 32.5, 41 and 51 for C905 PVC Pipe with equivalent cast iron pipe outside diameters.

Fittings shall be cast or ductile-iron, ANSI/AWWA C110/A21.10, with appropriate pressure rating.. All fittings shall have an appropriate lining for the intended service and a bituminous coating.

PVC to PVC type joints shall be to AWWA C900, stab type, with elastomeric gaskets. Gaskets shall be synthetic rubber; natural rubber is not acceptable. Mechanical joints shall not be used with PVC C900 pipe unless specifically approved by the County Technical Advisor.

Restraint systems for PVC C900 pipe shall be comply with ASTM F1674. Restraint shall be suitable for pipe to pipe joints as well as for pipe to fitting joints. . The pipe shall be made from PVC compounds Class 12454 A or 12454 B as defined in ASTM D1784. Each pipe length shall be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA designation number and seal of test agency that verified pipe material for potable water service.

All below ground piping shall be restrained. Restraining glands for PVC pipe shall conform to AWWA C111.

All piping shall be restrained joint without the use of thrust blocks.

Refer to the Refer to the MDWASD Design and Construction Standards for detail specifications.

3.3.3.3 Polyvinyl Chloride (PVC) Pressure Pipe, Solvent Welded Pipe and Fittings

Pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454-B in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F and shall be suitable for field cutting and solvent welding.

All PVC pipes shall be Schedule 80 pipe or heavier.

Fittings shall be the socket type for solvent welded joints conforming to ASTM D2467. Fittings shall be manufactured from PVC compound meeting ASTM D1784, Class 12454-B. Solvent cement shall be as specified in ASTM D2564. Primer shall be as recommended by the pipe and fitting manufacturer for the piping service (e.g., chemical type) and installation conditions.

For drain service, drain and waste fittings (e.g., long radius ells, sanitary tees, wyes, cleanouts, etc.) shall be used.

Pipe, fittings and solvent for use with potable water shall be certified by NSF in accordance with NSF Standard No. 14 and the NSF seal shall be included on the pipe.

Where flanged joints are used they shall be supplied with 1/8-in thick full-faced Viton, PFTE gaskets, or equal as required for product service. Flanged fittings shall be fabricated Schedule 80 PVC fittings with 150 lb. flanges to ANSI/ASME B16.5, at a minimum.

Flange bolt spacing, number and dimensions shall conform to the requirements of ANSI B16.5. CPVC and PVC flanges shall be single piece, suitable for solvent cementing to the pipe and shall be suitable for a minimum pressure of 150 psi.

Bolts, nuts and washers for flanged joints shall be for corrosive service conditions and shall be ASTM F593 and F594, Type 316 stainless steel. Anti-seize compound for stainless steel bolts and nuts shall be of a molybdenum disulfide base such as Molycoat-G or equal.

Fittings, specials, unions and flanges shall be of the same schedule number and manufactured of the same materials as the pipe.

The Company’s attention is directed to the importance that all employees assembling PVC piping be trained by the pipe and solvent cement manufacturer’s authorized representatives in correct assembly techniques to avoid damage to other components, ensure proper function, and to avoid guaranty period work to correct deficiencies caused by improper assembly techniques.

3.3.3.4 Chlorinated Polyvinyl Chloride (CPVC) Pressure Pipe, Solvent Welded

CPVC pipe shall be in accordance with ASTM F 441 - Chlorinated Poly (Vinyl Chloride) (CPVC), Plastic Pipe, Schedule 80 or heavier, from all new compounds, meeting the requirements of Class 23447 per ASTM D 1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds.

Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM F 493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings, and with primer in accordance with ASTM F 656 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings. Screwed joints which are necessary to match up to threaded valves or fittings shall be made up with Teflon tape. Flanged joints shall be made with solvent-welded CPVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, at a minimum, unless otherwise approved by the County Technical Advisor.

Gaskets shall be full faced, low torque, fully molded EPDM with dual concentric, convex sealing surface rings (and PTFE film bonded to the rubber). The dimensions shall comply with 150# ANSI B16.5 drilling. The flange bolts, washers and nuts shall be Type 316 stainless steel.

Solvent-welded fittings shall be Schedule 80 CPVC fittingsin accordance with ASTM F 439 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80. Threaded fittings shall be Schedule 80 CPVC fittings in accordance with ASTM F 437 - Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80. Flanged fittings shall be fabricated Schedule 80 CPVC fittings with 150 lb. flanges to ANSI/ASME B 16.5.

Expansion joints for PVC sizes 1/2-in to 6-in shall be telescoping type, Schedule 80, Expansion in pipes smaller than 1/2-in shall be accommodated with expansion loops. Acceptable expansion joint manufacturers: Plastinetics, Inc.; ASAHI/America, or approved equal.

All employees assembling CPVC piping be trained by the pipe and solvent cement manufacturer's authorized representatives in correct assembly techniques to avoid damage to other components, ensure proper function, and to avoid guaranty period work to correct deficiencies caused by improper assembly techniques.

3.3.3.5 High-Density Polyethylene (HDPE) Pressure Pipe

High Density Polyethylene (HDPE) pipe shall meet or exceed AWWA Specifications C906 for PE 3408. HDPE pressure pipe and fittings shall be made from a high density polyethylene resin compound meeting or exceeding cell classification 345434C per ASTM D3350; and meeting or exceeding Type III, Class C, Category 5, Grade P34 per ASTM D1248.

The polyethylene compound shall be suitably protected against degradation by ultraviolet light as required by ASTM D1603. If rework compounds are required, only those generated in the manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used. Compliance with the above requirements must be certified by the pipe supplier. All HDPE pipe shall conform to ductile iron pipe sizing (DIPS). The pipe and fittings shall be NSF -61 listed and approved for potable water service. The equipment and materials specified herein are intended to be of standard types for use in transporting raw conditional (pH 5.0) feed, permeate and concentrate discharge water.

Installation lengths shall be joined by the use of stub ends. All stub ends for attachment to the polyethylene pipe shall be made from the same type and grade of polyethylene, from the same raw material supplier as the pipe and shall be butt-fused to the pipe ends.

The polyethylene stub ends at joints shall be backed up by nylon coated steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The stub ends shall be connected with corrosion resisting bolts and nuts of Type 316 stainless steel as specified in ASTM A726 and ASTM A307. Flat gaskets of 1/8-inch black reinforced rubber conforming to ANSI B16.21 shall be installed between the opposing ends of the stub ends.

In no case shall threaded male or female adapters of any plastic material be used for adapting polyethylene pipe to systems, fittings or auxiliary equipment of other materials, or for joining the installation lengths to each other.

Termination to pipes, valves, or fittings made of other material shall be by the flanged joints. The pipe adjacent to these joints and to the joints themselves must be rigidly supported for a distance of one pipe diameter beyond the flange.

The maximum allowable bending radius and deflection shall be per the pipe manufacturer's written recommendations.

3.3.3.6 Alloy 20 Pipe

Alloy 20 pipe shall conform to ASTM B464 –Welded UNS N08020 Alloy Pipe. For buried applications, the tube shall be soft tempered. In exposed applications, the tube shall be hard-drawn. Pipe fittings shall conform to ASTM B462, and shall be made of forged chromium, nickel, iron, molybdenum, cooper, columbium stabilized alloy, (UNS N08020). Flanges shall be made of forged chromium, nickel, iron, molybdenum, cooper, columbium stabilized alloy, (UNS N08020). All flanges shall be smooth face finish. Gaskets for alloy 20 pipe shall be 1/8 inch thick, full face Garlock Style 2504 (Acid Service). All bolts and nuts shall be stainless steel hex-headed bolts and stainless steel heavy semi-finished, hex nuts.

3.3.3.7 Copper Pipe

Copper pipe shall conform to ASTM B88 – Seamless Copper Water Tube, Type K or Type L. For buried applications, the tube shall be soft tempered. In exposed applications, the tube shall be hard-drawn. Soldered fittings shall conform to ANSI B 16.18 - Cast Copper Alloy Solder Joint Pressure Fittings, or to ANSI/ASME B 16.22 - Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings. The soldering flux shall be the Manufacturer's approved type for the fitting and solder used. Buried pipe shall be taped coated in accordance with AWWA Standard C209.

3.3.3.8 Duplex and Super Duplex Stainless Steel Pipe

Stainless steel pipe specified below shall receive mill-applied surface treatments at the rolling and pipe mills prior to delivery to the site. The mill finish, and cleaning and descaling requirements shall be used as defined below to achieve the following surface roughness waviness and lay in accordance with ASME B46.1, following the procedures described below.

No. 1D – This surface treatment process creates a rough finish (150 to 200 µinches Ra) free of scale by hot-rolling, heat treating, and skin pickling. Pickling shall be by immersion in a 125˚F bath of 10% nitric acid and 3% hydrofluoric acid solution for a minimum of 15 minutes. Occasional grinding marks appearing on the surface of this finish shall be acceptable. This process shall be followed by a neutralizing rinse for passivation of the surface. Equivalent processes proposed for materials furnished under this specification shall be submitted for approval of the Engineer.

No. 2E – This surface treatment process creates a rough and dull finish (80 to 200 µinches Ra) free of scale by cold rolling, heat treating and mechanically descaling.

No. 2D – This surface treatment process creates a smooth finish (63 µinches Ra or better) by cold-rolling, annealing, and skin passivating the pipe and fittings after fabrication. Pipe and fittings shall be immersed in a 125˚F bath of 10% nitric acid and 3% hydrofluoric acid solution for a minimum of 15 minutes. This process shall be followed by a neutralizing rinse to passivate the surface. Equivalent processes proposed for pipe, tube, and fittings Pipe, having a wall thickness greater in 0.25, shall have a No. 1 mill finish.

Mill grade seamless stainless steel alloy pipe, ¼ inch to 48 inch diameter, shall be billet-pierced and manufactured from the following alloys, to ASME B36.10. (P-Numbers for base metal classification in the ASME BPVC Section IX are included in parenthesis):

- ASTM A790 Grade S32205 (ASME P-10H) duplex stainless steel.
- ASTM A790 Grade S32750 (ASME P-10H) super duplex stainless steel.
- ASTM A790 Grade S32760 (ASME P-10H) super duplex stainless steel.

Seamless stainless steel pipe, having a wall thickness of 0.010 inch or less, shall have a No. 2D mill finish. Seamless stainless steel pipe, having a wall thickness 0.010 inch to 0.25 inch, shall have a No. 2E mill finish when delivered to the mill. Seamless stainless steel pipe, having a wall thickness greater in 0.25, shall have a No. 1 mill finish.

Mill grade welded stainless steel alloy pipe, ¼ inch to 48 inch diameter shall be manufactured to ASME B36.10.

Welded pipe, having a wall thickness of 0.010 inch or less, shall have a No. 2D mill finish. Welded pipe, having a wall thickness 0.010 inch to 0.25 inch, shall have a No. 2E mill finish when delivered to the mill. Welded pipe, having a wall thickness greater than 0.25 inch or less, shall have a No. 1 mill finish.

Pipe shall be cold drawn and manufactured from the following alloys (P-Numbers for base metal classification in the ASME BPVC Section IX are included in parenthesis):

- ASTM A790 Grade S32205 (ASME P-45) duplex stainless steel.
- ASTM A790 Grade S32750 (ASME P-10H) super duplex stainless steel.
- ASTM A790 Grade S32760 (ASME P-10H) super duplex stainless steel.

The specified elastomers shall be used for ASME O-ring flanges; grooved joint couplings; and low pressure and high-pressure unions.

Elastomers shall be constructed of the following materials which acrylonitrile butadiene rubber grade to order from the Supplier. The Company shall furnish elastomer seals in the following rubber compounds where:

- Ethylene propylene diene monomer rubber (EPDM) shall have a working temperature range of -30 to 230 degrees F; 40 to 80 durometer hardness shore A, smooth finish up to 200˚F. ASTM D2000, Type B, Class A.

Wrought carbon steel buttwelding fittings, 2 inch to 48 inch diameter, shall be provided for use with mill grade ERW and seamless carbon steel pipe where buttwelding fittings are required. Buttwelding fittings shall have a minimum wall thickness corresponding to the wall schedule specified for the connecting Piping. Buttwelding fittings shall meet the requirements of ASME B16.9.

Wrought stainless steel buttwelding fittings for pipe ¼ inch to 60 inch diameter shall conform to ASME B16.9. Fittings shall be manufactured from the following alloys in accordance with the designated ASTM standard:

- ASTM A815, Grade WPS32205 Duplex (ASME P-10H) for pipes manufactured from ASTM A790 Grade S32205 duplex stainless steel pipe.
- ASTM A815, Grade WPS32750 Super Duplex (ASME P-10H) for pipes manufactured from ASTM A790 Grade S32750 Type 2507 super duplex stainless steel pipe.
- ASTM A815, Grade WPS32760 Super Duplex (ASME P-10H) for pipes manufactured from ASTM A790 Grade S32760 super duplex stainless steel pipe.

Forged stainless steel flanges for pipe ½ inch to 60 inch diameter and larger shall be the raised-face type in the weld-neck, slip-on or stub-end configuration. Forged flange dimensions and tolerances shall be manufactured in accordance with ASME B16.5 and ASME B16.47. Gaskets, bolts, stud-bolts, and nuts shall be as specified below. Flange gaskets shall be cut from sheet stock in the flat ring configuration in accordance with ASME B16.21, in the non-insulating and insulating materials specified below.

Forged flanges shall be constructed of the following alloys:

- ASTM A182, Grade F60 (Type2205) (ASME P-10H) for pipes manufactured from ASTM A790 Grade S32205 (Type 2205) duplex stainless steel pipe.

- ASTM A182, Grade F53 (Type 2507) (ASME P-10H) for pipes manufactured from ASTM A790, Grade S32750 (Type 2507) super duplex stainless steel.
- ASTM A182, Grade F55 (ASME P-10H) for pipes manufactured from ASTM A790, Grade S32760 super duplex stainless steel.

Flat polytetrafluoroethylene PTFE flange gaskets for ASME forged steel flanges shall be Type F or "ring pattern gaskets" with inside and outside dimensions as specified in ASME B16.21. All flat flange gaskets for steel ring flanges shall be Type F with inside and outside dimensions as specified in AWWA C207. Gasket types are detailed below.

Flat polytetrafluoroethylene flange gaskets shall be cut from sheet stock by a qualified gasket distributor. No field-cut or field-modified gasket shall be allowed. Gasket welding shall be performed only by the gasket manufacturer in the gasket manufacturer's shop. Flat polytetrafluoroethylene gaskets shall be:

- Durlon 9000, manufactured by Gasket Resources, Exton, Pennsylvania.
- Gylon 3500, manufactured by Garlock Sealing Technologies, Palmyra, New York.
- Sigma 500 manufactured by Flexitallic, Deer Park, Texas.

To assist in assembly of flanged joints, adhesive-backed non-insulating flange gaskets may be used. Adhesive backing material shall be:

- 467MP High Performance Adhesive Transfer Tape, manufactured by 3M Industrial Adhesives and Tapes Division, St. Paul, Minnesota. or equal.

Fiberglass reinforced dielectric insulating flange gaskets shall be installed where dissimilar metallic flanges having differing polarity ratings on the galvanic series are mated; pipe flanges applicable to this section include ductile iron, cast iron, cast copper alloy, stainless steel alloys, 90-10 copper-nickel alloy, or nickel alloy (Monel, Hastelloy, etc.); where metallic process pipe flanges mate with valve connecting flanges and other equipment of dissimilar metallic construction; where exposed piping makes a vertical transitions to buried piping; and where otherwise required.

Insulating flange gaskets shall be furnished as a kit including the dielectric gasket, bolt sleeves, and washers in accordance to the nominal flange size.

Each dielectric insulating gasket shall be a full faced isolating and sealing gasket, Type "E", 1/8" thick, epoxy-glass retainer with bolt holes cut to match ASME B16.1 drilling. The retainer shall contain a precision tapered groove to accommodate the controlled compression of a FKM (Viton®) sealing element. The quad-ring seal shall be pressure energized. The epoxy-glass retainer shall have 550-volts/mil dielectric strength and a minimum 50,000-psi compressive strength.

Insulating bolt sleeves shall be manufactured of Mylar having a dielectric strength of not less than 4000-volts/mil.

Insulating washers shall be manufactured of G-10 epoxy-glass having a dielectric strength of 400 to 500-volts/mil. Insulating washers shall be installed with metallic backing washers to prevent damage to the epoxy-glass washer during bolting. The metallic washers shall be constructed of the same material as the bolts.

The Company may use molded sleeve washers as an alternate to separate washers and sleeves, as long as the material of construction has equivalent properties to those above.

The length of each flange bolt shall be selected by the Company. Each bolt shall have sufficient length to permit three full threads, as a minimum, protrude from the hex nut and washers after assembly. Flange bolts for dielectric insulating flange kits shall be fully-threaded along their length. The

Company is cautioned that flange bolts having smooth shank segments along their length will not fit in Mylar sleeves or molded sleeve-washers.

Flange bolts shall have ASME B1.1, coarse threads, Class 2A fit, and manufactured of ASTM A193, Grade B8M stainless steel. Bolts shall conform to ASME B18.2.1.

Flange nuts shall have ASME B1.1, coarse threads, Class 2A fit, and manufactured of ASTM A194, Grade 8M stainless steel, having square or hex heavy dimensions in accordance with ASME B18.2.2.

Flange bolts shall be installed using a nickel anti-seize lubricant capable of achieving the required bolt torque and sealing stress, and permitting future disassembly with minimal manual input.

Excess anti-seize compound shall be removed by degreasing solvent prior to finish painting the piping.

3.3.3.9 Stainless Steel Pipe, Type 316

Type 316L stainless steel pipe shall conform to ASTM A312 - Specification for Seamless and Welded Austenitic Stainless Steel Pipe with Type 316 stainless steel welded fitting or flanged fittings.

Stainless steel pipe 12 inches in diameter and larger shall be in accordance with ASTM A 409 - Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service with welded or flanged joints.

Stainless steel pipe shall have welded joints with socket-welding fittings, butt-welding fittings, or socket welding flanges. All stainless steel flanges shall have stainless steel bolts and nuts. Stainless steel pipe may have grooved ends for shouldered couplings, except that no pipe with less than Schedule 40 wall thickness shall be grooved. Spilt ring couplings designed in accordance with industry standards and as recommended by the manufacturer may be used on Schedule 10 Stainless steel pipe. Stainless steel pipe shall have plain ends for sleeve-type couplings.

Forged stainless steel fittings shall conform to ANSI/ASME B 16.11 - Forged Fittings, Socket-Welding and Threaded.

Wrought stainless steel butt-welding fittings shall conform to ASTM A 403-Specification for Wrought Austenitic Stainless Steel Piping Fittings, and ANSI/ASME B 16.9 - Factory-Made Wrought Steel Butt-Welding Fittings. Wrought stainless steel grooved fittings shall conform to ASTM A 403 and ANSI/ASME B 16.9, with grooving conforming to ANSI/AWWA C606-Grooved and Shouldered Joints. Stainless steel flanged fittings and flanges shall conform to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings. All fittings shall have the same pressure rating as the pipe unless otherwise required by the Company.

Gaskets for flanged connections shall be a minimum of 1/16-in thick, compatible with the process fluid, and shall be expanded EPDM, PTFE or Viton. BUNA N may be used only when compatible with the process fluid as recommended by the gasket manufacturer.

If recommended for the process application, stainless steel pipe and fittings shall be pickled at the point of manufacture, scrubbed and washed until all discoloration is removed. Pickling of piping with hydrochloric acid or other acid harmful to the base metal shall not be allowed. Pipe and fittings shall be sandblasted or cleaned with solvent.

Shop welding of fabrications shall be done according to the procedures and by welders certified per ASME Section IX. Welds shall be by an inert gas shielding process using only extra low carbon filler metals. Welds shall have a bead height of no more than 1/16-in. Butt welds shall have 100 percent penetration to the interior or backside of the weld joint. Cross-sectional thickness of welds shall be equal or greater than that of the parent metal.

All gaskets, glands, bolts, nuts, and other required hardware shall be provided for connection of piping and appurtenances. Bolts, washers and nuts shall, except as otherwise required by the Company, be Type 316L stainless steel. Studs shall be of the same quality as machine bolts. All other hardware shall be of the size, type, and number as required and recommended by the piping or fitting manufacturer and as specified herein.

Buried pipe shall be tape coated in accordance with AWWA Standard C209.

3.3.3.10 Stainless Steel Pipe, Type 304

Type 304L stainless steel pipe shall conform to ASTM A312 with Type 304 stainless steel welded fitting or flanged fittings, similar to those described herein for Stainless Steel Pipe, Type 316.

Buried pipe shall be taped coated in accordance with AWWA Standard C209.

3.3.3.11 Stainless Steel Tubing

Small diameter stainless steel tubing (1/2-inch diameter and smaller) for instrumentation connection applications shall be seamless Type 316 stainless steel in accordance with ASTM A 269, soft anneal with the minimum wall thickness as indicated in **Table 3-28**.

Table 3-28 Stainless Steel Tubing Minimum Wall Thickness Schedule

Table Size (in.)	Wall Thickness (in.)
1/8 and 3/16	0.035
1/4 thru 3/8	0.049
½	0.065

Fittings

Bar stock material for compression type fittings shall be in accordance with ASTM A276, Type 316 and forgings shall be in accordance with ASTM A182, Type 316. Material shall be in accordance with ASTM A262, Practice A. Assemblies shall consist of tubing, fittings, and components of one manufacturer.

3.3.3.12 Black Steel Pipe

Black steel pipe in sizes 6 inches in diameter and smaller shall conform to the requirements of ASTM A 53 or ASTM A 106. Fittings for pipe of size 2-inch in diameter or smaller shall be of malleable iron with NPT ends. Fittings for 2-1/2-inch diameter and larger shall use welded, flanged or mechanical couplings.

Buried pipe shall be tape coated in accordance with AWWA Standard C209.

3.3.3.13 Polyvinyl Chloride Drain Pipe

PVC drain pipe shall be used for non-pressure gravity flows in buried applications. PVC non-pressure drain pipe shall conform to the requirements of ASTM D 3034, Class SDR 35. The material for PVC drain pipe shall conform to ASTM D 1784 for Class 12454-B or 12454-C as defined therein.

All fittings for PVC drain pipe shall conform to the requirements of ASTM D 2241. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible with cast iron or ductile iron fittings. The strength class of the fittings shall be not less than the strength class of any adjoining pipe. Elastomeric seals for compression type joints and fittings shall conform to ASTM D 3212. Flexible couplings shall be rubber, full-circle, clamp-on type conforming to ASTM C 425 and provided with two stainless steel band screw clamps to secure the coupling tightly. All screw clamps hardware shall be Type 304 or Type 316 stainless steel. Rubber material shall be suitable for raw wastewater (sewage) service.

3.3.3.14 Polypropylene Drain

Polypropylene drainage pipe shall be in accordance with ASTM F 1412 - Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems, of flame-retardant material in accordance with ASTM D 4101 - Propylene Plastic Injection and Extrusion Materials. Polypropylene pipe located under structures and slabs shall not be less than Schedule 80.

All permanent joints on polypropylene drainage piping shall be fusion-heat-welded to the Manufacturer's written specifications, and be in accordance with ASTM F 1290 - Practice for Electrofusion Joining Polyolefin Pipe and Fittings. All joints requiring the capability for disassembling shall have fusion-welded flanges or mechanical joints. The mechanical joints shall consist of a seal ring, followed by a grab ring and a threaded nut, threaded onto a fitting. Fusion-welded polypropylene fittings shall be drainage pattern fittings made of the same material as the pipe, in accordance with ASTM F 1412. Mechanical joint fittings for temporary joints shall be made of the same material as the pipe, of drainage pattern design, with seal rings, grab rings, and nuts, in accordance with ASTM F 1412.

3.3.3.15 Polyethylene Drain Pipe

Perforated and unperforated drainage pipe and fittings shall be corrugated high density polyethylene complying with ASTM F405 and AASHTO M294. Pipe and fittings shall have a smooth interior (corrugations filled with polyethylene). Corrugations may be either annular or spiral. Pipe and fittings shall be suitable for a minimum applied load as follows applied to the top of the piping with no more than 5 percent of pipe diameter deflection. Fittings shall not reduce the internal waterway diameter or impair the function of the pipe. Fittings shall be either molded or fabricated. Provide rubber or neoprene gaskets at all joints. Perforated pipe shall be wrapped in filter fabric or polyester knitted sock.

3.3.3.16 Cast Iron Soil Pipe

Cast iron soil pipe and fittings shall be made of gray cast iron, service weight, conforming to ASTM A 74, suitable for service in drainage, waste, vent, and sewer lines. The pipes and fittings shall have caulked ball and spigot joints or hubless joints with stainless steel couplings over suitable elastomer sleeves.

3.3.3.17 Copper Drain Pipe

Copper pipe and tubing used for drain, waste, and vent applications shall conform to ASTM B306, DWV, Temper H. Copper tubing shall conform to ASTM B75, Type C12200 (DHP), seamless, deoxidized.

Buried pipe shall be taped coated in accordance with AWWA Standard C209.

3.3.3.18 Reinforced Concrete Drain Pipe

Reinforced concrete pipe shall conform to the requirements of ASTM Designation C 76 provided, that pipe shall have tongue and groove joint designed to be self-centering and to leave a recess on the inside of the pipe for pointing with mortar after jointing. Pipe shall be designed for an internal pressure and all external loads. Pipe class and type shall be determined by the Company for the application requirements.

Quick-setting grout shall be a high strength, non-staining grout. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's written instructions.

3.3.3.19 Double Containment Piping Systems

All treatment process chemicals shall be provided with secondary containment systems in accordance with applicable local, state, national, and international codes and regulations. Where secondary containment is not provided by a chemical containment area of a structure (e.g., Chemical Building containment areas), chemical piping shall be double contained as specified herein and in accordance with the aforementioned codes and regulations.

The primary and secondary piping materials shall be suitable for the treatment chemical being conveyed. Where individual lines are being double contained, a pre-engineered double containment piping system shall be used

The outer (secondary) pipe shall be at least 1-1/2 inches larger in diameter than the inner (primary) pipe. The inner pipe shall be centered and supported by pipe carrier guides. Exposed secondary containment piping located within buildings shall be constructed of clear (transparent) schedule 80 PVC to facilitate routine inspection. The fittings shall be sealed by use of a gasket, suitable for the chemical being contained, which shall seal by compression against the secondary (outer) containment pipe.

Flexible, non-split couplings shall be provided in the secondary containment piping when entering a structure and between adjoining structures where differential settlement may occur. Terminating, non-split couplings shall be provided at the end of secondary containment piping unless indicated otherwise. The Company shall leak test both the primary and secondary containment pipes.

Termination fittings, pressure test fittings, drain and vent port fittings, tees, elbows, drop legs, and other appurtenances shall be provided to obtain a fully functional system with each pipe run individually tested. Expansion fittings shall be provided by the double containment system manufacturer for all above grade double contained piping. Expansion fittings shall be sized and spaced to accommodate temperature changes from 70 to 30 degrees F and 70 to 120 degrees F. Provide expansion fittings if required to make closures below ground, in buildings, and in vaults or trenches.

3.3.3.19.1 PVC x PVC

Double-containment pipe shall be fabricated using Schedule 80 PVC pipe for the inner (primary) pipe and Schedule 40 PVC pipe for the outer (secondary) containment pipe.

3.3.3.19.2 CPVC x PVC

Double-containment pipe shall be fabricated using Schedule 80 CPVC pipe for the inner (primary) pipe and Schedule 40 PVC pipe for the outer (secondary) containment pipe.

3.3.3.19.3 Black Steel x PVC

Double-containment pipe shall be fabricated using Schedule 40 black steel pipe for the inner (primary) pipe and Schedule 40 PVC pipe for the outer (secondary) containment pipe.

3.3.3.20 Sleeve Couplings

Sleeve-type couplings shall be in accordance with ANSI/AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe, and shall be of steel with steel bolts, without pipe stop, and be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts, washers and nuts shall be 316 stainless steel if buried or in corrosive area. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the specifications shown in **Table 3-29**.

The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.

Table 3-29 Sleeve Coupling Gasket Specifications

Description	Parameter
Color	Jet Black
Surface	Non-Blooming
Durometer Hardness	74+5
Tensile Strength	1000 psi minimum
Elongation	175 percent Minimum

3.3.3.21 Insulating Couplings

Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

3.3.3.22 Restrained Joints

All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the appropriate reference standard, or as indicated.

3.3.3.23 Grooved End and Banded-End Couplings

Cast mechanical-type couplings shall conform to the requirements of ANSI/AWWA C606 - Grooved and Shouldered Joints. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling Manufacturer's recommendations. The wall thickness of all grooved piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections with mechanical-type couplings shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. All mechanical-type couplings on buried piping shall be bonded. The Company shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. Ductile iron pipe couplings shall be furnished with flush seal gaskets.

3.3.3.24 Flexible Connectors

Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, (unless otherwise required by the application) or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise required by the application. The connectors shall be a minimum of 9 inches long, face-to-face flanges, unless otherwise required by the installation.

3.3.3.25 Expansion Joints

All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints.

Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service.

3.3.3.26 Pipe Insulation and Heat Tracing

Hot and cold liquid piping, flues, and engine exhaust piping shall be insulated, unless dehumidification is supplied in which case cold liquid piping will not require insulation. No unprotected hot piping shall be within reach of operating personnel or other persons.

3.3.4 Installation – General

Install the materials and equipment to provide a complete and working system in addition to the following installation requirements:

- All pipe and fittings shall be installed true to grade and alignment and pipe anchorage and/or restraint shall be provided where required.
- All pipe and fittings shall be protected from dirt, dust, oil, grease and other foreign matter during installation to prevent damage to pipe and to assure no foreign matter is left in the piping.
- The deflection at joints shall not exceed that recommended by the pipe manufacturer. Fittings shall be provided, if required, in areas where conflict exists.
- To assemble the joints in the field, thoroughly clean all joint surfaces and gaskets, if any, with soapy water before assembly. Bolts shall be tightened alternately, evenly to the manufacturer's specified torques. Under no condition shall extension wrenches or pipe-over-handle ratchet wrenches be used to secure greater leverage. Joint welding shall be in accordance with the AWS Standards. The strength of the weld shall develop the strength of the pipe. No field welding will be allowed.
- Fittings shall be provided if required. Due consideration shall be given to thermal expansion/contraction. When cutting of pipe is required, the cutting shall be done by machine neatly, without damage to the pipe. Cut ends shall be smooth and at right angles to the axis of the pipe

- Mechanical joints shall be in accordance with the "Notes on Methods of Installation" under AWWA C111 and the instructions of the Manufacturer.
- Joining Flanged Joints:
  - Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.
  - Bolts in flanged joints or mechanical joints shall be tightened alternately and evenly.
  - Sleeve (flexible or mechanical) type couplings and grooved joints using split ring couplings shall be installed in accordance with the procedures recommended by their respective manufacturers.
- All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit a certification stating that such requirements have been complied with.
- Sleeves of proper size shall be installed for all pipes passing through floors or walls Sleeves and wall pipes shall have thrust collar located at the mid-depth of wall.
- Concrete inserts for hangers and supports shall be furnished and installed as recommended by the manufacturer. The inserts shall be set in accordance with the requirements of the piping layout and their locations verified.
- Pipelines supported by pipe hangers from the ceiling, or otherwise supported where lateral displacement of pipe is probable, shall be braced.

3.3.4.1 Installation of Schedule 80 PVC and CPVC Piping

The installation of plastic pipe shall be strictly in accordance with the pipe and solvent cement (where applicable) manufacturer's technical data and printed instructions.

Joints for PVC and CPVC pipe shall be solvent cemented unless flanged or threaded. Solvent cement joints shall be made in accordance with ASTM D2855 except that solvent cement formulated especially for and as specified above shall be used for joining CPVC pipe and fittings.

Primer shall be used whenever recommended by the pipe, fitting, or cement manufacturer and in all cases for joints on pipe systems 4-in in diameter or larger. Solvent cement joints shall not be completed and the work shall stop when the temperature, measured in the shade, is less than or equal to 40 degrees F and falling.

Joints between PVC drain, waste and vent pipe and cast-iron soil pipe shall be made with approved mechanical compression joints or transition unions designed for such use.

Installation of valves and fittings shall be in accordance with the valve, fitting, and solvent cement (where used) manufacturer's instructions. Particular care shall be taken not to overstress threaded connections. In making solvent cement connections, the solvent cement or primer shall not be spilled on valves. Any cement allowed to run from joints shall be cleaned from the pipe and fittings immediately. Generally, all plastic valve bodies shall be removed from their union ends before cementing to the adjoining piping to protect the valves.

All piping shall have a sufficient number of unions to allow convenient removal of piping. Above grade PVC and CPVC pipe shall be installed with at least one expansion joint near the center of each straight run of pipe for every 100 feet of pipe.

Where plastic pipe passes through wall sleeves, the space between the pipe and sleeve shall be sealed with a mechanical sealing element.

All plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings.

Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout.

All buried PVC and CPVC piping shall have a conductive tracer wire taped to its top centerline. Conductive tracer wires shall be brought into all valve boxes, vaults, pipe trenches, and structures where they would be accessible for future tracing of the piping. Buried piping shall also have a continuous warning tape laid 12 to 24 inches above the piping.

All pipelines shall remain undisturbed for the minimum curing or cooling time specified for each type of pipe material but no less than eight (8) hours to develop full curing and complete strength at all joints. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for twelve (12) hours.

Special devices or valves that cannot be tested at the specified pressure shall be removed for testing, with suitable blind flanges, caps, or plugs added for testing. Testing shall be performed by slowly filling the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the pipe system is less than 2 fps. Once the system has been filled, the piping should be slowly brought up to the test pressure in such a manner so as to not create shock, surge or water hammer in the pipe system. The test duration time limit shall not begin until the full pressure specified above has been reached. Test duration shall be four (4) hours. All exposed joints shall be checked for leaks with a leak detection system. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure relieving device at a location remote to the location of the pressure monitoring equipment.

The pressure test shall be monitored by a recording type pressure gauge. The entire test process shall be recorded, including the initial pressurization of the piping system. The record shall be continuous through the system test and shall show the final de-pressurization of the pipe system.

All visible leaks detected during the pressure test shall be repaired and the pressure test rerun. A successful test shall be a test in which no visible leaks are detected and the pipe system pressure can be maintained within 1 psi of the specified value.

3.3.4.2 Installation of C900 and C905 PVC Piping

Storage, handling, and installation of PVC pressure pipe shall be in accordance with AWWA Manual No. M23, PVC Pipe- Design and Installation. Pipe, fittings, and appurtenances shall be handled in a manner that will ensure installation in a sound, undamaged condition. Pipe and fittings shall be carefully examined for cracks, damaged linings, and other defects immediately prior to installation. Spigot and bell ends shall be particularly examined and cleaned with care. All defective pipe and fittings shall be clearly marked as such and removed from the site of the work.

All PVC C900 and C905 pipe shall be restrained. Fittings shall be chosen to accommodate mechanical restraint. Mechanically restrained joints shall be installed so as to restrain the piping without concrete thrust blocks.

Pipe shall be protected from lateral displacement by pipe bedding material. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

Pipe shall be laid with bell ends facing the direction of laying. Foreign matter shall be prevented from entering the pipe during installation.

Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water in the trench shall be removed prior to removing the plug.

Pipe shall be kept shaded and as cool as possible during installation and shall be covered with backfill immediately after installation. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.

Alignment

- Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the maximum deflections specified by the pipe and fitting manufacturers.
- Either shorter pipe sections or fittings shall be installed as required to maintain the indicated alignment or grade.
- Curvature of the pipe shall not exceed the manufacturer's recommendations.
- Cutting shall comply with the pipe manufacturer's recommendations and Chapter 7 of AWWA Manual M23. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and beveled in accordance with the manufacturer's instructions. Jointing operations shall conform to the instructions and recommendations of the pipe manufacturer. All joint surfaces for gasketed joints shall be lubricated immediately before the joint is completed. Gaskets and lubricants shall be as supplied by pipe manufacturer, shall be suitable for use in potable water, shall be compatible with the pipe materials, shall be stored in closed containers, and shall be kept clean. Each spigot shall be suitably beveled to facilitate assembly.
- Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.
- Special care shall be taken to prevent contamination of potable water lines when dewatering, cutting into, and making connections with existing pipe. No trench water, mud, or other contaminating substances shall be permitted to enter the lines.
- Brass tapping saddles shall be used for all connections 2-inches in diameter and smaller. Direct tapping of PVC pipe will not be permitted.
- All bell and spigot or all-bell tees, bends deflecting 22-1/2 degrees or more, valves, and plugs which are installed in piping subjected to internal hydrostatic heads in excess of 30 feet shall be provided with suitable reaction blocking, anchors, joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure.
- Concrete blocking shall not be used.
- All steel clamps, rods, bolts, mechanical restraint systems and other metal accessories used in tapping saddles or reaction anchorages subject to submergence or in contact with earth or other fill material and not encased in concrete shall be protected from corrosion by a protective tape wrap system. Include 8 mil polyethylene plastic over tape wrap system before backfilling.
- All buried PVC piping shall have a conductive tracer wire taped to its top centerline. Conductive tracer wires shall be brought into all valve boxes, vaults, pipe trenches, and structures where

they would be accessible for future tracing of the piping. All buried piping shall also have a continuous warning tape laid 12 to 24 inches above the piping.

- After installation, the PVC pipeline or any isolated section thereof shall be tested for defective workmanship and materials by being subjected to a hydrostatic leakage test. If the pipeline under test contains pipes of various diameters, the allowable leakage will be the sum of the computed leakage for each pipe size.
- Each section of the pipe to be tested shall be slowly filled with water, and all air shall be expelled from the pipe. After the pipeline has been completed filled with water and all air expelled, all of the valves, if any, connected to the section to be tested shall be closed.

The duration of the hydrostatic test shall be for a minimum of two (2) hours and the pipe shall be pressurized to 150 pounds per square inch for C900 pipe and 100 pounds per square inch for C905 pipe. This pressure shall be maintained and the leakage accurately measured during the two (2) hour period to determine the total amount of leakage. The maximum allowable leakage shall be calculated from **Table 3-30**.

Table 3-30 C900 and C905 Allowable Leakage for 2-Hour Test

Pipe Diameter (in.)	Allowable Leakage Per Foot of Pipe Tested	
	Gallons	Cubic Feet
4	0.00066	0.00008824
6	0.001	0.000134
8	0.00132	0.000176
12	0.00198	0.000265
42	0.00693	0.000926

Should a pipeline test show more leakage than allowable, repairs shall be made and the pipeline shall be re-tested until a successful test is obtained.

3.3.4.3 Installation of Double Containment Piping

- Double containment piping shall be laid uniformly sloped to the leakage monitoring points. Assembly shall be in accordance with the manufacturer’s written instructions. The carrier piping shall be assembled in conjunction with the double containment. Provide a termination fitting sealing off the double containment at every point where double containment is stopped. Provide at least one test fitting per run of piping. Double containment piping shall be kept sealed at all times to minimize the introduction of water or water vapor.
- Leak monitoring points shall be provided with flanges, couplings, penetrations, and fittings as required to allow leak detection.
- The carrier piping shall be tested and meet its zero leak requirement before testing the double containment pipe. Purging, drying, and testing the double containment piping shall be completed only with clean, dry air or nitrogen. The dewpoint of such air or nitrogen shall be dried to –10 degrees F or lower to minimize the introduction of water into the double containment.
- Testing of the double containment piping shall include pressurizing the piping through a test fitting with 5 psig dry air or nitrogen. A calibrated pressure gauge with a range of 0 to 20 psig shall be used for testing. The test gauge shall allow accurate readings to 0.5 psig or less. Test

duration shall be a minimum of 2 hours. Apply leak detection solution to all exposed joints during the test period. Test reports at a minimum shall include the date, time, names of test participants and witnesses, define the piping tested, define the starting and ending test pressures, and test outcome. No leakage, as indicated on the calibrated pressure gauge is allowed for a successful test. More stringent testing requirements required by the authorities having jurisdiction, if any, shall also be met.

- Find and replace all faulty joints, fittings, gaskets, and pipe as required to obtain a successful pressure test. Retest after repairs are made.

3.3.4.4 Installation of Lab Acid Waste Drainage Polyethylene Pipe

- Install piping in accordance with the manufacturer's written installation instructions. Provide adapters as required to transition to sinks, neutralization tank, and other piping materials. Support piping with products and methods recommended by the piping manufacturer.

3.3.4.5 Installation of Copper Piping

- Flanged Connections
  - All flange faces shall be in perfect alignment with the holes straddling the vertical center line of the piping.
  - All bolts shall be well lubricated over the entire thread length with a heavy graphite and oil mixture prior to the tightening operation. Bolts shall be tightened with proper wrenches, care being taken to secure uniform pressure on the bolts and gasket and to avoid overstressing of the bolts, dishing of the flanges, and compression of the gasket beyond its proper limits. Commercial grade carbon steel bolts, ASTM A307, Grade B shall be tightened to obtain approximately 15,000 psi stress based on the root area of the thread. Alloy steel bolts, ASTM A193, Grade B7 shall be tightened to obtain a stress of 45,000 psi. Dielectrically separate steel bolts and nuts and flanges with washers and sleeves.
  - All bolts shall be of sufficient length so that when fully tightened, a minimum of two full threads shall extend beyond the nut.
- Screwed Connections
  - All screwed connections shall have full thread of true taper, accurate to gauge.
  - Reduction in size shall be made using reducing fittings.
  - The use of bushings or close nipples is prohibited.
  - Plugs shall be brass with square head.
  - Screwed joints shall be made with an approved joint compound applied to the male thread only. Caulking of screwed joints will not be allowed.
- Soldering (Copper Tubing Only)
  - Tubing shall be cut with square ends and reamed to prevent burrs, out-of-round or improperly sized ends.
  - After cutting, all surfaces to be soldered shall be thoroughly cleaned to a metal-bright finish, free from dirt, grease or other material before fluxing and soldering. This cleaning shall be performed by using emery cloth, sandpaper or steel wool. Clean the outside end of the tubing for a length of 1/2-in greater than the depth of the fitting. The inside of the fittings shall be cleaned in a similar manner. Apply non-corrosive flux and assemble the joint. Acid solder or acid flux will not be allowed.

- The surfaces to be joined shall be heated up slowly and uniformly to the melting point of the solder. The surface being soldered shall be maintained above the melting point of the solder for sufficient time to draw the solder completely into the joint. When the solder congeals to a plastic state the excess metal shall be removed with a cloth brush, leaving a fillet around the end of the fitting. Full penetration of the solder uniformly throughout the entire socket is required. The soldered joints shall be allowed to cool in still air. Quenching shall not be permitted.
  - Any type of crack, pinhole, area of incomplete penetration, or similar defect will not be accepted. Peening for closing up defects will not be permitted.
  - Heating torches of sufficient size equipped with multiple tips or ring burners for use on combination torches, shall be used for heating of large fittings of 2-in diameter and larger prior to soldering.
  - Remove all external and internal loose solder and flux after joint cools.
- Brazing (Copper Pipe, or Tubing Where Required)
  - Cutting and cleaning of tubing shall be as specified for soldering operations.
  - Apply flux in accordance with recommendations of manufacturer of brazing filler material being used. Apply to outside of fitting and heat affected area of tubing. Avoid getting flux inside tube. Flux may be omitted when joining copper tubes to wrought copper fittings but is required for joining to cast (bronze) fittings.
  - Assemble joint by inserting tube into socket hard against stop and turning.
  - Heat parts to be joined beginning 1-in from edge of fitting, continuously moving the flame. When flux has become transparent, begin to heat the fitting at the base of the cup, still continuously moving the flame. When flux at fitting is quiet and transparent, maintain heat along joint by moving flame along axis between fitting and tubing.
  - Apply brazing material at point were tubing enters socket of fitting. Avoid putting flame on brazing material. Heated joint should melt brazing material and capillary action will draw material into the joint. When joint is properly made, a fillet of filler metal will be visible completely around the joint. Stop adding filler metal when fillet is formed.
  - After brazing material has solidified, clean off flux residue. Fittings must cool naturally. Quenching will not be allowed.
  - Any type of crack, pinhole, area of incomplete penetration, or similar defect will not be accepted. Peening for closing up defects will not be permitted.
- Flared (Copper)
  - The tube must be cut square and reamed and burred in preparation.
  - Slip the sleeve-nut of the fitting over the tube end with the threaded end of the nut facing the end of the tube.
  - Lubricate the flaring tool with a drop of oil and center it carefully inside the tube. Drive the flaring tool with a hammer, keeping it plumb, until the tube has flared to the outside diameter of the tool.
  - After removing the flaring tool by pulling and twisting, clean flared surfaces of the tube and fitting, insert male end of fitting into sleeve and draw threaded sleeve-nut up tight with wrenches.
  - Leaks may be corrected by recleaning the flared surfaces and retightening.
  - Cracked or split flared surfaces of the tubing shall be cut off and the tubing reflared.

- Peening or packing a leaking joint will not be permitted.

3.4 Plant Process Valves

3.4.1 Description of Work

Valves and gates shall be supplied as required to meet the operational requirements of the system as described in other subsections of Volume III.A. This section includes specifications for valves expected to be used on the Project. Should the Company's design require other types of valves, such valves shall meet AWWA, ANSI or other Industry standards and be approved by the County Technical Advisor.

3.4.2 General Requirements

3.4.2.1 Codes and Standards

The valves and gates shall adhere to the following applicable codes and standards:

MDWASD Design and Construction Standard Specifications and Details

American Society for Testing and Materials (ASTM)

- ASTM A 48 – Standard Specification for Gray Iron Castings.
- ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- ASTM A 159 – Standard Specification for Automotive Gray Iron Castings.
- ASTM A 240 – Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Valve.
- ASTM A 276 – Standard Specification for Stainless Steel Bars and Shapes.
- ASTM A 436 – Standard Specification for Austenitic Gray Iron Castings.
- ASTM A 536 – Standard Specification for Ductile Iron Castings.
- ASTM B 30 – Standard Specification for Copper-Base Alloys in Ingot Form.
- ASTM B 62 – Standard Specification for Composition Bronze or Ounce Metal Castings.
- American Water Works Association (AWWA)
- AWWA C111 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- AWWA C500 Metal-Seated Gate Valves Supply Service.
- AWWA C504 Rubber Seated Butterfly Valves.
- AWWA C507 Ball Valves, 6 in through 48 in (150mm Through 1200mm).
- AWWA C508 Swing Check Valves for Waterworks Service, 2 in (50mm) Through 24 in (600mm) NPS.
- AWWA C509 Resilient Seated Gate Valves for Water Supply Service.
- AWWA C511 Reduced-Pressure Principle Backflow Prevention Assembly.
- AWWA C515 – Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
- AWWA C540 Power Actuating Devices for Valves and Sluice Gates.
- AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants.
- AWWA C800 Underground Service Line Valves and Fittings.

American National Standards Institute (ANSI)

- ANSI B2.1 – Specifications for Welding Procedures and Performance Qualifications.
- ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.

- ANSI B16.10 Face to Face and End to End Dimensions of Valves.
- ANSI B16.104 Butterfly Valves.

American Iron and Steel Institute (AISI)

Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

- MSS SP 61 Pressure Testing of Steel Valves.
- MSS SP 67 Butterfly Valves.
- MSS SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends.
- MSS SP 71 Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- MSS SP 72 Ball Valves with Flanged or Butt Welding Ends for General Service.
- MSS SP 78 Cast Iron Plug Valves, Flanged and Threaded Ends.
- MSS SP 80 Bronze Gate, Globe, Angle and Check Valves.
- MSS SP 82 Valve Pressure Testing Methods.
- MSS SP 98 Protective Coatings for the Interior of Valves, Hydrants and Fittings.
- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories (UL)
- Factory Mutual (FM)
- State of Florida Department of Environmental Protection Division (Drinking Water), Florida Administrative Code (FAC) Chapter 55 And Miami-Dade County Department of Environmental Resource Management (DERM), Chapter 24 of the Miami-Dade County Code.
  - Rules and Regulations Pertaining to Public Drinking Water
- National Sanitation Foundation:
  - NSF 61 - Drinking Water System Components - Health Effects

All other codes and standards listed herein.

Where reference is made to one of the above standards, the revision in effect at the time of Service Contract shall apply.

3.4.2.2 Design Submittal

The Company shall submit Design Submittals and Documentation to the County Technical Advisor. In addition, the following items shall be submitted by the Company for the County Technical Advisor's review prior to finalizing the design:

- The Company shall submit valve schedules showing proposed valve type, location, size, actuator type and manufacturers' model.
- Submit valve tag methodology.
- Documentation shall be provided to the County Technical Advisor demonstrating compliance with specification requirements.

3.4.2.3 Construction Submittal

The Company shall submit construction information on the products and materials related to the work in this Section to the County Technical Advisor. In addition, information shall be furnished to the County Technical Advisor on the following items:

3.4.2.3.1 General Submittal Requirements

- Submit complete product data and shop drawings required to establish compliance with these Technical Requirements
- Submittals shall include as a minimum:
  - Certified drawings showing all important details of construction and dimensions.
  - Descriptive literature, bulletins and/or catalogs of the valve assemblies.
  - The total weight of each item.
  - A complete bill of materials.
  - As applicable, valve Cv data and head loss characteristics as a function of the entire flow range for both full open and 10, 20, 30, 40, 50, 60, 70, 80, and 90 percent open.
  - Actuator torque requirements for normal and maximum pressure operation.
  - Recommendations on installation direction with respect to one and two-way flow.
  - Additional submittal data, where noted with individual valve specifications or pieces of equipment.
  - For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required hydrostatic tests and certification of proper installation.
  - Manufacturer's Installation and Application Data.

All construction submittal calculations, as applicable, shall be stamped by a Professional Engineer registered in the State of Florida.

3.4.2.3.2 Maintenance Submittals

- Submit a list of special tools and the manufacturer's standard spare parts being supplied.
- Provide a list of all spare and replacement parts with individual prices and location where they are available.
- Operation and Maintenance (O&M) instructions.

3.4.2.3.3 Performance Requirements

The Company's supply, design and construction of the valves shall meet the following performance requirements:

All valves shall be complete with all necessary actuators, handwheels, chain wheels, worm and gear actuators, operating nuts, chains, wrenches, and other accessories or appurtenances which are required for the proper completion and operation of the Project work. Actuators and other accessories shall be sized and furnished by the valve supplier and factory mounted.

Valve Designations: The Company shall assign unique tag numbers to all valves to include size, type, service, body material, etc.

3.4.3 Specific Requirements

3.4.3.1 Valves and Gates, General

The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

Valves and appurtenances shall be of the size required by the Company and as far as possible equipment of the same type shall be identical and from one manufacturer.

Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or indelibly marked upon some appropriate part of the body.

Unless required by the operational conditions, items shall have a minimum working pressure of 150 psig or be of the same working pressure as the pipe they are connected to, whichever is higher and suitable for the pressures noted where they are installed.

Joints, size and material – as required by the Company or required by the County Technical Advisor.

All joints shall be of the same type, nominal diameter, material and with a minimum rating equal to the pipe or fittings to which they are connected to.

Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings to which they are connected to.

Wafer-style valves shall not be provided unless required for a particular application. Unless otherwise required for a specific application valves shall have the following ends:

- 3-in and larger - flanged ends.
- 2 ½-inch and smaller in copper piping – brazed ends.
- 2 ½-inch and smaller in stainless steel or steel piping – threaded ends.

Prior to installation, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until installation. Oxygen-cleaned valves shall be suitably protected to preserve the integrity of the cleaning process.

- All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
- Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
- Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
- Any corrosion in evidence at Final Completion shall be removed and repaired, or the valve shall be removed and replaced.

Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping specifications and manufacturer's information for further requirements.

Provide all special adapters as required to ensure compatibility between valves, appurtenances and adjacent pipe.

Valves and actuators located outdoors, within 2 feet above a liquid surface, in vaults, or where otherwise noted shall be especially designed for submerged service where water may completely submerge the valve and actuator. Valve and actuators shall be capable of submergence of 20 –ft. All other units shall be as a minimum weather tight.

Single Manufacturer

Where two or more values of the same type are required on the Project, the valves shall be manufactured by the same manufacturer. Exception may be allowed by the County Technical Advisor when valves are provided or part of a purchase process unit or equipment.

3.4.3.2 Valve Actuators

3.4.3.2.1 Actuators, General

All valves shall be equipped with actuators. Each actuator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer. The actuator shall be sized to operate the valve for the full range of pressures and velocities specified. All valve actuators shall open by turning counterclockwise. Unless otherwise noted, all valves shall be manually actuated; non-buried valves shall have an operating wheel, handle or lever mounted on the operator; buried valves and those with operating nuts shall have a non-rising stem with an AWWA 2-inch nut. At least two (2) tee handles shall be provided for all operating nuts.

3.4.3.2.2 Manual Actuators

Valves in sizes up to and including 4 inches shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design. Larger valves shall have gear-assisted manual actuators, with an operating pull of maximum 40 pounds on the rim of the handwheel. All buried and submerged gear- assisted valves, all gear-assisted valves for pressures higher than 250 psi, all valves 30 inches in diameter and larger, and where otherwise required by the design, shall have worm-gear actuators, hermetically-sealed and grease-packed, where buried or submerged. All other valves 6 inches to 24 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm- gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

Traveling-nut with screw (Scotch yoke) operators shall be contained in a weather-proof cast-iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 end bearings, and the actuator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of grease nipples. All gearing shall be designed for a 100 percent overload.

All buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled. Wrench-nuts shall comply with AWWA C 500 -Metal - Seated Gate Valves for Water Supply Service, and a minimum of 2 operating keys, or one key per 10 valves, whichever is greater, shall be furnished.

Buried and submerged valve actuators and gear assemblies shall be provided with Type 304 and/or 316 stainless steel bolting and trim, and shall be rated for continuous submerged service. If buried, the valve actuator shall be suitable for a submerged service at a water depth of 20 feet (minimum). If submerged, the actuator shall be suitable for a submerged service at a water depth of 30 feet (minimum).

Manually-activated valves with the stem located more than 7 feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5 feet 6 inches above the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

3.4.3.2.3 Electric Actuators

The Company shall provide electric motor actuators, for either OPEN/CLOSE or MODULATING service, as required by its design and as required by the technical requirements. Motor operators shall be compatible with the instrumentation and control system as designed as specified in this Section.

Equipment Requirements

Where electric motor actuators are indicated, an intelligent non-intrusive electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece. The electric motor actuators for valves of size 4-inch and larger shall be manufactured by a single manufacturer.

Actuator Enclosures

Each motor actuator shall include the motor, reduction gearing, reversing starter, torque sensor, and limit sensor in a watertight NEMA 4/4X/6 enclosure. All actuators shall be rated for 7 meters for 72 hours (IP68), and shall have a double-sealed control compartment that is sealed separately from the termination compartment.

Gearing

The actuator shall be a single or double reduction unit consisting of spur or helical gears and worm-gearing that provides a self-locking characteristic. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the electric actuator.

Starting Device

Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The actuator motor must attain full speed before stem load is encountered.

Motor

The motor shall be of the totally-enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480-volt, 3-phase, 60-Hz current, unless indicated otherwise, and have Class F insulation and a motor frame with all dimensions in accordance with the latest revised NEMA MG Standards.

For ON/OFF duty, Class F motor shall have a time rating of at least 15 minutes at 104oF (40oC) or twice the valve stroking time, whichever is the longer, at an average load of at least 33 percent of the maximum valve torque.

With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. All bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement. The entire actuator shall include double-sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion. Actuators requiring a space heater to prevent moisture intrusion or condensation are not acceptable.

For actuators designed for MODULATING duty, the electric motor shall be suitable for up to 1200 starts per hour with a duty in accordance with IEC 34-1 to S4 50 percent.

Electric motor actuators for valves smaller than 4 – inches may be 120 volt single phase of 24 vdc. If required by the design the actuator shall be modulating type.

Torque and Position Sensors

Torque and turns limitation to be adjustable as follows:

- Position Setting Range: 2.5 to 100,000 turns, with resolution to 7.5 degrees of actuator output. Position sensing shall be via a solid-state position encoder that eliminates the use of counting gear trains or potentiometers.
- Torque setting: 40 to 100 percent of rated torque.
- Torque sensing must be affected directly electronically or electronically and shall be governed by a solid-state torque sensor that directly measures the output torque of the actuator to protect the valve and actuator from damage from possible obstructions. Extrapolating torque from mechanically measured motor speed is not acceptable due to response time. Torque measurement shall be independent of variations in frequency, voltage or temperature. Torque shall be adjustable in 1% increments. The actuator shall store actual operational torque curves for retrieval by plant maintenance staff.
- “Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads.

The electric circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

If used, a hand-held Setting Tool shall be provided and used for non-intrusive calibration and interrogation of the actuator. This Setting Tool will provide interrogation capabilities as well as security in a non-intrusive intrinsically safe watertight casing. The Setting Tool shall enable the user to extract and store actuator configuration and data logger files within the Tool. The Setting Tool shall store up to ten (10) configuration and four (4) data logger files. Stored configuration and data logger files shall also be able to be uploaded to both the actuators and to diagnostic software provided by the actuator manufacturer.

Control

Each motor actuator shall be equipped and configured for communication to allow control and monitoring from the PLCs and SCADA system. Each actuator shall have two local control switches: LOCAL/STOP/REMOTE and OPEN/CLOSE. Power and logic control boards, control power transformer, and fuses shall be located in a separate control compartment.

The control unit shall be microprocessor-based and shall contain an analog/digital converter, non-volatile random access memory for storage of calibration parameters and push-button or non-intrusive setting tool calibration elements for field-setup. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4-20 mA. For MODULATING or POSITIONING duty, the actuator shall be capable of responding to a remote positioning signal from the PLC/SCADA system to operate the valve between 0-100 percent of valve travel and also to provide a 0-100 percent position feedback signal to the PLC/SCADA as positive confirmation of position. Remote monitored statuses shall include: Valve in REMOTE, Valve OPEN, Valve CLOSED, Valve FAILED, Valve 0-100% Position (for modulating service). Remote controls shall include OPEN valve, CLOSE valve, STOP valve, set valve POSITION 0-100% command (for modulating service). The communication method between the actuators and the PLC/SCADA may be either by discrete (dry contact, 4-20mA) or be serial messaging (e.g., DeviceNet) at the discretion of the Design Build Company.

Actuator Display

Each motor actuator shall have a liquid crystal display (LCD) integral to the actuator housing to indicate valve position and diagnostic screens. The digital position indicator shall display from fully open to fully close in 1 percent increments with +/- ½ percent accuracy. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the main power to the actuator is lost. In addition to valve position, the local display shall also torque in percent of rated value as well as customer-configurable multilingual text.

Set-up and Calibration

Position limits, torque levels, control and indication settings shall be adjustable using a non-intrusive setting system. If a separate setting tool is required, a minimum of two tools shall be furnished.

Handwheel

A permanently-attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel.

Wiring and Terminals

Internal wiring for all actuators shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and three- phase power. Each wire shall be clearly identified at each end.

The terminals shall be embedded in a terminal block of high tracking resistance compound. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with a minimum of three threaded cable entries. When required, a forth cable entry shall be provided.

All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

- Serial Number
- External Voltage Values
- Wiring Diagram Number
- Terminal Layout

This must be suitable for the Company to inscribe cable core identification beside terminal numbers.

Factory Start-Up Kits

Each actuator shall be supplied with a startup kit comprising installation instruction, electrical wiring diagram, and sufficient spare cover screws and seals to make good any site losses during the commissioning period.

Performance Test Certificate

Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment should simulate a typical valve load and the following parameters should be recorded:

- Current at maximum torque setting
- Torque at maximum torque setting
- Flash Test Voltage
- Actuator Output Speed or Operating Time

In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

Acceptable Electric Motor Actuator Manufacturers:

- Rotork
- Limitorque
- Or equal

3.4.3.3 Valves

This section provides specific requirements for different types of valves. These requirements shall be followed by the Company unless more specific requirements are set in other sections herein for specific Project facilities or applications.

3.4.3.3.1 Butterfly Valves

Standard (AWWA) Butterfly Valves

Butterfly valves and operators shall conform to the AWWA Standard Specifications for Rubber Seated Butterfly Valves Designation C504, except as hereinafter specified. Valves shall be Class 150B for all pressure pipelines and Class 25B for all gravity pipelines. The valve bodies shall be ductile iron conforming to ASTM A536, Grade 65-45-12, Class 150. Valves 20-inches and smaller shall have fully rubber lined bodies with molded in seats. The exterior surfaces of valves 20-inch and smaller; and the interior and exterior surfaces of valves 24-inch and larger shall be factory coated with an epoxy coating meeting the requirements of AWWA C550. The valve discs shall be constructed of type 316 stainless steel for valves 20-inches or smaller and ductile iron conforming to ASTM A536, Grade

65-45-12 for Class 150 for valves 24-inch and larger. Discs for valves 24-inch and larger shall be factory coated with an epoxy coating meeting the requirements of AWWA C550. Valves shall be either double flange (flange x flange) or mechanical joint type as necessary. The face-to-face dimensions of flanged end valves shall be in accordance with Table 2 of AWWA Specification C504 for short-body valves. Adequate two-way thrust bearings shall be provided. Flange drilling shall be in accordance with ANSI B16.1. Wafer or spool type valves will not be accepted. Valve seats shall be a natural rubber or synthetic rubber compound. Valve seats 30-inches and larger shall be field adjustable and replaceable without dismounting operator disc or shaft and without removing the valve from the line. All retaining segments and adjusting devices shall be of corrosion resistant material with stainless Nylock screws and be capable of a 1/8-inch adjustment. Valves 24-inches and smaller shall have bonded or mechanically restrained seats as outlined in AWWA C504. The valve shaft shall be turned, ground and polished constructed of type 316 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. The shaft shall be of a one piece unit extending full size through the valve disc and valve bearing on valves 20-inches and smaller. Stub shaft design in which the shaft extends 1.5 times the shaft diameter into the valve disc is acceptable on valves 24-inches and larger. Operators shall be capable of seating and unseating the disc against the full design pressure and velocity, as specified for each class, into a dry system downstream and shall transmit a minimum torque to the valve. Operators shall be rigidly attached to the valve body. All valve operators shall conform to Section 3.8 of the AWWA Standard Specification and shall be manual unless otherwise specified and shall have permanently lubricated, totally enclosed gearing with gear ratio sized on the basis of line pressure and velocities of 10 feet per second. Operators shall be equipped with handwheel, position indicator and mechanical stop-limiting locking devices to prevent over travel of the disc in the open and closed positions. They shall turn counter-clockwise to open valves. Manual operators shall be of the traveling nut or link lever self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Operators shall be fully enclosed and designed to produce the specified torque with a maximum input torque of 50 ft-lbs. Operator components shall withstand an input of 450 ft-lbs at extreme operator positions without damage. Valves located above grade shall have handwheel operators, and valves located below grade shall be equipped with a two-inch (2") square AWWA operating nut located at ground level and cast iron extension type valve box. Valve operators shall conform to AWWA C504, latest revision. Where valves are submerged, an extended torque tube and operator shaft shall be supplied. A valve operator meeting the requirements of this Section shall be mounted above the water level. The torque tube and operator shaft shall be manufactured of type 316 stainless steel. Appropriate supports and guides shall be provided as necessary. All buried valves shall have cast-iron three piece valve boxes. Valve boxes shall be provided with concrete base and valve nameplate. Acceptable Manufacturers: DeZurik Corporation, Henry Pratt Company, or approved equal.

Stainless Steel High Performance Butterfly Valves

Stainless Steel high performance butterfly valves shall be of the ANSI B16.1 Class 150, high performance stainless steel body valves. The valves shall be flangeless or wafer, except at dead ends and removeable spools where a lugged valve shall be used. The body, disc, seat seal, seat retainer, shaft and packing gland shall be stainless steel type 316 for permeate piping, super duplex stainless steel for UFA concentrate piping and duplex stainless steel for raw water piping. The seat material shall be PTFE Teflon and the valves shall be rated for an ANSI B16.104 class IV shutoff. The seals will be Teflon PTFE. The actuators shall be side mounted rotary handwheels except for buried service, which shall have construction suited for buried service, and be provided with a 2-inch nut and two tee wrenches 6-feet long, valve box and cover.

Resilient Seat Butterfly Valves

Resilient seat butterfly valves shall be rubber lined (flange to flange) bonded to class 150 ductile iron body, EPDM seats, offset type 316 stainless steel disc, type 316 solid one piece shaft PTFE coated type 316 stainless steel bearings and stainless steel fasteners.

3.4.3.3.2 Plug Valves

Eccentric Plug Valves

Eccentric plug valves shall be of the non-lubricated, eccentric plug design with resilient faced plugs for valves through 36-inches. Plug valves 20-inches and smaller shall have an 80 percent minimum port area except for the 8 and 10-inch sludge blowoff and drawoff line valves which shall have a 100 percent port area. Plug valves designed for operation in a horizontal pipeline shall have the valve shaft in a vertical position.

Flanged valves shall have ends plain-faced and drilled conforming to ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 125. Bolt holes in the flanges shall be equally spaced and shall straddle the vertical and horizontal centerlines. Mechanical joint valves shall have ends complying with ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. Mechanical joint gaskets, glands, tee-head bolts and hex nuts shall be included with the valve. Tee-head bolts and hex nuts shall be high-strength cast gray or ductile iron. Follower glands held in place with set screws will not be acceptable. Bolts holes in the flanges of the mechanical joints shall be equally spaced and shall straddle the vertical center-line. Screwed Valves shall have ends threaded to American (National) Tapered Pipe Thread (NPT) Standard.

The body and plug shall be of semi-steel conforming to the requirements of ASTM A126, Class B, and all exposed nuts, bolts, springs, washers, and similar component items shall be AISI type 316 stainless steel. Resilient plug facings shall be of neoprene. Plug valves shall be furnished with a corrosion resistant seat consisting of a welded-in overlay of high nickel content on all surfaces contacting the plug face and shall comply with AWWA C507, Ball Valves 6 inch through 48 inch. All top and bottom shaft bearings shall be designed for replaceable multiple ring “V” or "U" type packing of Buna-N or neoprene. The valves shall be of the bolted-bonnet type and shall comply with AWWA C507. Plug valves shall have stops at the fully-opened and fully-closed positions. Plug valves shall be designed for drip-tight shutoff on wet service applications at pressure differentials up to the full rating of the valve with pressure in either direction. Plug valves shall be provided with a manual operator sized to suit the maximum differential pressure across the valves. Torques required to operate the plug valves shall be calculated according to the method outlined in the Appendix to AWWA C504

Sleeved Plug Valves

Sleeved plug valves shall be of the tapered plug, top entry type, with a one piece tapered sleeve positively locked into the body of the valve and fully encasing the plug. The plug shall be supported by the sleeve such that the downward thrust of the plug assures tight sealing against the sleeve. The plug shall have a minimum of 0.15-inch bottom clearance to the body such that some wearing of the sleeve may be accommodated by lowering the plug. The valves shall have ANSI 150 lb flanged ends for sizes 3-inch and larger, and flanged or screwed ends for smaller sizes as indicated. Sleeve plug valve for Sodium Hydroxide service shall have type 316 stainless steel body, Type 316 stainless steel plug and PTFE sleeve. Sleeve plug valve for Sulfuric Acid service shall have Alloy 20 (ASTM A351 CN-TM) body, Alloy 20 plug, and PTFE sleeve. The valve body and plug shall have smoothly-finished water passages free from sharp corners when the plug is in the wide open position. The valves shall be rated for ANSI class 150 or as indicated for service temperatures and chemical concentrations on the valve schedule. Manually operated valves of 3-inch size and larger shall have right-angle gear type operators with handwheel. Smaller sizes shall be provided with a T-handle wrench operator. Manually operated valves of 2-inch size and larger that require proximity position switches shall have right-angle gear operators except that such valves may have T-handle wrench operators through 2-inch size where the valve manufacturer offers compatible valve, operator and proximity switch units. The mounting of right-angle gear operators shall conform to ISO 5211.

3.4.3.3.3 Ball Valves

Brass Ball Valves (6-inches and larger)

General purpose and service air ball valves of size up to and including 1-1/2-inch diameter shall have bronze 2-or 3- piece bodies with threaded ends. Valves 2-inch to 4- inch in size shall have brass bodies with flanged ends. The balls shall be solid chrome plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings. The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other approved construction, with reinforced Teflon seal. The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

Stainless Steel Ball Valves

Ball valves for use with stainless steel piping systems and black steel piping for ammonia chemical service, including instrument isolation, air lines and moisture drains, shall be end entry type with type 316 stainless steel (ASTM A351 CF8M) body, ball, ends and trim, Teflon seats and seals and flanged or threaded connections as indicated. Valve body shall be either two or three piece design, no internal ring for the ball shall be acceptable. Valves shall be class 150. Manually operated valves of 4-inch and larger shall have right-angle gear type operations with handwheel. Manually operated valves of 2-inch size and larger that require proximity position switches shall have right-angle gear operators except that such valves may have lever operators through 3-inch size where the valve manufacturer offers compatible valve, operator and proximity switch unit. The mounting of the right-angle gear operators shall conform to 150 5211 ISO 5211.

Plastic Ball Valves

Plastic ball valves shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), or polyvinylidene fluoride (PVDF), to match the adjoining piping system. All plastic ball valves shall have socket true union ends or flanged ends to mate with ANSI B 16.5, class 150, for easy removal. The balls shall have full size ports and Teflon seats. All body seals, union O-ring seals, and stem seals shall be suitable for the service. In sodium hypochlorite service, the union O-ring seals and stem seals shall be Viton and the ball shall be drilled for venting gases. In caustic soda (sodium hydroxide) service, the O-ring seals and stem seals shall be EPDM. Scales and seals shall be FPM (Viton). Valves that are located below grating and in sumps and chemical containment pipe pits shall be furnished with handle extensions. The Company shall fabricate and install fiberglass guide brackets every 5 feet of vertical distance and just under the handle at the top of the extension.

Non-Metallic Composite Ball Valves

Non-Metallic ball valves for fluoride bulk tank and day tank isolation shall be Nil-Cor Composite valves, Series 300 or equal. Ball valves for sodium hypochlorite bulk storage tank and day tank isolation shall be Nil-Cor Composite valve, Series 410 or equal. Ball valves shall have flanged ends to ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings, Class 150. Valves shall conform to the face-to-face dimensions of ANSI/ASME B16.10. Valves materials of construction shall be as shown in **Table 3-31**.

Table 3-31 Materials of Construction (Non-Metallic Composite Ball Valves)

Description	Fluoride Materials	Sodium Hypochlorite Materials
Service	Bulk Storage tank and Day Tank Isolation Valve	Bulk Storage tank and Day Tank Isolation Valve
Body	Compression molded graphite and Derakane 470 vinyl ester resin	Solid construction FRP and polysulfone resin
Gland	Hastelloy-C with integral locking plate	Hastelloy-C with integral locking plate
Stem	Hastelloy-C metal insert with molded graphite fiber/vinyl ester composite on all wetted surfaces	Hastelloy-C metal insert with molded fiberglass/polysulfone composite on all wetted surfaces
Gland Bolts	Hastelloy-C	Hastelloy-C
Stem Packing	PTFE V-Rings	Chevron style PTFE
Thrust Washer	Glass and carbon filled PTFE	Glass and carbon-filled PTFE
Insert	Compression molded graphite and Derakane 470 vinyl ester resin	FRP and polysulfone
Seals	PTFE-coated Viton O-ring	PTFE-coated Viton O-ring
Ball	Compression molded graphite fibers and Derakane 470 vinyl ester resin	Solid construction of fiberglass and polysulfone resin
Seats	Virgin PTFE	Virgin PTFE, self-relieving
Handle	Nylon 6/6 FRP	Nylon 6/6 FRP

Alloy 20 Ball Valves for Sulfuric Acid Chemical Service

- Ball valves for sulfuric acid service shall be Alloy 20, three piece, full port.
- All ball valves up to 1-1/2-inches in size shall be socket weld ends. Ball valves 2-inches and up in size shall be butt weld ends.
- Valves materials of construction shall be as shown in **Table 3-32**.

Table 3-32 Materials of Construction (Alloy 20 Ball Valves)

Description	Sulfuric Acid Materials	Standard
Body	Alloy 20	ASTM A351 CN7M
Pipe Ends	Alloy 20	ASTM A351 CN7M
Stem	Alloy 20	ASTM B473 N08020
Ball	Alloy 20	ASTM B473 N08020
Stem Packing	Alloy 20	--
Valve Seat	RTFE	--
Body Seal	TFE	--
Thrust Bearings	Reinforced TFE	--
Handle	Stainless Steel	--

Manually operated valves of 4-inches and larger shall have right-angle gear type operations with handwheel. Manually operated valves of 2-inch size and larger that require proximity position switches shall have right-angle gear operators except that such valves may have lever operators through 3-inch size where the valve manufacturer offers compatible valve, operator and proximity switch unit. The mounting of the right-angle gear operators shall conform to ISO 5211. Acceptable

3.4.3.3.4 Cone Valves

Cone valves may be used in lieu of high pressure ball valves as pump control valves. The valves shall have cast steel bodies with ANSI B16.5 Class 300 flanged ends. The tapered conical plugs shall be of ductile iron with full (100 percent) circular port openings. Each valve body shall have monel seats around the bore. Each valve plug shall have two pairs of monel seats: one seat to mate with the body seat in the open position; the second to mate with the body seat in the closed position. The monel seats shall be precisely ground after welding to provide drop-tight shutoff. Each plug shall rotate on support trunnions that are integrally cast with the plug. Prior to rotating, each plug shall unseat by lifting so at to reduce seat wear.

3.4.3.3.5 Gate Valves

Resilient-seated Gate Valves

Resilient-seated gate valves shall conform to ANSI/AWWA C 509 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valve bodies shall be of cast iron with flanged, bell and spigot, or mechanical joint ends, rubber-coated cast iron disc, flanged bonnet, bronze stem, o-ring seals, and operators with handwheel or square nut, unless otherwise indicated.

Above Grade Gate Valves

All above ground gate valves shall be outside screw and yoke (OS&Y) type.

3.4.3.3.6 Diaphragm Valves

Diaphragm valves shall be of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), or polypropylene (PP) construction shall have solid Class 12454 A PVC or Class 23567 A CPVC or class 0210B67272 PP construction of the body and bonnet. The valves shall have a position indicator and adjustable travel stop. Diaphragm valves shall have flanged ends. The diaphragm shall be constructed of Teflon wetted face with PVDF vapor barrier and EPDM backing. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

3.4.3.3.7 Globe Valves

The globe valves for pipe 3-inches and smaller, shall be handwheel operated, shall have ends threaded to American Tapered Pipe Thread (NPT) Standard and shall be bronze body.

3.4.3.3.8 Check Valves

Swing Check Valves

Swing check valves for water, sludge, and general service shall be standard, outside lever-and-weight or outside lever-and-spring types, for normal horizontal installation and conforming to all of the applicable requirements of AWWA Standard C508-82, “Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS,” except as otherwise specified herein. The valves shall be iron body, bronze mounted. They shall be flanged type, bolted cap and for horizontal installation. The body clapper seating surfaces shall be stainless steel, conforming to ASTM A351. Seating surfaces on valves shall be metal or soft, pliable tetrafluoroethylene (TFE). The body and clapper seating surfaces shall be metal to metal and shall be bronze. The clapper disc and the clapper hinge arm, including the clapper disc cap screw, shall be bronze or cast iron. The clapper hinge pin shall be stainless steel conforming to AISI type 316.

Swing Check Valves (Sulfuric Acid Service)

Swing check valves for 93-98% sulfuric acid service in sizes 1/2-inch through 3-inch shall have Class 150 flanged ends and bolted cover. The body and cover shall be Cast Alloy 20 (CN-7M) and the internals shall be Alloy 20. Cover gasket shall be PTFE and cover bolts and nuts shall be type 316 stainless steel.

Swing Check Valves (Aqueous Ammonia Service)

Swing check valves for 19 percent aqueous ammonia service in sizes 1/2-inch through 3-inch shall have screwed ends in 1/2-inch through 2-1/2-inch sizes and Class 150 flanged ends in 3-inch size and bolted cover. The body and cover shall be cast type 316 stainless steel (CF8M) and the internals and fasteners shall be type 316 stainless steel.

Swing Check Valves (Wastewater Service)

Check valves for cast iron and ductile iron pipelines shall be swing type and shall meet the requirements of AWWA C508. The valves shall be cast or ductile iron body, bronze mounted, and single disc. Ends shall be 125 lb ANSI B16.1 flanges. When there is no flow through the line the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers. Valves shall be so constructed such that the disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight. Weight position shall be adjustable.

Swing Check Valves (2-1/2-Inch and Smaller) for Air High Pressure

Check valves Swing check valves for steam, water, oil or gas in sizes 2-1/2-inch and smaller shall have screwed ends, unless otherwise shown, and screwed cap. The valve body and cap shall be of bronze to ASTM B 61 with threaded ends to ANSI/ASME BI.20.1. Valves for steam service shall have bronze discs, and for cold water, oil, and gas service replaceable composition discs. The hinge pins shall be bronze or stainless steel.

Globe Style (Silent) Check Valves

Globe style (silent) check valves for water pumps, compressors, gas, air, and steam shall be of the full-flow internal spring-loaded poppet type. The bodies of all valves in sizes 3-inch and larger shall be of cast stainless steel conforming to ASTM A 351, Gr. CF8M with Class 150 flanged ends. Where necessary, there shall be a positive, watertight seal between the removable seat and the valve body. The stem guide shall be integrally cast with the body, or screwed into the body. Valves smaller than 3-inches shall have Gr. CF8M stainless steel bodies with screwed ends conforming to ANSI/ASME B 16.34 1.20.1, Pipe Threads, General Purpose (inch. The disc and stem of all valves in sizes 3-inch and larger shall be of stainless steel conforming to ASTM A 351 Gr. CF8M. Valves smaller than 3-inches shall have discs and retaining rings of Teflon, Nylon or other suitable material, and stems of stainless steel, suitable for the intended service. The stem guide must be either firmly fixed in the valve body to prevent it from sliding into the adjacent pipe and damaging the pipe lining, or the valve manufacturer shall furnish each valve with one matching flange compatible with the adjacent pipe and its lining to prevent damage to the lining. The compatible flange shall be part of the shop drawing submittal. All valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating stainless steel, as recommended by the manufacturer for the specific service condition. All valves in sizes 3-inch and larger shall have type 316 stainless steel springs, and valves smaller than 3-inch shall have stainless steel springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve.

Double Leaf Check Valves

Double leaf check valves shall be equipped with a spring mechanism to provide non-slam closure. The bodies shall be wafer style unless otherwise noted and be of stainless steel conforming to ASTM A 351 Gr. CF8M. Bodies shall be suitable for installation between ANSI Class 150 flanges. Sizes 6-inch and larger shall be equipped with a lifting eye bolt. The leaves shall be of type 316 stainless steel, revolving on stainless steel or monel hinge pins. The valves shall have resilient seats for bubble-tight shut-off. The seats shall be Buna-N, Viton or EPDM. The seat rings shall be firmly attached to the body or leaves by compression molding or mechanical means. The springs shall be 316 stainless steel or Inconel.

Rubber Flapper Check Valves

Swing check valves for concentrate and permeate piping shall be rubber flapper check valves with super duplex bodies for concentrate piping and stainless steel Type 316 for permeate piping. Valves shall be ANSI 125 pound class. Flapper shall be compression molded rubber with a steel reinforcing plate.

Spring-Loaded Check Valves

The stainless steel spring loaded check valves shall be provided on the overflow piping of chemical tanks, and for concentrate and permeate piping on the membrane skids. The valves shall be the same diameter as the service pipeline. Spring loaded check valves shall have a Type 316 stainless steel body, piston (or poppet) and spring for the overflow and permeate pipelines and a super duplex stainless steel body, piston (or poppet) and spring for the UFA concentrate pipeline. The valves shall be of the flanged insert, poppet type for installation between mating ANSI Class 150 flanges. Valve materials shall be stainless steel as previously specified with Viton, EPR or EPDM resilient seats best suited for the service.

Plastic Check Valves

Plastic check valves shall be swing check type or ball check type manufactured from PVC or CPVC compounds. PVC shall comply with ASTM D 1784, 12454B. CPVC shall comply with ASTM D 1785, 23447B. Swing check valves shall be furnished with Teflon seats, Teflon seals and flanged end connections. Ball check valves shall be furnished with Viton seats, and Viton seals.

Double Detector Backflow Preventor Check Valves

Detector check valves shall be manufactured in accordance with the applicable provisions of AWWA Standard C506-78, Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valves Types, as modified herein. Detector check valves shall have replaceable bronze valve seats conforming to ASTM Standard B61-86, Steam or Valve Bronze Castings, B584-90, Copper Alloy Sand Casting for General Applications, Copper Alloy C84400, or B62-96, Composition Bronze or Ounce Metal Castings. Clapper arms and discs shall be bronze conforming to ASTM Standard B139-83, Phosphor Bronze Rod, Bar, and Shapes, Grade A, C, or D; B584-90, Copper Alloy C84400; or B62-86. Clapper weight shall be cast iron lead. Clapper hinge pins shall be AISI type 304 stainless steel, and shall be bushed with hard rubber bushings. If used in the valve, all other rolled pins shall be type 304 stainless steel with hard rubber bushings. Valve bodies shall be bossed upstream and downstream on both sides of the bodies. All fittings shall be hot-dip galvanized per ASTM A153-82, Class A or B. Each valve cover shall be equipped with an air vent screw or plug, and this screw or plug together with the nuts and bolts for fastening the valve cover to the body shall be steel, hot-dip galvanized per ASTM A153-82, Class C or D; stainless steel; or brass conforming to ASTM Standard B16-85, Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

3.4.3.3.9 Air/Vacuum, Air Release, and Combination Air/Vacuum and Air Release Valves

Air /Vacuum Valves (AVVs)

AVVs shall be used to vent large quantities of air while a pipeline is being filled. These valves shall also allow air to enter a pipeline while it is being drained to prevent damaging levels of vacuum to occur. Valves shall have 316 stainless steel body and cover, 316 stainless steel float, Buna-N or Viton seat and all other parts 316 stainless steel. The fittings shall be threaded. Materials of construction shall all meet applicable ASTM standards. Valves with pipeline connections of 3-inch in diameter and smaller may have screwed ends. Valves with pipeline connections larger than 3-inches in size shall have flanged ends.

Air Release Valves (ARVs)

ARVs for water service shall be used to vent relatively small air pockets that accumulate in pipelines while in service and under pressure. Valve construction shall be the same as described above for AVVs.

Combination Air/Vacuum and Air Release Valves (AVARs)

AVARs shall incorporate the features described above for AVVs and ARVs. These valves shall be provided where these different features are required at the same point (e.g., high point) along a pipeline. Valve construction shall be the same as described above for AVVs.

Sewage-Type Combination Air/Vacuum and Air Release Valves

Sewage-type AVARs used for raw water, sludge, and other applications where solids are present that may clog the orifices of standards AVVs, ARVs, and AVARs and where specifically required by the Technical Requirements. The valve shall have a cast iron body and cover, stainless steel internal mechanisms and Teflon coated inner lining. Valve construction shall be similar to that described above for AVVs; however, the sewage type valves shall incorporate these other features: extra-long float stems and flushing features, including inlet shut-off valve, blow-off valve, clear water inlet valve, flushing water supply hose, and quick disconnect couplings. The internal mechanism shall be the compound lever type to permit the valve to open under pressure to vent pockets of entrapped air, gas or vapor as they accumulate. The compound mechanism shall be activated by a stainless steel concave float to lift the Buna-N needle to shut-off the air release orifice. Linkage shall be stainless steel. The air release valves shall be designed for a working pressure of 150 psi. The valves shall be supplied with a bronze isolation shut-off ball valve.

Air and Vacuum Valves for Vertical Turbine Pumps

AVVs on the discharge of vertical turbine pumps shall allow large quantities of air to be discharged during pump startup. The valve manufacturer shall confirm in writing that the AVVs are suitable for the application. The valves shall be provided with vacuum check to permit air to pass out, but not in.

Appurtenances

Each valve shall have a quarter turn ball valve or gate valve for isolating it from the pipeline. For pipeline connections of 3-inches and smaller, the isolation valve may have screwed ends. For pipeline connections larger than 3-inches, the isolation valve shall have flanged ends. The pipeline connection where the AVV, ARV, or AVAR is to be a flanged nozzle for connections up to size 2-1/2- inch. Smaller connections may be made using a welded half-coupling with NPT threads. Connection piping shall be copper unless otherwise approved by the County Technical Advisor. ARV discharge shall be piped to the adequate disposal location with PVC pipe or other approved material. A 2-inch minimum air gap shall be maintained. On finished water pipelines, provisions shall be made to prevent the backflow of water into pipeline.

Surge Check Valves

The AVVs and AVARs shall be fitted with surge check valves as necessary to control water hammer in pipelines. Surge check valves shall be added to AVVs and AVARs as determined by the Company's surge analyses. The surge check valves shall have bronze trim and stainless steel springs and be of a pressure class in excess of the application requirements.

3.4.3.3.10 Pressure Regulating, Sustaining, and Backpressure Valves

General

Pressure regulating valves shall be factory tested. Outlet pressure shall be easily field adjustable over the pressure range required.

All pressure regulating valves shall have flanged connections, or shall have unions mounted in the pipe on each side of the valve.

Valves 2 1/2-in and larger for pressure regulating in water service shall be flanged with globe body, fully bronze mounted, external pilot operated, piston type single seat with seat base equal to size of valve. Valve shall be designed to operate under severe throttling and/or cavitating conditions.

The valve shall be furnished with indicator rod, to show position of opening of the piston, and pet cocks for attachment to valve body for receiving gauges for testing purposes.

The pilot valve, controlling operation of the main valve, shall be easily accessible and so arranged to allow for its removal from the main valve, while the main valve is under pressure. The pilot valve shall be easily adjustable without removal of the springs, weights or use of special tools. The control piping on the valves shall have strainers to prevent plugging of control mechanisms.

The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line. The unit shall be flanged. The valve body shall be constructed of cast iron.

The valve shall maintain pre-adjusted downstream pressure for varying rates of flow through the positioning of the piston by the pilot without causing: water hammer or waste of water and without cavitation. Valve shall incorporate an anticavitation piston skirt and sleeve of stainless steel.

Pressure Regulating Valves – 2-in and Smaller for Water Service

Pressure regulating valves 2-in and smaller for water service shall have a bronze and brass body; renewable stainless steel seat and flexible diaphragm of suitable material. Outlet pressure shall be easily field adjustable over the pressure ranges tabulated.

Pressure Backpressure and Sustaining Valves – 2-inch and Smaller for Water Service

Pressure backpressure and sustaining valves 2-inch and smaller, for cold water service shall have a bronze and brass body with renewable seats and diaphragm. Valves shall consist of inline inlet and outlet ports to sustain the upstream pressure setpoint. Outlet pressures shall be field adjustable over the spring range.

Pressure Regulating and Sustaining Valves for Air Service

Pressure regulating valves for air service shall have a Type 316 stainless steel body, trim and diaphragm seat. Valve shall maintain a constant pre-adjusted downstream pressure. Outlet pressures shall be easily field adjustable.

Pressure sustaining valves for air service shall have a Type 316 stainless steel body, trim and diaphragm seat. Valve shall maintain a constant pre-adjusted upstream pressure. Inlet pressure settings shall be easily field adjustable.

Pressure Relief Valves for Air Service

Pressure relief valves for air service shall be bronze body with stainless steel spring and diaphragm/piston. Connections shall be female threaded inlet and outlet. Pressure relief adjustment shall be possible without removing the valve from the pipeline.

Pressure Relief Valves for Water Services

Pressure relief valves for water service shall be hydraulically operated, pilot controlled and diaphragm actuated. The main valve body shall be epoxy coated (inside and out), cast iron conforming to ASTM 48 with 303 stainless steel trim and flange ends conforming to ANSI B16.1. The main valve shall be a globe type with a single removable seat and a resilient disc. The valve shall have a 303 stainless steel stem guided at both ends by a bearing in the valve cover and an integral bearing surface in the seat. No external packing glands will be permitted and there will be no pistons operating the main valve. The valve shall be fully serviceable without removing it from the line. The pilot system will be provided with isolation cocks. The valve shall be designated specifically to minimize the effects of over pressure, resulting from power failure at the water plant or well pumps, or in order to blow off well water. The valve shall open hydraulically on high pressure. The valve shall be a 125 Class model 50-01 valve.

3.4.3.3.11 Needle Valves

Small needle valves shall be bronze, rising bronze stem, Class 200, globe style needle valve with threaded end connections conforming to Federal Specifications WW-V-51 Class C Type 1 (Globe) for nominal pipe sizes up to one (1) inch.

3.4.3.3.12 Vee Port Ball Control Valves

V-port ball valves shall be used for flow-modulating applications on the membrane skids and tune-up valves. Valves shall consist of a segmented, v-port ball of duplex or super duplex stainless steel with tungsten carbide or hard chrome facing. Shafts shall be of duplex or super duplex stainless steel with splined ball-to-shaft connections incorporating a blow-out proof design. Valve plug shall be removable without damage to the valve shaft. Bearings shall be duplex or super duplex stainless steel with PTFE bonded fabric or filament wound glass with Teflon lining. Seal shall be glass reinforced PTFE and shall provide ANSI Class VI shut-off. The valve body shall be duplex or super duplex stainless steel. Flanges shall be ANSI Class 150. Valves shall meet MSS-SP-25 marking requirements. Face-to-face dimensions shall meet ANSI B16.10, ISO 5752 (PN 10/16), and EN 558-1 or ISA 75.04 and IEC 534-3-2. Valves shall have a removable bottom shaft cover for maintenance purposes.

3.4.3.3.13 Foot Valves

Foot valves shall be supplied on the suction lines of various chemical feed pumps and at underground fuel storage tanks. The valves shall be PVC Type 1 construction, Viton ball and body seal, PVC strainer, and shall be supplied with spigot end connection and union nut.

3.4.3.3.14 Solenoid Valves

Solenoid valves shall be normally closed. All solenoid valves shall include a manual override operator (MO). Valves for the chlorination system shall be of brass body construction, Buna N seating, general service Red-Hat II model EF8210G100 as manufactured by Automatic Switch Company (ASCO), Florham, New Jersey, or equal. Valves for the air system shall be of stainless steel body construction with Buna N seating.

Solenoid valves specified above shall be suitable for operation on a 120 volt, AC, 60 Hertz power supply and be provided in a NEMA 4, watertight (WP) enclosure.

3.4.3.3.15 Buried Valves

Buried valves shall conform to the requirements above, except mechanical joint push-on, or flanged ends per AWWA C111. All exposed valve hardware (nuts, bolts, washers, etc.) including bonnet, bonnet cover, stuffing box, gear adaptor and joints shall be Type 304 stainless steel. Non-rising stem design, double O-ring seals for non-geared valves and shall incorporate packing for geared valves. DB Company shall provide valve box, 2-in operating nut, extension stem (as required) and valve box cover.

3.4.3.4 Valve Finishes – General

All coatings and lubricants in contact with raw, finished, washwater return, or other water streams that may enter the system shall be NSF-61 certified for contact with potable water.

3.5 Certificates, Warranties, and Guarantees

Refer to the Service Contract (RFP Volume II) for certificate, warranty and guaranty requirements.

3.6 Factory Testing and Reporting

All process equipment valves and operators shall undergo the manufacturer's standard tests to demonstrate satisfactory performance before shipping. All work under the section shall be leak tested.

3.7 Tools and Spare Parts

Any special tools and manufacturer suggested spare parts for operation and maintenance of the equipment shall be provided by the Company.

3.8 Delivery, Storage, and Handling

The Company is responsible for safe delivery, storage and handling of all equipment and materials.

In addition, care shall be taken in loading, transporting and unloading to prevent injury to the equipment valves, appurtenances, or coatings. Equipment shall not be dropped. All equipment valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired to a new condition.

3.9 Installation Requirements

The Company is responsible for installing the materials and equipment under this Section to provide a complete and working system. In addition, the following installation requirements shall be followed by the Company:

- Valves to be installed in correct flow orientation.

3.10 Field Quality Control

The Company shall provide all field quality control. In addition, the following field quality controls shall be carried out by the Company:

- Setting of limit switches and valve/actuator travel to prevent damage.

3.11 Field Testing and Reporting

The Company shall perform all necessary field testing to demonstrate the adequate installation of all materials and equipment under this Section. In addition, the Company shall perform the following field tests and report the results to the County Technical Advisor:

- Field testing of actuators and valves to make ready for operation.

3.12 Operations and Maintenance Information

The Company shall provide manufacturer's Operations and Maintenance Information. In addition, the information shall include the following:

- Complete operation and maintenance information including wiring diagrams of actuators.

3.13 Manufacturer's Field Services

The equipment manufacturer(s) shall provide on-site field services for the checkout, testing, startup and training. In addition, the Manufacturer shall provide the following field services:

- All necessary trips and labor to make equipment, valves and actuators ready for operation.
- A minimum of one (1) 8-hour day shall be provided for training in the operation and maintenance of each type of motorized operator.
- A minimum of two (2) 8-hour days (different shifts) shall be provided for training in the operation and maintenance of each type of process equipment and pumps.

3.14 Record Drawings

The Company shall provide complete and accurate Record Drawings of the installed work, including all work provided under this Section.

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Volume III.A - Section 4

Site/Civil

4.1 Description of Work

The site/civil work includes siting and design, including all applications and submittals to secure all required permit approvals, and all site work and construction to develop the WTP and wellfield. Schematic concept plans have been developed to illustrate how the new plant might be sited and are included in this document in Volume III.B. Site/civil work shall include grading, drainage, roadways, utilities, site piping, walks, parking, fencing, etc.

The site design shall incorporate "green" components to the extent possible. The Company is responsible for addressing green design as per Miami-Dade County guidelines and regulations.

4.2 Basic Requirements

4.2.1 Codes, Standards, and Regulations

The Site/Civil design shall comply with all applicable Federal, State, and Local Codes and Standards, including all amendments thereto including but not necessarily limited to the following:

- Miami-Dade County Water and Sewer Department (MDWASD) Design and Construction Standard Specifications and Details.
- Miami-Dade County Department of Public Works and Waste Management (PWWM) Standards and Specifications.
- Miami Dade County Department of Regulatory and Economic Resources (RER).
- Miami Dade County Planning and Zoning approvals, including compliance with local Design Review Guidelines, and Development Services Division, current planning branch of RER.
- Miami Dade County Division of Environmental Resources Management (DERM) Stormwater Design and Installation Standards.
- Miami-Dade County's Americans with Disabilities Act (ADA) and Uniform Federal Accessibility Standards (UFAS).
- South Florida Water Management District (SFWMD) Environmental Resource Permit (ERP).
- SFWMD Dewatering Standards and Regulations, C-1 ROW.
- Florida Department of Environmental Protection (FDEP) Stormwater Pollution Prevention Plan (SWPPP).
- Florida Building Code (FBC).
- Florida Department of Transportation Standard Specifications for Highway and Bridge Construction (SSHBC), latest edition.
- Manual on Uniform Traffic Control Devices (MUTCD) by US Department of Transportation, Federal Highway Administration, latest edition.
- American Association of State Highways and Transportation Officials (AASHTO).
- USEPA NPDES regulations.
- American Society of Testing and Materials (ASTM).
- Chain Link Manufacturer's Institute (CLMI) Product Manual, latest edition.

- MDWASD standards and specifications may include other requirements for the project not detailed herein.

4.2.2 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor. Documentation shall be provided to the County's Technical Advisor demonstrating compliance with the technical requirements. The following items at a minimum as shall be submitted by the Company for the County Technical Advisor's review prior to finalizing the design:

- Design calculations
- Design drawings
- Energy calculations

All calculations shall be sealed by a Professional Engineer registered in the State of Florida.

Design submittals shall be per the following MDWASD Construction Standards and Specifications, including but not limited to:

- Section 01031 Grades, Lines and Levels
- Section 01720 Project Record Documents
- Section 01725 Project As-Builts
- Section 01740 Permits
- Section 01775 Magnetic Media Submittals

4.2.3 Construction Submittals

Before proceeding with the erection of his construction plan, including the setting or placing thereof, and the erection of other temporary structures, the Company shall furnish the County's Technical Advisor with such information, product data, samples, shop drawings, and drawings as the County may require.

Construction submittals shall be per the following MDWASD Construction Standards and Specifications, including but not limited to:

- Section 01031 Grades, Lines and Levels
- Section 01100 Special Project Procedures
- Section 01340 Shop Drawings
- Section 01730 Operating and Maintenance Data
- Section 01775 Magnetic Media Submittals

4.2.4 Performance Requirements

Refer to the following sub-section, 4.3, for specific requirements.

4.3 Specific Requirements

4.3.1 General Layout and Site Work

The location and layout of the facilities shall be in strict accordance with environmental requirements. Construction impacts associated with new facilities adjacent to nearby resource areas and private properties shall be avoided.

Company shall limit their field operations at the project site to remain within the County's property and construction limits. Work required outside these limits is the responsibility of the Company, but requires owner's approval prior to beginning work in these areas.

Design/ Builder shall adhere to all access and easement conditions where construction may extend outside the County's property. The Company shall coordinate with the County to obtain necessary easements prior to construction.

The County will provide electronic copies of available environmental reference information to the Company upon written request.

The Company is responsible for verifying the adequacy and accuracy of the environmental referenced information and performing any additional site investigations or analyses necessary for design and construction of the project.

The Company shall be responsible to confirm that site locations and dredge sediments do not contain hazardous materials through proper studies and testing. These activities shall occur prior to starting excavation and then continue periodically during excavation.

The Company shall conduct any additional environmental investigations of the project site as necessary for design and construction, including sampling analyses for hazardous materials and identification and selection of appropriate disposal methods for dredged sediments and excavated material.

The Company is responsible for removal and disposal of all excavated and dredge material in a lawful manner.

If hazardous soils or hazardous dredged materials are encountered, Company shall notify the County immediately.

All facilities shall be located and laid-out within the boundaries established for the site in the site survey drawing.

The County shall provide electronic copies of available surveys and reference information to the Company upon written request.

The Company is responsible for verifying the adequacy and accuracy of the surveys and reference information provided, and shall perform any additional survey of the project site as necessary to complete the project.

The Company shall employ a Professional Surveying and Mapping firm, licensed in the State of Florida, to provide any additional surveying and mapping services for the project. All surveying and legal descriptions produced shall be certified by a surveyor licensed in the State of Florida.

The Company shall provide a survey that includes a map showing the regional location of the site with Tax Assessor's Parcel Number as well as township, range, section, basis of bearing, basis of coordinates, and other existing survey control features as well as existing and proposed easements as part of the design.

Each permanent structure shall be provided with a survey brass marker at finish grade or finished floor elevation. Benchmarks shall be stamped with elevation in feet, referenced to the North American Vertical Datum of 1988 (NAVD88). The benchmarks shall also be stamped with both latitude/longitude and Northing/Easting, references to the North American Datum of 1983 (NAD83). Elevations on the figures are shown in National Geodetic Vertical Datum of 1929 (NGVD 1929) and shall be converted to NAVD88.

Site layout shall conform to applicable Fire Protection requirements.

4.3.2 Selective Demolition

All demolished pumps, equipment, and associated components shall be provided to the County in an undamaged condition.

4.3.3 Grading

The Company shall provide excavation, filling and backfilling in connection with producing the final grade lines. If necessary to complete the work, the Company may obtain fill material and topsoil from offsite areas as required. This material must meet all applicable standards for its respective use. Excavation, fill, backfilling, compaction, dewatering, temporary and permanent sheetpile, sub-grade preparation and stabilization shall comply with the latest edition of applicable ASTM standards, FDOT SSHBC, Miami Dade Public Works Standards, or MDWASD Design and Construction Specifications criteria as applicable.

Grading shall provide positive drainage off walkways and other pavements, away from structures, concrete slabs on grade, tanks, and other critical areas where the accumulation of stormwater is not desirable. Transitions between grades shall be smooth.

4.3.4 Stormwater Management

4.3.4.1 Earthwork

Prior to initiating any clearing operations involving the removal of existing mature vegetation, the Company shall set construction limit staking or fencing to define the work boundaries. The Company shall then identify a well-defined boundary of existing mature vegetation located immediately beyond the work limits and shall positively delineate that boundary by tying ribbons to trees, setting wooden lathes appropriately painted and annotated, or any other appropriate means of positively identifying the boundary. The Company shall maintain all boundary markers.

The Company shall perform all work necessary to develop temporary and permanent erosion and sedimentation control, dewatering, stormwater control, vegetation clearing and grubbing, horizontal and vertical survey control, stripping, stockpiling, and screening of topsoil and cut material, and all earthwork including rock removal and backfill.

Prior to initiating any demolition or construction activities, all required erosion and sediment controls shall be installed to prevent the discharge of turbid water from the site.

Prior to initiating any dewatering activities or applying for a dewatering permit a dewatering plan shall be submitted to the County for approval. The dewatering plan shall be developed by a professional engineer, licensed in the State of Florida, with a minimum of five years of experience developing such plans.

The Company shall strip the work site of topsoil to adequate depths as determined by the Company. Topsoil is defined as having an organic content greater than 5%, as determined by ASTM D2974, and shall be free from all deleterious material, clods, and stones greater than four inches; or material that otherwise does not meet applicable specifications.

4.3.4.2 Stormwater Control

The Company is required, as a minimum, to adhere to the SFWMD/DERM SWPPP regulations and standards for stormwater compliance during construction and for the completed facilities. The Company shall comply with the current stormwater regulations by filing or obtaining the pertinent regulatory submittals/permits required for the completion of the Project.

The site is currently regulated by an Environmental Permit, ERP No. 13-02763-P.

Stormwater runoff shall be collected and retained in a stormwater retention basin(s). The stormwater retention basin(s) shall be designed to retain a portion of the 100-year 72-hour design rainfall event. At a minimum, the stormwater management system shall be capable of retaining the 10-year 24-hour rain event on site.

If onsite retention is proposed, site hydraulic conductivity shall be tested to demonstrate that it is sufficient to allow for appropriate treatment and recovery.

The existing on site pond can be utilized for stormwater retention.

No direct discharge to the C-1 Canal shall be permitted at any time. All storm water must be retained on site up to and including the 10-year event.

The stormwater collection system and site design shall be designed and certified by a licensed Florida Professional Engineer and design documents shall be submitted to the appropriate environmental review authorities for review and approval prior to start of construction. Throughout the construction period, comply with permit conditions issued by permitting authorities.

The Company shall install storm drains and the stormwater collection system in accordance with the requirements set forth herein, as applicable. Provide finished grading to convey drainage away from buildings, structures, concrete slabs on grade, tanks, and other critical areas where the accumulation of stormwater is not desirable. The following will be shown on the site design plans:

- Critical spot elevations of buildings, structures, pavements, curbs, etc.
- Proposed grading contours at 1-ft intervals.
- Locations where proposed grades meet existing grades.
- Major slopes will not be designed steeper than 3(H): 1(V).
- Major slopes shall be permanently stabilized with 100% cover of sod or naturalized seed mix ground cover vegetation on top of a minimum 6-in layer of topsoil in accordance with permitting conditions. All slopes 3(H):1(V) or steeper shall be stabilized with staked sod.

Site design and construction practices shall use recommendations and Best Management Practices and shall conform to local environmental review authority orders of conditions.

Pipe trenches and containment areas are anticipated to be below the stated FFE. The Company shall determine the elevations for these areas.

The Company shall verify all building elevations based on their design, the prevailing building code, drainage permit requirements, flood protection requirements, and all applicable standards.

4.3.5 Roadways and Sidewalks

Site plans showing preliminary layout of site roads, sidewalks, and parking at the different Project Facilities shall be prepared.

Site roads, sidewalks, parking areas, and other site structures shall be designed in accordance with all applicable codes and standards.

Final site design of the new WTP will generally provide potential for two-way vehicular circulation around the new facility via a 24-ft wide, paved access drive around. The new roads will provide the geometry required to accommodate AASHTO standard 55-ft long, WB-50 design vehicles.

All garage door entrances shall have a minimum 6-ft wide reinforced concrete pavement approach apron adjacent to the floor slab outside the door. Each apron shall be 1-ft greater than the width of the door, and will be sloped to direct drainage away from the structure. Each corner of garage entrances, and each corner of concrete pad mounted above grade utilities, shall be protected by 3'-6" high, 6-in OD steel bollards, painted black with reflective sheeting all around the top.

All pedestrian doorway entrances and exits shall have a concrete pad at the base of the doors, shall consist of a minimum 6-in layer of reinforced concrete pavement on top of an 8-in layer of processed gravel sub-base on top of compacted subgrade. Each pad will be dimensioned 6-in larger than the open door swing.

Concrete pads and aprons shall be structurally tied to foundation walls to ensure that potential heaving of pavement does not interfere with door swing.

Guardrail will be installed where access road side slopes are higher than 3-ft going down, and where slopes are 3(H):1(V) or steeper. Where applicable, guardrail will conform to SSHBC highway guard and be furnished with terminal sections with reflectors. Rails of guardrail shall be 12-in wide Corten steel beam, and support posts will be ground contact pressure treated 6" x 8" wood posts with 6" x 6" ground contact pressure treated wood offset blocks.

At the WTP building entry, provide accessibility for US mail, parcel post or equal deliveries, fire department, and emergency vehicle access, and small tour groups (no bus parking shall be required).

Paved roads shall be installed at the WTP. Access drives, loading/unloading areas, parking areas, and driveway apron pavements at garage door entries shall be designed to handle HS-20 vehicle loading and shall have a minimum life span of 20 years, with materials and installation in accordance with SSHBC and FDOT Standards.

Site roads shall be self-draining. Ponding shall not be allowed. Desired Level of Service 10-yr 24-hr as per ERP typical requirements.

Positive drainage shall be provided to the roads and drainage structures at a minimum grade of 1 percent.

Primary access roads and parking spaces shall be constructed of asphalt concrete per the FDOT-SSHBC with a 2.25-in thick asphalt base course and a 1.25-in thick asphalt surface course on 12-in compacted granular base, suitable for HS-20 vehicle loading.

Stone shoulders along access roads shall be constructed of crushed stone with an 8-in thick compacted aggregate.

Where indicated, a concrete roadway or parking surface shall be provided. The concrete section shall be constructed per the FDOT SSHBC with a 6-in thick slab and #4 rebar at 12-in spacing in each direction. Expansion joints with slip dowels shall be provided at 40-ft (maximum) intervals.

Secondary access roads for one-way usage shall have a total width of 16-ft (minimum).

Primary access roads for two-way usage shall have two 12-ft wide lanes (24-ft combined width), not including shoulders.

Primary access roads shall have a center crown and side slopes for positive drainage.

Secondary access roads without curb and gutters shall have a center crown. The shoulders shall be sloped away from the road. Shoulder construction shall match finished grade of the associated roadway.

Curb shall be Type D per the FDOT SSHBC. As an alternative to curbs, run-off can be routed through grassed areas for nutrient/sediment removal before reaching French drains.

Pavement markings for parking spaces and access aisles shall be epoxy resin reflectorized pavement type 4-in wide SSHBC reflective painted lines, white for parking spaces and access aisles, and yellow for 'no parking' areas. Handicap pavement symbols shall be waterborne pavement markings per SSHBC standards.

Parking areas shall be indicated for the sites.

Van accessible handicap parking spaces shall be provided in each parking lot and in accordance with prevailing building code, the ADA, and UFAS.

Sidewalk shall be graded to direct runoff away from buildings and prevent ponding.

Sidewalks shall be provided between structure/building entrances and vehicular parking areas and an accessible route shall be provided between handicap parking spaces and accessible entrances of buildings.

Sidewalks shall comply with prevailing building code, the ADA, and UFAS and shall have the minimal slopes where possible except to promote positive drainage.

Sidewalks can be non-reinforced pervious concrete or cast in place concrete, and shall have a minimum width of 4-ft, minimum thickness of 6 inches, expansion joints no more than 30-ft, and control joints no more than 5-ft., and maximum cross-slopes of 0.25-in per foot.

Sidewalks made of non-reinforced pervious concrete shall be on top of a minimum required thickness of open graded drainage stone. Sidewalks made of cast in place concrete shall be on top of subgrade.

Sidewalks that abut parking areas shall have a minimum width of 6-ft.

Sidewalks shall have a maximum side to side gradient of 2 percent and longitudinal gradient of 5 percent. Site stairways shall be used in-lieu of sidewalks for gradients steeper than 5 percent, if not an accessible route.

Access roads shall be looped to allow usage of a common in/out gate.

Where indicated for site security, as outlined in other sections of this document, main site access shall have a motorized gate with access card entry stations, remote control, and closed-circuit television monitoring. The gate shall open the full width of the associated access roadway with bollard or curb protection of gate posts provided. A mountable curb (refer to FDOT Type E or Type F design standards) shall be used at the primary entrance to comply with the Miami-Dade Fire Rescue (MDFR) Standards.

Chain link fences and gates, if applicable, shall be in conformance with SSHBC and CLMI standards.

Strategically located standard signs such as handicap parking, way finding for visitor parking, deliveries, 'Authorized Vehicles Only', 'One-Way', and 'No Parking-Fire Lane' signs will be considered where appropriate. Metal signs will be reflective. Signage shall be in accordance with MDC DPW standards and the FDOT SSHBC.

A concrete pad for a commercial size solid waste dumpster will be required. The dumpster location must be accessible by a commercial hauling truck, and will conform to screening/fencing zoning regulations. Bollards shall be installed to protect the screening enclosure.

Installation and finishing of above materials and other site appurtenances shall be in accordance with SSHBC and prevailing building code.

A freestanding 35-ft high fiberglass flagpole shall be installed within the site in close proximity to the main entrance to the new WTP building.

4.3.6 Geotechnical Investigations

The County will provide electronic copies of available geotechnical and subsurface exploration documents and reference information to the Company upon written request.

The Company is responsible for verifying the adequacy and accuracy of the referenced information.

The Company shall conduct any additional geotechnical and subsurface investigation of the project site necessary for design and construction of the project, including subsurface utility location, excavation requirements, dewatering requirements, and foundation requirements.

The Company shall employ a qualified firm to perform all geotechnical and subsurface investigations, which shall employ a professional geotechnical engineer, licensed in the State of Florida, to plan, oversee, and evaluate the results of all geotechnical and subsurface investigations and testing as part of the design of the project, including foundations, superstructures, and dewatering systems.

The Company's geotechnical engineer shall provide recommendations for excavation, dewatering and related construction activities that also consider minimizing erosion and impacts on existing canals, roads, structures and utilities.

4.3.7 Sanitary Pump Station and Sewer

The sanitary pump station shall be designed to meet the Miami-Dade Water and Sewer Department standards.

There is an existing sanitary sewer pump station on site (PS 951). If the Company chooses to utilize the existing pump station, the Company shall evaluate the available capacity as prescribed by RER-DERM to verify that the existing pump is capable of effectively servicing proposed build out conditions.

If a new pump station is required, the new pump station shall meet the MDWASD Standards for a submersible pump station, as well as, comply with the permit requirements of RER-DERM.

Connection pressures will be determined by MDWASD utilizing the pump station force main hydraulic computer model based on the estimated flow determined by the Company.

4.3.7.1 Site Piping

All piping in contact with raw, partially treated, and Finished Water shall be of materials that are NSF-61 approved.

Unless otherwise indicated, site piping for partially-treated water and Finished Water of 12-in diameter and larger shall be ductile iron, with mortar lining.

Approved backflow preventers shall be installed on all connections to Finished Water and potable/fire water pipelines.

Pipe bedding and backfill shall be in accordance with the MDWASD Design and Construction Requirements.

Sanitary sewer, potable water, and force main piping shall be buried with a minimum of 4-ft cover over the top of the pipe as per MDWASD standards.

Storm drain piping shall be buried with a minimum of 2-ft cover requirement over the top of the pipe.

Piping below structures and/or slabs shall be concrete encased, and shall include transverse and longitudinal steel reinforcement.

Drain lines shall include accessible cleanouts at bends.

Gravity pipes shall have a minimum slope of ¼" per foot.

Where water mains parallel or cross a line of potential contamination, the Ten State Standards requirements will establish the required separation both horizontally and vertically.

Pipelines shall be restrained by mechanical restraints.

The locations of existing pipes and utilities are approximate. The Company shall field verify the locations of existing pipes prior to starting construction.

Stormwater drainage structures shall be reinforced concrete, conforming to applicable sections of MDC MDWASD, MDC DPW, SSHBC and FDOT standards. Other storm drainage appurtenances shall conform to SSHBC and FDOT standards.

Stormwater drainage pipe, both solid and perforated, shall conform to applicable sections of the FDOT SSHBC.

Castings for manhole frames and covers and catch basin frames and grates shall conform to local Public Works Standards and Specifications.

Piping shall be protected with protective coatings for corrosion protection that provide the minimum life of 25 years.

Any piping or equipment exposed to sunlight shall be coated with protective coating suitable for UV exposure with a minimum expected coating life of 10 years before recoating.

Some piping systems that do not require protective coating include thermoplastic, polyethylene, and stainless steel.

Determine the stormwater chemical concentrations as needed to support corrosion control design.

Concrete –Type II or Type V cement shall be used where soil, groundwater or liquid exposure conditions are considered corrosive to concrete.

Stormwater collection and conveyance piping shall consist of Reinforced Concrete Piping. Corrugated Metal Piping, High Density Polyethylene (HDPE), or PVC piping shall not be utilized.

For non-metallic pressure pipe, a tracer wire and locator ribbon shall be installed over pipe.

4.3.7.2 Off-Site Piping

The Off-Site Piping includes the UFA and BA transmission Mains.

Piping shall be protected with protective coatings for corrosion that provide protection for the minimum life of 25 years.

Some piping systems that do not require protective coating include thermoplastic, polyethylene, and stainless steel.

Concrete –Type II or Type V cement shall be used where soil, groundwater or liquid exposure conditions are considered corrosive to concrete.

4.3.7.3 Fire Hydrants

Fire hydrants shall be included throughout the WTP site in accordance with all applicable codes and regulations.

Final design for access drives, vehicle circulation, structure placement, hydrant placement, distribution system design, and specifications shall be reviewed by, and meet the approval of, the Miami-Dade County Fire Rescue department authorities and insurance underwriters, as applicable.

4.3.8 Utilities

The Company shall refer to Section 11 - Electrical Requirements for any electrical site requirements.

The Company shall coordinate with Florida City Gas for natural gas service extension and provide a system for using natural gas at this site for heating and hot water services.

The Company shall be responsible for coordinating and providing all temporary and permanent utilities for the work and different facilities, as required to operate the WTP, pumps, and transmission facilities.

No interruption of service is allowed without prior approval from the County.

The Company shall have the full responsibility for verifying the presence and location of all subsurface structures and utilities at the project site, which includes but is not limited to water piping, electrical power, natural gas piping, communication, and other structures and utilities.

The Company shall coordinate location of utilities prior to excavation, which includes Sunshine State One Call, at a minimum.

The Company shall utilize the services of a qualified firm that specializes in Subsurface Utility Engineering (SUE) to field verify vertical and horizontal locations of all utilities prior to excavation, utilizing soft excavation methods that provide vertical and horizontal location of utilities that meet Quality Level A information in accordance with the ASCE Standard 38-02 Standard Guideline for the Collection and Depiction of Existing and Subsurface Utility Data.

Volume III.A - Section 5

Architectural

5.1 Description of Work

The architectural proposed solution of buildings included as part of the Technical Requirements shall be used in compliance with applicable codes and standards for the various components of the SMH WTP. The Architectural Design requirements will also take into account the functional space planning requirements of all buildings for the new SMH WTP and accommodate all of the program requirements including but not limited to: personnel functions, to enclose and protect the Project operating equipment, to store and maintain supplies and equipment, and to generally provide all aspects of the water supply, transmission and treatment processes. The design selection and specification shall include the required architectural materials and components to functionally and aesthetically complete the different buildings of the Project.

This section includes the Architectural Design requirements under the following subsections herein: Codes and Standards, Design Submittals, Construction Submittals and pertinent Performance Standards shall be enforced accordingly as stated herein.

5.2 Basic Requirements

5.2.1 Codes and Standards

The Architectural Design shall comply with all applicable latest editions of Federal, State and Local Codes and Standards, including all amendments thereto including, but not necessarily limited to, the following:

- FBC 2010 Florida Building Code
  - As Amended and Supplemented
  - The 5^{th} Edition (2014) FBC may be in effect at the time that the Company submits drawings to the Building Department. In that case the Company will have to comply with the current FBC being enforced.
- ADAAG American with Disabilities Act Accessibility Guidelines
- FAC 2012 Florida Accessibility Code for Building Construction
- UFAS Uniform Federal Accessibility Standards
- ANSI American National Standards Institute
- NEC National Electric Code
- NFPA National Fire Protection Association
- OSHA Occupational Safety and Health Act
  - U.S. Green Building Council (USGBC).
  - Florida Green Building Coalition [based on the International Green Construction Code (IGCC)].
  - Fire protection/prevention and other life/property safety codes and standards imposed by state and local fire marshals and other authorities having jurisdiction.

- The Company shall be responsible for adherence to all other codes, ordinances and standards imposed by local authorities having jurisdiction and shall design the buildings to comply with such codes, ordinances and standards.

Where reference is made to one of the above standards, the revision in effect at the time of the Service Contract shall prevail.

5.2.2 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor as required under project specifications.

All design submittals shall be signed and sealed by a Professional Architect Registered in the State of Florida.

In addition, Company shall submit, at a minimum, the following:

- Site plan showing all buildings and landscape layout.
- Building Plans depicting all floor and roof levels.
- Building Elevations, Sections and Details necessary to convey the Proposer's architectural design, indicating all required materials and building systems.
- Other pertinent details as applicable.
- The Company shall be responsible for verifying any special zoning and or concurrency requirements including public and zoning presentations as part of the Design Submittal.

5.2.3 Construction Submittals

The Company shall submit construction information on the products and materials related to the work in this section to the County Technical Advisor. In addition, information shall be furnished to the County Technical Advisor on the following items:

- Shop fabricated drawings prepared in accordance with current design criteria including notice of product acceptance (NOA) documentation.

5.2.4 Performance Standards

The Company shall comply with current ASTM and required testing for any materials being used on this project. All products shall have current Miami-Dade County NOA or approved FL number. The Company shall provide required signed warranties from the manufacturers and installers during construction for each product as part of the submittals.

5.3 Specific Requirements

5.3.1 Buildings and Structures

The South Miami Heights Water Treatment Plant Program consists of Membrane Treatment Process Building, Pre-Treatment Chemical Building, Post-Treatment Chemical Building, Clearwell and Degasifier Building, Switchgear Building, Administration Building, and a Guard House Building. A covered parking area shall be provided for a minimum of eight (8) spaces adjacent to the Administration Building. The project shall obtain a USGBC LEED Silver certification. Refer to requirements presented in section 2.3.3.1 and the guidance information presented in Volume III.B Appendix N for possible approach for achieving a USGBC LEED Silver certification.

Section 5.3.1.2 Florida Building Code Tables are the County's Technical Advisors interpretation of applicable codes as it relates to Occupancy Classifications, Building Types, Allowable Heights and Areas, Fire Resistance Rating Requirements, and Fire Separation of Occupancies. It is ultimately the

Company's responsibility to abide by the applicable FBC and obtain a building permit from Miami-Dade County.

5.3.1.1 Architecture, Aesthetics and Appearance

Membrane Treatment Building

The membrane treatment building is a one story building intended for industrial use. Occupancy classification falls under F3, H4 (Factory Industrial & High Hazard). The building is composed of two general areas. The first space is a process area which will have a high structure in order to provide clearance for equipment and crane with traveling bridge and hoist. The second area will house workshops, storage rooms, and instrumentation labs. Refer to **Table 5-1** for space requirements (Building Space Allocations). Building Frame Structure consists of cast-in-place concrete columns and beams and concrete precast panels. A concrete pre-cast roof shall be used (sloped at ¼" per foot). A minimum of 15% of the exterior walls in the process area shall be either glass storefront or glass block. Office spaces shall have 150 square feet of glass. Refer to section 5.3.1.2 for general requirements for all buildings. The Membrane Treatment Building shall be more than 60'-0" away from the Pre-Treatment Chemical Building. The Membrane Treatment Building shall be a maximum of thirty feet 30'-0" from the Administration Building. An enclosed air conditioned connector shall be provided between the Membrane Treatment Building and the Administration Building.

Pre-Treatment Chemical Building

The Pre-Treatment Building is a one-story building intended for industrial use. Occupancy classification is High Hazard (H3) and Storage (S2). The Building is composed of two general areas including the Sulfuric Acid and Anti-Scalant Bulk Storage and the Metering/Compressor and Day Tank areas separated by a two (2) hour fire rated enclosure. Building Frame Structure consists of cast-in-place concrete columns and beams and concrete precast panels. A cast –in-place concrete flat roof shall be used. Refer to **Table 5-2** for space requirements. The Pre-Treatment Chemical Building shall be more than 60'-0" away from the Membrane Treatment Building.

Post-Treatment Chemical Building

The Post-Treatment Chemical Building is a one story building intended for industrial use. Occupancy classification is High Hazard (H4) and Storage (S2). The Building is composed of five (5) areas including a Sodium Hydroxide Storage Room with a sample room and a day tank adjacent rooms, an Aqueous Ammonia Storage room with a day tank; corrosion inhibitor storage rooms; Hydrofluosilic Acid Storage Room and a Sodium Hypochlorite Storage room. All five (5) major spaces shall be separated by a two (2) hour fire rated enclosure. Building Frame Structure consists of cast-in-place concrete columns and beams and removable pre-cast panels for tank replacement. A pre-cast concrete roof shall be used (sloped at ¼" per foot). Refer to **Table 5-3** for space requirements. The Post-Treatment Chemical Building shall be no more than 40'-0" away from the Degasifier Building Contact Basin and Transfer Pump Station. The Post-Treatment Chemical Building shall also be more than 120'-0" away from the Membrane Treatment Building.

Clearwell and Degasifier Building

The Clearwell and Degasifier Building is a one and a half story building intended for industrial use. Occupancy classification is High Hazard (H4) and Storage (S2). The building is composed of two (2) major areas including a Clearwell at the lower level and a Degasifier area immediately above, separated by a concrete slab in between. Building Frame Structure consists of cast-in-place concrete columns and beams with a decorative screen block wall. There is no roof structure (open to above).

Table 5-1 Building Space Requirements – Membrane Treatment Building

No	Room Name	SF
1	UPS	35
2	Office Next To UPS	119
3	Storage	106
4	Cable Room 1	44
5	Cable Room 2	44
6	Cable Room 3	55
7	Lobby	205
8	Samples, Storage And Prep.	376
9	Gas Cyl	94
10	Lab H2O	33
11	Women Bathroom	526
12	Men Bathroom	535
13	Janitor Room	47
14	Mech Tools	73
15	Elect Tools	73
16	Maintenance Workshop	767
17	Corridor D	211
18	Mdf Room	288
19	Mech Room 1	261
20	Corridor C	405
21	Instrument Lab 1	564
22	Instrument Lab 2	372
23	Standard/Prep Storage	287
24	Elect. Trans. Room	1,507
25	MCC Room	778
26	Operator'S Lab	347
27	Operator'S Control Room	592
28	Corridor B	680
29	Elect Vfd Room	1,088
30	Mdf Room	312
31	SCADA Room	402
32	Corridor A	300
33	General Storage	217
34	Elect. Storage	115
35	Corridor E	83
36	Corridor F	356
37	Instrument Storage	109
38	Instrument Workshop	158
39	Process Bay	19,470
40	Support Areas (Walls & partitions)	1,050
	Total	**33,084**

Table 5-2 Building Space Requirements – Pre-Treatment Chemical Building

No	Room Name	SF
1	Outside Tanks	1,620
2	Anti Scalant Day Tank	145
3	Sulfuric Acid Day Tank	179
4	Compressor Room	86
	Total	**2,030**

Table 5-3 Building Space Requirements – Post-Treatment Chemical Building

No	Room Name	SF
1	Sample Room	148
2	Day Tank Area	154
3	Sodium Hydroxide Storage	1,040
4	Day Tank Area	100
5	Aqueous Ammonia Storage	553
6	Corrosion Inhibitor Storage	524
7	Day Tank Area	90
8	Hydrofluorosilicic Acid Storage	527
9	Day Tank Area	90
10	Sodium Hypochlorite Storage	1,828
11	Day Tank Area	167
12	Electrical Room	164
	Total	**5,385**

Refer to **Table 5-4** for space requirements. The Degasifier Contact Basin and Transfer Pump Station shall be more than 40'-0" away from the Post-Treatment Chemical Building.

Switchgear Building

The Switchgear Building is separated into four (4) areas including the Switchgear Room, a substation room and two (2) transformer rooms. Occupancy classification is Storage (S2). All four (4) major areas shall have a minimum of two (2) hour fire separation. Building Frame Structure consists of cast-in-place concrete columns and beams and concrete pre-cast panels. A cast-in-place concrete roof (sloped at ¼" per foot) shall be used for the switchgear building. Refer to **Table 5-5** for space requirements. The Switchgear Building shall be in close proximity to the Generators Building. Both the Switchgear and the Generator Buildings shall be placed on the northwest section of the site.

Administration Building

The Administration Building is a one story building intended for office work only. Occupancy classification is Business (B) and no fire rating is required between spaces within this building except for the mechanical room. The Administration Building is composed of a large reception / waiting area with one (1) conference room and one (1) training room, two (2) offices and support spaces. A covered porch entry shall be located on the east side of the reception area. A minimum of 40% of the exterior walls shall be glass storefront with brise-soleil forming an architectural solar screen. An enclosed air conditioned connector shall be placed on the west side of the reception area that connects

Table 5-4 Building Space Requirements – Clearwell and Degasifier Building

No	Room Name	SF
1	Degasifier	5,122
2	Clearwell	5,122
	Total	**10,244**

Table 5-5 Building Space Requirements – Switchgear Room Building

No	Room Name	SF
1	Primary Transformer Area 1	935
2	Primary Transformer Area 2	935
3	LV Electrical Room No. 1	664
4	Secondary Unit Substation Room	664
5	Switchgear Room	2,278
	Total	**5,476**

to the Membrane Treatment and Laboratory Building. Building Frame Structure consists of cast-in-place concrete columns and beams and concrete pre-cast panels. A cast-in-place concrete roof with a minimum roof slope of 1:12 shall be used for the Administration Building. Refer to **Table 5-6** for space requirements. The Administration Building shall be a minimum of 400'-0" from the property line on the Northeast of site along SW 117th Avenue.

Guard House Building

The Guard House Building is a one story building with an occupancy classification of Business (B) and no special fire rating requirements within the structure. The Guard House Building is composed of two (2) spaces including an ADA compliant toilet room and a clerical area. Building Frame Structure consists of cast-in-place concrete columns and beams and concrete pre-cast panels. A cast-in-place concrete flat roof shall be used for the Guard House Building. Refer to **Table 5-7** for space requirements. The Guard House shall be placed on the Northeast corner of the site perpendicular to SW 117th Avenue. Provide a minimum of four (4) cars stacking area from the Guard House to the property line on the NE corner of the site.

Covered Parking Structure

A covered parking structure shall be provided on the north side of the Administration Building. The building frame structure shall be concrete columns and beams on concrete foundation. The roof shall be cast in place concrete. The structure shall be sufficient to cover a minimum of eight (8) parking spaces.

Table 5-6 Building Space Requirements – Administrative Building

No	Room Name	SF
1	Covered Porch	205
2	Reception	200
3	Waiting Area	550
4	Office	210
5	Conference Room	254
6	Security	200
7	Storage (Non-Air Conditioned Space)	70
8	Bathroom Unisex	75
9	Kitchenette	212
10	Training/Lunch Room	320
11	Mech Room (Non-Air Conditioned Space)& Support	486
12	Corridor	62
	Total	**2,844**

Table 5-7 Building Space Requirements – Guardhouse Building

No	Room Name	SF
1	Security Work Station	160
2	ADA Bathroom	77
	Total	**237**

Grand Total	**58,641**

The following Florida Building Code Tables are the County's Technical Advisors interpretation of applicable codes as it relates to Occupancy Classifications, Building Types, Allowable Heights and Areas, Fire Resistance Rating Requirements, and Fire Separation of Occupancies. These are presented in **Tables 5-8** through **5-12**.

Florida Building Code Tables

Table 5-8 FBC Occupancy Classification

Facility	FBC 2010	F.F.P.C	Life Safety Code
Membrane Treatment Bldg	Group F2, F3 and Group B Incidental	Industrial and Special Purpose	
Pre-Treatment Chemical Bldg	Group H3 and S2	H3	H3
Post-Treatment Chemical Bldg	Group H4 and S2	H4	H4
Degasifier Structure	Group H4 and S2	H4	H4
Electrical Switchgear Bldg	Group S2	Group F	Group F
Guard House	Group B	Group B	Group B
Administration Bldg	Group B	Group B	Group B

Table 5-9 FBC Allowable Heights and Areas

Facility	FBC 2010	Construction Type*	Area Allowed	Area Provided	Height Allowed	Height Provided*
Membrane Treatment Bldg	Group F2, F3 and Group B	Type IB	UL	35,312 SF	11 Stories	34 feet
Pre-Treatment Chemical Bldg	Group H3 and S2	Type IB	60,000 SF	2,830 SF	6 Stories	15 feet
Post-Treatment Chemical Bldg	Group H4 and S2	Type IB	UL	5,385SF	7 Stories	24 feet
Degasifier Structure	Group H4 and S2	Type IB	79,000 SF	10,244 SF	11 Stories	24 feet
Electrical Switchgear Bldg	Group S2	Type IB	79,000 SF	4,817 SF	11 Stories	18 feet
Guard House	Group B	Type IB	UL	344 SF	11 Stories	13 feet
Administration Bldg	Group B	Type IB	UL	2,474 SF	11 Stories	21 feet

Note: There are additional MDC zoning height restrictions
* Types I and II construction are the only types of construction allowed. Note that this project was permitted by Miami Dade County Building Department with the construction Type IB.

Table 5-10 Fire-Resistance Rating Requirements for Building Elements (Hours)

Facility	FBC 2010	Sprinklered/ Non-Sprinlered	Interior Bearing Walls	Structure Frame*	Exterior Bearing Walls*
Membrane Treatment Bldg	Group F2,F3 , B	Sprinklered	3-1 = 2	2	3
Pre-Treatment Chemical Bldg	Group H3 and S2	Sprinklered	3-1 = 2	2	3
Post-Treatment Chemical Bldg	Group H4 and S2	Sprinklered	3-1 = 2	2	3
Degasifier Structure	Group H4 and S2	Sprinklered	3-1 = 2	2	3
Electrical Switchgear Bldg	Group S2		3-1 = 2	2	3
Guard House	Group B		3-1 = 2	2	3
Administration Bldg	Group B	Sprinklered	3-1 = 2	2	3

* Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting one floor or one roof only.

Table 5-11 Fire-Resistance Rating Requirements for Exterior Walls based on Fire Separation Distance

Facility	Distance	Construction Type	Group Ratings Required	Group Ratings Provided
Membrane Treatment Bldg	> 30 feet	Type IB,F2,F3,B	0	3
Pre-Treatment Chemical Bldg	> 30 feet	Type IB, H3	0	3
Post-Treatment Chemical Bldg (North Wall)	> 10 ft. < 20 ft.	Type IB, H4	2	3
Degasifier Structure (South Wall)	> 10 ft. < 20 ft.	Type IB, S2	2	3
Electrical Switchgear Bldg	> 30 feet	Type IB, S2	0	3
Guard House	> 30 feet	Type IB, B	0	3
Administration Bldg	> 5 ft. <10 ft.	Type IB, B	2	3

Note: Comply with Table 705.8 max area of exterior wall openings based on fire separation distance.

Table 5-12 Required Separation of Occupancies (Hours)

Occupancy	Business	Industrial Special Purpose	Storage Low/ Ordinary Hazard
Business	----	2	2
Industrial Special Purpose	2	---	1
Storage Low/Ordinary Hazard	2	1	1

5.3.1.2 General Requirements

The Company shall provide a description of the South Miami Heights WTP buildings and all spaces including process, pump rooms, chemical facilities, mechanical, electrical, administration, control, laboratory, lockers, toilet rooms, maintenance and support spaces. The description should include reference to the architecture and aesthetics provided as part of the design, including materials, furnishings, lighting, floor and wall coverings, ceiling finishes, doors, windows and all other appurtenances so that that the overall concept is adequately described.

The Company shall provide similar descriptions for all proposed buildings.

The Company shall describe the architectural approach of the building(s) and its relationship to the site as part of the proposal. The design approach shall take into consideration views to and from entrance way, adjacent properties, site features and landscaping, both natural and manmade, sustainable design, and future expansion of the plant. A site analysis shall be provided which clearly demonstrates the relationship of the proposed building architecture to existing and anticipated site characteristics.

Materials

Exterior and interior materials shall be durable, permanent, vandal resistant, easily maintained, and within the limits set by function, code requirements, and take into account life cycle cost analysis as part of the design solution.

Recommendations for materials:

- The building shall have a system of columns and beams referred throughout this document as “Building Structure”. Exterior Walls should be “Tilt-Up” or Precast Panels with Architectural finish. The roof shall be pre-cast concrete or cast in place concrete.

Building Design

The design solution for this project shall incorporate the following:

- Safety of the staff and visitors.
- Resistance to unauthorized intrusion.
- Life cycle cost effectiveness.
- Accessibility according to Florida Accessibility Code 2012 Edition, program requirements, ADA, and other applicable codes. (latest edition)
- Ease of pedestrian and vehicular circulation within and around buildings.
- Refer to **Table 5-13 (Buildings General Requirements)** for number of means of egress, construction type, fire rating, etc. The Company is responsible for code compliance; therefore, he/she shall review the life safety plan, confirm the code requirements and make any required adjustments to avoid any non-compliance issues. The Company shall comply with the Florida Fire Prevention Code 2012 Edition.
- The Company shall implement sustainable and energy efficient measures in their design providing “green building materials” under the LEED version applicable at the time of bidding. The goal is to achieve USGBC LEED silver certification.

Special Building Features

- The main entry lobby shall be One Story high with a special type of finish such as plaster. Exposed structure shall not be allowed inside lobby or office areas.

Table 5-13 Buildings General Requirements

Name of Building	Type of Building	Building Frame	Roof	Occupancy Classification	Stories	Floor	Clear Height Below Structure	Approximate Building Height	Plumbing Fixtures	Life Safety	Fire Sprinklers
Membrane Treatment & Labs	Industrial	Cast in place conc., Columns & Beams, Concrete Precast Panels	Concrete Pre-Cast System	F2, F3, H4 (Factory Industrial & High Hazard)	1	Concrete Slab	18'-0" & 29'-9" Process 15'-0" Labs & Supports	25'-3" & 33'-3" Process, 20'-0" Labs & Support	Women/Men 4 Fixtures Ea +1 Shower Ea (Ada)	6 Exits	Yes
Pre-Treatment	Industrial	Cast in place conc., Columns & Beams, Concrete Precast Panels	Cast in Place Conc. Slab (Flat)	H (High Hazard)	1	Concrete Slab	10'-0"	15'-0"	N/A	3 Exits/ Open	Yes
Post-Treatment	Industrial	Cast in place conc., Columns & Beams, Concrete Precast Panels	Concrete Pre-Cast Systems (Sloped ¼"/FT)	S-1 (Storage High Hazard)	1	Concrete Slab	18'-0"	25'-3"	N/A	14 Exits	Yes
Clearwell & Degasifier	Industrial	Cast in place conc., Columns & Beams, w/ decorative concrete screen block wall	No Roof	F-1 (Moderate Hazard)	2 (Basement & Upper Floor)	Concrete Slab	No Roof	Clearwell 12'-0", Degasifiers 24'-0"	N/A	Open	None
Switch Gear	Industrial	Cast in place conc., Columns & Beams, Concrete Precast Panels	Concrete Pre-Cast Systems (Sloped ¼"/FT)	F-1 (Moderate Hazard)	1	Concrete Slab	15'-0"	20'-0"	N/A	6 Exits	None
Admin Building	Business	Cast in place conc., Columns & Beams, Concrete Precast Panels	Concrete Pre-Cast Systems (Sloped 1"/FT)	B (Business)	1	Concrete Slab	Sloped, Varies From 11'-6" to 18'-2"	Sloped, Varies From 14'-1" to 20'-7"	1 Unisex Toilet (Ada)	2 Exits	Yes
Guard House	Business	Cast in place conc., Columns & Beams, Concrete Precast Panels	Cast in Place Conc. Slab (Flat)	B (Business)	1	Concrete Slab	9'-0"	13'-0"	1 Unisex Toilet (Ada)	1 Exit	None

- All main entrances shall be recessed. Other building entrances shall be provided with a metal canopy to protect these areas from wind driven rain.
- Metal louvers shall be placed throughout the building façade as needed for the building operation. Additional non-operable louvers shall be provided in order to organize building elements and for aesthetic purposes.
- Reveals shall be used as part of the building facade wherever possible in order to break up the monotony and organize the different building elements.
- Decorative screen units may be used at some of the process buildings.
- Glass Block may be used at the Membrane Treatment Building as a design element and to provide natural light into the building.
- Brise soleil shall be used in the Administration Building as an architectural feature to help deflect direct sunlight and total heat gain into the building.

Building Entrances

Emphasize the building entrances in accordance with its importance by providing a special architectural entrance feature. All Entrances shall be constructed of concrete, steel or a combination of both materials. Wood construction is not acceptable at any areas within the entire facility.

Building Circulations

- Non-air conditioned corridors shall be mechanically ventilated.
- All corridors shall be covered throughout the facility.
- Minimum width of interior corridors for administration area shall be 4'-0"
- Minimum width of interior corridors at process bay areas shall be 6'-0".

Natural Light and Ventilation

Glass blocks for natural light are allowed in areas without ventilation requirements. Glazing shall be designed and arranged in conjunction with the building design concept. Windows shall be grouped as much as possible for both cost effectiveness and aesthetic reasons.

Overhangs and Soffits

All exterior doorways shall be protected by an overhang or be recessed with an exterior soffit except at doors leading to service rooms, such as mechanical rooms. Such doors shall be protected with a rain guard the full with of the door and frame over the door. Exterior soffits, balconies, overhangs shall have continuous rain key or drip edge reveal to prevent horizontal traveling of rain into these areas.

Roofing Requirements

Roofing systems and components shall be watertight. Submit current Metro Dade County NOA. Provide a minimum slope roof solution at ¼ ft. and ½ ft. at any cricket areas. Metal roofs are not allowed, except as the entrance feature into the building. All roof areas shall slope to drain throughout the facility. Gutters and downspouts are permitted on the exterior of the building. The Company shall coordinate location of downspouts in order to avoid entrance doors and / or window locations. The primary roof system shall be connected to the storm drain system as required.

- Parapets: All roofs shall have 3'-6" minimum high parapets or as required for uplift conditions per FBC 2010.

Exterior Material and Finishes

- Provide accent material – and finishes. Recessed entries, overhangs, canopies, building masses, etc. shall be provided.
- The base material for the exterior wall shall be tilt-up construction or pre-cast panels with architectural finish. Acceptable accent materials include: glass block; architectural grade premium precast concrete; architectural grade stone veneer. Ceramic tile is not acceptable for an exterior finish on this project.
- Accent Materials shall be used to enhance volumes and building masses and not as bands or patterns. Do not concentrate the accent materials in one particular area or façade.

Exterior Building Colors

Provide at least three (3) colors at the building facades for review and approval by the County.

Interior Finishes

Refer to **Table 5-14** for acceptable equipment and material manufacturers.

Table 5-14 Preliminary List of Acceptable Equipment & Material Manufacturers

Equipment / Materials Description	Manufacturers
Expansion Control	Provide shop drawings
Cold Formed Metal Framing	Dietrich Metal Framing/Clark Framing/Unimast - USG
Exterior Insulation & Finish System (Eifs)	Dryvit Systems, Inc. / Parex, Inc. / Senergy Inc. -BASF
Air Vapor Barriers (Building Envelope)	3M Products / Carlisle / Grace Air Barrier
Roofing, Single-Ply Membrane, EPMD	Soprema Roofing & Waterproofing, Inc. / GAF Materials Corp & Firestone Products Co.
Roofing, Single-Ply Membrane, PVC	GAF Materials Corp. / Johns Manville / Firestone Products Co.
Roofing, Single-Ply Membrane, TPO Low slope min ¼” / ft.	Provide shop drawings (GAF Materials Corp. /Johns Manville / Fire Stone Products Co.)
Joint Sealants	Vulkem / Silaflex & Dynatrol II
Joint Systems, Fire Resistive & Fire Stopping	3M Fire Protection Products / Thermafiber LLC / Tremco
Roofing, Metal	Provide shop drawings. (ASC Building Products / Centria & Petersen Aluminum)
Doors & Frames, Steel	Provide shop drawings (Ingersoll Rand / Jeld-wen, Inc. / U.S. Door & Building Components).
Doors & Frames, Wood	Algoma Hardwoods, Inc. / Ideal Wood Products / Vancouver Door Co.
Doors And Frames, Aluminum, Flush Type	Provide shop drawings (Kawneer Series IR500 / Vistawall Arch. Products & United States Aluminum Series IG500).
Doors And Frames, Fiber Reinforced Plastic (FRP)	Provide shop drawings (Nanya Plastics/ Eurotech Industries, Inc.)
Doors, Service-Overhead Coiling & Sectional	Atlas Door Co. / Overhead Door Corp. / Cornell Iron Works
Storefront & Curtain Wall, Aluminum	Awneer / Vistawall Architectural Products & United States Aluminum
Windows, Aluminum	Arch Aluminium & Glass / RC Aluminium Industries & ES Windows LLC
Metal Louvers	Airolite Company / Greenheck / Ruskin Company
Glass Block Mortar System	Pittsburg Corning Corporation, NOA No.12-0406.06/ Mulia, Inc. NOA11-1020.02
Hardware, Locksets	Provide shop drawings (Schlage Lock Co. / Best Lock Co. & Marks Lock Co.)
Hardware, Hinges	Provide shop drawings (Stanley / Hager & Bommer)
Hardware, Exit Devices	Provide shop drawings (Precision Apex 2100 Series / Sargent 88 Series & Von Duprin 98 Series)
Hardware, Closers-Surface, Concealed	Provide shop drawings (LCN 4C40 EDA ,Stantley D-4550 EDA)
Hardware-Thresholds, Gasketing, Weatherstripping, Smoke Seals	Provide shop drawings (Pemko 290AV/National Guard 160A & Zero International 39A).
Paints And Sealants	Dupont Company / Bejamin Moore & Co. / Sherwin Williams
Epoxy	Dur-A-Glaze Novalak by Dur-A-Flex, Inc.
Drywall	American Gypsum Co. / United States Gypsum / Georgia Pacific
Acoustical Ceiling Tile	Armstrong World Industries, Inc. / Chicago Metallic Corp. / USG Interiors Inc.
Ceramic Tile	American Marazzi Tile, Inc. / Dal Tile / Monarch Tile, Inc.
Toilet Accessories	Bobrick Washroom Equipements, Inc./ American Specialties, Inc. & Bradley Corp.
Laboratory Cabinets	Kewaunee Scientific Corp. / Fisher Hamilton LLC & Cambell Rhea.
Laboratory Equipment	Kewaunee Scientific Corp. / Fisher Hamilton LLC & Air Systems Corp.

Walking Surfaces

Exterior and interior walking surfaces shall have textured or other non-slip finishes.

Exterior Doors

All exterior doors shall be provided with weather protection, roofs, soffits, and/or be recessed. Refer to Table 5-14 for recommended manufacturers.

Laboratories

Laboratory cabinets shall be provided in the following rooms:

- Instrument Lab 1, 65 lineal feet of base cabinets and 46 lf of upper cabinets.
- Instrument Lab 2, 38 lineal feet of base cabinets and 20 lf of upper cabinets with two (2) fume hoods with cabinets. One (1) epoxy sink.
- Standard Prep and Storage shall have 24 lineal feet of base cabinets and 24 lf of upper cabinets with two (2) fume hoods with cabinets. Two (2) epoxy sinks and one (1) ADA emergency eyewash / shower.
- Samples Storage and Prep shall have 27 lineal feet of base cabinets and 15 lf of upper cabinets with one (1) fume hood with cabinet. Two (2) epoxy sinks and one (1) ADA emergency eyewash /shower.
- Operators Lab shall have 35 lineal feet of base cabinets with 30 lf of upper cabinets. See table 6.3 for laboratory cabinet manufacturers.

Toilets Rooms

Provide separate toilet rooms for women and men according with the ADA, FBC 2010 with 2012 supplements and Accessibility Code 2012. Separate toilet rooms shall be provided for the administration area and laboratory area.

Storage Areas

Storage area shall be provided according to the program areas for Mechanical, Electrical, laboratories, workshops, administration, etc.

5.3.1.3 Visual Criteria

Visible portions of structures shall have architectural treatment to provide a thoughtful and cohesive appearance acceptable to the County and are aesthetically pleasing and compatible with the local vernacular architecture. Visible portions include superstructures and those elements of partially submerged structures that are above grade.

The design will contain a coherent and rich architectural vocabulary, as well as highly durable attractive exterior materials. Design strategies outlined herein are provided to illustrate the level of detail and quality of materials expected from a successful proposal.

Align elements along vertical edges and centerlines as part of the design solution.

Any equipment shall not be visible on rooftops except where absolutely unavoidable. Provide screening or built-in elements for ventilation and equipment. Mechanical roof top units shall not be allowed on this project.

Table 5-15 Toilet Room Requirements

Area Name/Location	WC	Lavatories	Urinals	Showers Handicapped	Lockers	Drinking Fountains	Sink	Comments
Membrane Treatment Building – Plumbing Fixtures								
Female Bathroom	4	3		1	8	NA	NA	1 Handicapped Toilet
Male Bathroom	2	3	2	1	8	N/A	NA	1 Handicapped Toilet
Corridor	NA	NA	NA	NA	NA	2	NA	Low-High Fountain
Janitor Room	NA	NA	NA	NA	NA	NA	1	
Administrative Building – Plumbing Fixtures								
1 Handicapped Toilet	1	1	NA	1	NA	NA	NA	1 ADA Bathroom
Vestibule	NA	NA	NA	NA	NA	1	NA	Low-High Fountain
Janitor Room	NA	NA	NA	NA	NA	NA	1	

Note: Provide Emergency Eyewash as required by code

Sloping roofs are encouraged over flat roofs wherever possible. Project roof eaves or overhangs to provide articulation as part of the building elevations and to provide shading and solar control as required.

Align windows openings, use belt courses, rustication strips and/or changes in materials as organizational elements, to break down the scale/massing of the building, and to define public access points.

Provide daylight openings high on the walls of process areas to create good working environment as well as visual interest on the building façade. Organize windows, louvers and door openings to provide proportion, scale and good composition to the facades.

Acceptable exterior wall finishes shall include architectural precast concrete premium finish.

Guard rails in process areas and exterior process conditions shall be non-corrosive anodized aluminum or fiberglass reinforced plastic (FRP). Guard rails and handrails in non-process areas may be stainless steel, fluoropolymer-coated steel, or anodized aluminum but shall be designed to achieve a less industrial appearance by the use of infill panels, smaller structural sections and refined connection details. Any guards along publicly accessed routes shall be designed to prevent passage of a 4-inch diameter sphere. All guard systems shall comply with the requirements of the FBC and OSHA.

5.3.2 Design Criteria

5.3.2.1 Safety

Meet or exceed the applicable requirements of the FBC 2012 and OSHA 1910, including but not limited to use classification and separation, egress requirements, railings, and guards, stairs, and handicapped accessibility.

Arrange interior spaces to provide a safe and convenient working environment, taking into consideration building codes, safety standards, barrier free design, operational needs, security, and indoor air environmental quality.

Provide appropriate signage and way finding devices to facilitate employee and visitor movement and awareness of hazards. Comply with Building Code and ADA requirements. A monumental entrance sign shall be provided with a minimum of 30’-0” long x 6’-0” high. The monumental sign shall be built with cast-in-place concrete walls with “premium” architectural wall finish including eight inches high stainless steel raised Helvetica type metal letters. The sign shall include the facility name, address and Miami-Dade County Logo.

Coordinate building and site design to provide barrier free accessible route that connects all the primary spaces on site.

Roof mounted equipment, if accepted, shall have access as required by the governing building and mechanical codes.

The guard house shall be provided with 'estate type" motorized rolling gates on both sides for vehicular traffic.

5.3.2.2 Energy

Design a thermal envelop that meets or exceed the requirements of the FBC, and USGBC. Refer to USGBC LEED Certification Evaluation for silver certificate technical memorandum special requirements.

Detail the building envelope to minimize uncontrolled air infiltration throughout the facility.

Glazed openings, shading devices and glazing materials shall be designed to minimize summer solar heat gain in spaces that are mechanically cooled and consider shading coefficient and U-factor as parts of the design.

Utilization of daylight to replace or supplement electrical lighting is encouraged through the use of windows and skylights.

Coordinate HVAC design in order to provide high level of occupant comfort and achieve energy saving options.

Use roof materials and light colors designed to reflect solar heat or consider vegetated roofs where appropriate as part of the design if allowed by code.

5.3.2.3 Durability and Design Life

5.3.2.3.1 General

- Civil works and Buildings: 75 years and longer.
- Equipment: 20 years and longer.
- Paint and Coating Systems: 15 years and longer.

Select and detail the exterior wall finish systems to withstand the natural elements for a minimum of 75 years without requiring the application of coatings, with only minimal periodic maintenance.

Select and detail roof systems to withstand the natural elements for a period of no less than 20 years without requiring the application of coatings and with only minimal maintenance.

Where resilient interior floor finishes such as carpet or sheet vinyl are used, select systems that will withstand normal wear and frequent cleaning without detrimental effect to appearances or function for a period of at least seven years.

Where hard interior floor finishes such as tile or hardened concrete are required, select systems that will withstand normal wear and frequent cleaning for a period of at least 20 years.

Where chemical resistance is required, select finishes that will resist staining from all proposed (and future) chemicals. Finishes shall also be acid resistant.

Stairs and Ladders shall be durable, low maintenance and constructed of metal (stainless steel or aluminum) or concrete as appropriate to the particular application. Comply with building code fire resistance rating requirements as applicable throughout the facility. Comply with building code, ANSI A 14.3 and OSHA requirements for stair and ladder details and safety requirements.

5.3.2.4 Equipment and Furnishings

To be determined by building functions as described in the general scope of work for the Project. The Company shall provide all furnishings so the Water Treatment Plant and non-Water Treatment Plant buildings can be immediately occupied without the need for additional furnishings and supplies. The Company shall provide the necessary laboratory case work and supplies for a functioning Water Treatment Laboratory. The following laboratory equipment should be included: autoclave, incubator, refrigerator, still, 45 degree water bath, hot air oven, dishwasher, and five (5) fume hoods. For the maintenance shops, the Company shall include the price a tool and equipment allowance of $50,000 for the County to determine the needed items at a future time. All other furnishings for the SMH WTP including maintenance building shall be provided by the Design Builder.

5.3.2.5 Accessibility

Comply with the requirements of the FBC 2010 edition with 2012 supplement and 2012 Florida Accessibility Code for Building Construction based on the 2010 ADA Standards for Accessible Design as applicable to each building occupancy.

5.3.2.6 Miscellaneous

Provide noise reduction, at a minimum specified level as listed in the following areas:

- Pump Rooms, Membrane Process Area and Pipe Galleries
- Generator Rooms
- Mechanical and Electrical Rooms

Window treatment: Provide vertical louver blinds at all Administration Building and Guard House windows.

5.3.2.7 Storage Fixtures

Durable, low maintenance materials as appropriate to application; metal materials at industrial/utility/maintenance functions – Wood/plastic materials shall only be allowed at office/administrative functions.

5.3.3 Program Requirements

5.3.3.1 General

Chemical Storage Facilities shall not be located adjacent to the Administration Areas.

Chemical Storage Facilities shall be placed in such a manner as to not require employees to cross through such spaces to access other process areas.

Provide design that allows the removal of equipment without destructive demolition of installed building components.

Electrical Rooms shall not be located below spaces that require below-slab water piping, e.g. toilet rooms, laboratories etc.

At least one stairwell shall provide full access to the roof by way of stairs. Use of ladder and hatch as the primary roof access is not acceptable.

Emergency generator shall be located within the WTP site and may be a separate building or stand-alone hurricane proof (Category IV) enclosure.

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Structural

6.1 Description of Work

The structural design includes the requirements for the new SMH WTP and any modifications to the existing facilities at the SMH WTP site presented herein. For information on the structural system for each of the proposed structures see the Architectural section.

6.2 Basic Requirements

6.2.1 Codes and Standards

The Structural Design shall comply with the latest version of all applicable Federal, State and Local Codes and Standards including, but not necessarily limited to, the following:

Codes

- Florida Building Code, with Amendment and Supplements
- Building Code Requirements for Structural Concrete (ACI 318)
- Code Requirements for Environmental Engineering Concrete Structures (ACI 350)
- Building Code Requirements for Masonry Structures (ACI 530)

Standards

- ASCE 7, Minimum Design Loads for Buildings and Other Structures
- ASCE 24. Flood Resistant Design and Construction
- Reinforced Concrete: American Concrete Institute (ACI)
  - ACI 301, Specifications for Structural Concrete
  - ACI 318, Building Code Requirements for Structural Concrete
  - ACI 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
  - American Welding Society (AWS) AWS D1.4/D1.4M, Structural Welding Code – Reinforcing Steel
- Masonry
  - ACI 530, Building Code Requirements for Masonry Structures
- Steel
  - AISC Steel Construction Manual
  - AISC 360, Specification for Structural Steel Buildings
  - American Welding Society (AWS) AWS D1.1/D1.1M, Structural Welding Code –Steel
  - Metal Building Manufacturers Association (MBMA) Metal Building Systems Manual and the Supplements to the Metal Systems Manual
- Aluminum
  - AA, Specifications for Aluminum Structures – Allowable Stress Design
  - Aluminum Design Manual

  - American Welding Society (AWS) AWS D1.2/D1.2M, Structural Welding Code –Aluminum
- Steel Joists and Joist Girders
  - Steel Joist Institute (SJI) Specification
- Steel Decks
  - Steel Deck Institute Manual
- Stainless Steel
  - American Iron and Steel Institute (AISI)
  - American Welding Society (AWS) AWS D1.6/D1.6M, Structural Welding Code –Stainless Steel
- ASTM Standards in Building Codes
- Standard Specifications for Highway Bridges adopted by the American Association of State Highway and Transportation Officials (AASHTO)
- Florida Department of Transportation (FDOT)
- Miami-Dade Water and Sewer Design & Construction Standards
- Miami-Dade County Public Works (MDCPW) Standards

6.2.2 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor demonstrating compliance with the requirements specified herein. Final construction drawings shall be signed and sealed by a Florida licensed Professional Engineer in addition to the construction submittals mentioned in the next section that require a signed and sealed submittal.

6.2.3 Construction Submittals

The Company shall submit construction information on the products and materials related to the work in this section to the County Technical Advisor. In addition, information shall be furnished to the County Technical Advisor on the following items:

- Shop fabricating drawings prepared in accordance with ACI Detailing Manual for all reinforcing steel.
- Information of proposed mechanical couplers to be used.
- Product data on the proposed waterstops and joint sealants to be used.
- For the concrete mix designs provide:
  - Sources of all materials and certifications of compliance with the requirements specified herein.
  - Manufacturer's data on all admixtures.
  - Concrete mix design for each type of mix proposed and its intended locations.
  - Results of the final batching compression test.
  - A schedule of all concrete placements with volume of concrete planned to be placed.
  - A layout of all structures with all planned construction joint locations.
- Samples of the architectural precast panels. Provide one 4' x 8' panel to be inspected at the batch site.
- Product information on the inserts to be used to connect the precast panels to the reinforced concrete frame.

- Signed and sealed calculations and shop drawings of all precast concrete members used for the structural framing of the building and for underground structures such as manholes, pump stations or vaults. Calculations shall be signed and sealed by a Florida licensed Professional Engineer.
- Provide method of curing concrete and information on curing compound product if used.
- Material certifications for metal products and fabrications.
- Provide metal fastener's manufacturer and type and certification of the fastener's material and capacity.
- Provide valid AWS welder certification for each person who is to perform field welding.
- Complete fabrication and erection drawings for all gratings, access hatches and access doors.
- Signed and sealed calculations and fabrication drawings for all pre-engineered metal roofing systems or metal building by a Florida licensed Professional Engineer.

6.3 Specific Requirements

6.3.1 Structural Considerations

6.3.1.1 Design Loads

Applicable loads and load combinations shall be determined as required by the governing code, occupancy, site and environmental effects, equipment and processes. Appropriate load combinations shall be established as well as appropriate allowable stresses, load factors and safety factors (as applicable). These criteria shall be confirmed at the beginning of final design.

6.3.1.1.1 Dead Loads

Dead loads are those resulting from the weight of all permanent non-removable stationary construction, such as walls, floors, roofs, ceilings, framing, permanent partitions, cladding, and equipment bases. In determining the dead loads for the purposes of design, the actual weights of materials of construction shall be used. Loads from process liquids within the structure and from soil and groundwater outside the structure will not be considered as dead loads. Dead loads used are shown in **Table 6-1**.

Table 6-1 Summary of Design Dead Loads

Material	Dead Load	
Concrete	150 pcf	
Steel and Stainless Steel	490 pcf	
Aluminum	169 pcf	
Fiberglass Reinforced Plastic	120 pcf	
Masonry, CMU, 8-inch	83 psf (grouted solid) 61 psf (grouted at 16-inches on center) 54 psf (grouted at 24-inches on center) 50 psf (grouted at 32-inches on center)	48 psf (grouted at 40-inches on center) 47 psf (grouted at 48-inches on center) 39 psf (hollow)
Masonry, CMU, 12-inch	127 psf (grouted solid) 90 psf (grouted at 16-inches on center) 78 psf (grouted at 24-inches on center) 72 psf (grouted at 32-inches on center)	69 psf (grouted at 40-inches on center) 66 psf (grouted at 48-inches on center) 54 psf (hollow)
Wood	30 to 40 pcf	
Structural Fill	135 pcf	

6.3.1.1.2 Live Loads

Live loads shall consist of loads due to occupancy, furnishings and equipment. Live load reduction shall not be employed for members of large influence area in the design of environmental facilities, due to the relatively high probability of simultaneous loads on all areas. Uniform live loads shall be established in accordance with the governing code. Values are listed below for purposes of preliminary design. Actual usage and equipment will be considered during final design and higher loadings used when appropriate.

General Administrative Buildings

▪ Office areas	50 psf
▪ Office file, record and mainframe computer areas	125 psf
▪ Personnel assembly areas	100 psf
▪ Stairways, corridors, lobbies	100 psf
▪ Partitions (present or future)	30 psf
▪ Roofs	30 psf
▪ Storage areas	250 psf
▪ Catwalks	100 psf
▪ Garages, passenger cars only	100 psf
▪ Garages, other vehicles	AASHTO load or design vehicle

Process Buildings and Structures

▪ Office areas	150 psf
▪ Office file, record and mainframe computer areas	150 psf
▪ Personnel assembly areas	150 psf
▪ Stairways, corridors, lobbies, catwalks	150 psf
▪ Storage areas	300 psf
▪ Process areas (including hatches and gratings)	200 psf
▪ Electrical rooms	300 psf
▪ Control rooms	150 psf
▪ Maintenance garages	AASHTO loading or 300 psf
▪ Unrestricted vehicular areas	AASHTO HL-93

Equipment Loads

Loads from equipment shall be considered live loads. The maximum loads and support details for each major piece of equipment shall be provided by the discipline designing or specifying it. Final weights of process-mechanical equipment shall be established during preliminary design. Preliminary weights of building service equipment (HVAC, plumbing, and electrical) shall be confirmed during final design.

In addition to the mechanism's static dead load, design shall be performed for other effects, such as those due to operation, maintenance and malfunction. Examples include, but are not limited to, the following.

- Rotating equipment (mixers): Design shall be performed for moment, torque, and lateral/vertical thrust.

- Vertical turbine pumps: Design shall be performed for suction load plus the weight of the suspended water column in the riser.
- Membrane skids: Design shall be performed for suction load plus the weight of the suspended water column in the riser.
- Sluice gates, non-self-contained: Design shall be performed for a load equal to the breaking strength of the operating stem, or the stalling torque of the motorized operator, in the event the gate is frozen.
- All equipment: Design shall be performed for required maintenance procedures, such as the removal of a large component and the placing of it temporarily on the adjacent structure.
- Degasifiers: Design shall be performed to take into account the load of the degasifier media and the column full of water.

Impact Loads

Static loads shall be increased for the effects of impact by the following percentages.

- Vehicular loads: In accordance with the AASHTO Specification
- Monorail supports: 25 percent of hoist capacity. 10 percent of the sum of the hoist capacity and hoist weight shall be applied as a longitudinal load.
- Light machinery supports, shaft or motor driven: 20 percent of the operating weight (minimum) or manufacturer's recommendation.
- Reciprocating machinery or power-driven unit supports: 50 percent of the operating weight (minimum) or manufacturer's recommendation.
- Hangers supporting floors or balconies: 33 percent of live load reaction

Construction Live Loads

When it is necessary to provide particular restrictions on construction sequencing, special load conditions may result. This situation is particularly applicable to work involving the modification of existing structures. These cases shall be evaluated and appropriate criteria established during final design. Such restrictions shall be indicated in the Project documents.

6.3.1.1.3 Environmental Loads

Rainwater Loads

Importance factor shall be established for each structure per governing code based on occupancy.

Roofs shall be designed for retained water to its maximum depth (accounting for deflection) assuming that the primary drainage system is blocked. Overflow scuppers or other secondary drainage systems may be used to minimize this load. This criterion shall be coordinated with architectural and plumbing design.

Wind Loads

Wind loads shall be developed from the following criteria in accordance with the Florida Building Code. Appropriate shape modification factors, uneven distributions, and orthogonal effects shall be considered for each structure. Main wind force resisting systems, as well as appropriate components and cladding, shall be designed for internal and external effects.

- Exposure Category: C
- Risk Category: IV
- Ultimate Design Wind Speed (minimum): 186 mph

Internal loads due to positive or negative air pressure caused by mechanical or process systems shall not be considered wind loads. These loads shall be considered in the manner of a process liquid load.

6.3.1.1.4 Process Liquid Load

Design shall be performed for liquid loads assuming liquid surface at the maximum working level and at the maximum possible worst case scenario level using appropriate material specific factors defined in the governing code and as required herein.

Where cells of a tank communicate so that one cannot be isolated from an adjacent cell (by valves, gates, stop logs, or other normal operational means), the separating walls shall not be designed for liquid on one side only. However, design shall be performed for a 12-inch minimum water level differential on either side of the wall to account for flow lag and minor dynamic effects, unless hydraulic analyses indicate a different level.

Closed liquid containing structures shall, whenever possible, be vented to preclude pressurization or depressurization. However, certain structures may experience pressure or vacuum effects due to particular mechanical or process systems, or the malfunction of systems or components. In such cases, design shall be performed for the maximum water, air or gas pressure as provided by the mechanical-process discipline in preliminary design.

6.3.1.1.5 External Earth and Groundwater Loads

Earth and groundwater loads shall be developed in accordance with recommendation of a Geotechnical Report. Walls to which vehicles can reasonably be expected to approach within a distance equal to half the wall height shall be designed for a uniform surcharge equal to 2 feet of soil or as more exactly determined using accepted engineering practice.

6.3.1.1.6 Miscellaneous Loads

Design shall be performed for other applicable loads as required by the project circumstances. Appropriate acceptable allowable stresses and load factors shall be established.

6.3.1.1.7 Combination of Loads

General

Design shall be performed for combinations of loads, along with appropriate load factors or allowable stresses, in accordance with the governing code. In the absence of specific direction by the code, or conflict, the most severe distribution, concentration and combination of design loads and forces shall be used. These combinations may be limited by practical considerations, such as the following:

- Combination of certain loads shall not be considered when the probability of their simultaneous occurrence is negligible.
- The effects of any load type (other than dead load) shall not be used to reduce the effects of another load type.

Liquid Containing or Below-grade Structures

Design shall be performed for structures that contain liquids, extend below grade, or both, for the following load combinations:

- Liquid-containing compartments full, no backfill for liquid containing compartments. No reduction shall be made for any counteracting soil pressure on the face remote from a contained liquid unless approved by the County and the County's Technical Advisor.
- Backfill and groundwater with liquid-containing compartments empty and full.
- Liquid containing compartments empty or full in any combination

- Buoyancy

6.3.1.2 Serviceability

Additional requirements for serviceability shall be considered as provided in subsequent sections and referenced standards for specific materials.

6.3.1.2.1 Deflection

Design shall be performed to limit deflections to the following. In cases indicated with an asterisk (*), deflection limit shall apply to live load effects only. For monorails and cranes, impact need not be included.

Monorails, including the effects of differential support deflection	L/800
Bridge crane girders	L/1000
Floor plates and gratings*	L/360
Beams, lintels or slabs supporting masonry (3/8 inch maximum at windows)	L/720
Roofs without plastered ceilings*	L/240
Roofs with plastered ceilings*	L/360
Floors, steel framed*	L/360
Floors, concrete	In accordance with ACI 318

6.3.1.2.2 Ponding

Ponding refers to water retention due to the effects of deflection on a flat roof. For flexible roof systems, sufficient stiffness shall be provided to prevent successive water retention and deflection leading to failure.

6.3.1.2.3 Vibration

Design shall be performed for the effects of vibration to provide appropriate protection against structural deterioration, mechanical deterioration, and significant occupant discomfort. Under normal circumstances, the requirements below shall generally be followed. If deemed necessary by the supervising structural personnel, a dynamic analysis of the system shall be performed.

Mechanical Vibration

Concern for mechanical vibration is greatest for equipment such as blowers, generators, compressors and vertical turbine pumps. Operating frequencies, unbalanced loads, and specific design recommendations shall be obtained from the manufacturer by the discipline specifying the equipment.

To avoid resonant vibration, the ratio of the structure's natural frequency to the operating frequency of the equipment shall be restricted to less than 0.50 or greater than 1.50. Where practical, the latter shall be used to avoid resonance during equipment startup and shutdown. Consideration shall be given to applicable modes of vibration, including vertical, lateral, and rotational.

Design shall be performed in accordance with the following requirements for equipment which produce significant vibrational effects, where possible and appropriate.

- Equipment shall be mounted on concrete foundations or supporting systems rather than metal supporting systems.
- A foundation mat shall be provided with a mass equal to ten times the rotating mass of the equipment or three times the gross mass of the equipment (minimum), whichever is greater.

- Major equipment foundations and supporting systems shall be isolated by expansion joints or independent supports from the remaining structure to minimize vibrational transmission.
- Vibration isolators, dampeners, and/or inertia blocks shall be provided where appropriate.
- Anchorage to foundations shall be provided by embedded anchor bolts. Drilled anchors shall not be used.

Transient Vibration

For elevated steel walkways or platforms, beams shall be provided with a depth greater than or equal to 1/20 of the span.

6.3.1.3 Foundation Design

6.3.1.3.1 Scope

A Preliminary Geotechnical Engineering Data Report by Terracon Consultants, Inc. has been provided for the project site. The Company will be required to provide a geotechnical recommendation with the design criteria for the structure foundations. Permanent structure foundation elements shall be designed to distribute loads to the supporting soil in accordance with their allowable loads, and to accommodate predicted deformations of the structure caused by settlement or movement of the supporting elements. Structure foundation elements shall be designed to resist effects of groundwater, including buoyancy.

6.3.1.3.2 Shallow Foundation Support

Design of shallow foundation elements (footings and mats), including excavation and backfill limits and details, shall be performed in accordance with the recommendations of the geotechnical report.

To the extent possible, buried piping and duct banks shall be maintained outside the influence zone of the foundation elements. Limits of this zone shall be established based on bearing materials' characteristics as documented in the geotechnical report. A reinforced concrete encasement or other appropriate protection shall be provided for any utilities extending into this zone.

6.3.1.3.3 Retaining Walls

The stability of retaining walls shall be confirmed for appropriate lateral soil and groundwater pressures, surcharges and other applicable loads. Passive pressures from the soil in front of the wall or footing keys shall not be used to reduce loads, stresses, or overturning and sliding effects, unless measures are taken to ensure against erosion or removal of the soil and approved. Design shall be performed for the following factors of safety.

- Overturning: 2.0
- Sliding: 1.5

For design of retaining walls with portions below the design groundwater level, the effects of uplift pressures shall be considered in stability analyses.

6.3.1.3.4 Buoyancy

Buoyancy is defined as the condition of instability resulting when uplift forces due to groundwater exceed resisting forces due to dead load and anchorage systems. Design for buoyancy shall be performed in accordance with the following.

Complete Structures

For groundwater at the design level, structures shall be designed to resist buoyancy considering only the structure dead load, soil directly above the structure and footing extensions. The groundwater design level shall be the 100 year flood elevation plus additional storm surge water level defined in the Site/Civil section. The effects of live loads, liquid contents, vertical soil friction and soil cohesion shall be neglected. When anchorage systems are used, they shall be designed to resist the net uplift force transmitted to the components of the anchorage. Structures shall be designed to provide a minimum factor of safety of 1.15, calculated as the ratio of total resisting force to total buoyant force.

Partially Complete Structures

Unless the partially complete structure is specifically designed to accommodate groundwater elevations otherwise the Company will maintain a dewatered excavation. It shall be assumed that groundwater shall be maintained, at any given time, at or below the surface of the backfill currently in place. If the completed portion of the structure has insufficient resistance against pressures generated in this condition, the groundwater elevations at which the structure is stable shall be provided in the design documents.

6.3.1.4 Concrete Design

6.3.1.4.1 Scope

Design of member sizes, reinforcement, and details of cast-in-place, site-cast, and precast concrete structures shall be performed in accordance with the governing code.

Design of site concrete work, such as paving, curbing, and sidewalks shall be performed as required.

Structures that convey, store or treat liquid, are subjected to severe exposures, or have restrictive leakage requirements shall be designed as environmental engineering structures.

Design of miscellaneous roadway structures, such as culverts and headwalls shall be performed in accordance with the Miami-Dade Public Works Department, Florida Department of Transportation highway standards and the AASHTO Specification.

6.3.1.4.2 Materials and Design Strength

Design shall be performed for concrete with the following minimum 28-day compressive strengths (f'c).

- Structural concrete: 5,000 psi
- Concrete topping: 4,000 psi
- Curbs and Sidewalks: 3,000 psi
- Conduit Encasements: 3,000 psi
- Excavatable Flowable Fill: 100 psi
- Precast concrete: 5,000 psi
- Prestressed concrete: 5,000 psi

Design shall be performed for the strengths and properties of the following materials.

- Deformed reinforcing bars: ASTM A615, Grade 60
- Welded wire fabric, plain: ASTM A185
- Welded wire fabric, deformed: ASTM A497

6.3.1.4.3 Design Methods

Strength Design Method (Ultimate Strength) shall be used for all concrete design. ACI 318 shall be used for buildings and non-liquid containment structures. ACI 350 shall be used for liquid-containment structures and below grade construction.

6.3.1.4.4 Concrete Design

Joints-General

Design shall be performed using the following joint types.

- Expansion joints are formed discontinuities in or between structures that allow movement perpendicular to the plane of the joint only. They are not considered to be load-transferring joints. Most often, this movement is due to both expansive and contractive forces generated by temperature and shrinkage. This movement is accommodated by providing smooth dowels across the joint, debonded on one side. Expansion joints are normally constructed using a joint filler that has sufficient stiffness to maintain its shape during concrete placement, but compresses under the subsequent movement. Keys will not be used in expansion joints. The end surfaces of the elements forming the joint will have face reinforcing to prevent spalling.
- Contraction joints function as a plane of weakness for crack formation to dissipate shrinkage stresses, and are not considered to be load-transferring joints. They may be formed by use of a bond breaker between concrete placements, discontinuing reinforcing steel, forming or sawing a partial depth groove, or by a combination of these methods. Keys will not be used in contraction joints.
- Construction joints are formed joints between adjacent concrete placements and are designed to be load-transferring joints. Bond between the placements is promoted and reinforcing steel is continuous through the joint so that the section behaves as though it was monolithically constructed. The surface of the first placement shall be roughened to promote bond. Keys will not be used.
- Control joints function to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove is formed or saw-cut in the concrete. This groove shall be filled with a joint sealant.

Layout and Design

The jointing system layout shall be determined at the beginning of preliminary design. Joint types, locations, and related criteria shall be selected. All joints shall go through the entire structure in one plane whenever possible. Staggers and offsets shall not be used for expansion, control and contraction joints, and avoided for construction joints unless absolutely necessary.

Joints

- Construction joints shall be suggested on the drawings where the length of the concrete placement is critical for crack control and as required for constructability. Reinforcing shall be extended and developed through the joint.
- Control and Expansion joints shall be located on the drawings.
- All construction, control and expansion joints in liquid-containment structures and below grade structures shall have a continuous waterstop.
- Expansion joints: Expansion joints shall be provided at approximately 120 feet on center unless the geometry of the structure dictates a greater spacing. Where possible, expansion joints shall be located at points of zero shear transfer across the joint. For expansion joints through and perpendicular to spanning systems, independent supports shall be provided on each side of the joint. A seated expansion joint for spanning members shall not be used unless project conditions prohibit the use of the double supports.
- Control joints: Control joints shall be provided at approximately 30 feet on centers in each direction, unless otherwise approved. If used other than parallel to one-way spanning

elements, the effects of discontinuity on the design will be considered. Control joints shall be shown on the Drawings.

Waterstops
Continuous waterstops shall be provided in all joints in walls, slabs, and other elements separating the following spaces. Additional installations may be required by special project conditions.

- Between liquid containing areas and dry, habitable areas
- Between liquid containing areas and external areas (air, water, or soil)
- Between below-grade dry, habitable areas and external areas (water or soil)
- Between adjacent liquid containing areas when one can be drained while the other remains full

Waterstops in vertical joints shall be extended to 4 inches below the top of the wall, or to the first horizontal joint above the design process liquid or groundwater level, whichever is lower. For horizontal joints at the intersection of walls and slabs, starter walls shall be provided as required to avoid interference between the waterstop and horizontal reinforcing. For new construction, waterstops shall be ribbed PVC, 9 inches wide with a center bulb at expansion joints and 6 inches wide at control and construction joints.

Reinforcement-General

Spacing
In general, 6 inches and 12 inches shall be used as the basic spaces for detailing on continuous elements such as walls and slabs.

Splices
Splices in deformed reinforcing bars shall be a Class B lap splices conforming to ACI 318, unless otherwise indicated. Mechanical splicers shall be used only in noncritical applications where failure of the splice would not result in structural failure. When used, they shall be the threaded-type mechanical splicers.

Anchors and Embedments

Anchor Types
Design shall be performed using the following anchor types.

- Cast-in anchors are set prior to casting of the concrete. Anchor bolts are the most common type, used in applications such as anchoring of steel columns. Other types include bolts with embedded plates, strap anchors, and headed anchor studs.
- Expansion anchors are generally drilled-in bolts that engage the concrete substrate by using a sloping mandrel to force wedges into the sides of the hole during tightening.
- Adhesive anchors are generally drilled-in bolts that engage the concrete substrate through the chemical bonding by a resin. Reinforcing dowels may also be anchored in this manner.

Selection
Cast-in anchors generally provide the greatest assurance of adequacy and shall be used whenever practical. Cast-in inserts (threaded receptacles set below the concrete surface) shall be avoided unless necessary, due to the difficulty of verifying adequate thread engagement. Drilled-in anchors shall be used when greater flexibility is required in positioning the anchored elements. Expansion anchors shall be used in non-critical applications only and not for tensile or vibratory loads.

Design
Anchor bolts shall be designed using the loads and location restrictions provided under the Florida Building Code and ACI 318/350 Appendix D. In determining capacity, effects including but not limited

to anchor spacing, edge distance, combined loadings and concrete stress condition shall be considered.

Waterproofing

Waterproofing shall be provided on walls separating dry, habitable areas from either liquid-containing areas or exterior water or groundwater. Apply to wet or dry side, as appropriate for the particular waterproofing used.

6.3.1.5 Masonry Design

6.3.1.5.1 Scope

Design of loadbearing and non-loadbearing elements (such as partition walls and veneer) and their connections shall be performed in accordance with applicable criteria.

6.3.1.5.2 Materials and Design Strengths

Design shall be performed for the specified strengths and properties of the following materials

Masonry Units:

- Concrete masonry units — ASTM C90, Type I (1900 psi)

Mortar and Grout:

- Mortar — ASTM C270, Type M (2,500 psi)
- Grout — ASTM C476, (3,000 psi)

Reinforcement:

- Deformed Bars — ASTM A615, Grade 60 and ASTM A706, Grade 60
- Joint Reinforcing — ASTM A82

The specified compressive strength of masonry, f'm, shall be as follows.

- Concrete masonry — 1500 psi

6.3.1.5.3 Design Methods

Design shall be performed for masonry elements and their components in accordance with ACI 530 and the Florida Building Code.

6.3.1.5.4 General Design and Details

Reinforcing

Deformed bar reinforcing shall be provided in loadbearing and exterior masonry and where necessary in interior partitions. All courses and cells containing bars shall be fully grouted. Horizontal joint reinforcement shall be provided at 16-inch maximum vertical spacing.

Below Grade and Submerged Applications

Masonry shall not be used in either below ground or submerged applications unless dictated by project requirements and approved. When required, solid or fully grouted hollow units shall be used with an appropriate coating for protection and leak prevention.

Veneer

Non-structural masonry veneers shall be selected, detailed and specified by the architectural discipline. The structural adequacy of veneer attachments and the weights used in dead load calculations shall be verified.

Control Joints

In general, the spacing of control joints in masonry walls shall be controlled by other building components and architectural requirements. The layout of control joints shall be reviewed for its effect on the structural design of the masonry, particularly in regard to structural elements such as masonry lintels and bond beams functioning as tension chords in "box system" buildings.

6.3.1.6 Structural Metal Design

6.3.1.6.1 Scope

Design of structural metal structures, systems, elements and details, shall be performed, except as indicated below, for the applicable criteria.

Design of the following structures and elements shall be performed by the fabricator or vendor, in accordance with criteria provided in the contract documents.

- Access hatches
- Pre-engineered buildings and stairways
- Castings, such as manhole covers and trench grates
- Storage tanks and silos
- Piping, ductwork, and conduit hangers and supports
- Patented track for monorails

6.3.1.6.2 Materials and Design Strengths

Design shall be performed for the specified strengths and properties of the following materials

Steel:

- Structural steel wide flange shapes: ASTM A 992
- Other structural steel shapes; plate; and bars: ASTM A 36
- Structural steel tubing: ASTM A 500, Grade B
- Structural steel pipe: ASTM A 53, Grade B
- High strength steel bolts: ASTM A 325-N
- Anchor bolts and threaded rods: ASTM F593 AISI Type 316
- Welding electrodes: AWS E70XX

Aluminum:

- Aluminum extruded shapes: ASTM B221, 6061-T6
- Aluminum sheet and plate: ASTM B209, 6061-T6
- Aluminum extruded pipe: ASTM B429, 6063-T6 or 6061-T6
- Bolts: ASTM F593 AISI Type 316

Stainless Steel:

- Stainless steel shapes: ASTM A276, Type 316
- Stainless steel plate and sheet: ASTM A167, Type 304 or 316

6.3.1.6.3 Design Methods

General

Design shall be performed in accordance with Load and Resistance Factor Design (LRFD) for steel design and Allowable Stress Design (ASD) methods for other metals.

Steel Deck

Deck sizes, profiles and connections shall be selected from load tables in the referenced standards.

Joists and Joist Girders

Sizes shall be selected from load tables in the referenced standards. Design loads shall be provided in the contract documents. For loads other than uniform loads, a load diagram shall be provided.

Gratings

Sizes of metal gratings should be selected in accordance with the manufacturer's load tables for uniform loads and limited concentrated loads defined in the tables. For other loads, design shall be performed in accordance with ASD methods specified in the appropriate material standards.

6.3.1.6.4 General Design and Details

Structural Steel

Steel column plates shall be designed and detailed using anchor bolts with shims or leveling nuts and shop welded base plates. Nonshrink, flowable grout shall be provided under base plates.

Steel Roof Deck

Where possible, 1-1/2 inch Type WR (wide rib) deck shall be used. For diaphragm action, welded or screwed connections shall be provided.

Steel Joist

Bridging shall be provided at all joists in accordance with SJI provisions. Concentrated loads will only be allowed at panel points of the joists.

6.3.1.7 Fiberglass Reinforced Plastic Design

6.3.1.7.1 Scope

Design of fiberglass reinforced plastic (FRP) members such as structural shapes, grating and handrails shall be performed in accordance with applicable criteria.

6.3.1.7.2 Materials and Design Strengths

All FRP resins shall be flame resistant and shall meet the requirements of ASTM D635 and ASTM E84, Class 1 with a maximum flame spread rating of 25.

Design shall be performed for the minimum specified strengths and properties listed below.

- Tensile Stress (ASTM D638) 30,000 psi
- Tensile Modulus (ASTM D638) 2.5×10^6 psi
- Compressive Strength (ASTM D695) 30,000 psi
- Compressive Modulus (ASTM D695) 2.5×10^6 psi
- Flexural Stress (ASTM D790) 30,000 psi
- Flexural Modulus (ASTM D790) 2.0×10^6 psi
- Shear Stress (ASTM D2344) 4,500 psi
- Density (ASTM D792) 0.70 lbs/in^3
- 24 hr. Water Absorption (ASTM D570) 0.6% max
- Coeff. Of Thermal Expansion (ASTM D696) 6×10^6 in/in/EF
- Barcol Hardness 50

6.3.1.7.3 Design Methods

There are no nationally recognized codes, standards or specifications for the design of FRP. Design shall be performed in accordance to the proprietary design manuals for FRP structural shapes, gratings and handrails.

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Volume III.A - Section 7

Heating, Ventilation, and Air Conditioning

7.1 Description of Work

The project includes a new WTP at the SMH site and nearby Wellfields. This portion of the documents will cover only Heating, Ventilation and Air Conditioning (HVAC) work. The following work descriptions are not intended to in any way limit the above broad statement, but are intended as a more specific mention important items included therein.

- Thermal Pipe, Duct and Equipment Insulation
- Building Pressure Control
- HVAC Equipment Vibration Isolation and Mounting
- Noise Control
- Startup
- Protective coatings
- Complete building heating system
- Complete building ventilation systems
- Complete air conditioning system for areas specified
- Air Handling Units
- Fans
- Metallic and non-metallic Ductwork (if required) and accessories
- Automatic Temperature Control (ATC) System
- Testing, Adjusting and Balancing

The County's existing facilities that will remain in use shall remain in service, without interruption, during the construction period.

7.2 Basic Requirements

7.2.1 Codes and Standards

The HVAC design shall comply with the applicable Federal, State and Local Codes and Standards including all amendments thereto (most current version in effect at time of bidding and permitting) but not necessarily limited to the following:

- 2010 Florida Building Code, 2010 Florida Building Code – Mechanical, 2010 Florida Building Code – Energy Conservation, 2010 Florida Fire Prevention Code, to include all applicable referenced codes
- International Building Code as modified by the Florida Building Code
- International Mechanical Code as modified by the Florida Building Code
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbooks
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Duct Construction

- Air Moving and Conditioning Association (AMCA).
- Associated Air Balance Council (AABC).
- National Environmental Balancing Bureau (NEBB).
- American Conference of Governmental Industrial Hygienists (ACGIH).
- Associated Air Balance Council (AABC)
- American Conference of Governmental Industrial Hygienists (ACGIH)
- Air Diffusion Council (ADC)
- American Bearing Manufacturers Association (ABMA)
- Air Movement and Control Association (AMCA)
- American National Standards Institute (ANSI)
- Air Conditioning and Refrigeration Institute (ARI)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- Factory Mutual (FM)
- Florida Energy Conservation Code
- Florida Fire Prevention Code
- Institute of Electrical and Electronic Engineers (IEEE)
- National Institute of Standards and Technology (NIST)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Administration (OSHA)
- Underwriters Laboratories (UL)

7.2.2 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor.

All engineering and design work on the project shall be done by a registered, Professional Engineer, in accordance with the applicable regulations for the area. Copies of engineering calculations shall be turned over to the County Representative for record purposes.

Calculations must follow the methodology outlined in the applicable energy codes, the latest edition of ASHRAE's Handbook of Fundamentals, and referenced ASHRAE handbooks and publications.

At a minimum, calculations shall be provided for the following:

- Cooling/Heating transmission coefficients
- Space heat loss
- Space heat gain
- Space ventilation rates
- Ductwork pressure loss
- Piping pressure loss
- Fan and pump motor sizing
- Condensation control

In general, internal building heat gains must not be used to reduce the capacity of building heating systems.

Ventilation rates shall be calculated for all applicable criteria, and the highest ventilation rate shall be used for design.

All design submittals shall be stamped by a Professional Engineer registered in the State of Florida.

7.2.3 Construction Submittals

The Company shall submit construction information on the products and materials related to the work in this Section to the County Technical Advisor as required.

7.3 Specific Requirements

7.3.1 Indoor Design Conditions

The indoor design conditions are shown under Indoor Design temperature and ventilation rates in **Table 7-1**. Specific types of spaces shall be defined by the final building layout. Care should be exercised to identify the type of occupancy and to apply the appropriate indoor conditions. The intended functions of these HVAC systems and this design are as follows:

- Maintain acceptable thermal comfort conditions within the limits required by the Florida Building Code, listed in this document, and any referenced Standards.
- Maintain ventilation rates and indoor air quality within the limits required by the State Mechanical Code, and any referenced Standards.
- Maintain acoustical isolation between spaces
- Minimize system energy use in accordance with the requirements of the State Energy Conservation Code, and any referenced Standards

7.3.2 Cooling

Cooling shall be provided by chilled water package cooling units or split system units according to areas and usage. Cooling controls in general shall be provided as part of the package unit.

Specific zone control shall be defined by the building layout.

Electrical rooms shall be provided with mechanical cooling, and a minimum of two units. Each unit shall be sized for 100% of the space load.

7.3.3 Heating

Heating shall be electric.

7.3.4 Condensation Control

In general condensation will occur in spaces with high humidity and with process water piping or tanks. Humidity control is to be provided. Condensation shall be collected and conveyed from the dehumidification equipment to the storm or dedicated dry well drainage system. To prevent corrosion of the process piping, an epoxy coating shall be provided on the process piping.

7.3.5 Spaces with Hazardous Substances

In addition to the ventilation criteria listed in Table 7-1, the ventilation rate for spaces with hazardous substances must be evaluated to provide a system that will satisfy the OSHA requirements for a workspace, as well as the Ten (10) State Standards. The ventilation rate shall be based on all hazardous materials contained in the space.

Table 7-1 Indoor Design Temperatures and Ventilation Rates

Area	Temperature (°F) Summer	Temperature (°F) Winter	Outdoor Air Ventilation Minimum Criteria	Comments
General Areas				
Conference Rooms	78	70	0.06 cfm/ft² plus 5 cfm/person w/ occupancy load of 50p/1000 ft²	Mechanical cooling, individual zone control
Control Rooms	78	70	0.06 cfm/ft² plus 5 cfm/person w/ occupancy load of 50p/1000 ft²	Mechanical cooling
Corridors	78	70	0.06 cfm/ft²	Mechanical cooling
Electrical Rooms	84	55	0.06 cfm/ft²	Minimum ventilation; mechanical cooling with 100% standby. Maintain positive pressurization.
Laboratories	78	70	0.25 cfm/ft² plus 15 cfm/p with an occupancy of 25p/1000 ft²	Lab hood exhaust with 3000 ft/min discharge velocity. Exhaust min. 1.0 cfm/ft²
Locker Rooms	78	70	35.0 cfm/person 0.25 cfm/ft², whichever is greater	100 percent exhaust, but rooms to be cooled and heated
Lunch Rooms	78	70	0.18 cfm/ft² plus 7.5 cfm/p with an occupancy load of 70p/1000 ft²	Mechanical cooling
Offices	78	70	See FBC for different type uses for lobby, reception area, and regular offices	Mechanical cooling, with individual control via VAV or VVT per office
Toilet Rooms	78	70	50 cfm/fixture or 6 ac/hr, whichever is greater	100 percent exhaust with isolated exhaust system. Cooling and heated directly
Process Areas				
Occupied areas	104[b]	55	3 ac/hr	Negative pressure[d]
Unoccupied areas	104[b]	55	3 ac/hr	Negative pressure[d]
Mechanical Rooms other than HVAC	104	55	6 ac/hr	Negative pressure[d]
HVAC rooms	78	55	0.06 CFM/SF	Cooling
Vehicle storage (if any)	104[b]	55	0.75 cfm/ft²	Exhaust
Chemical Storage	104[b]	55	1 CFM / SF	12 ac/hr emergency ventilation in regular chemical storage and 20 ac/hr emergency ventilation in ammonia storage
Generator Room	104[b]	55	N/A	Provide exhaust ventilation and generator combustion air.
Stairways	N/A	55	N/A	Use criteria based on the use of the stairway service.

Notes:
N/A=Not Applicable
ac/hr=Air changes per hour
[a] Occupied areas are areas where plant personnel are frequently present or that plant personnel enter on a regular basis to serve operations or perform maintenance.
[b] Ventilation systems shall be designed on the basis of the air changes per hour, pressure differential control or a space temperature of 10°F for eat removal, whichever results in the greater air flow. If the heat removal criteria is the larger air flow, the winter ventilation rate can be reduced to the next higher air flow criteria to conserve heating energy.
[c] Unoccupied areas are areas that are not entered under normal conditions and that require special procedures. Examples are covered tanks without internal walking surfaces.
[d] Provide dehumidification at all process areas with high humidity producing equipment and processes, such as pipe galleries, areas with wet tank walls and similar areas. Maintain humidity, not to exceed 60%.

7.3.6 Location of Ventilation Air Intake, Air Distribution and Exhaust Air

Outdoor air intakes must be located so taking in contaminated air and vehicle exhaust emissions is prevented. Short circuiting of exhaust air from exhaust discharges shall be prevented.

7.3.7 Cooling

Exhaust discharge points must be located away from outdoor air intakes. With the exception of clean ventilation relief air, exhaust discharges must not be located where they will discharge on to people. For example: louvers must not be used over doors for chemical exhaust. No exhaust can terminate at a walkway. Exhaust containing hazardous materials must be located so the discharge point is inaccessible to people and the exhaust plume shall discharge in a safe location. Vertical up blast discharge from roofs is preferred

7.3.8 HVAC System Noise Design Criteria

The selection of pumps, fans, air handling equipment, air conditioners, heating ventilating and air conditioning machinery and mechanical equipment and the installation of the system components such as duct work and piping shall be such as not to exceed to maximum permissible noise for non-equipment spaces as defined in Table 2 of Design Guidelines for HVAC System Noise in Unoccupied Spaces contained in the current edition of the ASHRAE Application Handbook. Under no conditions shall the noise created by equipment exceed the levels of permissible noise exposures of occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances.

7.3.9 Piping Systems

Piping 2-1/2-in in diameter and above shall be black steel. Piping less than 2-1/2-in in diameter shall be black steel or the Company can choose copper. (Chilled water.)

Joints for 2-1/2 in diameter piping shall be flanged. Joints for steel piping less than 2-1/2-in in diameter shall be screwed; copper piping shall be soldered. (Chilled water.)

Field installed refrigerant piping shall be pre-cleaned type K hard drawn copper with silver soldered joints made with inert gas pipe purging.

Piping shall be provided with thermal insulation as required by code. Cold piping shall be provided with a vapor barrier to prevent condensation. Insulation shall be provided with aluminum jacket.

7.3.10 Equipment Vibration Isolation

Unless otherwise specified, all HVAC machinery and vibrating HVAC system components shall be isolated from the building structure by vibration isolators with a minimum absorption efficiency of 90 percent for the lowest disturbing frequency of the particular vibration source. Provide special types of vibration isolators such as piping and ductwork flexible connectors and flexible wiring conduits, where connections are made to system components that vibrate or generate noise.

Select all isolation devices for a single piece of equipment for a uniform static deflection according to distribution of weight in the equipment.

Provide isolators with corrosion protection when exposed to the weather or wet environments.

7.3.11 Flame and Smoke Ratings

All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc., shall have flame spread ratings not over 25 (fire resistive), and smoke development ratings not over 50 and fuel contributed rating not over 50, as established by tests conducted in accordance with the Federal Standard 00136B, ASTM E84, National Bureau of Standards Radiant Energy Fire Test, UL Standard 723 and NFPA 255.

These requirements apply to all circumstances whether the materials are field applied or applied by a manufacturer at their shop, or elsewhere, prior to delivery to the Project.

7.3.12 Bearings

Equipment shall be furnished with bearings suitable for the intended equipment service. Extended lube lines with pressure reliefs shall be provided for all bearings which are not readily accessible from outside the equipment.

7.3.13 Hangers, Supports and Anchors

Furnish supports, hangers and other devices necessary to support firmly and substantially the piping, equipment and ductwork.

All piping shall be supported at a maximum of 10-ft-0-in intervals. Hangers or rings shall be sized to fit outside the insulation.

Anchor piping mains where necessary to limit pipe expansion and to prevent vibration. Furnish anchors constructed of coated steel or aluminum securely bolted to masonry and welded to pipes.

Rectangular, Round and Flat-Oval Ductwork - Spacing and size of hangers shall be as called for in the SMACNA standards.

All hanger and fastener material shall be of same finish as ductwork which they serve, e.g., galvanized, aluminum, black steel.

Design of hangers shall include the effect of all loads applied to the duct as well as the load of the duct.

Any HVAC components mounted on the exterior of the building (roof or walls) must comply with requirements of the FBC, Mechanical and Building sections.

7.3.14 Testing, Adjusting and Balancing

Furnish the services of a certified agency for the testing, adjusting and balancing of all HVAC systems installed under this Section.

The testing, adjusting and balancing agency shall be independent of all suppliers, installers and contractors on the project. Agency to be certified by AABC and NEBB.

7.3.15 Fans and Air Handling Units

In general, fans shall be all aluminum construction with the exception of fans in fiberglass duct systems where fiberglass fans shall be used. Fans shall have motors mounted outside of the air stream. Where possible, fans shall be backward inclined centrifugal fans. Drives shall be belt driven with variable sheaves. Air handlers shall be galvanized steel, of double wall construction with only metal in contact with the airstream.

V-belt drives shall consist of the driver and driven sheaves and one or multiple matched V-belts. V-belt drives shall have belt horsepower ratings equal to or greater than 1.5 times the driving motor nameplate horsepower.

The selection of fans, air handling units, air conditioners, heating, ventilating and air conditioning machinery and mechanical equipment and the installation of system components such as ductwork and piping shall be such as not to create noise that will exceed the levels of permissible noise exposures for occupational areas as established by the Occupational Safety and Health Act and other Federal, State and local safety and health standards, codes and ordinances.

Where fans of spark resistant construction are required, bearings shall not be placed in the air stream. Construction shall conform to AMCA 99-0401-82 Classifications. All electrical components shall be explosion proof.

- TYPE A - All parts in contact with the gas stream shall be non-ferrous material.
- TYPE B - Aluminum wheel and non-ferrous ring around shaft openings.

Inlet and/or discharge screens shall be provided for fans that are not directly duct connected.

7.3.16 Insulation

Provide insulation adhesives, coatings and vapor barrier materials, which are compatible and recommended, for use by the insulation manufacturer. Submit a certified statement from the insulation manufacturer attesting to their approval of the adhesives, coatings, and vapor barrier materials. See section 8.4.4 for insulation requirements for piping and see section 8.4.5 for insulation requirements for equipment and ductwork.

7.3.17 Ductwork

Sheet metal ductwork shall be constructed of the materials specified and required for the service using the gages or thicknesses and reinforcing called for by SMACNA for the material specified.

- Galvanized steel ductwork shall be constructed of hot-dip galvanized sheet steel, per ASTM, A525 and A527.
- Aluminum ductwork shall be constructed of 3003H-14 alloy B&S Gauges.
- Stainless steel ductwork shall be constructed of Type 304 stainless steel.
- FRP ductwork (see below) shall be constructed per ASTM D2310 standards

Fabricate and erect all ductwork in accordance with SMACNA requirements. Rigidly support and secure ductwork in an approved manner.

Ductwork shall be constructed of materials suitable for the space served and for the spaces the duct passes through. A preliminary selection is provided below:

▪ Dry areas	galvanized steel
▪ Wet areas to include areas with	aluminum
▪ Condensation	
▪ Exhaust for toilet rooms w/ showers	aluminum
▪ Organic chemical exhaust	stainless steel
▪ Inorganic chemical exhaust,	Fiberglass w/ suitable resin (FRP)

Design of ductwork shall include all loads applied to the ductwork, in addition to the load of the duct.

Sheet screws, drive cleats, cinch bands and other fasteners shall be fabricated from materials with an equal or greater corrosion resistance than the ductwork in which they are installed.

Fire dampers shall meet local codes and the requirements of the National Fire Protection Association standards contained in Pamphlet No. 90A. Dampers in systems constructed of materials other than galvanized steel shall be constructed of stainless steel.

7.3.18 Packaged Heaters

Unit heaters shall be substantially constructed, self-contained factory-assembled unit consisting of heating element, fan, motor, housing, outlet diffuser or vanes. They shall be the suspended or wall-mounted type arranged for horizontal or vertical air flow. Casings shall be painted with a primer and finished with baked-on enamel at the factory. Heavily brace and stiffen all parts to prevent vibration and hold all working parts rigidly in line. Casing sides shall be readily removable for access to interior parts. Casings of suspended-type units shall be designed for direct attachment of the hangers. Provide adjustable, horizontal and vertical vanes, nozzles or diffusers, arranged to give uniform air distribution without objectionable drafts for each heater. Furnish hanger brackets and other accessories as scheduled.

7.3.19 Electrical Equipment

Electrical enclosures and panels, including automatic temperature control panels and components, shall be suitable for the environment and electrical classification for the spaces in which they are located.

Electrical equipment to include enclosures, panels and motors which are furnished under this Section shall be in accordance with Section 11 Electrical.

7.3.20 Automatic Temperature Controls

Control systems shall be Direct Digital (DDC) with central control. Central control shall consist of a computer terminal with keyboard and mouse, screen and printer. The central control shall be able to perform all functions of the local panels and record alarms and print out reports. Process area units shall be operated continuously, office and administrative areas that are not continuously occupied shall be provided with timed occupied/unoccupied control and temperature set back.

Where specific area classifications are determined by code, all equipment and wiring shall be in conformance with the requirements for that classification. Special attention shall be given to hazardous areas specifically "Class I Div. 1 Group D" and "Class I Div. 2 Group D" to comply with code requirements for equipment selection and installation procedures.

All sensing devices, transmitters, controllers, not mounted in a clearly labeled panel, or which are not on obvious part of a clearly labeled device, shall be provided with an engraved plastic plate containing the name, function, and system or system number of the device.

7.4 Specific Criteria

7.4.1 HVAC System Selection

7.4.1.1 General Requirements

- HVAC shall be provided to all occupied spaces, staff occupied spaces and additional areas as required by Design Criteria.
- An Energy Management System (EMS) shall be provided.
- HVAC distribution systems shall be zoned to permit closing off of building areas when their use is not required.
- Electric motors for AHUs, pumps, fans and cooling towers that are 1-horsepower or larger, shall have high efficiency per Florida Energy conservation code (FBC). Motors shall be NEMA standard design, with grease lubricated bearings, wound for the specified voltage, and have a minimum power factor of 0.85 at 100% load and a minimum efficiency of 91% at full load. Provide motor starters with H-O-A switches.
- All exterior mechanical appliances and equipment that are exposed to wind, including package units, condensing units, fans, equipment casings, rooftop units, hold-downs, curbs, etc., (whether integral or loose), shall be designed and installed to resist wind pressures in accordance with the FBC wind load zone designated for the project. Provide calculations signed

and sealed by a Florida registered professional engineer to the Building Department establishing wind velocity pressure values for the specific project in accordance with ASCE-7 adopted by the FBC applicable to the project.

- VAV systems for labs, administration building, offices, and other rooms with variable loads. VAV systems shall use variable frequency drive fans.
  - In VAV systems provide heaters at VAV boxes as required.
- Provide single zone units for building areas that are 3,000 total square feet or less
- Whenever single zone DX units are provided, over 5 Tons capacity, use full face, intertwined evaporator coils and unloading compressors.
  - In single zone, constant volume systems provide heater at main supply duct.
- Air-cooled central plants with individual chillers shall consist of 2 rotary screw or scroll type chillers:
  - Size each chiller for approximately 50% of calculated peak cooling load on a primary loop. Utilize for membrane treatment and administration.
- Fiberglass materials used for insulation or sound reduction shall not be exposed to the airstreams of ducts, outlets, air-handlers, VAV boxes, sound traps or other HVAC equipment or components. Mylar is not allowed in contact with the air-stream, even if protected by sheet metal with round openings.
- All air handling unit motors with variable speed drives shall be installed with 3-phase overload monitors for protection of the drive and motor with an automatic restart feature, such as ICM 450 or approved equal. The 3-phase monitor must monitor the main voltage and control voltage. The phase monitor shall trip due to phase loss, phase imbalance, under voltage and over voltage.

7.4.1.2 Specific Requirements

- Return air from odor producing areas such as break rooms shall not be combined with return air from non-odor producing areas, and all exhaust air shall be terminated directly to the outside.
- Provide one exhaust fan and one supply fan for each fume hood.
- Laboratory fume hood exhaust system shall be stainless steel, 316. Provide low flow fume hood in any lab where testing is minimal.
- Provide mechanical ventilation or mechanical exhaust at work areas, storage areas, work rooms not otherwise conditioned, and custodial closets with service sinks and at storage rooms.
- Building shall be pressurized to maintain a 0.1" w.g. positive pressure (Membrane and administration). This refers to overall building pressurization. Individual spaces such as restrooms, lockers, labs which require exhaust shall be negative in relation to adjacent spaces.
- Condensing units installed at exterior ground floor locations shall receive a chain link roof and 8'-0" high minimum chain link perimeter fencing with lockable gates to deny unauthorized access.

7.4.2 Indoor Air Quality and Outside Air Requirements

- Outdoor air ventilation for appropriate indoor air quality shall be according to ASHRAE 62.1.
- Provide Outdoor supply air according to ASHRAE 62.1.

- Providing demand control ventilation with appropriate carbon dioxide measuring devices and outside air controls.
  - Provide a 6-row minimum outside air precooling coil.
- Odor Considerations: At areas where odor-generating conditions are present provide separate AC.
- Outside air shall be ducted to the AHU.
  - When on roof, air intake shall be located at least 36 inches above the roof.
  - Wall mounted air intakes must be 8 feet above grade to bottom of intake at areas subject to pedestrian traffic.
- Roof mounted outside air intakes and exhausts shall be installed in properly flashed curb, having side mounted and gasketed screws. The curb assembly shall be counterflashed as necessary.
- AHU rooms shall not serve as an outside air plenum.
- AHU condensate drain pans shall be IAQ type:
  - Pans shall be sloped at least 1/4" per foot to drain with a double slope break in the metal, and shall be designed to drain dry with no standing water.
  - Pans shall extend horizontally at least 1/2 the height of the coil face drainage area.
  - Pans shall comply with IAQ requirements of ASHRAE Standard 62.1, 5.11 through 5.11.4, and have a level lip with at least a 4-inch depth.
- Provide controls and actuators as required to interlock all supply/outside air fans, their motorized dampers, and exhaust air fans, with their corresponding AHU's so no exhaust or supply/outside air is activated, and no outside air is introduced for a period of 30 minutes during start-up, or during unoccupied periods.
- Buildings shall be pressurized by providing 10% more outdoor supply air than the sum of return and exhaust air.

7.4.3 Acoustical Considerations

- Include passive measures to reduce noise transmitted to occupied spaces, as recommended by ASHRAE and SMACNA, since fiberglass and internal insulation are not allowed in contact with airstream.
- The spectrum shape of the background noise shall approximate the appropriate ASHRAE Room Criteria (RC) curve over at least 3 continuous octave bands without exceeding the limits defined by the specified RC curve, ± 2 dB. The following limits shall be maintained:
  - Corridors RC 35 to 40
  - Laboratories RC 25 to 30
  - Offices/Conferences RC 30 to 35
  - Mechanical Rooms RC 40 to 50
- Seal wall openings around duct perimeters and provide external acoustical treatment when penetrating equipment room walls to reduce sound transmission via the duct or opening.
- The sound generated by an outside or interior installed chiller, air-cooled chiller condenser, or cooling tower shall not exceed 70 dbA at a distance of 30 feet from the equipment and 55 dbA at the property line.

7.4.4 Pumping and Piping System

- Provide flow meters at each chiller's chilled water piping. Signal from flow-meter to control device shall regulate flow to modulate flow and maximize delta T.
- Provide control and isolation valves necessary to allow operation of any chiller with any chilled water pump or any condenser water pump and cooling tower.
- Chilled water piping systems shall be ASTM A-53 Grade A or B, schedule 40, seamless, black steel pipe made in USA:
  - Piping 2-1/2" and larger shall be welded with flanges used for valves and other similar appurtenances requiring disassembly for servicing.
  - Piping less than 2-1/2" shall be screwed with ground joint unions instead of flanges.
  - Size piping with diameters larger than 2 inches at a friction loss equal to 4 feet water head pressure loss per 100 feet of pipe. Pipe velocities shall not exceed 8 feet per second for underground pipes and 6 feet per second for aboveground pipes:
    - Size piping with diameters 2 inches or less, to not exceed 4 feet per second.
    - Evaporator and condenser tube velocities inside chillers shall not exceed 12.0 feet per second. Use an evaporator fouling factor of 0.0001.
    - Provide isolated flanged connections for access and connection of a portable chillers.
- Pressure test all piping after installation.
- Provide necessary accessories at both ends of each piece of equipment, such as flow meters, isolation valves, balancing valves, control valves, flanges or unions, valved pressure gage wells, temperature wells, strainers, valved drains and air vents, dielectric fittings, and all other appurtenances necessary for balancing and maintaining the water side. Arrange piping to allow for the removal and/or service of coils, condensers, evaporators and heat exchangers in general without interruption of service :
  - Chillers and air handling units shall be provided with thermometers and pressure gauges. Pumps shall be provided with pressure gauges at flanges.
  - Balancing valves 2 inches and smaller shall be a combination circuit setter for two-way, or plug valves with memory stops for three-way valves.
- Balancing valves 2-1/2 inches and larger shall be butterfly type equipped with memory stop. Automatic flow control valves may be used as balancing valves, not as control valves.
- Full ported renewable seat ball valves are allowed as shutoff valves for sizes 2 inches and smaller. Butterfly valves may be used as shut-off valves in sizes 2-1/2" and larger.
- Provide eccentric reducers at pumps suction and concentric at discharge. Provide non-slam check valves on discharge and strainers with blow-off at suction. Suction piping at pumps shall be designed for ease of priming and high, available, net positive suction head (NPSH). Piping creating an air trapped high point at the suction side of the pump shall not be permitted.
- At all vibrating pieces of equipment provide spring or rubber mounts and flexible piping vibration isolators placed in the horizontal position.
- Isolate underground piping distribution systems at branches 3 inches and larger.
- Isolate piping at entrance to each building.

- Piping shall be suitably supported and allow for expansion and contraction of the installed piping, including surrounding insulation. Loops and anchors shall be provided, if necessary. Assume installation temperature to be 92° Fdb.
- Vertical piping shall be installed in architecturally finished chases or in unfinished areas such as mechanical rooms. Walls shall not be channeled for installation of piping.
- Provide manual air vents with shut-off valves at all chilled water piping high points where air will accumulate and not just the single highest point in the loop.
- Provide taps at each chiller's chilled water side. Taps shall be provided with sufficiently large ball valve screwed fittings and caps to be able to introduce the flow measuring device without water spillage.
- Piping drops to chillers and pumps shall be supported from the floor and have floor vibration isolation. Piping drops to air-handling units shall be supported within one foot of the horizontal elbow before the drop.
- Extraneous piping or equipment shall not be installed inside electrical rooms.
- Chilled water installations shall be provided with valved full size chilled water lines piped to the outside of the chiller enclosure and provided with blind flanges suitable for connection to a temporary chiller:
  - Provide a system friction curve and pump operating curves.
  - Operating points with a single operational pump and with all pumps operating in parallel shall be indicated in the curves.
  - Pump motor shall be non-overloading at all operating points.
  - Provide interlocked motorized butterfly valves to prevent chilled water flows through any unused chiller or to maximize delta T, whenever that possibility exists.
  - Variable speed drives may be used for installations larger than 10 horsepower.
- Provide pedestal mounted end suction pumps. All pumps shall have mechanical seals.
- Bolt pumps directly to a concrete slab or an inertia anti-vibration.
- Install braided metal flexible connections so movement is not in the axial mode.
- Show on the pump schedule, service, gpm, total dynamic head in feet of water, NPSH required, Pump efficiency, type of pump, motor horsepower, phase, volts, motor efficiency, and RPM.
- Pumps shall be bronze fitted.
- Specifications shall include request for submittal of impeller and trim information demonstrating compliance with Hydraulic Institute guidelines.
- Provide a chemical feeder that serves the chilled water system.
- Provide a gate valve, wye strainer, long radius elbow and eccentric reducer at the suction side of each horizontal split case, double suction pump.
- Provide a concentric reducer, check valve and a balancing cock on the discharge side of each pump.
- Suction diffusers are allowed for end suction pumps with a 90-degree piping entry.
- Pipe all drips and drains intended by the pump manufacturer to drain water, away from pump and into floor drains. No water shall be permitted to accumulate on pump, base or supports.
- Pumps with flanges shall have flanges drilled and tapped for gauges.

- Refrigerant Piping
  - Materials
    - Piping (Refrigerant):
      - Pipe: For size up to 3-inches, piping shall be copper tubing as per ASTM B88-89, Type K hard drawn, with silver soldered connections.
      - Fittings: For size up to 3-inches, fittings shall be wrought copper, soldered type. Where required for connection to gauges and control devices tubing not larger than 3/8-inch O.D. may be Type K soft (annealed) with flared tube or double ferrule compression fittings suitable for high pressure.
  - General Piping Installation
    - Arrangement: Arrange piping so as not to interfere with removal of other equipment or devices not to block access to doors, windows, panels or other access openings.
  - Refrigerant piping shall be installed so as to insure continuous automatic return of oil to the compressors at all system capacities. Oil traps shall be properly sized, located and installed. Install piping in accordance with standard engineering practice as recognized by ASHRAE.
  - Refrigerant piping shall be installed to allow removal of D.X. coil.
  - All refrigerant piping shall be cut with an accepted type of pipe cutter and reamed before brazing. Pipe shall pitch sharply toward the reamer during reaming and all cuttings shall be carefully removed after reaming. All moisture and dirt shall be removed from piping before joining as follows:
    - A clean, lintless cloth shall be drawn through the tubing by means of wire or an electrician's tape, to remove all coarse particle of dirt and dust.
    - A clean, lintless cloth saturated with trichloroethylene shall be pulled through the pipe, until the saturated cloth is not discolored by dirt.
    - A clean, lintless cloth saturated with compressor oil, squeezed dry, shall be drawn through the tubing. Visually inspect tube to confirm that tubing is perfectly clean.
    - Cleaning shall be completed by pulling through a clean, dry, lintless cloth.
  - All joints are to brazed with silver solder containing 45-percent silver and having a melting point of 1120 degrees Fahrenheit.
  - Prior to charging lines, all lines are to be pressure tested. When testing is complete, lines are to be evacuated, by the double evacuation method, breaking each vacumn with the system refrigerant to 5.16 mm of pressure absolute. Bring first vacuum break to 2 psig and final break to normal operating pressure. The compressor shall not be used to evacuate the system.

7.4.5 Pipe Insulation

- Chilled water piping shall be insulated using the thicknesses and materials as follows:
  - Interior aboveground except inside chiller room: Provide foamed plastic inserts every 40 feet and at changes of direction with cellular glass insulation.
    - 1" and smaller: 1" foamed plastic.
    - 1-1/4" to 2": 1-1/2" cellular glass.
    - 2-1/2" to 6": 2" cellular glass.

        - 8" and larger: 2-1/2" cellular glass.
    - Exterior aboveground or inside chiller room: Increase interior aboveground insulation by one size.
    - Exterior underground:
        - 2" thick cellular glass: With expansion and contraction controls as needed.
        - Optional: Urethane pre-insulated piping system, with factory recommended thicknesses and consisting of seamless black steel ASTM A-53 Grade B pipe, Schedule 40, with foamed-in-place closed cell polyurethane insulation and ASTM D-1784 outer jacket. Seal ends and couplings. Seal and protect piping and insulation against moisture intrusion during and beyond installation. Provide concrete anchors at elbows.
- Provide jacketing for insulated pipe as follows:
    - Finish above ground piping exposed to weather with 0.016" thick sealed, aluminum jacket, continuous over pipe, except at valves, and fittings. Install with seam underneath pipe.
    - Exterior underground jacketing:
        - For all sizes of urethane piping, use PVC jacketing provided with pre-insulated pipe.
        - For all sizes of cellular glass piping, use factory applied jacket with field installed joints.
    - Interior aboveground jacketing:
        - Concealed: Provide factory applied all service jacket (ASJ).
        - Exposed fittings everywhere: Provide field applied fabric and mastic finish consisting of 10 x 10 glass fabric embedded in two coats of white breather weather barrier mastic.
- Refrigerant piping shall be insulated with 1” foamed plastic and butt jointed.

7.4.6 Equipment Selection

- Outdoor Air Intakes
    - Locate outdoor air intakes on the upwind side of exhaust openings, based on the prevailing summer southeast wind direction, and separated by:
        - 15 feet minimum from toilet exhausts and plumbing vents through roofs.
        - 25 feet minimum from process exhaust.
        - 36 inches minimum from the finished roof deck.
    - Intakes shall not exceed 600 fpm velocity through the net louver free area at 100% fresh air to minimize noise pressure drops and rain carry over.
    - Selection and sizing of outside intake louvers and the management of rain entrainment through them shall be in accordance with ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.
    - Provide a minimum of one floor drain next to air-handling units in each equipment room. Provide a hose bibb in each large AHU room.
- Air Filters
    - Provide 4" thick MERV 8 throwaway media type air filters with reusable metal frames at air-handling units. Filters shall not contain fiberglass.

- Air Handling Units and Outside Air Supply Fans
  - Air-handling units shall be floor mounted. Air-handling units supported from ceilings or roof structures or accessed by climbing over any equipment are not allowed.
  - Air-handling units shall be provided with access doors to reach items requiring periodic maintenance. The use of access panels in lieu of access doors for this purpose is not allowed.
  - Provide adequate service space around unit and in front of access doors for required service to take place.
    - Show by dotted lines on drawings the clear space allotted for the coil pull out.
    - Arrange chilled water piping to AHU to allow for coil pull out area without shutting system down and with minimal pipe disturbance.
  - Provide each AHU in a VAV system with a ducted outside air supply fan and downstream VAV box or other engineered means to maintain a constant outside air supply throughout the AHU's full range of operation.
  - Air-handling units assembled with filter banks, coils, cabinet fans, plenums, and dampers shall be draw-through type.
  - Air-handling units shall be double wall construction.
  - Condensate drain pans shall have slopes, drains, curb heights, and other indoor air quality design features.
  - Provide one of the following fans designs:
    - Non-overloading backward curved blade design selected on a stable point of operation of the fan curve.
    - Forward curved fans for use in VAV systems.
  - Provide hot-dipped galvanized cabinets, fan wheel assemblies, and structural supports.
  - Provide fans with internal factory mounted vibration isolation. If factory internal isolation is not available, provide field installed external floor mounted vibration isolation with adequate structural rigidity as follows.
    - Cabinet fans, centrifugal fans, and packaged air-conditioning units with fan wheel diameters of less than 15 inches shall be hung or mounted using rubber-in-shear or spring mounted isolators.
    - Units with fan wheel diameters of 15 to 24 inches shall be mounted on spring isolator rails.
    - Units with fan wheel diameters over 24 inches shall be mounted on a concrete inertia base with spring isolators.
    - Units located on a slab with factory mounted internal vibration isolation do not need duplicate external vibration isolation.
  - Select the proper fans for the required operating conditions, economical operation and to minimize fan noise. Limit fan outlet velocity to +/-5% maximum specified duct velocity.
- Coils
  - Schedule heating and cooling coils on the drawings to include:
    - Service required.
    - Cubic feet of air per minute.

- Maximum face velocity.
- Maximum allowable air friction loss.
- Entering and exiting air-dry bulb and wet bulb temperature of heating and cooling medium.
- GPM for chilled water coils, with entering and leaving water temperatures.
- Maximum pressure drop.
- Saturated suction temperature for direct expansion coils.
- Minimum number of rows.

- Sensible Heat Ratio: Any AHU otherwise meeting the requirements for not being provided with a dedicated outside air coil or preconditioned air, and having a sensible heat ratio of 0.70 or below, shall be provided with enthalpy wheel, hot gas reheat or other Florida Energy Conservation Code accepted energy efficient re-heat method to maintain interior design conditions.
- Cooling coils shall be designed for 45° F. entering chilled water temperature and 55-57° F. leaving chilled water temperature.
- Air leaving temperature from chilled water coils shall be approximately 55° F.
- Base selection of direct expansion and chilled water cooling units on a maximum of 500 fpm face velocity for the calculated quantity of air passing through the coil.
- Chilled water or refrigerant shall flow opposite to airflow with the flow entrance at the downstream airside of coil for flow through the rows, for the most efficient heat transfer. Flow shall also enter at the bottom of coils and exit through the top connection to relieve possible air binding.
- Provide the following for chilled water coil use:
  - VAV piping system with 3-way mixing valves capable of bypassing the coil upon reaching desired air leaving temperature on constant volume systems.
  - Use 3-way two-position valves for constant volume AHU's equipped with face and bypass dampers.
  - VAV systems control valves shall be equal percentage type.
  - Air vents at the top of the return riser.
  - Gate valves on the supply side of coil section.
  - Flow indicating balancing type lubricated plug valves with memory stops or circuit setters on the return side of coil section. Ball valves are not acceptable for balancing.
  - Thermometers.
  - Pressure gauges with 1/4" bottom connections, shut-off cocks, and vibration snubbers. Pressure gauges shall be liquid filled, read in feet of water and shall have a maximum graduation interval of 2 feet of water.
  - 3/4" globe valve drain at system low point connected to a floor drain.
  - Water strainer upstream of control valve and gate, butterfly, or ball valves in the main chilled water supply and return for shut-off and repair of control valve.
  - Coil size based on a 10° to 12° F. water temperature rise except thermal storage or low temperature air requirements of a special system design.

    - Coil selection based on a 1° to 2° F higher supply water temperature than the chiller set point capacity, but not lower than 45° F.
    - Two-way or three-way valve sizes shall not be more than 1 size smaller than the coil's size. Reduce piping at the control valve, and increase immediately thereafter to reduce again at the coil. Control valve pressure drop shall not exceed 50% of the pressure drop of the branch or coil.
  - Provide the following for direct expansion systems:
    - Minimum steps of capacity controls
    - Individual suction risers with oil traps as required by the refrigerant.
    - Stop valves, strainers, solenoid valves, and external equalizing thermal expansion valves at liquid lines.
    - Isolation valves at each DX piece of equipment for ease of maintenance.
    - Sight glasses installed upstream of thermal expansion valves to observe premature flashing conditions.
    - Filter dryer in suction line.
    - Pump down system as recommended or used by the system manufacturer.
    - Intertwined coils whenever that option is available for the size of the unit.
    - Corrosion protective coating not less than 25 microns thick for evaporator and condenser coils.
  - Chillers shall be provided with the manufacturer's recommended access area fronting required maintenance spaces and removable panels for maintenance access. Show by dotted lines on floor plans the clear space allotted for the coil pull out.
  - Provide the manufacturer's recommended protective coating for exposed condenser coils with a 5-year replacement warranty.
  - Condenser coils shall be coated aluminum fins mechanically bonded to copper tubes.
    - Evaporators shall receive copper tubes and aluminum fins:
    - Air-cooled condenser coils, sized for 2 tons and larger, shall have fins protected with a coating not less than 25 microns providing an extended fin lift.
    - Black fin coating or polycoat is not allowed.
  - Provide 10 fins maximum per inch at evaporator coils.
- Air Duct Design
  - Supply, return, and outside air shall be ducted. Return or outside air plenums are not allowed. Ductwork shall not be installed on outside walls or roofs of the building.
  - Ductwork shall be galvanized steel designed and constructed according to required or recommended SMACNA standards:
    - At all pressure classifications, seal seams at supply, return, exhaust, and outside air ducts according to SMACNA Seal Class A using an accepted sealant.
    - Pressure indicating flags as required by SMACNA shall be used in the drawings.
    - Duct tape shall not be used as a sealant.
  - Use velocities and pressure drops as noted elsewhere on this document.

- Make all turns on ducts with both dimensions less than 8 inches with radius elbows. Rectangular elbows with double thickness turning vanes may be used for ducts having both dimensions greater than 8 inches.
- Provide opposed blade dampers at outlets and provide volume dampers for duct branches not having VAV boxes to allow for proper air balancing:
  - Dampers shall be stable under operating conditions.
  - Damper shafts shall be supplied with extensions to properly clear the 2-inch thick insulation and be supplied with memory stops.
  - Provide medium duty quadrants.
  - Dampers at air-handing unit rooms, outlets, and branch ducts where the total static pressure is more than 0.5 inches or with any dimension over 12 inches shall be opposed blade.
  - Damper stems shall be installed parallel to the duct run.
  - Splitter dampers are not allowed.
  - Provide access door for large opposed blade dampers.
- Supply and return ductwork shall be sealed and insulated with a 2-inch thick, 1-1/2 pound density fiberglass insulation blanket. Insulation shall comply with the following:
  - Design duct insulation to comply with FBC and FEEC. Provide minimum R-6 value.
  - Ductwork located in mechanical equipment rooms and above ceilings shall be insulated
  - Insulation shall be sealed with a continuous Kraft paper vapor barrier on the outside, to prevent moisture intrusion and condensation.
- Outside air ducts shall be insulated with external rigid insulation to prevent internal condensation.
- Branches shall not be designed or installed with extractors or scoops:
  - For rectangular ducts, provide for 45 degree entry tee according to Figure N. Page 14.37 of the SMACNA HVAC Systems Duct Design 1990 – Third Edition.
  - For round ducts, or rectangular to round ducts, provide 45 degree conical wye similar to Figures J. & L. Page 14.36 of the SMACNA HVAC Systems Duct Design 1990 – Third Edition.
  - Branch dampers shall not be placed so part of the damper intrudes into the main duct's air stream.
  - Branch damper stems shall only be placed in the horizontal position.
- Design the duct system for accessibility and ease of maintenance and balancing:
  - Provide for adequate access to each damper and balancing device.
  - Access doors shall be the hinged type with locking handle.
  - Access plates with sheet metal screws or any access requiring disassembly are not allowed.
- Provide fire, smoke and opposed blade balancing dampers with access doors. Locate access doors only on the bottom of the duct:

        - Recommended or required NFPA 90A sizing and accessibility requirements shall be followed.
        - Access doors are required for fire dampers connected to flexible duct connectors. Extend fire damper sleeve to allow for installation of access door.
        - No accessibility claim shall be made for the disconnection of flexible duct.
    - Fire dampers are required for ductwork penetrating fire rated assemblies.
    - All HVAC ductwork shall be non-combustible metal. Ductwork shall be designed, fabricated, and installed to comply with ASHRAE and SMACNA recommended and not maximum allowed requirements.
    - Provide round ductwork whenever possible.
    - Rectangular ductwork velocities shall be less than 1600 feet per minute for working areas and less than 1200 feet per minute for office and conference areas.
    - Size conditioned air ductwork using maximum recommended velocities, not maximum allowed velocities, according to SMACNA and ASHRAE. And as specified herein before.
    - Limit distances to 6 feet minimum to 10 feet maximum length for flexible ducts. Avoid kinks, support from structure above, and if necessary where space is limited provide a sheet metal elbow at the register. Flexible ducts shall be continuous in length. Splices are not acceptable.
    - Locate fire damper access doors at the bottom of the ductwork for easy access.
    - Provide accessible access doors in the bottom of ductwork for maintenance of fire dampers, smoke dampers and opposed blade dampers.
    - Provide opposed blade dampers at:
        - Dampers with a dimension greater than 12 inches.
        - Supply, return or exhaust air register outlets.
- Air Distribution Devices
    - Use accepted design practices to select supply grilles and diffusers to provide adequate air distribution. Coordinate outlet and diffusers locations with the lighting layout.
    - Registers serving VAV systems shall be limited to a maximum of 350 CFM each.
    - The use of perforated type diffusers is not allowed in VAV systems. Use the louvered type.
    - Diffusers shall be sized to fit a 2 foot x 2 foot ceiling grid whenever a lay-in type ceiling is used.
- Return and Exhaust Air
    - Ductwork and Plenums:
        - Return ducts and shafts shall be sized for a maximum 1600 feet per minute velocity.
        - Provide angle iron reinforcing to prevent buckling due to negative pressure, at fan inlet ducts per recommendations of SMACNA.
        - Return ceiling plenums and shafts are not allowed.
        - Prevent fan noise entering rooms by following ASHRAE guidelines between fan and returns or use electronic sound wave cancellation, if feasible.
        - Fiberglass duct-board is not allowed.
    - Registers and grilles shall be sized not to exceed RC 35 noise criteria:

    - Provide a schedule with size, manufacturer, and type of supply, return and exhaust air registers.
    - Provide insulation at back surface of registers in attics or any other non-conditioned spaces.
    - Select diffusers to provide adequate air motion throughout space served.
  - Provide motorized dampers and bird screens at exhaust systems as required by FBC.
  - Exhaust fans up to 1250 CFM, to be direct drive with integral variable speed switch. Fans above 1250 CFM to be belt driven.
  - Special exhaust fan requirements shall comply with FBC and other applicable codes and include the following:
    - At the labs and emergency exhaust: Provide galvanized ductwork.
    - At fume hoods: Provide stainless steel ductwork and fans and housings with chemical resistant metals, plastics, or coatings.
    - At any areas with explosion-proof requirements: Provide fans with non-sparking wheels and drives and explosion-proof motors as required by NFPA.
- Cooling System
  - Refrigerant selection shall take into consideration environmental safety issues. Specify the following accepted refrigerants:
    - HFC – 134a.
    - HFC – 410A.
  - Direct expansion (DX) systems, consisting of an evaporator, a compressor, expansion valves, an air or water cooled condenser, accessories shall be used.
  - Chilled water systems, easily adjustable for capacity control and consisting of centrifugal, screw, scroll, or reciprocating chiller compressors shall be used in the recommended load ranges in this division:
    - Provide integrated partial load performance evaluation.
    - Provide parallel flow piping.
- Heating System
  - The following, but not limited to, equipment shall be considered for heating and as described in HVAC System Selection, this Division:
    - Air VAV system with strip heaters.
    - Modified multi-zone or single zone units.
    - Strip heaters.
- Controls
  - Provide HVAC direct digital controls and HVAC.
  - Provide Operational Sequences in for Energy Management System (EMS), controls, lighting, HVAC and ventilation systems. Operating sequences descriptions shall be made part of the construction documents.

Volume III.A - Section 8

Plumbing

8.1 Description of Work

The design build project includes a new WTP at the SMH site and nearby wellfields. This portion of the RFP will cover only the plumbing work.

The plumbing systems shall include the following:

- Sanitary Sewer and Vent System (regular plumbing and toilet room fixtures)
- Building Waste System (floor drains and equipment drains)
- Special Waste System (lab waste)
- Trench Drainage System
- Storm water Drainage System (roof and area drains)
- Potable Water System
- Service Water Systems (protected potable water for process usage and other non-potable water requirements including emergency shower/eyewash units)
- Sample Water System
- Sump Pump Discharge System
- Natural Gas System (as applicable)
- Laboratory Gases, including but not limited to: nitrogen, hydrogen, methane-argon, helium, vacuum, compressed air.

8.2 Basic Requirements

8.2.1 Codes and Standards

The Plumbing Systems and components shall be designed in accordance with all applicable Federal, State and Local Codes and Standards including all amendments thereto including, but not necessarily limited to (latest adopted edition at the time of permitting) of the following.

- FBC — Florida Building Code
- FBC/P — Florida Building Code ,Plumbing Section
- FEC — Florida Energy Conservation Code
- FFPC — Florida Fire Prevention Code
- NSF — National Sanitation Foundation
- NFPA 1 — Uniform Fire Code
- ANSI/ASME A17.1 — Safety Code for Elevators and Escalators
- NEC 2008 — National Electric Code
- OSHA — Occupational Safety and Health Act
- UL — Underwriters Laboratory Inc.
- FM — Factory Mutual Approval

▪ ANSI Z358.1	American National Standard for Emergency Eyewash and Shower Equipment
▪ FDEP	Florida Department of Environmental Protection (Chapter 62 FAC)
▪ DERM	Division of Environmental Resource Management (Miami-Dade County Code)
▪ ANSI/ACME A112.6.1	Supports for Off-the-Floor Plumbing Fixtures for Public Use.
▪ ASME A112.18.1	Finished and Rough Brass Plumbing Fixture Fittings.
▪ ANSI/ASME A112.19.2	Vitreous China Plumbing Fixtures.
▪ ANSI/ASME A112.19.5	Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).
▪ IAPMO/ANSI Z124.2	Plastic Shower Receptors and Shower Stalls.
▪ ANSI/ARI 1010	Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.

8.2.2 Design Submittals

- Signed and sealed drawings
- Engineering calculations, specifications

8.2.3 Construction Submittals

- Shop drawings and technical literature covering details of all plumbing-piping systems being furnished under this Section prior to fabrication, assembly or shipment.
- Plumbing fixture Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- Manufacturer's installation Instructions.
- Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- Results of all piping pressure tests.
- Results of all disinfection tests.

8.2.4 Performance Standards

American Society for Testing and Materials (ASTM)

▪ A53-96	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
▪ A74-96	Specification for Cast Iron Soil Pipe and Fittings.
▪ A106-95	Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
▪ B32-96	Specification for Solder Metal.
▪ B42	Standard Specification for Seamless Copper Piping.
▪ B88-96	Specification for Seamless Copper Water-Tube.
▪ B306-96	Specification for Copper Drainage Tube (DWV).
▪ C564-95a	Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
▪ D312-95a	Specification for Asphalt Used in Roofing.
▪ D2241-96	PVC Pressure Rated Pipe.

- D2564-96a Specification for Solvent Cements for Poly (Vinyl Chloride)(PVC) Plastic Piping Systems.

8.3 Specific Requirements

8.3.1 General Mechanical Requirements

- Systems shall be easy to operate, maintain, and allow for expansion.
- Except for regular sanitary waste, all other piping, including domestic hot and cold water, shall be visibly field identified by legend, flow arrows and color coding according to ANSI 13.1.

8.3.2 General Plumbing Requirements

- Routings shall generally parallel building walls. Standardized symbols and text shall locate and identify lines rises, drops, valves, cleanouts and other related items.
- Locate plumbing lines in finished areas in chases. Lines routed in stud partitions shall be coordinated with electrical and other trades to ensure adequate fit. Block walls shall not be cut or channeled to install vertical or horizontal lines.
- No gas, water or drainage piping shall be routed through electrical or telecommunication rooms.
- Note elevations on floor plans of:
  - Sanitary lines above ceilings.
  - Domestic water lines being fed from below.
  - Aboveground horizontal lines 3 inches and larger.
- Plumbing lines at obstructions, offsets at HVAC ducts, allowable beam penetrations, and limited or congested areas shall be detailed separately or shown on 1/4" per foot minimum scale drawings.
- Pressure lines, gravity lines, or systems grouped for compatibility at congested areas may be shown on separate drawings. Reference separated systems to a specific drawing.
- Coordinate the storm drainage system for roofing membrane material, roof assembly thickness. All storm water to be drained via internal roof drains and piped independently to drainage structure.
- Evaluate the need for insulation for condensation protection for rainwater leaders, domestic cold water lines, or other similar systems.
- Trap primer valves and distribution units, when used, shall be installed in a mechanical space or in a conspicuous and readily accessible location.
- Provide accessibility to the disabled at group toilet rooms and single occupant toilet rooms according to FBC, Accessibility, carefully noting those requirements applicable to children.
  - Coordinate mounting height of grab bars with length of flush valve tail piece to avoid interference with valve operation.
- Provide hot water to staff toilet rooms.
- Maximum flow rate and water consumption of shower head shall be as per FBC – Plumbing and Miami-Dade County Water Conservation Ordinance.
- Fixture counts shall comply with FBC-Plumbing Code – “Minimum Number of Plumbing Facilities”

- Shut-off valves, cleanouts, access panels and water hammer arrestors shall be identified on the drawings. Valves shall be located above ceilings and not inside walls or chases. Provide access to all devices requiring maintenance and replacement as recommended by manufacturer. Access and the locations of access panels shall be coordinated with architectural drawings.
- Floor Drainage:
  - Provide lab areas with floor drains having hinged gratings, sediment buckets, and reseals.
  - Seal traps from waste lines of suitable fixtures with clear water discharge.
  - Reseals, if used, shall be fed from a water closet flush valve tailpiece, an electric water cooler, or drinking fountain if available, not from a lavatory or sink.
  - Locate reseals in mechanical or custodial rooms if a water closet, electric water cooler, or drinking fountain is not available within 30 feet.
  - Locate and select floor drains and floor sink for easy dismantling and cleaning by the custodial staff.
  - Floor drains shall be in plain view and accessible for cleaning and maintenance.
  - Floor shall slope at 1/8" per foot down to drains.
- Laboratories
  - Provide acid resistant piping systems at any fixture or equipment utilizing acids.
  - Acid waste shall be routed through a neutralizing tank installed outside the building inside an underground concrete vault filled with pea gravel to a level just below the tank inlet and outlet pipes. The tank cover shall be bolted and provided with an access door for visual inspection of the limestone level and tank interior without the need to remove the tank cover. The tank shall be filled with 1 to 3 inch diameter limestone chips having a calcium carbonate content of 90% or greater.
- Equipment Areas or Rooms:
  - Locate and identify equipment and lines with standard symbols or text denoting rises, drops, valves, instrumentation, cleanouts and other appurtenances. Note inverts or elevations at crossovers, obstructions and aboveground horizontal lines 3 inches and larger.
  - Provide access and clearance to allow equipment removal and maintenance according to the manufacturer's recommendations without removing adjacent equipment or piping.
  - Fasten equipment to a 4-inch high minimum housekeeping concrete pads. Extend the pad at least 6 inches from the equipment outline. Vibration isolation requirements may require larger pads.
  - Provide vibration isolation at moving equipment and as required to meet the acoustical requirements of adjacent spaces.
  - Provide piping support at equipment to relieve equipment from stresses.
  - Provide valving and disconnect flanges or unions at equipment to accommodate disconnections and repairs.

- Hot Water Systems
  - Mount water heaters on a 6 inch concrete housekeeping pad with chamfered edges. Pad dimensions shall extend a nominal 4 inches beyond the heater's footprint.
  - Water heaters located on upper floors or mounted on a shelf shall be provided with a secondary pan with a 1 inch drain. Both the pan drain and the 3/4 inch P&T heater relief line shall be made of copper and run separately into a mop sink or floor drain provided with an appropriate splash guard for the protection of personnel.
- Domestic Water
  - Service shall be extended underground from a water meter next to the property line to an adjacent reduced pressure backflow preventer, located within a fenced enclosure, and enter at an appropriate building mechanical equipment room or chase for overhead distribution.
    - The 20 feet of exterior underground water service prior to entering any building shall be ASTM A-64 polybitumastic covered type "K" copper pipe, for electrical grounding provisions.
    - Piping shall not be embedded in concrete slabs.
    - Piping shall not be installed below interior slabs on fill, except to floor drain reseals, and other program required locations with island equipment. Use type "K" copper without any joints, coated with ASTM A-64 polybitumastic and sleeved under slabs
    - Domestic water piping located above accessible corridor ceilings and over 2 inches in diameter shall be Type "L" copper with soldered fitting. fittings.
  - Size metal water line mains for a maximum velocity of 7 feet per second (fps). PVC and CPVC lines (allowed only outdoors underground) shall be sized for a maximum velocity of 5 fps. Soft water branches and branches with a pH less than 6.9 shall be sized for a maximum velocity of 4 fps.
  - Piping size shall be determined to accommodate pressure drops instead of velocity requirements at remote fixtures.
  - Peak design flow minimum pressure requirements at flush valve operated fixtures shall be according to fixture manufacturers' recommendations.
  - Locate an exterior master shut-off underground in a lockable valve box near each building served.
    - The distribution system shall contain shut-off valves for each floor, wing, or building.
    - Valves shall be installed immediately adjacent to main or branch junctions.
    - Major fixture groupings shall be valved.
    - Locate toilet room valves above the nearest ceiling with lay-in-tile or access panel in a hard ceiling.
    - Aboveground valves shall be full ported ball valves with renewable seats for 2-1/2" and smaller. Use iron body bronze mounted outside stem and yoke gate valves for valves greater than 2-1/2".
    - Use full-ported ball valves with renewable seats for hot water system balancing and FBC required emergency 1/4-turn shut-offs.
    - Do not install valves in toilet room wall valve boxes or behind wall access panels.

    - Provide services stops at each fixture.
    - Equipment not receiving service stops shall be provided with valves.
    - All valves shall be accessible.
  - Emergency Water Supply:
    - Water supplies for drench hoses as required for emergency showers and eyewashes shall be from a source not prone to inadvertent shutoff.
  - Provide properly sized water hammer arresters to eliminate water hammer in cold and hot water lines.
  - Exterior hose bibbs shall be 3/4", loose keyed, flanged, chrome plated, independently valved, vacuum breaker equipped, and at the building perimeter at intervals not to exceed 150 feet.
  - Domestic water system shall contain lead-free components. Lead-free solder, containing silver for easy flow, shall comply with Federal Specifications for potable water systems.
- Drainage, Waste, And Vent Systems
  - Building drain piping shall comply with the following:
    - 3" diameter lines or larger shall be sized for 1/8" per foot minimum slope.
    - Lines less than 3" diameter shall be sloped at 1/4" per foot minimum.
    - 1/16" per foot slope shall only be used for lines 8" or larger.
    - Cleanouts shall be full sized up to 4inches and at intervals not to exceed 100 feet.
    - Provide concrete protection doughnuts for cleanouts in landscaped areas.
  - Storm Drain System:
    - Drainage calculations shall be based on the rainfall rates FBC – Plumbing.
    - Roof drainage, including downspouts, shall be connected to a storm drain system complying with the FBC – Plumbing, using a rainfall rate of 5 inches per hour.
  - Condensate Drainage System:
    - Provide all AHU's traps (with cleanouts) sized for the static pressures used.
    - PVC piping is allowed.
    - Condensate system shall be independently routed and discharged to a catch basin or a properly sized drywell.
    - Condensate drains for rooftop units shall be property pitched and supported. Roof supports shall be attached to the roof deck and flashed.
    - Insulate lines with 1 inch Armaflex. Insulation on condensate drains exposed to weather shall be provided with two coats of elastomeric paint.
- Fuels And Energy Sources
  - Gas and other specialty piping shall not be installed underground below interior slabs except for short runs not exceeding fifteen (15) feet without joints. Such lines shall be installed in sealed metal sleeving vented to the exterior. Pipe sleeve shall be at least two and a half to three pipe sizes larger than the carrier pipe, but not less than 2 inches for a 3/4 inch gas line. Use wrought iron, cast iron, or steel pipe for underground sleeves for aboveground gas venting. PVC is not allowed for sleeves or gas venting.
  - Gas piping shall not be embedded in concrete slabs or in slab raceways.

- Compressed Air
  - Air compressors shall be located in a mechanical equipment room.
  - Compressors shall be tank mounted and sized to accommodate student loads, tools, or other diverse requirements. Compressor capacity shall be designated as having “x” CFM at “y” psig.
  - Compressors 3 HP and larger shall be two stage.
  - Automatic water traps with shut-off valves and piped drains shall be provided at the following locations:
    - Airline exiting from the air compressor.
    - Compressor storage tank.
    - First air riser from the compressor and risers over 1 story in height.
    - End of the main line branch.
    - Provide a petcock at the bottom of piping riser/drops without an automatic water trap, and at the bottom of each air outlet.
  - Water trap drain lines of different pressures shall not be combined except in infrequently used systems.
  - Provide 1 inch in 40 feet slope down in the airflow direction of airlines and avoid water collection pockets. Reverse slopes are not allowed. Air branch lines shall be taken from only the top of the main line

8.3.3 Drainage Systems

Sanitary system shall serve all regular plumbing fixtures consisting of toilets, urinals, shower, sinks, electric water coolers and regular use floor drains and open ended drains.

- Floor drains shall not be included within chemical containment areas.
- Floor drains shall not be located in the floor slab directly over any Finished Water Reservoir.
- Floor drains shall be provided for the Chemical Storage Area, outside the containment areas.
- Floor drains shall be included for mechanical rooms, women’s and men’s toilet and locker rooms.

8.3.4 Building Waste Systems

Building waste systems shall be designed to handle the largest flows from any of the following:

- Equipment leakage
- Wash down water
- Controlled drainage from equipment or vessels
- Fire suppression flow

Individual or combined building waste systems provided under the plumbing work shall terminate approximately five feet out from the inside face of the foundation wall. Continuation from outside the building shall be by gravity to the site sanitary collection system. Portions of the interior building waste systems, which cannot flow by gravity, shall incorporate sump pits and duplex sump pump systems for pumping into the gravity piping systems. Where below slab waste collection piping cannot be piped directly to a common sump without causing a very deep sump elevation, multiple sumps shall be considered.

8.3.5 Special Waste Systems

Special wastes are those waste streams requiring treatment prior to discharging directly to the sewer system. A special waste system shall be provided for the laboratory drains, which shall include conveying the waste in a corrosion resistant piping material and pretreatment using an acid neutralization tank(s) prior to discharging into the sewer system.

8.3.6 Trench Drainage Systems

Trench drainage systems are a portion of the building waste systems and shall meet the same criteria. Trench drains shall be provided at the base of all potentially wet walls, e.g., areas adjacent to wet wells, tankage or exterior walls which are subject to groundwater levels above the floor slab elevation. Trench drain fixtures shall be provided at low points within the trenches and trenches shall be designed for a minimum slope of ¼-in per foot. Trenches shall be covered in areas only when the trench crosses over a path of egress otherwise they shall be uncovered since they are adjacent to a wall.

8.3.7 Stormwater Drainage Systems

Storm water drainage system shall serve all roofs and area drains, shall either exit the building below grade and terminate five feet from the building for continuation under the civil/utility portion of the work or discharge to grade on splash blocks. If a parapet is installed on the roof an overflow roof drainage system must be installed in accordance with code. The overflow roof drainage system shall either consist of the installation of scuppers or the addition of another roof drainage system that shall be installed separately from the main primary roof drainage system and shall discharge to grade in a highly visible area per code.

8.3.8 Water Systems

The source of water for potable, water shall be extended from the exterior water main into the individual buildings, as required, under the civil/utility portion of the work. This water service shall be provided with a water meter and backflow preventer, as required, prior to splitting into a dedicated potable water system and a dedicated service water system.

- All piping shall be labeled to identify its contents as required by the plumbing code.

8.3.8.1 Potable Water Systems

The potable water systems shall be extended throughout the building to serve all the regular plumbing fixtures as well as being the source of water for the emergency shower/eyewash tepid water system. In addition to providing storage type water heaters for the larger demand areas, point-of-use electric water heaters may be provided for remote areas of small demands. All potable water piping shall be sized to limit flow velocities to approximately 6 fps.

8.3.8.2 Potable Water System for Service Uses

Service water shall be provided to wash hose stations, chemical processes, hose bibs, service sinks, emergency shower/eyewash stations, and miscellaneous process needs, which are subject to contamination from backflow. The systems shall be supplied from the potable water system and include backflow preventers. The system shall include external wall hydrants for outdoor use.

8.3.8.3 Emergency Shower/Eyewash Units

Combination Emergency Shower/Eyewash Units shall be provided and located in accordance with the general requirements of OSHA and current ANSI Z358.1. However, the maximum travel distance, from the point of potential contact with the hazard, shall be limited to 25 feet except for strong acid or strong caustic where they shall be located immediately adjacent to the hazard.

As a minimum, an Eyewash Unit shall be included within each chemical containment area with one or more combination shower/eyewash units located outside the containment areas, in the common areas.

Combination Emergency Shower/Eyewash Units shall be provided at exterior chemical fill stations.

8.3.9 Sample Water System

The sample water lines to the laboratory shall be designed so that the water is providing a fresh sample to the laboratory technician at all times. Consideration shall be given to providing a continuous loop or recycled so that the water is not discharged to the site.

8.3.10 Sump Pump Discharge System

The discharge from the sump pumps that collect building drains that cannot flow by gravity shall be routed to the gravity drainage system within the building where possible.

8.3.11 Natural Gas System

The natural gas piping system, if provided, shall supply natural gas to the equipment located in the building. The piping system shall be designed in accordance with the state plumbing code and NFPA 54. All low pressure (less than 14-in of water column) piping 2-in and smaller shall be schedule 40 black steel piping. All piping larger than 2-in diameter shall be schedule 40 welded piping.

The local gas company provider shall be contacted and a letter sent to them stating the intended gas usage. The total connected gas load and pressure requirements should be stated in the letter as well as a drawings showing the proposed location of the gas line on the site plan.

8.3.12 Insulation

All hot water piping shall be completely insulated throughout with 1-in thick Heavy Density Pipe Insulation. All fittings, flanges and valves shall be covered with permanently non-combustible, one-piece, factory premolded, insulated fitting covers. Insulation shall be rated to 500 degrees F, have a minimum density of 3.5 lbs/cu ft and a maximum “K” factor of 0.24 at 75 degrees F.

Cold water piping running in any air conditioned area shall be insulated.

8.4 Specific Requirements of Plumbing Systems

8.4.1 Plumbing – Piping Systems

8.4.1.1 Products

8.4.1.1.1 Piping System Materials

Sanitary

- The pipe and fittings shall be SV (Service) hub and spigot cast iron soil pipe and fittings conforming to ASTM A74 and ANSI A112.5.1 tarred inside and out at the foundry.
- Joints shall be made using resilient gaskets. Caulking lead shall conform to U.S. Department of Commerce CS-94 and Fed Spec QQ-L-156.
- As an option to lead and oakum, resilient gasketed compression joints conforming to ASTM C564 may be used. If optional gaskets are used, provide additional supports and hangers as required to provide piping system rigidity equal to that of leaded joints.
- Piping above grade shall be of the above mentioned hub and spigot type or of the No-Hub type conforming to the Cast Iron Soil Pipe Institute Standards 301.

- The No-Hub coupling shall be Anaheim Foundry Co. Husky SD4000, Clamp-All 125 or by MG Coupling Co.
- Copper piping may be used for sanitary waste and vent in sizes 2-in and smaller. Pipe shall be Type "K" used with either cast or wrought DWV fittings. Refer to Section 15063 – Copper Piping and Tubing for detail requirements of copper piping system.

Rainwater Leaders

- Pipe and fittings shall be SV (Service) hub and spigot, cast iron, soil type conforming to ASTM A74 and ANSI A112.5.1 tarred inside and out at the foundry. Above ground horizontal rainwater piping, at Contractor's option, may be No-hub cast iron soil pipe and fittings.
- Joints shall be resilient gasketed compression type. Above ground horizontal rainwater piping joints, at Contractor's option, may be No-hub neoprene joints with stainless steel removable clamps.

Water Systems (Potable, Non-Potable, and Emergency)

- Piping shall be Type "K" copper with cast bronze or wrought copper, solder type fittings or shall be flanged end, ductile iron conforming to the requirements of Section 15072. Soldered connection shall be in accordance with Section 15063 – Copper Piping and Tubing.
- All copper piping 2-1/2-in and larger and all buried copper piping shall be Type S-2 brazed in accordance with requirements of Section 15063 – Copper Piping and Tubing.

Insulating Fittings

- Provide on all connections between cast or ductile iron and copper water service lines.
- Fittings shall be of type to provide control of electrolysis.
- Acid Resisting Piping System
- The system shall be made up of DWV pattern, flame retardant, polypropylene fittings and Schedule 40 flame retardant polypropylene pipe. Joining of all pipe and fittings shall be of the fusion method.
- The system shall include all required adapters between piping, equipment, acid resisting floor drains and flush cleanouts.

Compressed Air and Vacuum Systems

- Unless otherwise noted on Drawings or herein, piping shall be Type “L” copper with cast bronze or wrought copper, solder type fittings. Refer to Section 15063 – Copper Piping and Tubing for more detailed requirements of copper piping systems.
- All compressed air and vacuum piping shall be cleaned for oxygen service per CGA G-4.1.

Laboratory Gas Systems

- All special gas piping systems shall be stainless steel hydraulic tubing grade, Type 316 conforming to ASTM A269 (2001), hardness Rb 80 or less. Fittings shall be Swagelok, Type 316L stainless steel tube fitting. All stainless steel laboratory gas pipe and fittings shall undergo chemical passivation treatment per ASTM A967.
- Ball valves shall have a Type 316L stainless steel body, stainless steel ball and stem, Teflon seat and socket weld ends. The valve shall have a 250 psig maximum working pressure and be the Model 466TM by Worcester or approved equal.

Laboratory Grade Water Piping

- All piping for the laboratory grade water system shall be stainless steel hydraulic tubing grade, Type 316 conforming to ASTM A269. The piping shall be chronically passivated per ASTM A967.

8.4.1.1.2 Valves

General

- It is the intention of the Drawings and these Specifications to require control valves at the bottom of all potable hot and cold water service risers and as shown on the Drawings.
- Install drawoff valves on the house side of main control valves, at the bottom of all risers, at all low points and where shown on the Drawings. Drawoffs shall consist of a hose end valve as hereinafter described.
- Group and locate control valves in all locations so they may be easily operated, through access panels, doors, or adjacent to equipment.
- Valves, in general, shall be of the same manufacture throughout unless noted otherwise. All valves, except as noted otherwise, shall be made for 125 pound steam working pressure and shall have round iron wheel handles.

Water Valves

- All water valves 2-inch and smaller shall be full port ball type similar to Hammond 8411; Watts B-6081; Apollo 77-100 or equal.
- Hose end valves (HEV) shall be a ball valve with hose end adapter. Units on potable water systems shall be equipped with a hose connection vacuum breaker similar to Watts No. 8A or equal.
- All water valves 2-1/2-inch and 3-inches unless otherwise noted, shall be brass body gates and shall be Nibco Inc. S-113; Stockham B-112 or Hammond 1B-647.
- All water valves, 4-inches and larger, shall be iron body gates, bronze trim, flanged ends, OS&Y pattern, solid wedge, rising spindle and shall be Nibco Inc. F-617; Stockham G-623 or Hammond 1R-1140.
- All check valves 3-inches and smaller shall be Hammond 1B-940; Stockham B-321 or Nibco Inc. S-413-B.
- Check valves 4-inches and larger shall be flanged and equal to Hammond IR-1124; Stockham G-931 or Nibco Inc. F-918.

Pressure Reducing Valves

- Shall be Watts Muesco Regulator Co. Series 115 for 1-1/4-inch and larger and Model 223-S for units smaller than 1-1/4-inch or equal with strainer and of size shown on the Drawings. Shall be diaphragm type, pressure reducing globe valves.
- Provide and install a valve full size bypass around each PRV.
- Provide and install an all brass strainer ahead of each PRV with pressure gages on high and low side.
- Smaller PRV shall have pressure setting 10 psi higher than main valve.

Compressed Air and Vacuum System Valves

- All compressed air valves shall be ball type and approved equal to Nibco Inc. S-585-70; Hammond 8411 or Watts B-6081.

Special Gas System Valves

- Isolation valves used on laboratory special gas systems shall be Whitey Co., Catalog No. SS-44F4, Type 316 stainless steel ball valve adapted with Swagelok connections or approved equal.

8.4.1.1.3 Drains

For the purpose of explanation and description only, the following drain catalog numbers are taken from the catalogs of Zurn Industries, Inc. unless otherwise noted. Those drains as manufactured by J.R. Smith Mfg. Co. or Josam Mfg. Co. and determined to be equal in every respect to those specified shall be acceptable for installation.

Roof Drains (R.D.)

- Furnish roof drains under this Section for installation under Division 7 – Thermal and Moisture Projection.
- Roof drains shall be Zurn Z-100-ERC.
- Roof drains which serve as scupper drains shall be Zurn Z-187.
- Roof drains designated "Prom-Deck" shall be Zurn Z-158-C-85.
- Overflow roof drains shall be Zurn Z-100-ERC-W2 which includes a 2-in internal water dam.
- Cavity drains shall be Zurn Z-572.
- Provide hubless cast iron quarter bends where required to maintain height at roof drain locations.
- Make final connection to each roof drain and install rainwater leader piping as shown on the Drawings.

Floor Drains (FD) / Trench Drains (TD)

- All floor drains and open ended drains shall be fitted with a deep seal cast iron "P" type or "running" type trap to suit drain outlet. Traps shall be acid resisting material where noted.
- Floor drains shown on the Drawings as (AW) and installed in corrosive resistant piping systems shall be of same material as the acid resisting pipe and fittings described above.
- All floor drains shall have cast iron or acid resisting drainage flange, seepage control, clamping collar and inside caulk outlet unless noted otherwise to be IPS outlet. These floor drains are to be metal and resistant to rust/corrosion.

Trench Drainage

- Provide pre-sloped trench drains complete with connections, channels, catch basins, trash buckets, gratings and end caps. Trench channels, catch basins and end caps shall be precast vinylester concrete or precast polyester concrete. Channel units shall be modular type in length of approximately 2-feet or 4-feet and grating shall be slotted cast iron with locking bolts. Channels shall be installed using manufacturers' standard channel support system. All components of the trench drains shall be supplied by the same manufacturer. Drain shall be Polycast by Strongwell; Aco by Aco Drain Incorporated or Polydrain, Inc.

8.4.1.1.4 Cleanouts

- For the purpose of explanation and description only, the following cleanout catalog numbers are taken from the catalogs of Zurn Industries, Inc. unless otherwise noted. Those drains manufactured by J.R. Smith Mfg. Co. or Josam Mfg. Co. as and determined by the Engineer to be equal in every respect to those specified shall be acceptable for installation. All cleanouts shall be of size shown on the Drawings.

- In cast iron bell and spigot pipe, cleanouts shall consist of a cast iron ferrule and extra heavy brass tapered screw cleanout plug with square or hexagonal nuts.
- In threaded pipe, (galvanized steel with recessed drainage pattern fittings) cleanouts shall consist of standard iron pipe size (IPS) brass plugs screwed into drainage fittings.
- In copper tubing they shall consist of copper to IPS adapters with IPS brass plugs screwed into female threaded portion of the adapter.
- Flush Floor Cleanouts
  - Flush floor cleanouts (FCO) shall be Zurn ZB-1400-HD-1C or equal.

8.4.1.1.5 Acid Waste Neutralizing Chamber

- Chamber shall be of high-density polyethylene with bolt down cover, neoprene gasket and stainless steel bolts, nuts and washers.
- Inlet, outlet and vent connections shall be included in sizes as shown on the Drawings. Orientation and type of connections shall be as selected by the plumbing installation contractor, to best suit the proposed piping arrangement.
- Unit shall have a capacity of 55 gallons and include an initial charge of limestone chips.
- Unit shall be as manufactured by R&G Sloane Manufacturing Co., Inc.; Nalgene Industrial Products; Town and Country Plastics, Inc. or approved equal.

8.4.1.1.6 Underground Waste Scavenger Storage Tank

General

- Furnish and install where shown on the Drawing one 5,000 gallon storage tank. The tank for the storage of drainage shall be complete with all connections as required for a complete installation. The tank shall also be complete with all connections as required for one chemical sump pump to bleed the waste chemicals into the concentrate lift station.
- Tanks shall be doubled-wall UL labeled fiberglass designed for buried underground installation equal to Containment Solutions, Model DWT-6 Type II 5,000 gallon, complete with hydrostatic tank continuous leak monitoring system. The tank construction shall be compatible with mild acidic or basic solutions.
- Each tank shall be furnished with, but not limited to, the following accessories and equipment.
  - Sump pump as described below.
  - 48-inch diameter fiberglass sealed piping sump equal to FCI Model STE48B-6.
  - 48-inch diameter fiberglass secondary containment collar.
  - Provide FRP coupling kits and FEB flexible entry boots for each required piping and conduit penetration of the piping sump.
  - Manhole frame and covers shall be provided as shown on the Drawings and in accordance with Division 2 – Site Work requirements.
  - 4-inch riser pipe and 24-inch cast iron manhole frame and cover for lank leak detection device.
  - 4-inch tank vent and ball float vent assembly.
  - Fiberglass-reinforced plastic anchor straps with number, location and size as recommended by manufacturer.

- Other accessories or options as indicated on the Drawings and details on the Drawings.

Pump

- Furnish and install a remote sump pump as required.
- Pump shall be Penguin Model P-3/4 or equal, polypropylene construction compatible with mild acidic or basic solutions. Pump shall be ¾ Hp, 460 Volts, three phases. Pump shall deliver 40 gpm at 20-feet of head.
- Furnish a polypropylene pump suction extension to bring the pump suction inlet to within four (4) inches of the tank bottom. Furnish a polypropylene foot valve with screen at the base of the suction extension to maintain the pump prime.
- All pumps and control components shall be UL listed.
- Motor shall meet the requirements of Section 16151 -Motors.

Pump Controls

- Furnish a NEMA 4X stainless steel, flush mounted remote pump control panel, at the location shown on the Drawings. The pump control panel shall be complete with a magnetic motor starter, disconnect switch, Hand-Off-Auto switch, indicator lights, terminal board, sealed magnetic float switches, audible alarm, amber flashing alarm light and all other equipment required for a complete installation. The wiring, panel, and electrical equipment shall meet all Division 16 – Electrical requirements and specifically Section 16191 – Miscellaneous Equipment.
- The pump control panel shall start the pump when the tank begins to fill with chemical wastes and shall stop the pump when the tank is within six (6) inches of the tank bottom. The pump control panel shall have a low level alarm to indicate the tank is with four (4) inches of the tank bottom level. The pump control panel shall have a high level alarm to indicate the tank is within twelve (12) inches of the tank full level. The pump control panel shall have a high level alarm to indicate the tank is with six (6) inches of the tank full Ievel. All of the pump control set points shall be adjustable.
- The pump control panel shall be labeled the "WASTE SCAVENGER STORAGE TANK CONTROL PANEL". The exposed front cover shall include the audible alarm speaker, the visible alarm light, and the label only. The internal pump control panel cover shall include the Hand-Off-Auto switch, power on indicator light, trouble indicator light, pump off indicator light, pump run indicator light, high level alarm indicator light, high level alarm indicator light, low level alarm indicator light-
- All pump control components shall be UL listed.

Piping System

- Piping shall be Schedule 80, polyvinyl chloride (PVC) as described in Section 15064 – Small Diameter Single – Wall Plastic Pipe and Fittings.
- Pipe and fittings shall be installed in accordance with manufacturer's instructions and local code requirements. Testing shall be as per manufacturer's instruction.

Tank Vent Piping

- Fuel tank vent piping shall be shall be UL listed single wall fiberglass designed for underground use. Systems shall be Ameron Dualoy 3000/L; A.O. Smith Inland Inc.; Red Thread II or equal.

8.4.1.1.7 Sleeves and Castings

Sleeves

- Sleeve all piping through walls, beams and partitions. All wall sleeves shall finish flush with the finish line.
- Sleeve all piping passing through floor slabs. All sleeves shall extend 2-inch above the finish floor slab.
- All sleeves for exterior emergency shower eye wash units shall be packed with insulation.

Castings

- Provide waterproof castings on each plumbing pipe penetrating walls of wet wells, tanks or pits. Castings shall be of size and length to suit pipe and wall thickness.

8.4.1.1.8 Hangers, Supports and Anchors

- Hangers supporting the vertical stacks of soil, waste, drain, vent and rainwater leaders shall be heavy friction clamps at each floor and at ten foot intervals. Supply and service vertical risers shall be supported by friction clamps on the riser which shall rest on the sleeve at each floor level and at ten foot intervals.
- Hangers supporting horizontal piping at ceilings shall be of the clevis type and spaced 5-ft apart for soil, waste, drain, rainwater leaders and vent pipes; 8-ft apart for supply and service pipe 1-1/2-inch diameter and larger; and 6-ft apart for pipe smaller than 1-1/2-inch diameter.
- Horizontal piping buried in earth under lowest floor slabs or buried within the slab shall be supported with the hanger types shown on the Drawings.
- Materials and installation conforming to the requirements of Section 15060 – Supports and Hangers shall be furnished under this Section. All hangers and supports for copper piping shall be PVC coated where in contact with copper.

8.4.1.1.9 Insulation

- All water piping of every description specified herein including potable water piping, drinking fountain waste shall be completely insulated throughout with 1-inch thick pipe insulation.
- All fittings, flanges, roof drain bodies and valves shall be covered with permanently non-combustible, one-piece, factory premolded, insulated fitting covers.
- Provide at each hanger location a rigid insulation insert with a galvanized metal covering protector shield, equal to items as manufactured by Pipe Shields Inc. or equal. Protector shields shall be of length as recommended by the Manufacturer and shall be the same thickness and jacket material as the adjoining insulation.
- Insulation for piping shall include but not be limited to the following:
  - Potable Water Piping (Hot, Cold) as follows:
    - Insulation Material
      - Molded rigid fiberglass sectional pipe insulation rated to 500 degrees F. The insulation shall have a minimum density of 3.5 pounds per cubic foot and a maximum "K" factor of 0.24 at 75 degrees F mean temperature.
    - Jacket
      - Indoor Piping - Jacket shall be kraft paper bonded to aluminum foil reinforced with fiberglass yarn and self-sealing lap with maximum permeability of 0.02 perms.

    - Exposed Indoor Piping - Exposed piping within 8 feet of the floor shall have an additional field applied 0.016-inch thick aluminum jacket secured with removable stainless steel bands.
- Fitting Covers
    - Indoor Piping - Premolded one piece PVC covers.
- Fitting Covers
    - Indoor Piping - Premolded one piece covers.
    - Exposed Indoor Piping within 8 feet of the floor - Premolded one piece covers with an additional field applied 0.016-inch thick aluminum jacket secured with removable stainless steel bands.
- Acceptable manufacturers shall be Armstrong Cork, Certain-Teed, Owens Corning, Johns-Manville, or equal.

8.4.1.2 EXECUTION

8.4.1.2.1 Installation

Install all piping, valves, hangers and appurtenances as specified herein and in the referenced.

Valves

- Install control valves to all locations grouped and located to be easily operated, through access panels, doors, or adjacent to equipment.
- Install all final Protected Water connections to Process and HVAC equipment. Each connection shall be preceded by a ball valve directly adjacent to the unit.
- Install all valves in a horizontal to upright position. Valves shall not be installed in down position from the horizontal.
- Securely anchor pressure reducing valves and components to wall or floor at a height.

Insulation

- Do not apply insulation until pipes and tanks have been tested and accepted by all parties making inspection. All insulated covering shall be guaranteed for a period of one year.
    - Insulate hot and cold water runouts to fixtures in partitioned pipe spaces.
    - Insulate drops to wash hose stations and hose outlets to a point six feet above the floor.
    - Short exposed supply pipe at or immediately near regular plumbing fixtures shall not be covered but shall be finished as trim for regular plumbing fixtures.

Cleanouts

- Install cleanouts as directed by applicable code, at end of each branch soil, waste and rainwater line where rainwater, waste and soil lines change direction, at the bottom of every riser either as a cleanout tee above floor or end cleanout in the horizontal below the floor.

8.4.1.2.2 Field Testing

- Provide all air and water necessary for testing the piping systems as specified under this Section of the work. Provide all connections for testing under this Section. Remove all debris resulting from testing. Use the water in an efficient and economical manner.
- Provide all apparatus and all other supplies or materials which may be necessary for testing the systems and operating the apparatus during the period while tests of any kind are being made, or for carrying out the work of the Contract.

- The various piping systems shall be subjected to water, smoke, or air tests as noted and shall hold tight at pressures stated without extra pumping or water addition for the time intervals stated.
- All additional tests, methods or materials that may be required by the local ordinances and not specifically specified herein, shall be made as directed by the Department.
- Provide for all repeated tests as necessary to make systems tight as required.
- Test soil, waste, drain, vent and rainwater piping as follows:
  - Test rough drainage of soil, waste, drain, vent and rainwater leader by plugging piping where it terminates in the building or where it leaves the building by filling each system completely with water to the outlets on the roof after all outlets in section have been plugged or capped, for at least one hour duration.
  - If it becomes necessary during the construction of the building to test a part of a section for any reason or to cover permanently any pipe before piping above the part or section has been completed, apply a water test to such part or section of the piping by maintaining a ten foot head of water on the highest section of the piping and the test shall hold tight for one hour.
- Test water piping as follows:
  - Test all interior potable hot and cold water piping to a water pressure of 150 psi to the lowest level and maintain this pressure without additional pumping for two hours.

8.4.1.2.3 Cleaning

- At the completion of the work, clean all piping, fixtures, equipment, apparatus and exposed trim for same included in this Section and, where required, polish ready for use.
- Thoroughly disinfect the entire potable water distribution systems with a solution of not less than 50 parts per million of available chlorine. Allow the disinfecting solution to remain in the system for a period of 3 hours after which time, open all valves and faucets and flush the system with clean water until the residual chlorine content is not greater than 0.2 parts per million, unless otherwise directed.

8.4.2 Plumbing Fixtures

Electric Water Heater

- Heater shall have immersion elements, fully automatic operation with high temperature limit control, glass lined tank guaranteed for 10 years by manufacturer, heavy steel jacket with an acrylic finish, magnesium anode rod for corrosion protection, drain valve, inlet, outlet, and electric junction box, nipple to be of noncorroding material. Heater shall have a factory or field installed temperature and pressure relief valve with temperature setting at 205 degree F or less to prevent steam flashing from over temperature relief action.
- The electric water heater shall be of storage capacity as required with screw-in type heating elements, polyurethane closed-cell foam insulation, U.L. labeled.
- The electric water heater shall be manufactured by Lochinvar Water Heater Corporation, Model KSK, or approved equal.

Water Closet

Plumbing fixtures to be current model compliant fixtures: American Standard, Toto, or Kohler.

- Bowl
  - Manufacturer: Direct-fed siphon jet action, elongated bowl, 1½-inch top spud, bolt caps.
- Flush Valve
  - Manufacturer: Sloan Royal.
  - ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker.
- Seat
  - Manufacturer: American Standard.
  - White, open front, with check hinge, without cover.

Water Closet (Handicap)

- Bowl
  - Manufacturer: American Standard, direct-fed siphon jet action, elongated bowl, 1½-inch top spud, bolt caps.
- Flush Valve
  - Manufacturer: Sloan Royal.
  - ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker.
- Seat
  - Manufacturer: American Standard.
  - White, open front, with check hinge, without cover.

Urinal - UR

- Urinal
  - Manufacturer: American Standard vitreous china water saver siphon jet urinal with flushing rim, 1¼-inch inlet spud, outlet connection threaded 2-inch inside, wall carrier as required.
- Flush Valve
  - Manufacturer: Sloan Royal.
  - ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, escutcheon, integral screwdriver stop and vacuum breaker.

Lavatory

- Lavatory (Counter top) – LAV
  - Manufacturer: American Standard, 19-inch diameter self-trimming vitreous china lavatory with mounting kit. Supply fitting with pop-up drain (2) ½-inch x 12-inch C.P. supply lines with stop 1-½-inch C.P. tube P-trap, 17 gauge.
- Lavatory (Wall Hung) – LAV HC
  - Manufacturer: American Standard 20-inch x 18-inch, acid resistant, enameled cast iron lavatory with wall hanger supply fitting with pop-up drain (2) ½-inch x 12-inch C.P. supply lines with stop 1-½-inch C.P. tube P-trap, 17 gauge.

Sink

- Service Sink
  - Manufacturer: Kohler service sink, 24-inch x 24-inch, floor mounted cast iron corner sink with coated wire rim guard and 6 strainer or approved equal.
- Kitchen Sink
  - Elkay, double compartment, 18 gauge stainless steel, self-rimming, satin finish, with strainer, dual handle swing goose neck faucet. (2) ½-inch C.P. supply pipes with stop, (1) ½-inch C.P. tube P-trap, 17 gauge, 8-inches.
- Service Sink
  - Manufacturer: American Standard, 28-inch x 28-inch x 13-inch acid resistant enameled cast iron sink with removable vinyl coated rim guard. Rockwell, Chicago, faucet with vacuum breaker and hose end. C.P. faucet hole cover. Standard 3-inch trap with strainer.

Showers

- Showers - SH
  - "Speakman" Colortemp, Moen, shower with screw driver stops and head. Shower floor 36-inch x 36-inch precast terrazzo.
  - “American Standard” Ultramix + single control handshower with hose, wall supply, Standard Slide Bar.

Emergency Eyewash and Shower Stations

- General: Furnish and install a combination emergency shower and eye wash unit where required by use and OSHA.
- Acceptance Manufacturers: Subject to compliance with the Specifications provide products from one of the following manufacturers:
  - Haws
  - Guardin
  - Bradley
- Construction
  - Shower Head: 10 ½ inch stainless steel.
  - Dust Cover: Stainless steel dusk cover assembly to protect the receptor, the eyewash assembly and face spray ring from airborne contaminants.
  - Receptor: Stainless steel with twin stainless steel eyewash and face spray ring. Face spray ring shall bathe the entire facial area.
  - Pull Rod: Furnish with a stainless steel pull rod that activates shower. Rod shall include a triangular handle.
  - Foot Treadle: Foot control assembly shall activate the eyewash and shall include the chain, clamp, nut, ring, screw, spring and stainless steel treadle.
  - Push Flag: Furnish with a push flag to activate the eyewash in addition to the foot treadle.
  - Eyewash Valve: Type 316 stainless steel stay-open ball valve, equipped with a stainless steel ball and stem. Full flow occurs with activation of the stainless steel flag.
  - In-line Strainer: A 50 X 50 mesh water strainer stainless steel strainer shall be provided.

  - Signage: Eye wash shall include universal sign, high visibility stripe and test tag for inspector to log date and initial weekly inspections.
  - Pipe and Fitting: 1-1/4 inch Type 316 stainless steel.
  - Supply and Waste: 1-1/4 inch IPS
  - Certification: Equipment shall be certified by CSA to meet the ANSI Z358.1 Standard for Emergency Eyewash and Shower Equipment.
- Flow Control Devices: Units shall be complete with automatic flow control devices as required to limit emergency shower flow to 30 gpm and eye wash flow to 1.2 gpm.

Alarm Horn and Light System

- General: All emergency eyewash and shower stations shall be equipped with flow switch that activates an emergency alarm horn and alarm light system. The flow switch, alarm horn, alarm light and associated wiring and mounting brackets shall be supplied by the same manufacturer as the emergency eyewash and shower stations.
- Alarm Horn: 90 db sound output at 10 feet.
- Alarm Light: Flashing amber light.
- Flow Switch – DPDT: Brass double pole, double throw flow switch that activates the alarm horn, the alarm light and extra set of elevtrical contacts for connection with the Plant Control System.
- Operation: Alarm system shall activate when the emergency shower or eyewash is in use.
- Mounting Brackets: Furnish alarm unit with mounting brackets for mounting on a wall within 5 feet of the proposed location for the eyewash and shower station.
- Alarm System Power Requirements: 120 volts, single phase, 60 Hz.
- Wiring to Plant Control System: Conduit and wiring from the flow switch to the plant control system is the responsibility of Division 16.

Miscellaneous Plumbing Fixtures

- Air Chambers
  - Shock absorbers on hot and cold water piping to all fixtures shall be Josam or approved equal, of suitable size and dimension and shall be placed vertically on the end of the supply pipes to fixtures to prevent water hammer in the pipes.
- Manufacturer: Haws Model with 10-inch ABS plastic head, stainless steel rigid pull rod operating a stay open chrome plated brass ball valve, 9-inch diameter floor flange stand, 11-inch stainless steel bowl eye wash receptor, twin eye wash heads, stainless steel push flag and foot treadle operation of a brass stay open ball valve, steady flow water stream control, 50x50 mesh in line filter.
- Gate Valves
  - Gate valves 3/8-inch through 3/4-inch diameter shall be 125-pound bronze body, with bronze disc, non-rising stem, handwheel, and solder ends, Crane Co. No. 1324, or approved equal.
  - Gate valves 1-inch through 3-inch diameter shall be 125-pound bronze body, with bronze wedge disc, non-rising stem, handwheel, and threaded ends, Crane Co. No. 438, or approved equal.

- Vacuum Breaker
  - Vacuum Breaker for all hose bibbs per Florida Building Code, and shall be Watts No. 8, or approved equal.
- Floor Drains
  - For Toilet Area and building interiors, Josam, Type 38253, with cast iron body-Nikaloy top, cleanout, backwater valve and side outlet.
- Roof Drains
  - Roof drains shall be Josam, Series 21000, (adjustable), for 3-inch, 4-inch and 5-inch pipe, with rough bronze dome, drain receiver, deck clamp, gravel stop, flashing clamp, extension collar with gasket and Neoprene joint gasket.
- Cleanouts
  - Floor and wall cleanout plugs shall be installed in accordance with Plumbing Code requirements, at each change in direction and at each interval of 50 feet in horizontal runs and/or where shown on the Drawings. Cleanouts shall be placed in readily accessible locations and where necessary. Flush plates with screw fastenings shall be placed in walls or floors to allow access to cleanouts. These shall be Josam 58050, 58020 and 58760, access covers. Cover plates occurring in tile walls shall be chrome plated. Accessible cleanout plugs shall be brass with recessed type wrench nuts and shall be made up in graphite and oil. Concealed plugs shall be raised bead type.
- Trap Primer Valves: Trap primer valves for maintaining water seal in floor drains at meter shop test area shall be ½-inch NPT male inlet and ½-inch female outlet Model P-2 complete with backflow preventer and vacuum breaker.
- Trap Primer Distribution Unit: For utilization with one trap primer valve for maintaining water seal simultaneously in two meter shop test areas floor drains, for straight stand pipe.
- Pipe Insulation: All domestic hot water lines, all horizontal waste lines from electric water coolers, and all horizontal and vertical air conditioning condensate drain lines above grade shall be insulated with ½-inch thick O.C. flexible tubing.
- Electric Water Cooler - EWC
  - Halsey-Taylor, HAWS, or Elkay, with all stainless steel cabinet. 1-1/4-inch P-trap, 17 gauge tube, 3/8-inch IPS water supply pipe.
  - EWC shall operate on 120 VAC.

Preparation

- Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture schedule for particular fixtures.

Installation

- Install fixtures in accordance with manufacturer's instructions.
- Install each fixture with trap, easily removable for servicing and cleaning.
- Install components level and plumb.
- Install and secure fixtures in place with wall carriers and bolts.
- Seal fixtures to wall and floor surfaces with sealant.
- Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

Adjusting

- Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

Cleaning

- At completion clean plumbing fixtures and equipment.

Protection of Finished Work

- Do not permit use of fixtures, until acceptance as required in Division 1 Specification Sections.

Fixture Heights

- Install fixtures to heights above finished floor as indicated and meet all requirements of the FACBC - Florida Accessibility Code for Building Construction.

Volume III.A - Section 9

Fire Protection

9.1 Description of Work

The project includes a new WTP at the SMH site and nearby wellfield(s). This portion of the RFP only includes fire protection.

This section summarizes the fire protection Technical Requirements and Guidelines for the Design Build Project. This includes design concepts and criteria, codes and standards, design approaches, and materials of construction.

A fire protection system is required and either a wet/dry sprinkler system or another type of fire protection such as an inert gas system will be required to be installed. As an option to a wet sprinkler system for the electrical rooms, a pre-action system could be designed. If acceptable to the authority having jurisdiction, the Company has the option of fire rating the room with a two hour rating and thus not providing sprinklers (only acceptable if there are dry type transformers in the room.)

During the design phase of the Project, a meeting shall be held with the Company's architect or project manager, electrical engineer, fire protection engineer and the local Fire-Rescue Department to present the fire protection design and ensure it is in accordance with the local fire department's requirements.

Sprinklers shalll be provided for both dry and wet systems. The design shall be based on adequate pressure being available and not using a fire booster pump. A dedicated fire service shall be piped from the site water main into the new building (s) under the civil/utility portion of the work. The fire suppression system incorporates a fire department pumper connection (Siamese) and shall include a double check valve assembly as required by the cross connection regulations. Portable fire extinguishers shall be provided and located appropriately. Site fire hydrants shall be installed under the civil/utility portion of the work and shall be strategically located to maximize accessibility for fire department use. The local fire department shall be asked to participate in determining the number and locations of the fire hydrants and emergency vehicle(s) access requirements.

Arrange for, obtain, and bear the cost of necessary permits, bonds, and fees.

9.1.1 Building Description

- Refer to the Architectural, Plumbing and Structural Drawings which clearly indicate the type of building construction, floor depressions, furred spaces, dropped ceilings, etc.
- The Company shall make his/her own piping installation drawings drawn at a minimum scale of 1/2-in equals one foot.

9.2 Basic Requirements

9.2.1 Codes and Standards

Fire Protection design shall comply with all applicable Federal, State and Local Codes and Standards, including all amendments thereto, including but not necessarily limited to the following codes and standards, of the most current adopted edition at time of permitting:

- FBC — Florida Building Code
- NFPA 1 — Uniform Fire Code

- ANSI/ASME A17.1 Safety Code for Elevators and Escalators
- NEC National Electric Code
- NFPA 13 National Fire Protection Association
- NFPA 24 National Fire Protection Association
- OSHA Occupational Safety and Health Act
- UL Underwriters Laboratory Inc.
- FM Factory Mutual Approval
- National Fire Protection Association (NFPA)
  - Any other applicable NFPA standards beyond those listed specifically above.
- American Water Works Association (AWWA)
  - AWWA C508 - Standard for Swing-Check Valves for Waterworks Service 2-in through 24-in NPS.
- American Society for Testing and Materials (ASTM)
  - ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- State and local codes as applicable.
- Where reference is made to one of the above standards, the revision adopted by the County at the time of bid opening shall apply.
- NFPA No. 2001 – Clean Agent Fire Extinguishing Systems
- NFPA No. 70 – National Electrical Code
- NFPA No. 72 – National Fire Alarm Code
- Requirements of the Authority Having Jurisdiction (AHJ)
- The standards listed, as well as all other applicable codes and standards, shall be used as “minimum” design standards. Also to be considered are good engineering practices.

9.2.2 Design Submittals

Provide a complete fire code analysis for each facility building based on the applicable codes for the Project and WTP and well field sites. Include documentation listing requirements and discussions with local Fire Rescue officials.

Calculations must follow the methodology outlined in the applicable fire codes, the latest edition of NFPA, and fire protection industry standards. Calculations must be signed and sealed by a Registered Fire Protection Engineer in the State of Florida.

At a minimum, calculations shall be provided for the following:

- Fire water demands
- Hydraulic Calculations

Drawings shall be signed and sealed by a Registered Fire Protection Engineer in the State of Florida.

- Operation and Maintenance Data
  - Complete operating and maintenance instructions shall be furnished for all equipment included under the Fire Protection Sections. The maintenance instructions shall include trouble shooting data and equipment specifications, preventative maintenance and testing schedules.

  - Instruct such person or persons as the Owner may designate in the installation, care and use of all the systems and all equipment and components pertaining thereto.
- The installing Contractor shall be a qualified Fire Protection Contractor regularly engaged in the installation of Automatic Sprinkler Systems and other Fire Protection Systems and Equipment and shall design and install the fire protection system to conform to the Design Requirements and shall obtain the approval of acceptance from the following authorities:
  - State, county and local.
  - Local Fire Department, as required.
  - Insurance Underwriter, if applicable.
- Work Standards - All work shall be in accordance with the applicable requirements of National Fire Protection Association Standards.
- Submit Shop Drawings on the following – Clean Agent:
  - Chemical cylinders.
  - Control panel and actuators.
  - Discharge nozzles.
  - Detectors.
  - Manual station.
  - Suppression abort station.
  - Layout in plan and field installation drawings; isometrics.
  - Electrical layout.
  - Internal control panel; graphic annunciator.
  - Hydraulic calculations.
  - Battery calculations.
  - Sequence of operation.

9.2.3 Construction Submittals

Submit for approval a complete list of materials and equipment to be incorporated in the work, together with the names and addresses of the manufacturers, their representatives, catalog numbers and trade names.

Submit for approval at least ten copies of manufacturer's shop drawings and technical literature covering details of all equipment and accessories being furnished under the Fire Protection Sections. This data shall be provided prior to fabrication, assembly, or shipment.

9.2.3.1 Manufacturer

The manufacturer of the Suppression System hardware and detection components shall have a minimum of 10 years' experience in the design and manufacture of similar types of suppressions systems and can refer to similar installations providing satisfactory service.

The name of the manufacturer, part numbers and serial numbers shall appear on all major components.

All devices, components and equipment shall be the products of the same manufacturer.

All devices, components and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.

All devices and equipment shall be U.L listed and/or FM approved.

Locks for all cabinets shall be keyed alike.

9.2.3.2 Installer

The installing contractor shall be trained by the supplier to design, install, test and maintain Suppression Systems.

When possible, the installing contractor shall employ a NICET certified special hazard designer, level 2 or above, who shall be responsible for this project.

The installing contractor shall be an experienced firm regularly engaged in the installation of automatic Clean Agent, or similar, fire suppression systems in strict accordance with all applicable standards.

The installing contractor must have a minimum of five (5) years' experience in the design, installation and testing of Clean Agent, or similar, fire suppression systems.

The installing contractor shall show evidence that his company carries a minimum $2,000,000.00 liability and completed operations insurance policy. These limits shall supersede limits required in the general conditions of the specifications.

The installing contractor shall maintain, or have access to, a Clean Agent recharging station. The installing contractor shall provide proof of his ability to recharge the largest Clean Agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.

The installing contractor shall be an authorized stocking distributor of the Clean Agent system equipment so that immediate replacement parts are available from inventory.

The installing contractor shall show proof of emergency service available on a twenty-four hour, seven-days-a-week basis.

9.2.3.3 Warranty

During the 1 year warranty period, perform a semiannual and annual inspection of installation to verify its proper operation.

Actuation components include remote manual pull station, mechanical or electrical devices, detectors, actuators, etc. and shall be checked for proper functioning during inspection.

Fusible links shall be replaced at the annual inspection.

Complete inspection shall be performed according to NFPA.

Forwards to the insurance company, and local Fire Department results of inspections and tests.

9.2.4 Performance Standards (Wet System)

9.2.4.1 Scope of Work

Furnish all labor, materials, equipment services and incidentals required and install properly operating fire protection systems in accordance with the rules and regulations of NFPA, local authorities having jurisdiction and as specified herein. The work shall include, but not be limited to the installation of the following type systems:

- Wet-Pipe Sprinkler Systems
- Pre-Action Sprinkler Systems
    - All Interior Fire Service Piping
    - Clean Agent Fire Protection Systems

9.2.4.2 Design Requirements

Sprinkler systems shall be hydraulically designed to provide the tabulated water densities over the most remote area of coverage. A cushion of 5 psi or 10 percent of design pressure (whichever is greater) below the water supply shall be incorporated into the design calculation. The water supply pressure shall be the minimum available while considering both fire suppression demand and average plant use.

Piping distribution shall be designed to provide for alarming of each designated zone by the use of individual flow sensing devices.

9.2.4.3 System Description – By Building

- Wet Pipe System - System shall conform to the requirements of NFPA 13 for wet pipe systems and shall contain waterflow alarm indicators to provide local and remote alarms, low pressure switch, alarm check valve, drain valve, gages and fire department pumper connections.
- The Membrane Process Building shall be designed to meet applicable criteria per NFPA 13. The lab shall be provided with a Clean Agent Protection System. The remainder of the building shall be provided with a Wet Pipe Fire Protection System.
- Pretreatment Chemical Building – Same as Membrane Process Building
- Post Treatment Chemical Building - Same as Membrane Process Building
- Electrical Room – Subject to exclusion of wet pipe system if there is dry type transformer equipment inside.

9.2.4.4 General Materials

All materials and equipment shall be new and shall be FM approved and UL listed.

Pipes and Fittings

- Supply pipe, including nipples, shall be steel pipe, black, standard weight (Schedule 40) iron pipe size conforming to ASTM A53.
- Fittings and flanges shall be black cast iron sprinkler pattern.
- Couplings and flanges as manufactured by Victaulic Co. of America; Gustin-Bacon Co., or equal, may be used, in whole or in part, in lieu of threaded fittings described herein. The grooved piping system shall utilize Schedule 40 piping. Installation methods and materials shall conform to all regulations and requirements by authorities having jurisdiction.
- All flanged and mechanical bolted joints shall be joined with Type 304 stainless steel nuts, bolts and washers.
- All piping and fittings in the ozone area shall be painted with one primer coat and two finish coats of epoxy paint. See Division 10 for application instructions and requirements.

Valves

- Gate valves shall be OS&Y Underwriters' approved and of same manufacturer throughout for working water test pressure to meet requirements of all authorities having jurisdiction noted above and with round iron wheel handles. Gate valves 2-in and smaller shall be bronze body iron size, screw end; 4-in and larger gate valves shall be iron body, flanged OS&Y bronze mounted.
- Each gate valve shall be wired and sealed in the open position and fitted with a supervisory switch.

- Check valves shall be Underwriters' approved and check valves serving Fire Department Siamese supplies shall be fitted with a ball drip.
- Post indicating valve (yard type) shall be UL listed and be manufactured by Kennedy or equal.

Sleeves

- Sleeves shall be a Schedule 40 one-piece galvanized steel pipe sleeve for all pipes through walls and partitions; shall extend 1/4-in beyond the finish wall or partition.
- Sleeves through the floor shall extend through the full thickness of the slab and 2-in above the rough slab, when the pipe is concealed, and 3-in above the finished slab when the pipes are exposed.
- All penetrations through firewalls and floors, as indicated on the architectural drawings, shall be provided with fire rated sleeves.
- Seal space between sleeves and pipe with retardant pliable material as manufactured by Sealtite Co., Fig. No. 310 or American Manufacturing Co., White Oakum W.S. - 600.

Hangers

- Hangers shall be NFPA - Factory Mutual Engineering Division, approved, adjustable clip or swivel loop type for branch lines and clevis pattern for mains.
- The hanger rods and supports shall be secured to the structure by means of approved type inserts which shall be set in underside of slab. Method and materials for supporting the hanger rods shall be approved prior to starting any work.
- Furnish and erect all iron work consisting of beams, plates, angles, channels and rods that may be required for the supporting and hanging of piping and for the construction of anchors.
- All rods, nuts, washers, hangers, inserts, brackets and components shall be constructed of Type 304 Stainless Steel.

Sprinkler Heads

- Shall be of manufacture as approved by the National Fire Protection Association and the Factory Mutual Engineering Division.
- Shall be exposed and either pendent, upright or sidewall type, in areas with exposed structure.
- Shall be bulb type stainless steel construction or brass construction with corrosion coating suitable for the application for classification of area of the building.
- Shall be bulb type, white concealed pendent with white escutcheons in finished ceilings, center of tile.
- Spare Heads
  - Sprinkler cabinets with spare sprinkler heads and wrench for emergency use shall be furnished and installed in accordance with the requirements of NFPA 13. Cabinets shall be located as designated by the Owner.

Fire Department Pumper Connection

- Shall be one or more siamese type with the Departments standard threads. Shall include check valve and ball drip installed with visible discharge. The word "Sprinkler" or "Combination Standpipe and Auto Sprinkler", as applicable shall be cast-in each pumper connection. It shall be the responsibility of the Contractor to ascertain the compatibility of connection size and threads with the local Fire Department standard.
- All exposed finishes shall be polished brass.

- Individual drop clapper valves shall be included, together with plugs and chains.
- Two way Free Standing Type Hydrant 4 x 2½ x 2½, hose threads to match local fire department type.

Water Flow Indicator Unit

- Flexible vane type alarm indicator with pneumatic time delay, one N.O. and one N.C., which is designed to activate the alarm when flow is detected in the system.
- Unit shall be preceded by an OS&Y gate valve with supervisory switch.

Valve Supervisory Switch and Valve Locks and Chains

- Valve supervisory switches shall be an OS&Y valve signaling unit of normally open position of rising stem gate valves.
- Each OS&Y gate valve serving the wet standpipe systems shall be locked in the open position and secured with a chain.
- Lock shall be cylinder padlock type extruded brass case, brass shackle with removable core, six pins, two 2-in case size and 11/16-in shackle. Lock shall be equal to units manufactured by Sargent Co. Model No. 63-756.
- Chains shall be straight link light duty carbon steel electrically welded. Inside link width shall allow lock shackle to pass through. Chain shall be of length suitable to secure OS&Y valve in the open position.
- Provide two spare lock cores and six master keys in a 8-in by 12-in by 4-in deep Type 302 stainless steel cabinet with continuous hinge lock and keyed door. Label in red "FIRE VALVE KEYS".

Alarm Check Valve

- Waterflow alarm check valve with retard chamber, electric circuit closer with one N.O. and one N.C. contact.

Rise Check Valve

- Rubber-faced check valve used wherever a check valve with a drain connection and gauge connections can be utilized. When used with a flow switch on wet pipe systems not requiring a mechanical alarm, this device can be used in place of an alarm check valve. These riser check valve assemblies shall include all trim associated with system.

Fire Department Connection (FDC) Check Valve

- Ductile iron body, brass seat, and rubber faced clapper assembly, hinged to a removable access cover for easy inspection and maintenance.

Water Motor Gong

- Shall be a mechanical device required to sound a local alarm with strainer. Designed for mounting on the outside of building wall above Fire Department pumper connection.

Miscellaneous Requirements

- Provide sprinkler branch lines OS&Y and control valves with tamper indicators monitored at the Central Control Station.
- Audible electrically operated sprinkler alarms specified under Division 16.
- Escutcheons: Chromium plated steel or chromium plated brass, either one piece or split patterns.

- Valve Directory: Plastic laminated on solid backing, giving number, location, and function of each valve.
  - Where it is necessary to operate more than 1 valve to control a section of piping, note this fact and show the number of second valve on directory.
- Inspector's Test Connections: One test pipe and valve connection of not less than 1 inch diameter, terminating in a smooth bore, ½" brass outlet, discharging through a suitable air gap connection to sanitary collection system.

9.2.4.5 Installation – Wet Pipe / Preaction

Install all the items in accordance with the applicable manufacturer's recommendations and approved shop drawings and approved installation drawings and as specified under this Section. All work shall be done by experienced mechanics.

Sprinkler Alarm Valve

Sprinkler Alarm Valve sight waste outlets and water gong drain shall be valved and extended to and over the nearest sprinkler waste outlet drain or as a through wall discharge to the exterior.

Drainage and Cleaning

- All parts of the sprinkler system shall be installed to permit drainage. All trapped sections must be provided with a drain.
- The system shall be thoroughly flushed through the flush connections before testing. If flow appears restricted the system shall be checked for blockage by foreign materials before testing.

Fire Sprinkler System

- Install system according to NFPA 13 "Standards for the Installation of Sprinkler Systems".
  - Place main piping with minimum 12 inch clearance between other mechanical and electrical services.
  - Branch piping shall clear light fixtures by at least 6 inches.
  - Where automatic sprinkler protection is indicated for suspended ceiling, install piping above ceiling in pendant position.
- Materials installed in fire sprinkler system shall be suitable for pressures and temperatures encountered. Installation shall be as required by NFPA and as specified.
- Protection to Materials and Equipment: Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. Upon completion of work, materials and equipment shall be thoroughly cleaned, adjusted, and operated.
- Provide test and drain lines as required by NFPA 13. Pressure gauges, signs, and other standard appurtenances shall be furnished as required for a complete installation according to NFPA 13.
- Install sprinkler piping so it can be thoroughly drained, and where practical, arranged to drain at the main drain valves. The main drain valve shall be capable of a full discharge test without allowing water to flow onto the floor. Drips and drains shall conform to NFPA 13.

Piping Joints and Methods of Connection

- Steel threaded pipe after cutting and before threading. Ream pipe and remove burrs. Make screw joints of lines tight with joint compound brush applied to male threads only. After installation, paint exposed threads as specified in the Painting Section.

Escutcheons

- Provide escutcheons on both side of piping in partitions, ceilings, and floors.
- Fit and firmly secure escutcheons to pipes passing through finished floors, ceilings and walls with escutcheons of sufficient outside diameter to cover sleeved openings.
- Set in fire retardant mastic.

Piping

- Run piping enclosed in wall chases, partitions, and ceilings where provided.
- Use reducing fittings for changes in pipe size. Bushings are not allowed.
- Use extra heavy pipe for nipples where unthreaded portion is less than 1-1/2”. Close nipples are not allowed. Use saddle nipples.
- Install piping to allow freedom of movement during expansion and contraction operations, without causing warping, by using expansion joints and pipe loops.
- Offset piping as necessary to avoid interference with other work and to maintain headroom.
- Provide proper drain and drip where necessary.
- Run pipe in the most direct, straight mechanical manner and properly graded.

Identification

- Identify piping, valves, and specialties as specified under general mechanical identification section.

Joints

- Make joints in screwed piping with acceptable compound on male threads only. Do not use lamp wick in joints. Threads shall be perfect, clean cut, and of properly length. Pipe shall be properly reamed after cutting and threading.
- Make flanged joints with full-face rubber gaskets or stainless steel.

Hangers and Supports

- Properly support piping by accepted hangers and supports.
- Chain, straps, perforated bar, or wire hangers are not allowed.
- Provide necessary supplemental steel for proper support or attachment of hangers.

Sleeves

- Provide sleeves large enough to accommodate pipes passing through floors, ceilings, walls, or partitions.
- Pack sleeves through firewalls or slabs according to UL requirements.
- Provide square ends projecting 2 inches above floor for sleeves through floors.
- Make sleeves passing through walls or beams flush with adjacent sides.
- Provide flashing for sleeves passing through roof.
- Make sleeves watertight (where required) by caulking space between pipe and sleeve.

Caps and Plugs

- Keep openings closed during construction with cast-iron or malleable caps, plugs, or blind flanges.

Pipe Anchors

- Provide anchors to support risers, to maintain pipes in position, and to properly regulate expansion.

Valves

- Control Valves
  - Place valves in readily accessible locations or with suitable means of access.
- Seal gate valves
  - Place valves in open position with riveted straps or wire and lead seals designed for this purpose.
- Alarm Valves, Variable Pressure
  - Provide in each main automatic sprinkler system riser, where indicated, an accepted variable pressure alarm valve complete with trim.

Circuit Closer Switch

- Designed for 100 volts AC with two pairs of reversible contacts for connection to and suitable for operation of the alarm system.

Inspector's Test Connections

- Extend from highest point of automatic sprinkler system to a point where discharge can be readily observed.
- Locate test valve at an accessible point, not over 7 feet from the floor.

Sprinkler Systems

Systems shall be tested and certified in conformance with the following test procedures:

- Preparation for Test
  - Open all line control valves in section to be tested.
- Relief Valve
  - A relief valve set to relieve at 20 to 25 percent above the test pressure shall be installed in series with a suitable pressure gage.
- Mechanical Joints
  - All tests shall include mechanical joints.
- Test Pressure
  - Test pressure shall be 250 psig or, in cases where the static pressure exceeds 200 psig, 50 psig above the static pressure.
- Test Procedure
  - Open supply main valve and flood system. High points shall be vented to remove all air from the piping.
  - Inspect all joints for leakage under normal operating pressure.
  - Shut off supply valve.
  - Using a low-volume pump capable of the required pressure, bring the system up to 250 psig or, in cases where static pressure exceeds 200 psig, static plus 50 psig on the pressure gage.
  - Hold this pressure for two hours.
  - Inspect for leaks. There shall be no apparent leaks in the entire system. Leaks, if encountered, shall be repaired and the system retested.

- Post-Test Procedure
  - Any equipment or parts added for the test shall be removed.

Certification

- Upon satisfactory completion of the test, a Sprinkler Approval Form shall be filed with the Code Enforcement Department by the Fire Prevention designated Inspector.

9.2.5 Performance Standards (Clean Agent System)

9.2.5.1 System Description

Performance Requirements: System shall be capable of automatically extinguishing electrical fires occurring on equipment, in the spaces, and in ductwork.

- Upon detection of products of combustion, the sensing devices shall:
- Sound the alarm.
- Activate the discharge head on chemical cylinder.
- Shut-of air handling equipment and exhaust fans.
- A local alarm and the building fire alarm shall be activated upon operation of fire suppression system.
- The automatic gas shut-off valve shall be of the mechanical type and be capable of manual reset. Electrical solenoid gas shut off valves are not allowed.

Material and Manufacturers Equipment: Fike, Walter Kidde & Company, Inc. or equal.

- Automatic Controls: Fike, Walter Kidde & Company, Inc. or accepted equivalent.
- Alarm Gongs: Grinnell, Star, or Viking.
- Joint Compound: White Tite Seal or accepted equivalent.

Equipment

- Materials used in system shall be approved by manufacturer of base equipment.
- Piping
  - Under 1 inch size: Galvanized steel, standard weight, schedule 40, ASTM A53; 1 inch and larger: Schedule 80.
  - Exposed: Chrome-plated or stainless steel pipe.
- Fittings
  - Galvanized threaded malleable iron; 1 inch or larger extra heavy; chrome-plated malleable iron or stainless steel fittings compatible with type of pipe used; 2-1/2" and larger: threaded 300 PSI black steel, or flanged 600 PSI black steel.
  - Flanges 2-1/2" and larger: 600 PSI, black steel.
- HFC-227ea Storage and Distribution
  - Each system shall have its own supply of clean agent.
  - The system design can be modular, central storage, or a combination of both design criteria.
  - Systems shall be designed in accordance with the manufacturer's guideline.
  - Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.

    - Engineered discharge nozzles shall be provided, within the manufacturers guidelines, to distribute the HFC-227ea agent throughout the protected spaces. The nozzles shall be Fike P/N 80-XXX designed to provide proper agent quantity and distribution.
    - Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using good, accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.

- Control Panel – Clean Agent
  - The Control System, and its components, shall be UL listed and FM approved for releasing service and be suitable for Deluge and Pre-action sprinkler service.
  - The Control System shall perform all functions necessary to operate the system detection, actuation and auxiliary functions, as outlined.
  - The Control System shall be capable of providing 7 Ah, 18 Ah, 33 Ah, or 65 Ah of battery standby power supplies.
  - The Control System shall be microprocessor based with hardware and software integration designed to guarantee reliability.
- Addressable Devices – Clean Agent
  - Photo/Ion/Thermal Detectors
    - The detectors shall be spaced and installed in accordance with the manufacturer's specifications and the guidelines of NFPA No. 72 – 1996 edition.
  - Solenoid Release Module (SRM)
    - The SRM shall be capable of supporting up to 2.0A @ 24 Vdc of releasing current.
  - Supervise Output Module (SOM)
    - The SOM shall be capable of supplying up to 2.0A @ 24 Vdc of supervised output current for connection to compatible bells, horns, strobes, etc.
  - Dual Relay Module (R2M)
    - The R2M, Fike P/N 55-023, shall be capable function programmable by the control panel. Each contact shall be capable of switching up to 2A @ 30 Vdc.
  - Fast Response contact Module (FRCM)
    - The FRCM shall be functionally identical.
    - The FRCM shall monitor normally open or normally closed contacts and shall be programmed for a variety of input types as defined in the programming.
- Manuel Release (Electric) – Clean Agent
  - The electric manual release switch shall be a dual action device which provides a means of manually discharging the Suppression System when used in conjunction with the Control System.
  - The Manual Release switch or Manual Pull station shall be a dual action device requiring two distinct operations to initiate a system actuation.
  - Manual actuation shall bypass the time delay and abort functions, shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.

  - A Manual Release switch shall be located at each exit from the protected hazard and shall have an advisory sign provided at each location.
  - The Manual Release or Manual Pull station shall be connected to a FRCM which is programmed for the intended function.
- Abort Station – Clean Agent
  - The optional Abort Station shall be the "Dead Man" type and shall be located next to each manual switch.
- Audible and Visual Alarms – Clean Agent
  - Alarm audible and visual signal devices shall operate from the Control Panel.
- Caution and Advisory Signs – Clean Agent
  - Provide signs, as required, to comply with NFPA 2001 and the recommendations of the equipment supplier:
    - Entrance sign: (1) required at each entrance to a protected space.
    - Manual Discharge sign: (1) required at each manual discharge station (
    - Flashing Light sign: (1) required at each flashing light over each exit from a protected space.
- Auxiliary Panels – Clean Agent
  - A Graphic Annunciator panel shall be mounted adjacent to the CONTROL PANEL. The graphic annunciator shall show a scale layout of the protected area(s) and have indicator lamps to locate each system detector and/or other system components. The panel shall have a lamp test switch located on the panel face. Other panel options shall be available. Scale shall not be less than 1/8" = 1'-0" (1:100m).
- System and Control Wiring – Clean Agent
  - All system wiring shall be furnished and installed as part of scope.
    - All wiring shall be installed in electrical metallic tubing (EMT), or conduit, and must be installed and kept separate from all other building wiring.
    - All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, installed parallel and perpendicular to walls and partitions.
    - The sizes of the conductors shall be those specified by the manufacturer. Color coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors.
    - The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

Installation

- Installation shall be made by authorized representatives of the fire control system manufacturer's company, and according to local and state codes and NFPA 17 and NFPA 96.
  - Installation shall be certified in writing by the installer to:
    - The Owner's insurance rating authority.
    - Local fire authority.

    - The manufacturer.

- The fire protection system provided shall be capable of detecting fire and automatically discharge chemical extinguishing agent into space. Design to extinguish the fire and produce a chemical reaction to ensure against re-ignition or reflash.
- Piping
    - Run piping enclosed where possible in wall chases, recesses, pipe shafts, wall partitions, and ceilings where provided.
        - Non-concealed piping shall run as inconspicuously as possible in schedule 40 chrome-plated (CP) piping or stainless steel piping.
- Joints
    - Make joints in screwed piping with acceptable compound on male threads only. Do not use lamp wick in joints. Threads shall be perfect, clean cut and of proper length. Pipe shall be properly reamed after cutting and threading.

System Description and Operation

- The system shall provide an HFC-227ea minimum design concentration by volume, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. System design shall not exceed the NOAEL value of 9.0%, adjusted for maximum space temperature anticipated, unless provisions for room evacuation, before agent release, are provided.
- The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, HFC-227ea agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional, U.L. Listed and/or F.M. approved HFC-227ea Clean Agent Suppression System.
- Provide two (2) inspections during the first year of service. Inspections shall be made at 6 month intervals commencing when the system is first placed into normal service.

System Inspection and Checkout

- After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards.

Training Requirements

- Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system Control Panel operation, manual and (optional) abort functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

Operation and Maintenance

- Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, four (4) copies for each system, to the owner. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

As-Built Drawings

- Upon completion of each system, the installing contractor shall provide four (4) copies of system “As-Built” drawings to the owner. The drawings shall show actual installation details including all equipment locations (i.e.: control panel(s), agent container(s), detectors, alarms, manuals and aborts, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed. One (1) copy of facilities modifications, including door and/or damper installations completed. One (1) copy of reproducible engineering drawings shall be provided reflecting all actual installation details.

Acceptance Tests

- At the time “As-Built” drawings and maintenance/operations manuals are submitted, the installing contractor shall submit a “Test Plan” describing procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the owner and shall not be conducted until the Test Plan has been approved.
- The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.
- A room pressurization test shall be conducted, in each protected space, to determine the presence of openings, which would affect the agent system concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA 2001 current edition.
- If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. **The suppression system installing contractor shall be responsible for the success of the room pressurization tests.** If the first room pressurization test is not successful, in accordance with these specifications, the installing contractor shall direct the general contractor to determine, and correct, the cause of the test failure. The installing contractor shall conduct additional room pressurization tests, at no additional cost to the owner, until a successful test is obtained. Copies of successful test results shall be submitted to the owner for record.
- Upon acceptance by the owner, the completed system(s) shall be placed into service.

System Inspections

- The installing contractor shall provide two (2) inspections of each system, installed under this contract, during the one-year warranty period. The first inspection shall be at the six month interval, and the second inspection at the 12 month interval, after system acceptance.

Inspections shall be conducted in accordance with the manufacturer's guidelines and the recommendations of NFPA 2001.

- Documents certifying satisfactory system(s) operation shall be submitted to the owner upon completion of each inspection.

Warranty

- All system components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

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Electrical

10.1 Description of Work

The project includes a new WTP at the SMH WTP site and wellfields. This portion of the RFP will cover only the electrical work for the project.

The design build requirements of this project includes the electrical service(s) from FP&L for the WTP and wellfields, including but not necessarily limited to 13,200 V primary cable installation, step down transformers and appurtenances and secondary service at 4,160 V, 3 phase, 4 wire, 60 HZ (impedance grounded) and 480V, 3 Phase, 4 Wire 60 HZ (solidly grounded) to the WTP and wellfields equipment. Additionally, the project shall include 4,160V and 480V distribution and equipment for utilization voltage at these facilities as described herein.

The Company shall provide a complete electrical system design and construction in accordance the contract requirements. The Electrical System installed and work performed under this section will include but not necessarily be limited to the following:

- Electrical service(s) including utility back charges
- Standby Diesel Engine Generator(s) and ancillary equipment
- Complete underground system
- Raceways, boxes and fittings
- Wires and cables
- Motor control centers
- Variable frequency drives and harmonic mitigating equipment if required
- Disconnect switches
- Dry type transformers
- Switchgear
- Panelboards
- Unit Substations
- Switchboard
- Convenience and special purpose outlets
- Lighting systems
- UPS for laboratory
- Data jacks for desktop computers
- Telephone
- IT network router
- Building Lightning protection system
- Grounding systems
- Power wiring and connections to electrical equipment provided under other Sections of this proposal

- Instrumentation and control wiring, as well as, connections to electrical equipment provided under Section 12 of this proposal
- Sustainability as defined herein

10.2 Basic Requirements

10.2.1 Codes and Standards

The Electrical Systems and components shall be designed in accordance with all applicable Federal, State and Local Codes and Standards including all amendments thereto including, but not necessarily limited to, the following:

- FBC Florida Building Code
- NESC National Electrical Safety Code
- OSHA Occupational Safety and Health Act
- NEC National Electrical Code
- NFPA National Fire Protection Association
- NEMA National Electrical Manufacturers Association
- ANSI American National Standards Institute
- ICEA Insulated Cable Engineers Association
- IEEE Institute of Electrical and Electronics Engineers
- IES Illumination Engineering Society
- IBC International Building Code
- NETA National Electrical Testing Association
- UL Underwriters Laboratories Inc. Standards
- FM Factory Mutual

Where reference is made to one of the above standards, the revision in effect at the time of submittal of construction documents to the Miami-Dade Building Department for construction permit shall apply.

10.2.2 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor. In addition, the following items shall be submitted by the Company for the County Technical Advisor's review prior to finalizing the design.

The Company shall establish and maintain a set of design guidelines which will be used for this Project:

- Analysis and studies
- Calculations
- Sizing tables
- Load tables
- Cable pulling calculations
- Manufacturers' application brochures
- Lighting calculations
- Standby generator

Copies of the design guidelines shall be submitted to the City's Advisor.

The following studies shall be performed for the design of the electrical systems at each site:

- Power system load analysis including normal and standby power systems
- Load flow analysis
- Harmonic analysis
- Equipment sizing calculations
- Voltage drop calculations
- Motor starting voltage dip calculations
- Short circuit analysis
- Lighting calculations
- Protective device coordination analysis
- Arc flash hazard analysis
- Provide arc flash hazard warning labels on all pieces of equipment which allow access to live parts. Labels shall be in compliance with the NEC, IEEE 1584 and NFPA 70E.
- Generator sizing calculations including instantaneous voltage dip calculations
- Proposed Sustainability required items

Studies shall be provided to the County Technical Advisor and shall be stamped by a Professional Electrical Engineer registered in the State of Florida.

The Company shall prepare and submit design and construction drawings as specified herein to the County Technical Advisor to show the design and the intended electrical installations for construction. The Company shall use the standard symbols typically shown on electrical drawings. All design and construction submittals shall be stamped by a Professional Electrical Engineer registered in the State of Florida.

10.2.3 Construction Submittals

The Company shall submit construction information on the products and materials related to the work in this Section to the County Technical Advisor. In addition, additional pieces of information shall be furnished to the County Technical Advisor as specified herein.

The Company shall submit to the County Technical Advisor manufacturers' data and catalog sheets for the pieces of equipment and materials where detailed submittal requirements are not specified. Applicable portions and/or part numbers shall be highlighted or pointed to with red arrows or equal designation.

10.2.4 Performance Standards

Motors shall be premium efficient and meet the efficiency requirements of the EISA (Energy Independence and Security Act) and NEMA EPAct (Energy Policy Act).

Transformers shall meet the efficiency requirements of the Department of Energy.

Variable frequency drive harmonics shall be limited to the levels established in the latest revision of IEEE 519.

Illumination levels shall meet the minimum guidelines established in the latest revision of the IES.

Illumination power density shall not exceed the limitations established in the latest revision of the FBC.

Voltage drop shall be limited to the percentages recommended in the latest revision of the NEC.

Diesel engine generator emissions shall meet EPA Tier 4 requirements.

10.2.5 Redundancy, Safety and Reliability Requirements

The electrical system for the SMH WTP shall obtain normal utility power from the following two separate FPL feeders:

- 13.2 kV FPL feeder No. 7334 from SW 117th Ave.
- 13.2 kV FPL feeder No. 7338 from SW 117th Ave.

Each feeder shall be capable of powering the entire WTP together with the Canal C-1 wellfield and the Roberta Hunter Park wellfield.

The FPL feeders shall be installed through an FPL easement in a concrete encased ductbank to be designed and furnished by the Company.

Each FPL feeder shall feed a 13.2-4.16 KV primary substation transformer designed, installed operated and maintained by the Company.

The 13.2 KV FPL feeder from the FPL pole on SW 208th St which currently provides utility power to the existing high service pump station shall remain in service. This feeder shall not feed the WTP.

Emergency power shall be furnished by on-site diesel engine driven standby emergency generators. The on-site diesel engine generators shall be sized to carry all essential plant loads in the event of a utility power interruption, allowing full plant production without altering normal plant operating procedures, while one generator is out of service for maintenance. In addition, the standby generators shall provide emergency power to the high service pump station, C-1 Canal wellfield, and the Roberta Hunter Park wellfield. The maximum voltage dip when starting the largest single piece of equipment while already carrying the remaining plant loads shall be 20%. The on-site diesel fuel storage tanks shall have sufficient capacity for 72 hours of plant operation on generator power.

For redundancy and reliability the in plant distribution system and equipment shall be designed to prevent common mode failures that render the plant's ability to process water inoperable. The following minimum requirements for redundancy and reliability apply:

- Main switchgear shall be main-tie-tie-main (secondary selective configuration) with auto transfer controls between utility sources and generator.
- Dual bussed switchboards and dual MCCs, (secondary selective configuration) with similar loads equally divided between each side of the switchboard or each pair of MCC's.
- Each dual ended switchgear or switchboard, and each pair of MCC's shall have double tie circuit breakers.
- Medium voltage switchgear, low voltage switchgear and MCC's shall have arc flash resistant construction and arc flash labels.
- To the extent possible, medium voltage and low voltage switchgear, motor control centers and panelboards shall be the products of a single manufacturer, who shall also prepare the short circuit and coordination study for the plant.
- LV distribution equipment feeding process critical components such as PLCs shall be powered from dedicated uninterruptable power supplies (UPS's) with 30 minutes of battery time under full load and make-before break maintenance bypass switches.
- Pairs of primary or secondary substation transformers feeding each side of dual ended switchgear shall be sized so that a single transformer will be capable of feeding the entire

estimated running load of both sides of the switchgear with the other transformer out of service. The transformer's fan-cooled overload rating may be used to achieve this capacity. Liquid-filled transformers shall have FR-3 environmentally friendly or vegetable oil and a temperature rise of 55°C.

- Pairs of primary substation transformers shall be separated by a fire/blast rated wall.
- The distribution system shall include 20% spare capacity in the main feeders to the service entrance switchgear, MCC, power panels, etc. as well as 20% spare capacity in the main bus. In addition there shall be 10% spare circuit breakers and motor starters and space for 10% more.
- Lighting panels shall have 20% spare capacity and circuit breakers and 10% spaces for additional circuit breakers.
- Lighting and power panels shall be powered from both sides of the tie circuit breaker. Provide manual transfer between the sources.
- Main underground power cables between buildings shall be installed in concrete-encased ductbanks.
- The main fiber optic communication cable described in Section 13 shall be installed in a concrete encased ductbank when routed between buildings.
- Lighting levels shall meet the minimum requirements established by IES for each type of area.
- All electrical equipment shall be new and unused.
- All electrical equipment shall be UL listed and labeled.

10.2.6 Utilization Voltage

Utilization voltage throughout the plant shall be as follows:

- Incoming FPL service: 13.2 kV, 3 phase, 4 wire.
- In-plant distribution voltage: 4.16 kV, 3 phase, 3 wire impedance grounded.
- Large motors and VFD's: 400 HP and greater: 4.16 kV
- Motors ½ to 350 HP and VFD's: 480 V, 3 phase
- Motors less than ½ HP: 120V, 1 phase
- General process utilization equipment: 480 V, 3 phase, 3 wire, solidly grounded.
- Low voltage lighting: 120V, 1 phase
- Roadway lighting: 120V, 1 phase
- Facility lighting: 120 V, 1 phase.
- Motor control: 120 V, 1 phase.

10.2.7 Power Monitoring Requirements

Power monitors shall be furnished for each 4160 V switchgear main, generator tie, 480 V switchgear main and MCC main. Power monitors shall be Siemens Model 9600 or most current model number by Siemens at the time of equipment delivery. Associated software and hardware shall be included as necessary to utilize all of the power monitor's functions.

10.2.8 Switchgear Protective Relaying

Feeder protection, motor protection and bus protection shall accomplished by the use of micro-processor based, solid state protective relays. Relays shall be as manufactured by Basler, G.E., or Schweitzer. Relays shall be used for the following protective functions:

- Under Voltage (27)
- Over Voltage (47)
- Current Unbalance (46)
- Over Current (51)
- Ground Fault (51G)
- Over / Under Frequency (81)
- Differential (87)
- Bus Differential (87B)
- Motors less than ½ HP: 120V, 1 phase

10.2.9 Switchgear Source Transfer Controls

Upon loss of utility power at the WTP, the main circuit breakers shall open, and the station tie circuit breakers shall close. Closing of the station tie circuit breaker shall signal the generators to automatically start and parallel to a common generator bus. Generator tie circuit breakers shall close, powering the WTP from the generators. Return to normal power shall be open transition. In the event of a loss of power at the high service pump station, the generators shall automatically start and feed the high service pump station through a transfer switch arrangement.

10.2.10 Grounding

The 4,160 V system shall utilize a low impedance ground with ground-fault relaying.

The low voltage, 480 V and 120 V systems shall be solidly grounded.

10.2.11 Underground Ductbanks

Main underground concrete encased electrical ductbanks shall be routed along the main access roads. Ductbanks shall not be routed through areas reserved for future expansion. Concrete encased ductbanks shall be installed as follows:

- Located on one side of the street to ensure access to plant facilities during repairs or maintenance of feeders.
- Reinforced with rebar when installed under roads.
- Feeder capacity calculations shall include inductive heating resulting from multiple parallel runs of conductors per NEC 310.
- Feeders originating from Bus A or Bus B of the main service switchgear shall not be in common handholes and manholes.
- Low voltage feeders shall not occupy the same manholes as medium voltage feeders.
- Signal or data highway cabling shall not occupy the same handholes as 480 V voltage feeders.
- Incoming FPL service: 13.2 kV, 3 phase, 4 wire.

10.2.12 Equipment Enclosure Requirements

The following criteria shall be used for equipment enclosure requirements:

- NEMA 1 painted steel - dry, non-process indoor locations.
- NEMA 12 painted steel – indoor dry process areas, including electrical rooms.
- NEMA 4X, 316 stainless steel: indoor damp, wet or corrosive areas and outdoor areas.
- NEMA 7: for classified (hazardous) areas.

10.2.13 Equipment Environmental Requirements

Switchgear, switchboards, MCC's and VFD's shall be located in air conditioned rooms.

Ceiling height in switchgear rooms shall be 15'-0" minimum, or as required for arc flash resistant gear.

Dry type transformers shall be located in ventilated rooms. Liquid type transformers shall be located outdoors on concrete pads, protected either by bollards or block walls. Transformer room or vault construction shall meet the requirements of NEC Article 450.

10.2.14 Primary Unit Substations

The switchboard and Transformer(s) shall be designed, built and tested in accordance with the latest revision of the following standards:

- ANSI C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.
- NEMA Standard TR1 - Transformers, Regulators and Reactors.
- IEEE Sta. 462A, B-1978 "Short Circuit Requirements Supplement to ANSI C57.12.00-1973".
- ANSI C57, 12.27 "Conformance Requirements for Liquid Filled, Distribution Transformers used in Pad Mounted Installations, including Unit Substations

Coolant and insulating fluid shall be FR-3 or vegetable oil.

Switchgear shall be Power Vac by General Electric VacClad-W by Cutler Hammer or VACARC Series 3 by Square D Company.

10.2.15 Medium Voltage Switchgear

The switchgear and components shall be designed, built and tested in accordance with the latest revision of the following standards:

- NEMA SG.5 - Power Switchgear Assemblies.
- NEMA SG.4 - Alternating - Current High - Voltage Circuit Breakers.
- ANSI C37.20.2 - Standard for Metal-Clad and Station-Type Cubicle Switchgear
- Underwriters Laboratories (UL) Standards for Medium Voltage Switchgear.

Source transfer controls shall utilize GE Fanuc programmable logic controllers (PLC).

Each breaker shall be electrically operated at 125 volts DC from two redundant station battery consoles.

Main and riser bus shall be tin plated copper

Switchgear shall be Power/Vac by General Electric, VacClad-W by Cutler Hammer/Westinghouse; or VACARC Series 5 by Square D Company.

Switchgear shall have arc flash resistant construction.

10.2.16 Medium Voltage Variable Frequency Drives

The medium voltage VFD's shall be rated for the HP, full load current and rpm of the motor furnished.

The VFD manufacturer shall furnish an isolation/phase shift transformer, unless the VFD uses Active-Front-End technology

The variable frequency drives shall be variable torque design.

Surge arrestors shall be porcelain station class.

Power unit fan loss protection shall be by automatically switching to a 100% spare cooling fan.

The VFD shall be of the minimum 24-pulse or Active-Front-End

The medium voltage VFD's shall be Allen Bradley, Toshiba or ABB.

10.2.17 Secondary Unit Substations

The fused, primary, air insulated, load break switch shall be designed, built and tested with the latest revision of the following standards:

- ANSI/IEEE C37.20.3 - Standard for metal-enclosed interrupter switchgear
- ANSI/IEEE C37.20.4 - Indoor AC switches (1 kV-38 kV) for use in metal-enclosed switchgear
- ANSI/IEEE C37.22 - Preferred rating and related required capabilities for indoor AC medium-voltage switches used in metal-enclosed switchgear
- ANSI/IEEE C37.57- Metal-enclosed interrupter switchgear assemblies - conformance testing
- ANSI C37.58 - Indoor AC medium-voltage switches for use in metal-enclosed switchgear – conformance test procedures
- IEC 60420 - High-voltage alternating current switch-fuse combinations (test duties 4 and 5).

The primary fused switch shall have arc-flash resistant construction.

The liquid filled transformer shall be designed, built and tested with the latest revision of the following standards:

- ANSI C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
- ANSI C57.12.10 American National Standard for Transformers 230kV and Below – 833/958 through 60,000/80,000/100,000kVA, Three Phase Without Load Tap Changing;- Safety Requirement
- NEMA TP1 Guide for Determining Energy Efficiency for Distribution Transformers.
- NEMA TR1 Transformers, Regulators, and Reactors
- IEEE C57.12.90 Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- IEEE C57.12.70 Terminal Markings and Connections for Distribution and Power Transformers.
- IEEE C57.12.98 IEEE Guide for Transformer Impulse Tests.
- IEEE C57.109 Guide for Liquid Immersed Transformer Through-Fault-Current Duration.
- IEEE C57.120 Loss Evaluation Guide for Power Transformers and Reactors
- IEEE C57.131 IEEE Standard Requirements for Load Tap Changers
- IEEE C62.22 Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems

The transformer shall be suitable for outdoors, NEMA 3R rated or better, and shall resist 150 MPH wind loads.

The transformer shall carry its continuous rating with average winding temperature rise by resistance that shall not exceed 55 degrees C,

The transformer shall have FR3 or vegetable oil filled and shall be less flammable in accordance with the latest edition of the NEC. High fire point fluids shall be Factory Mutual and UL listed.

Transformer windings shall be copper.

Refer to Section 11.2.18 for low voltage switchgear requirements.

10.2.18 Low Voltage Switchgear

Low voltage switchgear shall be designed, built and tested in accordance with the latest revisions of the following standards:

- ANSI C37.20.1 - Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
- ANSI C37.20.1A - Metal Enclosed Low Voltage Power Circuit Breaker Switchgear-Amendment 1: Short Time and Short Circuit Withstand Current Tests Minimum Areas for Multiple Cable Connections.
- ANSI C37.13.1 - Definite Purpose Switching Devices for Use in Metal-Enclosed Low-Voltage Switchgear
- ANSI C37.17 - Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers
- ANSI C37.50 - Test Procedures for Low Voltage AC Power Circuit Breakers Used In Enclosures.
- ANSI C37.90.1 - Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- NEMA SG3 - Low voltage power circuit breakers.
- NEMA SG5 - Switchgear assemblies.
- NETA ATS - Acceptance Testing Specifications.
- NFPA 70 - National Electric Code
- UL1558 - Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
- UL 1066 - Low Voltage AC and DC Power Circuit Breakers Used in Enclosures

Low voltage switchgear shall be free-standing, dead-front type metal-enclosed switchgear equipment, utilizing drawout power circuit breaker devices.

Low voltage switchgear shall have arc flash resistant construction.

Switchgear busses shall be tin-plated copper.

Low voltage switchgear shall be: Magnum DS by Eaton/Cutler Hammer, Power Zone 4 by Square D, or AKD 20 by General Electric.

10.2.19 Low Voltage Motor Control Centers

Motor Control Centers and all components shall be designed, manufactured and tested in accordance with the latest revisions of the following standards:

- ANSI C37.50 - Test Procedures for Low-Voltage AC Power Circuit Breakers Used In Enclosures.
- NEMA ICS 1 - Industrial Control and Systems General Requirements
- NEMA ICS 2 - Standard for Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC
- NEMA ICS 2.3 - Industrial Control & Systems: Controllers. Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers
- NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices
- NEMA ICS 6 - Industrial Control and Systems: Enclosures
- NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency A.C. Power Drive Systems
- NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)

- ANSI/IEEE C37.13 - Low Voltage AC Power Circuit Breakers Used in Enclosures.
- ANSI/IEEE C37.90.1 - Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- ANSI/IEEE C62.41-1991 - Surge Withstand Capacity
- ANSI/IEEE 519 - Standard Practices and Requirements for Harmonic Control in Electrical Power Systems
- ANSI/IEEE 1531 - Guide for the Specification and Application of Active Harmonic Filters
- NETA ATS - Acceptance Testing Specifications.
- NFPA 70 - National Electric Code.
- UL 845 - Standard for Safety Motor Control Centers.
- UL 489 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
- UL 508 - Industrial Control Equipment
- UL508C - Power Conversion Equipment
- UL 1066 - Low Voltage AC and DC Power Circuit Breakers Used in Enclosures.

Motor control centers shall have arc flash resistant construction.

Motor control center buses shall be tin plated copper.

Manufacturers:

- Square D Company
- General Electric Company
- Eaton/Cutler - Hammer

10.2.20 Low Voltage Variable Frequency Drives

18 pulse drive systems shall be provided for motors from 100 HP to 350 HP.

6 pulse drive systems with line reactors shall be provided for motors up to and including 75 HP.

To the maximum extent possible, all VFDs shall be provided by the same manufacturer, who shall furnish the harmonic analysis for the entire facility to verify compliance with IEEE 519, latest edition.

Manufacturers:

- ABB Drives Division
- Allen Bradley
- Siemens/ Robicon

10.2.21 Diesel Engine Driven Standby Generators

The diesel engine driven standby emergency generators shall be designed, built and tested in accordance with the latest revisions of the following standards:

- NFPA 70 - National Electrical Code
- NFPA 30 - Flammable and Combustible Liquids Code.
- NFPA 37 - Standard for Installation and use of Stationary Combustible Engine and Gas Turbines.
- NFPA 70 - National Electrical Code.
- NFPA 110 - Standard for Emergency and Standby Power Systems.
- NEMA MG1 - Motors and Generators.

- NEMA MG2 - Safety Standard for Construction and Guide for Selection, Installation and Use of Motors and Generators.
- NEMA AB1 - Molded Case Circuit Breakers.
- ISO STD 8528 - Reciprocating Internal Combustion Engines.
- ISO STD 3046 - Performance Standard for Reciprocating Internal Combustion Engines.
- UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.
- UL 508 - Industrial Control Equipment.
- UL 2200 – Stationary Engine Generator Assemblies
- EGSA - Electrical Generating Systems Association.

The diesel engine generator set shall be EPA Tier 4 rated.

The engine and generator shall be 1800 RPM, rated for standby service. Provide diesel fueled engine driven generators for standby power in accordance with NFPA 110 and NEC 701. Generators shall to conform to UL 2200.

Generator enclosures shall be walk-in, weatherproof, sound attenuated, and meet the requirements of the Florida Building Code, latest edition.

Generator manufacturers:

- Caterpillar
- Cummins

Investigate the feasibility of using the generator in Peak Shaving /Demand Reduction applications.

Fuel storage tanks shall be sized for a minimum of 72 hours of useable at full rated load without refilling the tank.

10.2.22 Motors

Motors shall be designed, built and tested in accordance with the latest revision of the following standards:

- NEMA MG1 - Motors and Generators [2006]
- NEMA MG2 - Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators [2001]
- NEMA MG3 - Sound Level Prediction for Installed Rotating Electrical Machines [2000]
- NEMA MG10 - Energy Management Guide for selection and use of Polyphase Motors [1999]]
- NFPA 70 - National Electric Code [2005]
- UL 674 - Motors and Generators, Electric, for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F and G.
- IEEE 841 - Standard for Petroleum and Chemical Industry - Severe Duty Squirrel Cage Induction Motors Motors - Up to and Including 500 HP [2001]
- IEEE 43 - Recommended Practice for Testing Insulation Resistance of Rotating Machinery [2000]
- IEEE 85 - Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery [1986]
- IEEE 95 - Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage [1991]

- IEEE 112 - Standard Test Procedure for Polyphase Induction Motors and Generators [2004]

Motors connected to Variable Frequency Drive Controllers shall be inverter duty. Motors shall not be overloaded at any operating condition. Motors shall have a service factor of 1.15, copper windings, Class F insulation or better, Class B temperature rise or les, and shall be premium efficient.

To assure unity of responsibility, the motors shall be furnished and coordinated by the manufacturer of the driven equipment. The Company shall assume responsibility for the satisfactory installation and operation of the entire system as specified.

10.2.23 Panelboards

Panelboards shall be in accordance with the Underwriter Laboratories (UL) "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist.

Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).

Panelboards shall have tin plated copper busses.

Panelboards shall be fully rated. Series rated panelboards are not acceptable.

Panelboards shall be manufactured by Cutler Hammer, Square D or General Electric.

10.2.24 Conduit Applications

Aluminum exposed conduit in non-corrosive process areas.

PVC coated GRS conduit in corrosive areas.

PVC Schedule 80 underground, except for analog signal wiring.

PVC Schedule 40 conduit for concrete encased ductbanks (except for analog wiring).

GRS conduit for analog signal wiring (PVC coated GRS in corrosive areas).

EMT conduit for office areas (EMT is not allowed in electrical or mechanical rooms).

All wiring, including low voltage fire alarm, access control and telephone wiring, shall be installed in conduit.

10.2.25 Wire and Cable Applications

All conductors shall be copper.

Medium voltage: EPR insulated, 133% rated, bare copper tape shield.

Low voltage conductors: RHW insulation for sizes 250 kcmil and larger, XHHW insulation for sizes 4/0 and smaller.

Splices shall not be allowed except as approved in writing the County Technical Advisor.

10.2.26 Lightning Protection System

Provide a complete lightning protection system for the SMH WTP and wellfield in accordance with UL96A and NFPA 780

The lightning protection system shall be aluminum type comprised of air terminals, roof cables, connections and fasteners.

10.2.27 Lighting Fixtures

- HID metal halide fixtures for roadway and sidewalk light poles
- HID metal halide fixtures for outdoor process areas

- HID metal halide fixtures for high bay process areas
- HID metal halide fixtures for low bay process areas
- Fluorescent light fixtures for electrical rooms
- LED light fixtures for the LEED administration building and LEED parking lots

10.3 Specific Requirements

The electrical systems shall be designed and constructed in accordance with the Company requirements and as outlined herein. The complete electrical system including labor, materials, equipment, testing, startup, commissioning, and documentation required for complete operable electrical installation shall be provided. The Company shall be responsible for the detailed design and installation of the electrical system.

The Company shall design the power distribution system to meet the State of Florida requirements for critical operations facilities.

The Company shall provide complete systems in accordance with the intent of the Technical Requirements. Furnish and install all incidental items, but which are required by good practice to provide complete functional systems. Provide complete raceway systems including all fittings, devices, boxes, and other items needed for a functional raceway system.

The Company shall coordinate the details of all pieces of equipment and construction for all trades which affect the work covered under this section.

The Company shall design and specify all lighting, motors and systems to a high level of energy efficiency and shall meet the latest energy rebate criteria from FP&L.

The Company shall include at least three sustainability features in their electrical design. The proposed sustainability features shall be listed in the Company's proposal.

The Company is responsible for electric service and standby power at the WTP, the existing high service pump station and the wellfield.

The Company shall provide standby diesel engine generator(s) as required allowing for full undiminished plant production during periods of utility power failure. In addition generator(s) shall be sized to carry the existing high service pumps station, the C-1 canal wellfield and the Roberta Hunter Park wellfield, together with the building support system electrical loads.

Refer to the following drawings for additional electrical system guidelines:

- E-1: Electrical Symbols and Abbreviations
- E-2: 4,160 Volt Switchgear Single Line Power Diagram
- E-3: 4,160 Volt Switchgear Single Line Power Diagram (Continued)
- E-4: Generator Switchgear Single Line Power Diagram
- E-5: 480 V Switchgear Single Line Power Diagram

10.3.1 Utility Power Supply

The utility company supplying service for this project is FP&L. The Company shall be responsible for all coordination and paying all fees including back charges required to provide utility service(s) to the WTP and wellfield. This includes but is not necessarily limited to the following:

- Two new primary services at 13.2 kV.Primary underground concrete encased conduits and conductors

- FPL area with concrete pads for FPL primary vacuum switches, sectionalizing cabinets, Powell-ESCO transfer switches and metering equipment.
- Temporary construction power requirements

10.3.2 Electrical Studies and Calculations

The Company shall provide engineering services and reports for the following studies and calculations to be submitted to the County Technical Advisor during the design phase and construction phase as noted below:

Electrical Systems Analysis

- General
  - The Company shall obtain and pay for the services of the independent engineering specialty firm to provide both a preliminary and a final fault current short circuit, selective coordination study; arc flash study; and harmonic study of the complete electrical distribution system as specified herein. The study shall include motor starting/running calculations:
- Referenced Standards
  - Institute of Electrical and Electronic Engineers, Inc. (IEEE):
    - Standard 141, Recommended Practice for Electrical Power Distribution for Industrial Plants
    - Standard 241, Recommended Practice for Electrical Power Systems in Commercial Buildings
    - Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Systems
    - Standard 399, Recommended Practice for Industrial and Commercial Power System Analysis
  - American National Standards Institute (ANSI):
    - Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
    - Standard C37.91, IEEE Guide for Protective Relay Applications to Power Transformers
    - Standard C37.95, IEEE Guide for Protective Relaying of Utility-Consumer Interconnections
    - Standard C37.96, IEEE Guide for AC Motor Protection
    - Standard C57.12.59, IEEE Guide for Dry-Type Transformer Through-Fault Current Duration
    - Standard C57.13, IEEE Standard Requirements for Instrumentation Transformers
    - Standard C57.109, IEEE Guide for Liquid-Immersed Transformer Through Fault-Current Duration
  - National Fire Protection Association (NFPA)
    - NFPA 70 National Electrical Code (with Florida Amendments)
    - NFPA 70E Electrical Safety in the Workplace

- Fault Current, Short Circuit and Selective Coordination Study
  - Short circuit, protective device coordination and motor starting studies shall be performed on nationally recognized computer software such as SKM System Analysis, EDSA, ETAP, or approved equal.
  - The study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and including the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with emergency and standby generators, and the associated paralleling equipment and distribution switchgear. All information required to perform the study shall be obtained by the entity performing the study.
  - Submit a preliminary short circuit, selective coordination and motor starting/running study prior to submittal of electrical distribution equipment shop drawings.
    - The preliminary study shall verify equipment is being applied within their design ratings and electrical protective devices will be coordinated.
    - Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments, and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the Company at no additional cost.
  - Submit a final short circuit, selective coordination and motor starting/running study.
    - Provide a report summarizing the selective coordination and motor starting/running study including: one-line diagram of the system, relay and breaker setting tabulation, coordination curves, relay curves, circuit breaker curves, motor starting/running curves, protective device coordination and short circuit calculation, all prepared by the specialty firm.
    - Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the Company at no additional cost.
- Arc Flash Study
  - The Arc Flash Study shall include the following information:
    - An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.
    - Provide a detailed bus label for each fault location. Each label shall include a listing of the protective device settings and incident energy at several different working distances.

  - Provide A NFPA 70 E work permit form for each fault location.
  - Provide a bus label for each fault location. The label shall include a summary of the flash boundary, incident energy, PPE classification and the Limited, Restricted and Prohibited Approach boundaries based on the nominal system voltage.
  - PPE Table – Provided a PPE table that defines the Personnel Protective Equipment classes and clothing descriptions identified in the reports and labels.
  - Provide arc flash hazard warning labels on all pieces of equipment which allow access to live parts. Labels shall be in compliance with the Florida Building Code, IEEE 1584 and NFPA 70E.

Harmonics Study

- Provide an electrical system harmonics study for the WTP. The goal of the study shall be to determine requirements for the drives, transformers and filters as required to comply with the harmonic distortion levels (current and voltage) allowed per IEEE Standard 519. In addition, the study shall verify stability of the standby generator(s) operation (if harmonic filters are used).
- The harmonics study shall verify compliance with the harmonics and line notching requirements and shall provide information on the filter system (if necessary) required to achieve the specified levels. The study shall be submitted in IEEE format and contain as a minimum the following:
  - All input data and assumptions.
  - Explanation of method used to perform the study.
  - Explanation of study results with specific recommendations on filters and/or other measures that will be implemented to meet the specified limits.
  - All calculations and/or computer printouts used to arrive at the recommendations.
  - Individual drive harmonic content and the combined total drives harmonic content reflected in the system source supply voltage as a percent of the 60 Hz fundamental under actual load conditions at full load speed. Data shall be presented in tabular form similar to as depicted in Tables 13.2 and 13.3 of IEEE 519.
  - A detailed description of the tests, the procedures and supporting calculations required to substantiate the installed systems compliance with the specified THD limits.
- Under normal operating conditions, harmonic currents introduced into the power system supply network from the variable frequency drives shall not exceed the distortion limits for a general system as defined in IEEE Standard 519, when measured at the point of common coupling. The following short circuit information is preliminary. Exact short circuit data shall be obtained from the power company serving this facility prior to performing the harmonic analysis which is submitted for review and approval by the Company.
- Under emergency operating conditions, harmonic currents introduced into the power system supply network from the variable frequency drives shall be within the distortion limits for a dedicated system as defined in IEEE Standard 519, when measured at the point of common coupling.
- In addition to the distortion factor limitation specified, the drives shall not create line notching in excess of the limits called for in Table 2 of the IEEE 519 guideline. These limits shall be met

for the same conditions specified above. The total distortion shall be below the levels identified by IEEE 519 for both voltage and current.

- The harmonic analysis shall include a system impedance diagram based on the electrical one line diagrams. The VFD manufacturer shall coordinate with the manufacturer of the standby generator(s) to obtain the generator impedance data for the study.
- As a minimum, provide input line reactors for all drives furnished under this Section. Line reactors shall:
    - Provide a minimum of 5 percent line impedance.
    - Be capable of handling of 150 percent overload for at least one minute.
    - Have a saturation rating which is no less than 3.5 times rated continuous current.
    - Be UL and CSA recognized or approved.
- If the specified harmonic distortion limits cannot be obtained by the addition of line reactors, or if required to meet the specified input true power factor, the drive manufacturer shall provide shunt type harmonic filters. Filters shall be a second order high pass design utilizing line reactors, capacitors and damping and bleeder resistors. Provide an input line contactor with overcurrent and short circuit protection. Line contactor shall be interlocked with VFD operation and shall include blown fuse and filter overtemperature shutdown interlocks, with contacts for remote alarm.

Voltage Drop Calculations

Lighting Calculations

Generator Sizing and Instantaneous Voltage Dip Calculations

Studies and calculations shall be submitted and shall be stamped by a Professional Electrical Engineer registered in the State of Florida.

10.3.3 Power Distribution System

The main incoming electrical service to the primary unit substations shall be 13,200 V, 4-wire . The neutral conductor shall be terminated in the service entrance cabinet and shall not be used at any point beyond.   Loads shall not be connected between line and neutral at the 4,160 V and 480 V level. The generator voltage system shall be 4,160 V, 3 phase, 3 wire and shall function in like manner.

Downstream of the main switchgear, the secondary distribution system will consist of 4,160 V and 480 V, 3-phase, 3-wire and 208/120 volt, 3-phase, 4-wire power systems and equipment.

Voltage drop for feeders and branch circuits shall be in accordance with the National Electrical Code requirements.

10.3.4 Primary Unit Substations

The switchgear and transformer shall be designed, built and tested in accordance with the latest revision of the following standards: ANSI C57.12.00, NEMA Standard TR1, IEEE Sta. 462A, B-1978, ANSI C57.12.00-1973" and ANSI C57, 12.27.

The average temperature rise of the windings, measured by the resistance method, shall be 65° C when the transformer is operated at rated MVA output in a 40° C ambient. The transformer(s) shall be capable of being operated at rated load in a 30° C average, 40° C maximum ambient. The insulation system shall allow an additional 12% MVA output at 65 degrees C average winding temperature rise by resistance, on a continuous basis at full rated MVA load, without any decrease in normal transformer life.

Coolant and insulating fluid shall be FR-3 or vegetable oil.

Terminations shall be side-wall mounted for close-coupling to high voltage switch on the primary side and terminating in an air-filled terminal chamber for cable connections to the secondary voltage side.

Bushing location and phase rotation shall be coordinated with primary and secondary switchgear to provide correct alignment when switchgear and transformer are connected in the field.

The transformer(s) shall two 2-1/2% full capacity above normal and two 2-1/2% full capacity below normal taps. Impedance shall be 6.50%, ±7-1/2%. Basic impulse level of the primary winding shall be 95 kV. As specified in ANSI C57.12.00 for comparable kV class.

Sound level, as measured by the NEMA audible sound-level test procedure, shall be less than 64db when the transformer(s) are operated at normal voltage and frequency and no load.

The transformers shall be of sealed-tank construction of sufficient strength to withstand pressures 25 percent greater than the required operating design without permanent distortion. All seams and joints shall be continuously welded. When required, cooling panels will be provided on the back and front of the tank. Lifting eyes and jacking pads shall be provided.

Coils shall be wound with copper conductors.

Core and coil assembly shall be the wound core type, providing 5-legged construction. Cores shall be fabricated of high grade, grain-oriented, silicon steel laminations, carefully annealed after fabrication to restore high magnetic permeability. Magnetic flux is to be kept well below the saturation point. Windings and internal leads shall be copper, insulated and braced to prevent phase flashovers during fault conditions.

Tank, radiators, and terminal chambers, shall be treated to remove oil and scale by either shotblast or phosphatizing treatment to provide proper paint adhesion. All exterior surfaces shall be primed, using a high quality solid two-paint catalyzed epoxy. Minimum dry film thickness shall be 2 mils. A durably hard polyurethane top coat with a minimum dry film thickness of 1 mil shall be applied to all primed surfaces. The color of the finish coat shall match the primary switchgear and air terminal sections.

Switchgear Construction

Power circuit breakers shall have the following symmetrical ratings in accordance with ANSI Standard C37.06:

- Nominal 3 phase interrupting rating: 500 mVA
- Nominal voltage class: 13.8 kV, RMS
- Maximum rated voltage: 15.0 kV, RMS
- Crest impulse voltage (BIL): 95 kV
- Maximum interrupting capability: 23,000 Amps, RMS
- Rated interrupting time: 5 cycles
- Closing and latching current: 37,000 Amps, RMS.

The bus shall be designed to carry its rated continuous current in the specified ambient temperature without exceeding the temperature rise limits specified in ANSI Standard C37.20.2. The bus supports, bus and connections shall be designed to withstand the specified circuit breaker close and latch short circuit current. Line and load bus connections to circuit breakers shall be rated to carry the full continuous current of the device frame.

The switchgear and protective devices shall be designed for continuous operation at its rated current in a 50 degree C ambient temperature.

Switchgear shall be Power Vac by General Electric VacClad-W by Cutler Hammer or VACARC Series 3 by Square D Company.

Switchgear shall be outdoor aisleless type, completely metal enclosed and sectionalized to isolate and minimize the effects of internal short circuit currents. The structure shall consist of a framework of preformed steel channels or angles covered with bolted steel sheets. Each individual breaker/metering cell shall be completely segregated from adjacent compartments and sections by steel barriers at top, bottom, rear and sides.

Breaker compartments shall be equipped with grounded metal shutters to protect against contact with the energized primary disconnects when the breaker is removed from its compartment. Each individual breaker cell, metering and auxiliary compartment shall be provided with a hinged front panel door.

Provide side barriers between adjacent vertical structures in cable and bus compartments.

Rear cable compartments shall be isolated from the main and riser bus by insulated or grounded steel barriers. Cable compartments shall have adequate space for terminations and accessories. Provide hinged and bolted covers on the rear of each vertical section.
Main and riser bus shall be tin plated copper with a flame retardant, track resistant fluidized bed epoxy insulation system rated for 105 degree C operation. Bus joints shall be silver plated, bolted and insulated with removable PVC boots.

The main and vertical riser busses shall be enclosed in a segregated metal compartment with removable covers for accessibility. Horizontal bus supports between adjacent cubicles shall be flame retardant, track resistant molded glass-reinforced polyester through-bushings.

Circuit breaker load side runbacks shall be copper bus with epoxy insulation and porcelain support bushings.

Circuit breaker primary connections shall be mounted in molded glass-reinforced polyester insulated contact tube assemblies, bolted to the rear of each breaker cell compartment.

Connections to transformers shall be of the flexible design to reduce vibration from transmitting to the switchgear.

Make provisions for connection of incoming and outgoing cable sheaths and for the copper grounding conductors as required and as shown on the Drawings.

Provide a continuous horizontal tin plated ground bus extending through the entire length of the switchgear. Bus material and short circuit rating shall be equal to the main bus. The ground bus shall have at least one bolted connection to the structure in each bay.

Provide a ground bus riser assembly in each cable compartment connected to the ground bar in each circuit breaker or potential transformer drawout assembly compartment. Connect metering, relaying and instrument transformer grounds to this riser assembly

Provide a grounding disconnecting device between each circuit breaker removable element and the equipment ground bus which shall maintain contact at all times, except when the primary disconnecting devices are separated at a safe distance.

Provide a static grounding device on each voltage transformer drawout carriage to contact the primary fuses in the disconnected position. Each drawout carriage shall be bonded to the ground riser bus assembly.

Circuit breakers: Removable, electrically operated, vacuum interrupter type with stored energy trip/close mechanism, mounted in a heavy gauge steel frame with a removable front panel cover. The following mechanical indicators and devices shall be visible and accessible through the front cover:

- Manual trip/close pushbutton
- Open/close indicator
- Operations counter
- Spring charge indicator
- Manual charging arm
- Racking screw

Each breaker shall have a self-contained racking mechanism to move the breaker between the TEST/DISCONNECT and CONNECTED positions and to align and secure the primary disconnects in the CONNECTED position.

Circuit breakers shall be capable of being racked in or out with the compartment door closed. Provide interlocks to prevent the following operations:

Racking a closed breaker into or out of the CONNECTED position.

Closing a circuit breaker until it is fully racked into the TEST/DISCONNECT or CONNECTED position.

Withdrawing a circuit breaker from the cubicle while the closing springs are charged. The operating springs shall be discharged automatically when the breaker is inserted or removed from the compartment or is moved between the TEST/ DISCONNECT and the CONNECTED position.

Insertion of a breaker of incorrect ampere rating or inadequate interrupting capacity.

Means shall be provided for padlocking the breaker racking mechanisms in either the CONNECTED or TEST/DISCONNECT position.

Each breaker shall have a secondary control power plug which automatically engages a cell mounted mating receptacle in the CONNECTED position and disengages as the circuit breaker is racked out to the TEST/DISCONNECT position. Provide a means to manually engage the control power plug in the TEST/DISCONNECT position.

Breaker contacts on the removable element (TOC) auxiliary switch shall be wired to terminal blocks. Provide 6 normally open and 6 normally closed spare auxiliary contacts in addition to the auxiliary contacts required for breaker operation. Normally closed auxiliary contacts shall break before the normally open auxiliary contacts make.

Circuit breakers shall be equipped with mechanism operated (MOC) auxiliary switch contacts for remote status indication. Provide 6 spare "a" and 6 spare "b" contacts wired to terminal blocks.

Cells for future breakers shall be fully equipped with drawout carriage, racking mechanism, primary and secondary contacts and current transformers.

10.3.5 Medium Voltage Switchgear

The switchboard and components shall be designed, built and tested in accordance with the latest revision of the following standards:

- NEMA SG.5
- NEMA SG.4
- ANSI C37.20.2
- UL

Source transfer controls shall utilize GE Fanuc programmable logic controllers (PLC). System operation shall be as follows: The relay scheme shall provide for the generators to operate in parallel to provide emergency power to Main Bus 2 or to Main Bus 1. The incoming utility line shall be the preferred source. "Power Failure" and "Return to Normal" sensing relays shall be provided as required to signal the generators to start and stop. Manual/Automatic selector switches shall be provided in the Station Switchgear. The safety interlocks shall be independent of the Manual/Automatic selector switches. The source-transfer control shall utilize the split-bus primary-selective system. The normal condition shall be with the two main circuit breakers closed and with the bus-tie circuit breaker and generator tie circuit breakers open, so that each section of medium-voltage bus is energized by its associated, separate source. The source-transfer control shall monitor the condition of both utility sources and shall initiate automatic operation when its respective voltage has been lost (or reduced to a predetermined level) for a period of time sufficient to confirm that the loss is not transient. Failure of the utility source shall open its respective main breaker. Opening of the main breaker shall energize generator run relay. Contacts on the generator run relays shall signal the generators to start. Once the contacts have closed, the generators shall complete a normal cycle. Relay contacts in the Generator Control Panel will signal one of the generator breakers to close when the generator has reached rated voltage and frequency, then the second generator will parallel with the first generator on line, then the third generator will parallel with the first and second generator on line. When the generators have paralleled, then the generator tie circuit breaker will close providing standby power to the effected switchgear bus. Return of utility power shall energize "Return to Normal" timing relays, to time out and stop the generators.

Switchgear Ratings

- Distribution system configuration: 4160 kV, 3 Phase, 3 Wire, solidly grounded 60 Hz system.
- Power circuit breakers shall have the following symmetrical ratings in accordance with ANSI Standard C37.06.
- Nominal 3 phase interrupting rating: 350 MVA
- Nominal voltage class: 4.16 kV, RMS
- Maximum rated voltage: 4.76 kV, RMS
- Crest impulse voltage (BIL): 60 kV
- Maximum interrupting capability: 49,000 Amps, RMS
- Rated interrupting time: 5 cycles
- Rated short circuit current: 41,000 Amps, RMS
- Closing and latching current: 78,000 Amps, RMS.
- The continuous current rating of each circuit breaker shall be as shown on the Drawings.
- The continuous current rating of the bus shall be 2000 amperes. The bus shall be designed to carry its rated continuous current in the specified ambient temperature without exceeding the temperature rise limits specified in ANSI Standard C37.20.2. The bus supports, bus and connections shall be designed to withstand the specified circuit breaker close and latch short circuit current. Line and load bus connections to circuit breakers shall be rated to carry the full continuous current of the device frame.
- The switchgear and protective devices shall be designed for continuous operation at its rated current in a 40 degree C ambient temperature.

Switchgear Construction

Switchgear shall be Power/Vac by General Electric, VacClad-W by Cutler Hammer/Westinghouse; or VACARC Series 5 by Square D Company.

- Switchgear shall have arc flash resistant construction.
- Switchgear shall be indoor NEMA 1 gasketed type, completely metal enclosed and sectionalized to isolate and minimize the effects of internal short circuit currents. The structure shall consist of a framework of preformed steel channels or angles covered with bolted steel sheets. Each individual breaker/metering cell shall be completely segregated from adjacent compartments and sections by steel barriers at top, bottom, rear and sides.
- Breaker compartments shall be equipped with grounded metal shutters to protect against contact with the energized primary disconnects when the breaker is removed from its compartment. Each individual breaker cell, metering and auxiliary compartment shall be provided with a hinged front panel door.
- Provide side barriers between adjacent vertical structures in cable and bus compartments.
- Rear cable compartments shall be isolated from the main and riser bus by insulated or grounded steel barriers. Cable compartments shall have adequate space for terminations and accessories. Provide hinged and bolted covers on the rear of each vertical section.
- The switchgear shall include an auxiliary cable pull section as required for transition from underground cable feed.
- Main and riser bus shall be tin plated copper with a flame retardant, track resistant fluidized bed epoxy insulation system rated for 105 degree C operation. Bus joints shall be silver plated, bolted and insulated with removable PVC boots.
- The main and vertical riser busses shall be enclosed in a segregated metal compartment with removable covers for accessibility. Horizontal bus supports between adjacent cubicles shall be flame retardant, track resistant molded glass-reinforced polyester through-bushings.
- Circuit breaker load side runbacks shall be copper bus with epoxy insulation and porcelain support bushings. Provide two hole NEMA drilling for two cables per phase at each cable connection point.
- Circuit breaker primary connections shall be mounted in molded glass-reinforced polyester insulated contact tube assemblies, bolted to the rear of each breaker cell compartment.
- Provide a continuous horizontal tin plated ground bus extending through the entire length of the switchgear. Bus material and short circuit rating shall be equal to the main bus. The ground bus shall have at least one bolted connection to the structure in each bay.
- Provide a ground bus riser assembly in each cable compartment connected to the ground bar in each circuit breaker or potential transformer drawout assembly compartment. Connect metering, relaying and instrument transformer grounds to this riser assembly.
- Provide a grounding disconnecting device between each circuit breaker removable element and the equipment ground bus which shall maintain contact at all times, except when the primary disconnecting devices are separated at a safe distance.
- Provide a static grounding device on each voltage transformer drawout carriage to contact the primary fuses in the disconnected position. Each drawout carriage shall be bonded to the ground riser bus assembly (PT's shall be mounted above the switchgear as shown on Drawings).

- Power Circuit breakers: Removable, electrically operated, vacuum interrupter type with stored energy trip/close mechanism, mounted in a heavy gauge steel frame with a removable front panel cover. The following mechanical indicators and devices shall be visible and accessible through the front cover:
  - Manual trip/close pushbutton
  - Open/close indicator
  - Operations counter
  - Spring charge indicator
  - Manual charging arm
  - Racking screw
- Each breaker shall have a self-contained racking mechanism to move the breaker between the TEST/DISCONNECT and CONNECTED positions and to align and secure the primary disconnects in the CONNECTED position.
- Circuit breakers shall be capable of being racked in or out with the compartment door closed. Provide interlocks to prevent the following operations:
- Racking a closed breaker into or out of the CONNECTED position.
- Closing a circuit breaker until it is fully racked into the TEST/DISCONNECT or CONNECTED position.
- Withdrawing a circuit breaker from the cubicle while the closing springs are charged. The operating springs shall be discharged automatically when the breaker is inserted or removed from the compartment or is moved between the TEST/ DISCONNECT and the CONNECTED position.
- Insertion of a breaker of incorrect ampere rating or inadequate interrupting capacity.
- Means shall be provided for padlocking the breaker racking mechanisms in either the CONNECTED or TEST/DISCONNECT position.
- Each breaker shall have a secondary control power plug which automatically engages a cell mounted mating receptacle in the CONNECTED position and disengages as the circuit breaker is racked out to the TEST/DISCONNECT position. Provide a means to manually engage the control power plug in the TEST/DISCONNECT position.
- Breaker contacts on the removable element (TOC) auxiliary switch shall be wired to terminal blocks. Provide 6 normally open and 6 normally closed spare auxiliary contacts in addition to the auxiliary contacts required for breaker operation. Normally closed auxiliary contacts shall break before the normally open auxiliary contacts make.
- Circuit breakers shall be equipped with mechanism operated (MOC) auxiliary switch contacts for remote status indication. Provide 6 spare "a" and 6 spare "b" contacts wired to terminal blocks.
- Circuit breaker frame sizes shall be as shown on the Drawings.
- Cells for future breakers shall be fully equipped with drawout carriage, racking mechanism, primary and secondary contacts and current transformers.
- Each breaker shall be electrically operated at 125 volts DC from two redundant station battery console. Breaker operating mechanism shall be electrically charged, stored energy type. Charging motor shall include a limit switch feature and an anti-pump relay. Make provisions for

manual charging of the mechanism and for slow closing of the contacts for inspection and adjustment.

- The tripping and closing battery shall be a console-mounted, lead-acid gell-cell type, especially designed for switchgear service.
- The battery shall be rated 125 Volt, DC, and shall be sized for no less than 6 close-open-close cycles per breaker, for each breaker operated in succession at the end of a 6 hour period at a battery temperature of 45 degrees F (including the two 15 kV primary circuit breakers specified in Section 16430). In addition, battery size shall not be less than 140 A hr.
- Furnish and install an automatic battery charger for charging the gel-cell battery being supplied. The charger shall be a phase-modulated type using solid-state control circuits and SCR in the power circuit, with d-c voltmeter, d-c ammeter, adjustable float and equalizing voltage potentiometer, with AC and DC circuit breakers and "ON" pilot lamp mounted on the front of the hinged door, and 0-72 hour automatic equalizing timer. A ground detection relay and alarm and a low voltage relay and alarm shall be furnished. It shall operate from 120 volt, single-phase, 60 Hertz supply, and shall be capable of automatically recharging the battery in 12 hours when the battery is 50 percent discharged.
- The charger batteries, charger and accessories shall be mounted in a free-standing, NEMA 1 ventilated console enclosure. The console shall be compartmentalized with the batteries and the charger isolated by a metal barrier. A hinged door for each section shall be provided. The charger controls, metering, etc. shall be mounted on the charger compartment door. The console shall maintain a constant height, width and depth. The console battery charger system shall be provided with an overall UL label. The battery system shall be manufactured by American Battery Charging, Inc., Energy Applications, Inc., or equal.
- Battery charger console shall be furnished by the switchgear manufacturer.
- Control Wiring: 600 volt, stranded tinned copper, type SIS, flameproof switchboard wire, minimum size No. 14 AWG for control, No. 12 AWG for power and instrument transformer secondaries. Wiring shall be grouped together with harnesses or in ducts and shall be secured to the structure. Pull out type fuse holders shall be used for control circuits.
- Identification and termination: All wiring shall be numbered at each end with type-written heat shrinkable markers. Terminal blocks shall be rated 20 amps minimum, 600 volt, screw type with white marking area. Current transformer secondaries shall be wired to shorting type terminal blocks.
- Instrument and control switches: 600 volt switchboard rotary type, rated 20 amps continuous, with black molded phenolic escutcheon plates, white characters, General Electric Type SB-1 or equal.
- Circuit breaker control switches shall be of the momentary contact, spring return type having mechanical target or flag (target position shall not prohibit operation in any cases) and a black, fixed, pistol grip handle.
- Indicator lights: Provide green, red and amber pilot lights for each circuit breaker OPEN, CLOSED and TRIP indication. Indicators shall be full size, LED type.
- Potential transformers: Two-winding, encapsulated drawout type with primary and secondary fuses. Voltage ratings shall be as required for the application. Thermal rating and metering accuracy per ANSI standards. PT's shall be mounted above the switchgear as shown on drawings.

- Current transformers: Toroidal type suitable for mounting on breaker stabs. Continuous thermal current rating, relaying and metering accuracy shall conform to ANSI standards.
- Control power transformers: Two-winding dry type with primary fuses, secondary circuit breaker, NEMA sized for the application. CPT's shall be mounted above the switchgear.
- Indicating meters: 4-in square, 250 degree scale switchboard type with a full scale accuracy of plus or minus 1 percent. Types and quantity as shown on the Drawings.
- Power circuit monitors shall be provided on the circuit breakers as indicated in the single line diagrams. The circuit breaker monitor shall have the system display and shall be capable of monitoring up to 16 remotes on a standard RS-485 communications link, 10,000 feet (maximum). The power circuit monitors shall replace the standard voltmeters and ammeters and shall be Siemens 9600 or equal, with all features available for field connection. Uninteruptable Power Supply (UPS) shall be provided for operating all Power Monitors within the switchgear. UPS shall be provided with overcurrent protection.
- Protective relays shall be multi-function electronic type, Schweitzer Engineering Laboratories or equal.
- Lightning arresters: Provide a set of three Station Class, porcelain type lightning arresters at each location shown on the Drawings.
- Surge arresters: Provide surge protectors on each circuit using a vacuum circuit breaker.

10.3.6 Medium Voltage Variable Frequency Drives (VFDs)

The medium voltage VFD's shall be rated for the HP, full load current and rpm of the motor furnished. The variable frequency drives shall be designed to provide microprocessor-based continuous speed adjustment of three-phase motors. The VFD shall be of the minimum 24-pulse or Active-Front-End design and shall consist of four (4) sections: converter, inductor, inverter and control logic. These sections shall be grouped into separate sections with each section modularized for ease of troubleshooting.

The converter section shall be a full wave, phase controlled, three phase converter to change the input AC power to DC power.

The output of the converter shall feed an inductor and the converter/inductor combination shall form a source whose output is regulated and limited. The current limit feature of the converter shall be sufficiently fast and effective so as to protect against a sudden and/or random application of a short circuit to the output terminals of the source.

The inverter section shall convert the DC power to a PWM source for adjustable frequency power to the motor. The VFD shall not induce excessive power losses in the motor. The worst case Root-Mean-Square (RMS) motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.

The VFD shall incorporate an input fused load break disconnect switch or non-load break switch with vacuum contactors mechanically interlocked with the power unit enclosure door. The input breaker may be located in a separate enclosure and electrically interlocked with all power unit doors.

The VFD manufacturer shall furnish an isolation/phase shift transformer, a full voltage non-reversing starter, and the transformer as specified herein.

The VFD manufacturer shall provide the necessary design and filtering required to meet the harmonic requirements of IEEE 519-1992. A preliminary harmonic analysis shall be provided prior to design.

The AC power units shall be enclosed in a sheet metal housing of NEMA 12 Force ventilated (with replaceable air filters) construction requiring front access only. VFD's requiring rear access for any maintenance are not acceptable. VFD shall be constructed with air-cooled assemblies and inductors for a minimum amount of complexity and highest reliability. VFD's using liquid-cooled assemblies in conjunction with associated pumps, piping and separate remote mounted heat exchangers, are not acceptable.

Provide fused space heaters with thermostat to minimize condensation potential upon drive shutdown.

The variable frequency drives shall be variable torque design.

Variable frequency drives shall have 115 Vac control power for operator devices.

The variable frequency drive shall include copper ground bus.

Surge arrestors shall be porcelain station class.

Power unit fan loss protection by automatically switching to a 100% spare cooling fan. Cooling fans shall be on when the VFD is operating and off when drive is off (fans shall be timed to run for a period of time after the VFD shuts down to dissipate heat from within the VFD).

Isolation/Phase shift transformers shall conform to the following specification, as well as prevailing codes and standards, including IEEE-519.

Primary windings shall be connected 4160 volts delta. Secondary windings shall be field reconnectable for 4160 volts, both delta and wye with an electrostatic shield.

Transformer shall be designed for SCR duty service with three phase, twenty four-pulse static power converter connected to the secondary windings. The increased eddy and stray losses due to harmonic currents shall be minimized and shall be included in the specified temperature rise.

10.3.7 Unit Substations

Switches

The unit substation primary switch shall be designed for 4160 volt, 3-phase, 3 wire, 60-Hertz service. The switch shall be fused, with a 3-pole, load break, air interrupter, front operable, gang operated, stored energy closing and opening. The switch shall be equipped with arc chutes and barriers between poles.

Continuous and interrupting ratings shall be 600 Amps. Momentary and fault-close ratings shall be 40,000 Amps asymmetrical. The switch shall be provided with station class, porcelain surge arrestors. Buses shall be tin plated copper rated not less than 600 Amps. Each bus bar shall be totally-enclosed with insulating material. Grounding lugs shall be furnished.

The primary switch shall consist of one or more metal enclosed cubicles and one termination cubicle. One cubicle shall contain a two-position switch with stored energy mechanism for both closing and opening. The cable termination cubicle shall house the incoming line lugs. Three low sparkover distribution type lightning arresters shall be mounted in the switch compartment. The cubicle shall have a separate compartment below the switch suitable for a set of self-contained current limiting power fuses that can provide fast, clean interruption with minimum let through current.

Viewing windows of not less than 1/4-inch safety glass shall be furnished. The fuse compartment door shall be interlocked so that the door may not be opened unless the switch is opened. The fuse compartment shall be at the bottom of the enclosure. The switch cubicle shall have a thermostatically controlled heater, unswitched, to prevent condensation, with control power from a local 120 volt lighting panel.

The switch enclosure shall be suitable for outdoor installations, phosphate cleaned to remove oxide film and painted. The enclosure shall be rated NEMA 3R (or better). The enclosure shall withstand 150 MPH wind loads.

Transformer

The transformer shall have FR3 or vegetable oil filled and shall be less flammable in accordance with the latest edition of the NEC. High fire point fluids shall be Factory Mutual and UL listed.

The transformer shall carry its continuous rating with average winding temperature rise by resistance that shall not exceed 55 degrees C, based on average ambient of 30 degrees C over 24 hours with a maximum of 40 degrees C. The insulation system shall allow an additional 12% kVA output at 65 degrees C average winding temperatures rise by resistance, on a continuous basis, without any decrease in normal transformer life.

The transformer shall be designed to carry short time emergency overloads in accordance with ANSI C57.12.92 as applicable. Duration and magnitude of designed withstand capability shall be as outlined in ANSI C57.12.90 and the latest draft of the IEEE short-circuit test code.

The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA TR1. The measurement procedure shall be as specified in ANSI C.57.12.90.

High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be by Insuldur paper or equal.

The main transformer tank and attached components shall be designed to withstand pressures 25% greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel plate reinforced with external sidewall braces. All seams and joints shall be continuously welded. Each radiator assembly shall be removable with valves and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour leak test shall be performed after the transformer is tanked, welded and completed to ensure that there are no leaks before shipment.

The transformer shall be suitable for outdoors, NEMA 3R rated or better, and shall resist 150 MPH wind loads.

10.3.8 Low Voltage Switchgear

Switchgear

The low voltage switchgear shall be Type PZ IV as manufactured by Square D, Type DS Magnum as manufactured by Cutler Hammer or AKD 20 as manufactured by GE.

Switchgear shall be indoor NEMA 1 gasketed type, completely metal enclosed and sectionalized to isolate and minimize the effects of internal short circuit currents.

The switchgear shall have arc flash resistant construction. The structure shall consist of a framework of preformed steel channels or angles covered with bolted steel sheets. Each individual breaker/metering cell shall be completely segregated from adjacent compartments and sections by steel barriers at top, bottom, rear and sides.

Breaker compartments shall be equipped with shutters to protect against contact with the energized primary disconnects when the breaker is removed from its compartment. Each individual breaker cell, metering and auxiliary compartment shall be provided with a hinged front panel door. Provide side barriers between adjacent vertical structures in cable and bus compartments.

The vertical bus shall be so arranged as to have insulating barriers interposed between phases to inhibit phase to phase faults. In addition, protective devices shall be completely compartmentalized by the addition of barriers above and below each device to minimize fault communication.

Line and/or load terminals of each circuit breaker shall be extended to the rear so that it will be unnecessary to reach across or beyond a line bus to make connections. Removable insulation boots shall be provided to insulate the cable connections after the feeder cables have been installed.

Rear cable compartments shall be isolated from the main and riser bus by insulated or grounded steel barriers. Provide cable supports in each vertical section. Cable compartments shall be standard depth with bending space in accordance with the NEC. Provide hinged and bolted covers on the rear of each vertical section. All live buses shall be phase isolated in the rear to help prevent accidental contact with buses when making upload terminations.

The vertical buses shall be isolated from the main buses with full length glass polyester barriers. The main buses shall be phase isolated from each other and from the device load/line lugs by means of isolating barriers. Joint bolts in the isolated bus system shall be insulated yet, maintainable without removal of the barriers. Insulation and isolation shall be designed to reduce entrance of foreign objects and contaminants, serving as a deterrent to fault initiation, yet designed to facilitate inspection and maintenance.

Protective devices shall be arranged so they are individually removable and readily interchangeable from the front of the switchgear. Rotary operating handles for all protective devices shall be of the same design and shall be prominently labeled to indicate device ampere ratings, and color coded for device type. ON/OFF and other indication shall be clearly shown by prominent markings and handle position. The protective devices shall be individually mounted with front hinged cover plates and all necessary buses and straps shall be provided.

Buses

Main bus, riser bus, and circuit breaker connections shall be tin plated copper, with bolted connections. All bus bars shall be 98 percent conductivity copper with a current density of 1,000 amperes per square inch. Surfaces shall be tin plated by the Alstan 70 (or comparable) process to have a uniform appearance, free of blisters.

The bus structure shall be mounted on supports of high impact non tracking insulating material. Bus bars shall be uniformly arranged to provide A B C sequency left to right (from front), front to rear and top to bottom. Bus bars shall not be tapered. Bolted connections shall be made with high strength bolts and locking hardware.

Individual horizontal and vertical phase bus bars shall be insulated where industry standard 600 Volt clearances cannot be met. Breaker runbacks shall be insulated. Provide a continuous, 1/4 inch by 2 inch (minimum), tin plated copper ground bus extending throughout the entire length of the switchgear, bolted to each vertical section, equipped with lugs for external ground connections. All hardware used on conductors shall be zinc or cadmium plated, have a tensile strength of 120 psi.

Circuit Breakers

Circuit breakers shall be metal frame construction, low voltage, drawout type, manually or electrically operated with stored energy closing mechanism. Circuit breakers shall be Square D Company, Master Pack, Cutler Hammer, Type DS Magnum or GE EntelliGuard.

Circuit breakers shall conform to ANSI standards C37.13 and C37.16 and NEMA SG 3. Where required to meet the specified equipment short circuit rating, breakers shall be equipped with integrally mounted current limiting fuses, coordinated with the trip devices.

Each breaker shall be equipped with an open fuse tripping device and blown fuse indicator. Circuit breakers shall be equipped with a temperature insensitive, adjustable, static overcurrent trip device with true three phase RMS sensing of sinusoidal and non-sinusoidal currents. Trip units shall be Cutler Hammer, "Digitrip RMS", Square D Company, "Digitrip RMS" or GE EntelliGuard.

Electrically operated circuit breakers shall be charged by a 125 VDC electric motor. Electrically operated breakers shall also be provided with a mechanically operated manual trip pushbutton or lever mounted on the front of the breaker, a manual charging handle and racking position indicator.

Circuit breakers shall be equipped with a shunt trip and provisions for remote closing when automatic control is required. Circuit breakers shall be capable of being racked out without exposing the operator to live parts.

10.3.9 Motor Control Centers (MCCs)

Motor Control Centers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL 845. MCCs shall include arc flash resistant construction. MCCs shall be designed for 480 volt, 3-phase, 3-wire, 60 Hertz service with voltage and ampere ratings as required.

All buses will be of sufficient capacity (including spare capacity) and fault current bracing for the load served and available fault current. A continuous ground bus will be furnished. Buses shall be tin plated copper.

Main–Tie–Tie-Main breaker or, Main breaker only configurations as required for reliability and redundancy.

Combination Starter Units

- Combination starters shall include a motor circuit protector (MCP) in series with a motor controller and an overload protective device. The MCP shall have an adjustable magnetic trip range and a trip test feature. MCP's shall be labeled in accordance with UL489.
- Motor starters: three Pole, 600 Volt, electrically operated, of the types shown on the Drawings, minimum size shall be NEMA Size 1. Starters shall have 120 Volt encapsulated operating coils, an individual control power transformer with primary and secondary fuses, and silver cadmium oxide renewable line contacts.
- Multi speed and reversing starters: provide two motor rated contactors mechanically and electrically interlocked so that only one device may be energized at any time.
- Motor overload protection: Standard or ambient compensated , bimetallic-type with interchangeable heaters, visual trip indication, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated normally open and normally closed contacts shall be provided on the relay. Overload relays shall be manually reset from outside the enclosure by means of an insulated pushbutton.

Feeder breakers shall be group mounted, minimum 80% rated, molded case.

- Feeder breakers shall have fixed thermal magnetic trips.

All busses shall be tin plated copper.

Overall short circuit rating of the MCC's, starters and breakers shall be minimum 65kA, Isc at 480VAC; but; in no case, lower than that indicated in the short circuit study if higher than 65kA.

Motor control centers will be standard metal-enclosed, freestanding, dead front structures, not more than 90 inches in height. Motor control centers will have NEMA 1G gasketed enclosures. Minimum starter size will be NEMA 1.

Wiring will be NEMA Class II-S, Type B.

Local Metering

- Siemens 9600 power meter. The metering shall be data linked to SCADA.

Surge Protection Devices (SPD's)

- Where MCCs are fed from feeder cables external to the building they shall be provided with surge protection devices.
- Standards
  - UL 1449 3rd Edition. Underwriters Laboratories Safety Standard for Surge Protection Devices.
  - NFPA 780. Standard for the Installation of Lightning Protection Systems.

Manufacturers

- Square D Company
- General Electric Company
- Eaton/Cutler - Hammer

10.3.10 Low Voltage Variable Frequency Drives (VFDs)

18 pulse drive systems shall be provided for motors 100 HP and above. 6 pulse drive systems with line reactors shall be provided for motors up to and including 50 HP. Provide harmonic mitigating filters if required to meet the conditions of the harmonic study.

To the maximum extent possible, all VFDs shall be provided by the same manufacturer, who shall provide the harmonic study for the entire WTP.

Service Conditions:

- Input power: 460 VAC, plus 10 percent, minus 10 percent, 3 Phase, 60 Hz.
- Input frequency: 57 to 63 Hz.

Minimum drive efficiency: 97 percent or better at 4/4 motor base speed and rated torque. Losses shall include all control power and cooling system losses associated with the drive. Filter losses shall be listed separately.

True power factor: 85 percent or higher at full speed and full load, measured at drive input terminals.

Drive output: 100 percent rated current continuous, suitable for operation of the driven equipment over the required speed range without overloading. Drives shall be capable of a 60 second overload for up to 110 percent rated current for variable torque loads, or 150 percent rated current for constant torque loads. Starting torque shall be matched to the load.

Voltage regulation: Plus or minus 1 percent of rated value, no load to full load.

Output frequency drift: No more than plus or minus 0.5 percent from setpoint.

Drives shall withstand five cycle transient voltage dips of up to 15 percent of rated voltage without an undervoltage trip or fault shutdown, while operating a variable torque load.

Power transistor PRV rating shall be 1200 Volts, minimum.

Drive sound level: 80 dBA (maximum) at 3-ft, test method A. This shall include noise made from the entire drive enclosure including filters, capacitors, fans, transformers, etc, and all other components associated with the enclosure. The VFD manufacturer shall provide sound attenuation equipment necessary.

The VFDs shall utilize a digital pulse width modulated (PWM) design to convert the fixed AC input to a variable voltage, variable frequency AC output. Construction shall be modular, using plug in type component mounting or keyed ribbon cable connections wherever possible to minimize downtime during repair.

The VFD shall consist of a full wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. A DC link inductor shall be provided to smooth out converter ripples and to limit fault current throughput. The PWM strategy shall be of the IGBT type implemented through a microprocessor which generates a sinecoded output voltage. The inverter/converter control shall be designed to minimize audible motor noise to a level at or near the motor noise that would be produced while operating on a pure 60 Hz sine wave.

The output shall be generated by power transistors which shall be controlled by identical, optically isolated base driver circuits. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation. The VFD shall have an output voltage regulator to maintain correct output Volt/Hertz despite incoming voltage variations. The VFD shall have a continuous output current rating equal to or greater than the motor full load nameplate current.

Each drive shall be designed for standalone operation. Multiple drive units shall not utilize shared components. Drive components shall be mounted in free standing, front accessible, NEMA 1, force ventilated with filtered air, single or multi bay, sheet steel cabinets with hinged front doors. Doors shall have concealed hinges and three point latching mechanism with lockable handle. Rear access shall not be required.

Each VFD shall have a molded case, circuit breaker type main power disconnect switch, with an external operating handle capable of being padlocked in the open position.

Make provisions to accept a remote dry contact closure to start and stop the drive(s) with the drive control system in the AUTO mode.

Make provisions to accept a 4 20 mADC input signal for remote speed control. Input shall be isolated at the drive and active with the drive control system in the AUTO mode. Zero and span adjustability shall be provided.

Provide a 4 20 mADC isolated output signal proportional to speed for remote speed indication. The signal shall have a minimum of 750 ohm load capability.

Manufacturers

- ABB Drives Division
- Allen Bradley
- Siemens/ Robicon

Medium Voltage Motors

Motors connected to Variable Frequency Drive Controllers shall be specifically designed for compatibility with the actual inverter design furnished specifically for this project, and shall comply with IEEE 841 or ANSI/API 541.

- Torque output: minimum performance characteristics for locked rotor torque, pull-in torque and pull-out torque with rated voltage and frequency applied as defined by NEMA MG1, to accelerate and operate the load throughout its operating speed range, including conditions imposed by reduced voltage starting methods.
- Motors shall deliver the specified performance at rated load under the combinations of voltage and frequency variations and voltage unbalance specified in NEMA MG1.
- Horsepower rating: sized with a minimum of 5 percent margin on the maximum load BHP throughout the full range of mechanical or hydraulic operating condition.
- Starting intervals: Based on NEMA MG1, each motor shall be capable of 3 cold and 2 hot starts per hour.
- Torsional critical speed: first or second torsional shall not be encountered within the operating speed range.
- Cooling provisions: maintain temperature rises at design levels while operating at the lowest constant torque operating condition and throughout the speed range. Auxiliary cooling fans may be provided to maintain proper low speed cooling.
- Insulation system for VFD applications: design for the peak line-to-line and line-to-ground voltage from the inverter. The insulation material and resin system shall have corona inception voltage levels above the peak voltages of the inverter. The insulation system shall be designed to accommodate any voltage transients or common mode voltage in the output waveform.
- Rotor bars: rectangular copper or copper alloy with uniform resistance characteristics, tightly fitted in the slots and permanently locked in the slot by a swaging process, and brazed to resistance rings at each end of the rotor. Rotor end rings shall be free of circumferential joints.
- Rotor assembly: coated with a corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced with the first lateral critical speed at least 15% above the maximum running speed.
- Rotor shaft: forged or rolled steel stiff shaft design, accurately machined, smoothly finished, with sufficient strength to withstand all stresses resulting from normal operation at any speed up to and including a 25 percent overspeed condition. Coordinate shaft end details with driven equipment coupling.
- Rotor core: solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
- Stator core: built up, fully processed, high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end. Coil slot wedge material shall be Class F or better glass reinforced polyester.
- Stator winding: assembled using form wound copper coils of the same size and shape. A split component epoxy insulation system shall be used in order to provide high resistance to moisture and other contaminates. Turn-to-turn insulation shall be provided to ensure machine winding protection against surges at the machine terminals (L-N) of 2X peak rated line-to-line voltage with a rise time of 1.3 micro seconds.

- Insulation: completely sealed, chemical, caustic, and fungus resistant insulation system consisting of Class F or H materials, two complete oven cured vacuum pressure impregnation cycles using solventless resins, and a post-impregnation process for better thermal conductivity.
- Motor leads: same insulation class as the windings, rated 150 degrees C, and sized for the motor nameplate amperes at 1.0 SF.
- Grease lubricated bearings: furnished with provisions for in-service positive lubrication and a drain to guard against over lubrication.
- Oil lubricated bearings: contained in an oil reservoir with sight level gauge, fill and drain openings with plugs, designed to prevent leakage and excessive aeration of the oil.
- Bearings: manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements, rated for an in-service B-10 life of 8800 hours per ABMA, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
- Coordinate all thrust conditions, including shutoff, and shaft requirements with the manufacturer of the pumping equipment.
- Normal thrust applications: use grease lubricated deep-groove ball type thrust bearings only on normal thrust design motors, capable of handling thrust loads in either direction.
- High thrust applications: use single or multiple angular contact ball bearings. Anti-friction thrust bearings shall be designed for an L10 life of 100,000 hours including rotor weight. For applications with higher thrust loads which cannot meet the L10 life, spring loaded spherical roller thrust bearings may be used.
- Guide bearings: deep-groove ball type located at the bottom of the motor, capable of withstanding all stresses incident to the normal operation of the unit and to the specified overspeed condition, with sufficient means for preventing the leakage of lubricant or entrance of foreign matter along the shaft. When furnished as guide bearings for high thrust units, they shall be oil lubricated. Hollow shaft motors shall have a steady bushing to support the head shaft at the lower end of the motor.
- Motor frames: cast iron or welded heavy plate steel box frame construction, stiff enough to withstand the rotating forces and torques generated and shall be designed to limit or avoid any undesirable harmonic resonances. Provide lifting lugs on motor frame. Hoods, baffles, and ducts shall be a corrosion-protected steel fabrication. Access covers shall be of aluminum, cast iron or sheet metal and shall be easily removable for maintenance purposes.
- Condensate drain openings: locate drain openings and breathers to allow removal of accumulated moisture from enclosures.
- Enclosure type: WPII designed in accordance with NEMA MG1.
- Hardware: corrosion resistant machined bolts and screws and other hardware shall be standard UNF/C thread, hex head type and shall be stainless steel. Metric hardware is not allowed.
- Nameplates: engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information listed in NEMA MG1-10.38 or MG1-20.60, as applicable.

- Main terminal box: cast iron main terminal box, arranged to rotate in 90 degree increments to accommodate conduit entry from any quadrant, with gaskets between the box and motor frame and between the box and its cover
- Air filters for WPII enclosures: reusable, washable type inlet air filters with corrosion resistant stainless steel screens.
- Bearing temperature sensors: replaceable 100 ohm platinum three wire RTD's, one per bearing with spring loaded tip, mounted as closely as possible to the outer surface of each bearing. with conduit connection head, terminal block, and cabling brought out to a common terminal box.
- Accessory terminal boxes: separate cast iron motor mounted terminal boxes for RTD's, bearing relays, space heaters, and other specified accessories, arranged to rotate in 90 degree increments to accommodate conduit entry from any quadrant.
- Space heaters: silicone rubber strip type, accessible for inspection, rated for 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to a separate terminal box. The heater wattage and voltage shall be embossed on the motor nameplate
- Grounding: minimum of two copper faced pads on motor frame, grounding terminal mounted in the main terminal box.
- Bearing vibration sensors: accelerometer type, two per bearing, mounted per vibration monitoring system manufacturer's instructions, with cabling brought out to a common terminal box.

Low Voltage Motors

To assure unity of responsibility, the motors shall be furnished and coordinated by the manufacturer of the driven equipment.

Torque output: minimum performance characteristics for locked rotor and breakdown torque with rated voltage and frequency applied as defined by NEMA MG1, to accelerate and operate the load throughout its operating speed range, including conditions imposed by reduced voltage starting methods.

Motors shall deliver the specified performance at rated load under the combinations of voltage and frequency variations and voltage unbalance specified in NEMA MG1.

Horsepower rating: sized for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.

Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degree C ambient.

Enclosures: TEFC

Nameplates: engraved or embossed on stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG1.

Energy efficiency: meet or exceed requirements of NEMA MG1 Part 12 for NEMA Premium Efficient motors, for 1 Hp and larger.

Severe duty: Motors installed in process areas and wet or corrosive locations shall be of a type designated by the manufacturer as "Corro Duty", "Mill and Chemical", "Severe Duty", or similar quality designation.

Class 1, Division 2 locations: Motors in Class 1, Division 2 locations shall be marked with a temperature code label suitable for use in the hazardous area classification where installed. Motors shall also comply with IEEE 841 severe duty requirements,

Inverter Duty: Motors connected to Variable Frequency Drive Controllers shall be designed for inverter duty and shall comply with the following:

- Definite purpose: Motors operated on variable frequency drives shall be designed specifically for inverter duty, per NEMA MG1, Part 31, and comply with IEEE 841. Motors shall be designed for constant or variable torque over the speed range required by the driven equipment application. Motors shall be capable of across the line starting at the motor minimum terminal voltage with an acceptable maximum locked rotor current.
- Torsional critical speed: first or second torsional shall not be encountered within the operating speed range. Rotors shall be stiff shaft design, statically and dynamically balanced with the first lateral critical speed at least 15% above the maximum running speed.
- Thermal protection: three internal bi-metallic, temperature actuated switches.
- Cooling provisions: maintain temperature rises at design levels while operating throughout the speed range. Ventilation system shall be designed for maximum heat transfer including larger fans or auxiliary cooling fans to maintain proper low speed cooling.
- Inverter grade insulation system: minimum Class F or better insulation materials with additional phase insulating material, extra end-turn bracing and Class H spike resistant wire. The resultant system shall withstand up to 2000 volt transients without premature motor failure and have no cable limitations in motor application.

Stator core: built up, fully processed, high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.

Stator winding: assembled using random wound copper coils. A split component epoxy insulation system shall be used in order to provide high resistance to moisture and other contaminates.

Insulation: manufacturer's premium grade non-hygroscopic, chemical and humidity resistant insulation system consisting of Class F or H materials, operated at Class B temperature rise, with at least one impregnation cycle using solventless resin, and multiple additional dip and bake cycles using polyester varnish.

Motor leads: non-wicking type, minimum Class F temperature rating and permanently numbered for identification.

Rotor shaft: forged or rolled steel, accurately machined, smoothly finished, with sufficient strength to withstand all stresses resulting from normal operation at any speed up to and including a 25 percent overspeed condition.

Rotor core: solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations, with die cast aluminum or fabricated copper bars or their respective alloys. Rotors on frames 213T and above shall be keyed to shaft and rotating assembly dynamically balanced.

Cooling fan: corrosion-resistant, bi-directional, keyed, clamped and shouldered on the shaft.

Rotor assembly: coated with a corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced. Balance weights shall be securely attached to the rotor resistance ring by welding or similar permanent method.

Horizontal Bearings

- Bearings: anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality. Metric size bearings are not acceptable.
- Maximum bearing temperature rise: 50 degrees C for two pole motors, 45 degrees C for all other motors, measured at rated load by RTD or thermocouple at bearing outer race.
- Lubrication: factory lubricated with a premium moisture resistant polyurea thickened grease containing rust inhibitors and suitable for operation over temperatures from -30 to 150 degrees C. with standard lube and relief fittings for re-greasing external lubrication while machine is in operation. Motors shall be NEMA size 140 frame motors and smaller than may be permanently lubricated.
- Minimum Rated fatigue life: L10 life of 100,000 hours per ABMA 9 or ABMA 11 for direct coupled applications and 26,000 hours for belted applications based on NEMA belting application limits per NEMA MG1. Severe duty motors shall have increased bearing life of 150,000 hours for direct coupled applications and 50,000 hours for NEMA belted applications per IEEE 841.
- Shaft seals: prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors shall have improved sealing per IEEE 841.

Vertical Bearings

- Bearings: manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements, rated for an in-service B-10 life of 8800 hours per ABMA, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
- Normal thrust applications: use grease lubricated deep-groove ball type thrust bearings only on normal thrust design motors, capable of handling thrust loads in either direction.
- High thrust applications: use single or multiple angular contact ball bearings. Anti-friction thrust bearings shall be designed for an L10 life of 100,000 hours including rotor weight. For applications with higher thrust loads which cannot meet the L10 life, spring loaded spherical roller thrust bearings may be used.
- Guide bearings: deep-groove ball type located at the bottom of the motor, capable of withstanding all stresses incident to the normal operation of the unit and to the specified overspeed condition, with sufficient means for preventing the leakage of lubricant or entrance of foreign matter along the shaft. When furnished as guide bearings for high thrust units, they shall be oil lubricated. Hollow shaft motors shall have a steady bushing to support the head shaft at the lower end of the motor.
- Grease lubricated bearings: furnished with provisions for in-service positive lubrication and a drain to guard against over lubrication.
- Oil lubricated bearings: contained in an oil reservoir with sight level gauge, fill and drain openings with plugs, designed to prevent leakage and excessive aeration of the oil.
- Anti-backspin device: when specified or requested by the pump manufacturer, provide a shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.

Motor frames: cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and shall be designed to limit or avoid any undesirable harmonic resonances. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting.

Condensate drain openings: locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe duty motors.

Enclosure type: as specified in the mechanical equipment section, designed in accordance with NEMA MG1. Totally enclosed designs shall be suitable for outdoor use.

Hardware: hex head, SAE Grade 5 or better, plated for corrosion protection.

Main terminal box: fabricated steel or cast iron, sized per the NEC for number and size of conduit connections as indicated on the drawings, arranged to accommodate conduit entry from any quadrant, with a grounding terminal and gaskets between the box and motor frame and between the box and its cover.

Bearing housings: provide machined surfaces for attaching a magnet mounted accelerometer in order to monitor the motor vibration in the vertical, horizontal, and axial

Space heaters: provide silicone rubber strip type enclosure heaters for outdoor motors, or where otherwise specified. Heaters shall be rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to the motor terminal box. The heater wattage and voltage shall be embossed on the motor nameplate.

Frame grounding: provide motor frame grounding pad or threaded stud.

Accessories

- Winding temperature switch: three, snap action, bi-metallic, temperature actuated switches embedded in the connection end-turns of the motor winding with normally closed contacts and leads terminating in the main conduit box.

Power factor correction capacitors: provide for constant speed motors 100 HP or larger:

- UL listed, NEMA rated and tested, three phase dry film or non-PCB dielectric liquid insulated, with three current limiting fuses rated for 100 kA interrupting capacity at 480 Volts, equipped with internal discharge resistors and fuse loss indicators, mounted in hermetically sealed steel enclosures suitable for conduit connection. Covers shall be gasketed, bolt-on type.

10.3.11 Panelboards

The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows: UL 67 , UL 50, NEMA PB1, Fed. Spec. W-P-115C, Circuit breaker – Type I class I

Panelboards shall be dead-front type and shall be surface or flush mounted as required.

Panelboards shall be housed in:

- NEMA 1 general purpose enclosures where installed in clean, dry areas.
- NEMA 12 enclosures where installed in electrical rooms and dusty areas.
- NEMA 4X enclosures where installed in wet and/or corrosive areas.

Circuit breakers in the panelboards will be trip-indicating bolt on type. The minimum interruption rating of all molded case circuit breakers located in lighting panels will be 22,000 amperes at the rated system voltage of 208/120V. Circuit breakers in 480V panelboards shall have a minimum interruption rating as required by Short Circuit Coordination Study.

Manufacturers:

- Square D Company
- General Electric Company
- Eaton / Cutler – Hammer

10.3.12 Wire and Cable

Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper. All conductors shall be stranded, except that lighting, receptacle and fire alarm system wiring may be solid. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

Wire for lighting, receptacles and other circuits not exceeding 150 Volts to ground shall be NEC Type XHHW. Wire for circuits over 150 Volts to ground shall be NEC type XHHW for sizes up to No. 4/0 AWG and Type RHW for sizes greater than No. 4/0 AWG.

Wire for control, status and alarm circuits shall be No.14 AWG NEC type XHHW.

Wire for process instrumentation signals (i.e. 1-5 VDC, 4-20 mA), R.T.D., potentiometer and similar signals shall be:

- Single pair cable:
  - Conductors: 2- No.16 stranded and twisted on 2 in lay
  - Insulation: PVC with 300 Volt, 105 degrees C rating
  - Shield: 100 percent mylar tape with drain wire
  - Jacket: PVC with UL Subject 13, UL 1581, and manufacturer's ID
  - Misc: UL listed for underground wet location use.
- Three conductor (triad) cable:
  - Conductors: 3- No.16 stranded and twisted on 2 in lay
  - Insulation: PVC with 300 Volt, 105 degrees C rating
  - Shield: 100 percent mylar tape with drain wire
  - Jacket: PVC with UL Subject 13, UL 1581 and manufacturer's ID
  - Misc: UL listed for underground wet location use

Medium voltage cable shall be EPR insulated, 133% rated, bare copper tape shield.

10.3.13 Raceways and Fittings

All wiring shall be run in conduit. A complete system of raceways, fittings, support hardware and appurtenances will be furnished and installed in accordance with code requirements.

Minimum size conduit shall be 3/4 in electrical trade size. Conduits shall not have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required by the NEC after every 270 degrees of bends and for straight run not to exceed 200 feet or as directed. The types of raceway systems listed in **Table 10-1** shall be provided.

Table 10-1 Raceway Application Requirements

Location/Circuit Type	Raceway Type
All Locations 4-20 mA instrumentation cables. Copper Ethernet data highway	▪ Interior Process and Finished Areas, exposed – Clean, Dry, Damp or Wet: Galvanized rigid steel (GRS) conduit. ▪ Corrosive Areas, exposed: PVC coated rigid steel conduit. ▪ Concealed in floor slab – Clean, Dry, Damp, Wet or Corrosive: PVC coated rigid steel conduit ▪ Exterior, exposed: PVC coated rigid steel conduit. ▪ Underground in duct bank or direct buried: PVC coated rigid steel conduit.
All Locations Class 2 and 3 signal wiring. Copper fire alarm, security, and communications system wiring	▪ Interior Process, exposed – Clean, Dry, Damp or Wet: Galvanized rigid steel (GRS) conduit. ▪ Interior Finished Areas, exposed, concealed in walls and above hung ceilings: EMT. ▪ Corrosive Areas, exposed: PVC coated rigid steel conduit ▪ Concealed in floor slab – Clean, Dry, Damp, Wet or Corrosive: Schedule 80 PVC conduit with rigid metal elbows. ▪ Underground in duct bank: Schedule 40 PVC conduit with rigid metal elbows.
All Locations Fiber Optic wiring systems (Instrumentation, fire alarm, security, and communications system wiring)	▪ Interior Process, exposed – Clean, Dry, Damp or Wet: Galvanized rigid steel (GRS) conduit. ▪ Interior Finished Office Areas, exposed, concealed in walls and above hung ceilings: Electrical metallic tubing (EMT) ▪ Corrosive Areas, exposed: PVC coated rigid steel conduit Concealed in floor slab – Clean, Dry, Damp, Wet or Corrosive: Schedule 80 PVC conduit with PVC coated rigid metal elbows. ▪ Underground or direct buried: Schedule 80 PVC conduit.
Clean, Dry Finished Areas Offices, administrative areas, lobbies, control room, lunch room, toilets, and laboratories, etc.	▪ Conceal raceways in walls above hung ceilings in rooms and areas that have finished interiors. Provide surface raceway for multiple receptacle, voice, and data outlets in labs and control rooms or in offices where specified. ▪ Lighting, switch, and receptacle circuits exposed above hung ceilings or concealed in partition walls: Electrical metallic tubing (EMT)
Clean, Dry Non-Finished Areas Electrical rooms, generator rooms, mechanical rooms, shops, dry storage, etc.	▪ Conduit for power wiring, lighting, switch, and receptacle circuits, concealed in floor slab: Schedule 80 PVC conduit with rigid metal elbows.
Process Areas Damp or Wet (non-corrosive, non-hazardous)	▪ Conduit for power wiring, lighting, switch, and receptacle circuits, exposed - Rigid aluminum. ▪ Conduit for power wiring, lighting, switch, and receptacle circuits, concealed in floor slab: Schedule 80 PVC with rigid metal elbows. ▪ Conduit for power wiring, lighting, switch, and receptacle circuits, concealed within masonry block walls: Galvanized rigid steel (GRS) conduit.
Corrosive Areas Chemical storage and handling areas, underground vaults, within tanks or clearwells	▪ Conduit for power wiring, lighting, switch, and receptacle circuits, exposed: PVC coated rigid steel conduit ▪ Conduit for power wiring, lighting, switch, and receptacle circuits, concealed in floor slab or structures: Schedule 80 PVC with rigid metal elbows.
Outdoor Areas All locations	▪ Conduit for power wiring, lighting, switch, and receptacle circuits, exposed - Rigid aluminum. PVC conduit shall not be used where exposed.

All junction boxes pull boxes, wireways, and fittings will be metal, constructed of materials and furnished with hardware suitable for the environment in which they are installed. All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel conduit. The ends of couplings and fittings shall have a minimum of one pipe diameter PVC overlap to cover threads and provide a seal.

Cast or malleable iron device boxes shall be Type FD. All cast or malleable iron boxes and fittings shall have cadmium zinc finish with cast covers and stainless steel screws.

Aluminum boxes and fittings will be provided with aluminum raceways. Cast aluminum device boxes shall be Type FD. All cast aluminum boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws.

Steel elbows and couplings shall be hot dipped galvanized. Elbows and couplings used with PVC coated conduit shall be furnished with a PVC coating bonded to the steel, the same thickness as used on the coated steel conduit. Steel elbows shall be used on all embedded Schedule 80 PVC conduits where they leave the concrete encasement (slab or duct bank) and are exposed. Galvanized or PVC coated shall be used according to the environment in which they are installed.

Where conduits cross structural expansion joint, combination expansion-deflection fittings shall be used. Conduit Mounting Hardware:

- In dry indoor areas, hangers, rods, backplates, beam clamps, channel, etc shall be galvanized iron or steel.
- Fiberglass channel with stainless steel hardware shall be used in Wet and Corrosive areas and in outdoor locations. Fiberglass channel shall be resistant to the chemicals present in the area in which it is used.

Link seals or equivalent shall be provided for all conduits penetrating wall below grade.

Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.

Liquid tight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present.

Aluminum conduit shall not be imbedded in concrete. Aluminum conduit shall be isolated from other metals with plastic sleeves or plastic coated hangers. Strap wrenches shall be used for tightening aluminum conduit.

10.3.14 Underground System

Underground system is the collection of underground raceways, manholes and handholes. Furnish and install a complete underground system of raceways, manholes and handholes.

Duct banks are a collection of underground raceways. Duct banks shall be encased in steel reinforced concrete up to the building, structure, vault, manhole and handhole unless otherwise specified.

- Duct bank, manhole and handhole depths vary. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required depths and install raceways, manholes and handholes at that required depth.
- For duct bank routing, coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths.

Raceways shall be polyvinyl chloride conduit encased in concrete except that PVC coated rigid steel conduit shall be used for 4-20mA shielded instrumentation cables and copper Ethernet data highway wiring.

Set manholes and handholes at the proper elevation such that the pitch of raceways will be towards manholes and handholes and away from structures, vaults and buildings.

Handholes shall be precast concrete, heavy-duty type, designed for a Class H 20 wheel load and conform to ASTM C478. Handhole frames and covers shall be cast iron, heavy duty type for Class H 20 wheel loading.

10.3.15 General Purpose Transformers

Transformers shall be built in accordance with ANSI C89.2 and NEMA ST 20. General purpose transformers will be dry, indoor, two winding type, having KVA and voltage ratings as required.

Primary windings will be rated 480V for use on 3-phase, 3 wire circuits. Secondary windings will be rated for 120/208V, 3-phase, 4 wire. Transformers up to 10 KVA will have two - 5 percent taps below normal. Transformers larger than 10 KVA will have four - 2.5 percent taps - two above and two below normal. Transformers will have Class H (220 C) insulation with a maximum temperature rise of 80 degrees C.

Transformer windings shall be copper. Transformers shall be furnished with mounting hardware.

Manufacturers

- Square D Company
- General Electric Company
- Eaton/Cutler - Hammer

10.3.16 Disconnect Switches

Disconnect switches shall be provided within sight of all motors in accordance with the NEC. Disconnect switches shall be heavy duty, quick-make, quick break, visible blades, 600 volt, 3-pole type, horsepower rated with full cover interlock, flange mounted operating handle and provisions for pad locking.

Horsepower rated, 3-pole, 600 volt toggle type switches will be furnished with handle guard and lock-out feature.

Manufacturers

- Square D Company
- General Electric Company
- Eaton/Cutler - Hammer

10.3.17 Grounding System

A complete grounding electrode system in accordance with Article 250 of the National Electrical Code shall be provided.

All buried connections to grounding electrodes and to building steel columns will be exothermic weld.

Ground rods shall be minimum 3/4 in by 10 ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm.

Grounding conduit hubs shall be malleable iron type or equivalent and of the correct size for the conduit.

Water pipe ground clamps shall be cast bronze saddle type or equivalent and of the correct size for the pipe.

10.3.18 Lightning Protection System

Provide a complete lightning protection system for the SMH WTP and wellfield, provide safety for all buildings, above grade structures and occupants from damage caused by lightning.

Reference Standards

- ANSI/LPI 175
- ANSI/LPI 176
- ANSI/UL 96
- UL 96A
- NFPA 780

The lightning protection system shall be aluminum type comprised of air terminals, roof cables, connections and fasteners. Copper conductors shall be used to interconnect the aluminum roof cables to the ground terminations.

Employ the services of a licensed lightning protection systems engineering company to design and install the lightning protection system and prepare detailed installation drawings and material specifications.

The lightning protection system shall be checked by a UL field inspector upon completion of the installation.

All materials shall be installed by experienced workmen that specialize in this type of work. The lightning protection system shall be installed per approved shop drawings and UL and NFPA recommended practices.

The lightning protection system engineering company shall provide job site assistance and supervision of the installation as required, and shall be present during the UL inspection.

Upon completion of the installation, the Company shall furnish the Master Label issued by UL for this installation.

10.3.19 Lighting

General Requirements

For the purpose of lighting calculations, reflectance for finished rooms shall be 80 percent for ceilings, 50 percent for walls, and 20 percent for floors. Reflectance for unfinished rooms shall be 70 percent for ceilings, 30 percent for walls, and 10 percent for floors.

Light fixture mounting heights shall be determined on an individual room basis taking into consideration any conflicting piping, ductwork, and other interferences. In general, do not mount light fixtures higher than a standard maintenance ladder height or a safe ladder platform.

Emergency illumination shall be provided in all spaces as required by code to provide life safety, property, and equipment protection. Adequate emergency lighting levels shall be provided to maintain safe building egress and to maintain critical plant process functions. Emergency lighting shall be provided at all building egresses to allow occupants to reach a public pathway outside the building. Where installed in areas having high intensity discharge little the emergency unit shall be equipped with a time delay relay to allow the normal lighting to come up to full illumination before the unit is switched off. Emergency light fixtures shall have test pushbuttons and are to be connected to un-switched 120 volt lighting circuits.

Outdoor roadway lighting shall be designed to provide minimum lighting levels as required by IESNA Standards for safe travel. Exterior building lighting and general lighting for open tank walkway areas shall also be provided for safe entrance and egress. All permanent exterior lighting shall be directed downward and oriented so that no light source is directly visible from neighboring residential areas. Exterior and roadway light fixtures shall be controlled by photocell and manual override for testing purposes. General outdoor lighting shall comply with local lighting ordinances for low-level illumination and for maintaining dark sky by preventing light spillage upward. Fixtures shall be provided with a bullet-resistant clear Lexan shields to protect both the housing and the lens.

Exterior lighting shall also be provided for operators to maintain and monitor process and open tank areas such as the filters and basins. Lighting for the open tank water surface illumination shall be controlled by locally mounted toggle switches. All fixtures visible from the facility perimeter fences shall be provided with clear Lexan shields to protect both the housing and the lens.

Lighting shall be in compliance with the requirements of applicable state and local energy codes. Design Lighting Levels in average maintained footcandles shall be as shown in **Table 10-2**. In no case, however, shall energy levels exceed local and State energy codes.

Table 10-2 Design Lighting Levels

Area	Footcandles
General Office	50, supplement with task lighting if required
Individual Offices	50, supplement with task lighting if required
Laboratories	50, supplement with task lighting if required
Maintenance Shops	75
Control Rooms with video display terminals	30
Lunchroom	30
Restrooms	20
Stair landings	20
Corridors	10
Storage	20
Open Tank Areas, General Lighting	5 and in compliance with Dark Sky Protection Act
Process/pump Areas	30
Mechanical Rooms	30
Electrical Rooms	40
Truck Unloading Areas	10
Roadways	0.4
Emergency Lighting along Egress Pathways	1.0 on the floor or stair

Materials

Lighting fixtures for offices, laboratories, electrical rooms, mechanical rooms, control rooms, lunch rooms, restrooms, stair landings, corridors:

- Use fluorescent fixtures with high efficient warm lamp color, and energy efficient ballasts. In these areas where computer monitors shall be used, specify fluorescent light fixtures with deep louvers or pendant mounted indirect fixtures to reduce glare and reflections.
- For suspended ceiling areas, coordinate with architectural.

Indoor process/pump areas:

- For areas with ceilings lower than 15 feet, use enclosed and gasketed, vapor-tight fluorescent fixtures with light white lamp color, and energy efficient ballasts.
- For areas with ceilings 15 feet and higher where “instant start” is not required by operations, use industrial enclosed and gasketed, metal halide fixtures, high or low bay, with pulse-start lamps.

Corrosive and chemical handling areas:

- For areas with ceilings lower than 15 feet, use corrosion-resistant, enclosed and gasketed, vapor-tight fluorescent fixtures of non-metallic construction suitable for wet locations with light white lamp color, and energy efficient ballasts.

Outdoor roadway and parking lots:

- Pulse start Metal Halide cut-off roadway and area lighting fixtures on poles.

Building and tank exterior lighting:

- Cut-off metal halide fixtures suitable for use in wet and damp locations on poles and building walls.
- For areas with canopy 15 feet and higher where “instant start” is not required by operations, use corrosion-resistant, industrial enclosed and gasketed, metal halide fixtures UL listed for marine duty, high or low bay, with pulse-start lamps.
- For water surface illumination, use enclosed and gasketed, water-tight fluorescent fixtures constructed of all stainless steel with light white lamp color, and energy efficient ballasts. Install fixtures from catwalks or bridges near the water surface and also where they are accessible for relamping. Provide toggle switches to turn the lights on and off in close proximity of fixtures.

Emergency Exit signs:

- In process, pump and chemical handling areas, signs shall be self-powered units with corrosion resistant enclosures rated NEMA 4X, temperature compensated, sealed 12 volt maintenance-free nickel cadmium batteries, LED light source, battery charger with LED indicator light, sealed push to test switch, and time delay.
- In non-process areas, signs shall be similar, except with standard enclosures such as die cast aluminum or high impact thermoplastic. All emergency exit signs shall be red colored.

Emergency lighting fixtures:

- In process, pump and chemical handling areas, fixtures shall be self-powered units with corrosion resistant enclosures rated NEMA 4X, temperature compensated, sealed 12 volt maintenance-free nickel cadmium batteries, dual high intensity incandescent sealed lights, battery charger with LED indicator light, sealed push to test switch, and time delay.
- In non-process areas, fixtures shall be similar, except with standard enclosures such as steel or high impact thermoplastic.

Lighting Controls

- Roadway and parking

- Combination circuit breaker - magnetic contactors NEMA 1 size minimum.
- Alternate photocell controlled light poles with time controlled light poles.
- “Hand-Off- Auto” maintained three-position selector switch. In hand, overrides the photocell / In auto, controlled by the photocell and time clock function.
- Indoor areas
  - Occupancy sensors shall be used in all spaces unless otherwise permitted by the County’s Technical Advisor.

Lamps

- All lamps shall be high efficiency, low-mercury type with green end cap identification. Each lamp shall have been tested and certified by an independent laboratory that the lamps have successfully passed the Toxicity Characteristic Leaching Procedure (TCLP) for Mercury EPA Method 1311 of Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846 and the NEMA Standard, NEMA LL 1, “Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP.”
- Fluorescent lamps shall be 265 mA, F32T8, instant start, and medium bi-pin with 3500 Kelvin correlated color temperature and CRI of 85.
- Metal halide lamps shall be the phosphor-coated type and shall be suitable for burning in any position.
- All HID lamps shall be the lead -free type.

Ballasts

- Fluorescent ballasts shall be premium efficient electronic, 25 kHz or higher, full-output, rapid-start type for use on 265 mA, T8 lamps. Ballasts shall be U.L. listed, ETL certified, Class "P", high power factor. Ballasts shall have an "A" sound rating or better. Ballasts shall have a minimum starting temperature of 0 degrees F. Ballasts shall be series wired type and designed to operate the number and length of lamps specified. The total harmonic distortion (THD) shall in no case exceed 10 percent THD. Ballasts shall have a minimum ballast factor of 0.95. Ballasts shall have nominal power factor 0.99 or higher. Ballasts shall have a maximum lamp current crest factor of 1.5.Ballast shall provide normal rated life for the lamp specified. Electronic ballasts shall be warranted for parts and replacement for one full year from the date of installation.
- Metal Halide ballasts shall be of the constant wattage type of the correct size and voltage for the fixture it is to serve. Ballasts shall provide at least plus or minus 3 percent voltage variation to the lamp with plus or minus 10 percent line voltage variation. Ballast power factor shall be at least 90 percent.

Poles

- Poles shall be fabricated to withstand a wind velocity of 110 mph at the base with a wind gust factor of 1.3; as well as; the height and drag factors recommended by AASHTO standard specification for Highway Signs, Luminaires and Traffic Signals. The effective projected area of the luminaire(s) shall be accounted for in pole fabrication/selection. Poles shall be 6063 aluminum alloy with a T6 temper, straight or round, 20 ft length, integral vibration damper to alleviate harmonic vibration, pole top cap, handhole, aluminum alloy base, provisions for minimum four (4) anchor bolts, stainless steel anchor bolts and base cover.

10.3.20 Receptacles

Space duplex receptacles for general service no more than 30-feet apart, in all process areas no more than 40-feet apart on tanks, and in offices and rooms in buildings no more than 10-feet apart. Limit 4 duplex receptacles on one 20-amp circuit. Do not connect all receptacles in a single room or area on the same circuit. Provide duplex receptacles, including GFCI, rated for 20 amps, 125 volts, grounding type.

Install GFCI receptacles with corrosion resistant and weatherproof "In-Use" covers in corrosive areas, damp areas, process/pump areas, areas subject to wash down and outdoor locations. Install GFCI receptacles with stainless steel plates in clean, dry areas adjacent to sinks and as required by Code.

Typical mounting heights for receptacles shall be 12-inches above floors for indoor non-industrial areas, 48-inches above floors for indoor process/pump areas, and 36-inches above grade or slab for outdoor areas (heights are to the centerline of the receptacle device box).

Provide a dedicated simplex receptacle which will provide power to any laboratory or kitchen device rated 1 to 1.8 kw at 120vac requiring a portable plug. Connect only one simplex receptacle on a given 120-volt circuit.

Manufacturers

- Hubbell Lighting, Inc
- Lithonia Lighting
- LSI Lighting
- Genlyte Thomas Group
- Cooper Lighting

Manufacturers

- Cooper Wiring Devices
- Leviton Manufacturing Company
- Pass & Seymour/Legrand

10.3.21 Standby Diesel Engine Generator(s)

Provide complete diesel engine driven generator(s) including outdoor weatherproof enclosure, hospital grade critical silencer(s), fuel storage tanks, fuel day tank, starting batteries and battery charger, keep warm system for the engine, generator, and control panels. The diesel engine generator set shall be EPA Tier 4 rated. The engine and generator shall be rated for standby service. Provide diesel fueled engine driven generator(s) for standby power in accordance with NFPA 110 and NEC 701. Generators to conform to UL 2200 as applicable. Standby rating to provide for 70% of the maximum day demand plus all support systems..

Fuel storage tanks shall be sized for a minimum of 168 hours at full rated load without refilling the tank.

Provide remote alarms via the SCADA System to be annunciated important alarms and information in the main control room.

Support the base with heavy duty spring type vibration isolators with multi-directional snubbers for seismic restraint, anchored to the concrete foundation, and as manufactured by Korfund; Ace; Mason or equal. The vibration isolators, snubbers, and attachment bolts shall support the generator set gravity load, dynamic loads, and seismic forces and shall conform to applicable requirements of the Florida Building Code.

Provide exterior access to the generator room.

The Company shall investigate the feasibility of using the generator in Peak Shaving /Demand Reduction applications. Provide a report to included Electric Utility's terms including preliminary utility contracts that would delineate requirements and economic benefits. Provide costs analysis examining a Standby Generator with and without Peak Shaving; include equipment costs and lifecycle analysis.

10.3.22 Solar Panels

If renewable energy is claimed as a LEED credit, furnish and install a solar energy photovoltaic system.

The Company shall employ the services of a photovoltaic systems design company certified by North American Board of Certified Energy Practitioners (NABCEP) to prepare detailed installation drawings and material specifications. The Company shall provide the services of a structural engineer registered in the State of Florida to be fulfill all requirements of the Florida Building Code for the PV system structural supports. The Company shall coordinate with FPL for the installation requirements of PV systems operating in parallel with the utility.

PV system equipment shall meet the following standards, latest edition:

- UL 1703 – UL Standard for Flat-Plate Photovoltaic Modules and Panels
- UL 1741 – UL Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems

Photovoltaic modules shall consist of series-connected mono-crystalline silicon solar cells and shall have polarized, weatherproof, DC-rated plug-and-socket connectors. The cells shall be laminated between sheets of ethylene vinyl acetate and high-transmissivity tempered glass. The modules shall be UL listed and shall have a UL Class C fire rating.

Combiner boxes shall be steel, NEMA 3R with an integrated DC disconnect. Power inverter for the Solar PV array shall have voltage ratings as required, and be able to deliver AC continuous power, even in the event of partial shade coverage. Inverter shall be UL1741 compliant and have a fully integrated design including transformer, filters, AC&DC disconnects, DC Combiner Fuses. The inverter shall have a NEMA 3R enclosure, suitable to be installed outdoors

10.3.23 Plans

The Company shall provide detailed installation drawings for lighting, power, and all miscellaneous systems (i.e., power monitoring, etc.). Plans (or drawings) shall include all equipment locations and buried, embedded, hidden and exposed conduits. Plans shall indicate sizes of all conduits, junction boxes, special fittings, pieces of electrical and instrumentation/control equipment along with associated quantities, sizes and types of conductors and cables. Plans shall show, but not limited to:

- Symbol Legend
- Power and Lighting Panel Schedules showing the circuits served by each circuit breaker
- Lighting Fixture Schedule
- Grounding Plan
- Details for underground duct banks, manholes and handholes
- Underground and embedded conduit runs and duct banks
- Electrical room layouts at ¼ inch equals one foot (1/4-inch = 1 foot) scale or larger
- Exposed and embedded conduits in all areas and structures
- Low and medium voltage feeder and branch circuits

- Grounding and bonding for all facilities and structures/buildings
- Instrumentation and control systems, data highway
- Communication systems
- Security systems
- Building lightning protection system
- Empty conduits for future use
- Empty spaces for future conduits

Plans shall be plotted out with scale not greater than 1-inch equals 20 feet for site plans and 1/4-inch equals 1-foot for building and structure plans.

Drawing borders, title block, layer names and layer colors shall be as required by Miami Dade Water and Sewer Department.

10.3.24 Single Line Power Diagrams

Single line power diagrams shall show by means of single lines and graphical symbols the course of an electrical power circuit or system of circuits and components, devices, or parts used therein. Physical relationships are represented schematically.

The Company shall prepare a main power distribution single line power diagrams as well as single line power diagrams for each piece of switchgear, motor control centers, etc. Diagrams shall show equipment rating, bus rating, overall interrupting rating, protective device functions, component sizes and ratings, load KW or horsepower ratings and equipment designations, etc.

10.3.25 Elementary or Schematic Diagrams

An elementary or schematic diagram shall be provided for every piece of equipment which requires a control function or scheme. Typical diagrams for groups of equipment may be provided but shall include an adapter table listing the pieces of equipment for a given type, e.g., Booster Pump Nos. 1 through 4, Generators Nos. 1 through 6, etc., equipment designations, control device designations, wire numbers, time delay fittings, etc.

An elementary or schematic diagram shall show all circuits and devices of a system, equipment item, or assembly, or any defined functional portion thereof. A system is defined as any assembly of electrical, electronic, mechanical, hydraulic, pneumatic, and other various types of components and devices and/or materials which are combined, connected, and integrated as necessary to perform some specific function. Such a diagram emphasizes the functional arrangement of system components and devices as opposed to their physical arrangement, and is intended to provide a functional understanding of the operation of the system or circuit. "Elementary" and "schematic" are equivalent terms unless additional definitions or requirements are stated.

Unless otherwise specified, electrical elementary or schematic diagrams shall be drawn in accordance with the latest issue of Joint Industrial Council (JIC) Electrical Standards for Mass Production Equipment (EMP-1). All circuits and devices of a system shall be shown. A detailed description of the sequence of operation of the circuit shall be included for each diagram.

10.3.26 Interconnection Diagrams

Interconnection diagrams shall be provided for all systems such as fire alarm, security, power monitoring, showing each piece of equipment all wiring between all devices, panels, terminal cabinets, control equipment, motor control center, and any other devices and equipment. References shall be shown to all diagrams which interface to the interconnection diagrams.

Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of individual wires clearly shown. Wireless diagrams and wire lists are unacceptable. Non-sequential terminals, on which wires are landed, shall be shown with gaps on the terminal block to depict they are not adjacent. Equipment terminal blocks shall be shown in the exact physical order (including spares) as they are installed. Each wire labeling code as actually installed shall be shown. The wire labeling code for each end of the same wire must be identical. All device and equipment labeling codes shall be shown.

Terminal blocks within equipment with interconnection wiring connected shall be shown complete with labeling code and all termination point labeling codes shown. All jumper, shielding and grounding termination details not shown on the connection diagrams shall be shown on the interconnection diagrams. Each wire and cable size and color code shall be shown. Signal and DC circuit polarities shall be shown. Multiple conductor cables shall show all wires.

Wire and cable routing through conduits, junction boxes, terminal cabinets, and other electrical enclosures shall be shown with the appropriate equipment labels. Labeling codes for terminal blocks, terminals, wires, cables, panels, cabinets, instruments, devices, and equipment shall be shown. All spare wires and cables shall be shown.

10.3.27 Upper Floridan Aquifer Wells

The conceptual electrical plan for the proposed UFA wells is shown on sheets E-1 through E-3 of the UFA Wellfield set presented in Volume III.B. Technical Background and Information. The proposed well configuration considers an independent feed to the nine (9) UFA wells along the C-1 canal and an independent feed to the five (5) UFA wells to be located within Roberta Hunter Park. The proposed nine (9) UFA wells along the C-1 canal require a 4160 V feed to each of the wells, which will be stepped down via transformers to 480 V. It is proposed that the electrical enclosure and transformers for each of the C-1 Canal wells will be integral to each well and located along the canal right-of-way.

The five (5) UFA wells in Roberta Hunter Park will be supplied with power via common electrical distribution building. This building shall be located near the intersection of SW 200 street and 117th Avenue, and will receive power from the above mentioned 4160 V feed. The building will contain all electrical control equipment for the Robert Hunter Park wellfield, and include transformers to provide the wells with 480 V electrical service.

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Volume III.A - Section 11

Security, Personnel Protection, and Communication Systems

11.1 Description of Work

The project includes a new WTP at the SMH site and nearby wellfields. This portion of the RFP includes security, personnel protection and communication systems.

The Company is responsible for providing security, personnel protection and communication measures to protect the new WTP facilities including the wellfield during construction, startup and testing through Final Completion. During construction, temporary security measures shall be provided by the Company as necessary to protect the facilities and its equipment and personnel. Additional care shall be taken during performance testing and periods through Final Completion, as protection of equipment and vandalism prevention is critical.

To reduce risk to the integrity of the facilities and to protect the public water supply, included herein are requirements for the design and construction of security, personnel protection and communication systems for the Project facilities. These requirements emphasize the facility design considerations, not the management and operations of the facilities. The Company shall adhere to the requirements for security, personnel protection and communication equipment selection as outlined in these requirements.

For the WTP and wellfield, security, personnel protection and communications shall be a major priority for the Company. Through the course of the Company's design, the following security, personnel protection and communication issues, at a minimum, shall be addressed with the electronic surveillance systems. The systems shall incorporate the SCADA communication system for data transmission:

- Threats to the wellfield and water treatment facilities
- Threats to the SCADA/telemetry system
- Fire detection and notification
- Communications

Threats may be in the form of one or more of the following: vandalism, criminal acts, or deliberate/malevolent acts.

11.2 Basic Requirements

11.2.1 Codes and Standards

The fire alarm system and its components shall be in accordance with the latest editions of the following codes and standards:

- NFPA 70 — National Electrical Code
- NFPA 72 — National Fire Alarm Code
- NFPA 101 — Code for Safety to Life from Fire in Buildings and Structures

All security and communication systems shall be in accordance with the latest editions of the following codes and standards:

- NFPA 70 — National Electrical Code
- UL — Underwriters Laboratories
- NEMA — National Electrical Manufacturer's Association
- FCC Compliance
- NTSC — National Television System Committee
- ADA — Americans With Disabilities Act

The design and installation of all wiring, cable and equipment shall be in accordance with NFPA 70, and specifically with Article 760, Article 770 and Article 800.

11.2.2 Design and Construction Submittals

Fire Alarm System

The Company shall employ the services of a licensed fire alarm protection systems engineering company to design the fire alarm protection system and prepare detailed installation drawings and material specifications for approval by the local Fire Department and the County Technical Advisor.

Access Control System

The Company shall employ the services of a licensed security firm actively engaged in the design of card reader systems to prepare detailed installation drawings and material specification for approval by the County Technical Advisor.

Gate Security System and Perimeter Intrusion Detection

The Company shall submit a scaled site plan showing locations of site property perimeter fences and gates, including one automatic sliding gate at the main entrance, and other site entry gates for vehicles and pedestrians, and a perimeter fiber optic intrusion detection system for approval by the County Technical Advisor.

Closed Circuit Television System

The Company shall employ the services of a licensed video surveillance firm actively engaged in the design of surveillance systems to prepare detailed installation drawing and material specifications for approval by the County Technical Advisor.

Telephone and Page/Party System

The Company shall submit detailed installation drawings and material specifications or the facility telephone system for approval by the County Technical Advisor.

11.2.3 Performance Standards

Fire Alarm System

The fire alarm system design shall provide total coverage for all the facilities and shall be in accordance with the applicable local building codes. The fire alarm system shall be electronically operated, addressable double-supervised, closed circuit, covering the entire WTP facility and wellfield structures.

The existing fire alarm system for the high service pump station shall be integrated into the new fire alarm system for the WTP.

Upon activation of any manual pull station or automatic detector they system shall:

- Automatically notify the Fire Department
- Automatically start the audible and visual alarm indicating appliances throughout the building under alarm.

Audible alarm appliances shall sound the standard evacuation tone temporal pattern 3 and visual alarms flash until alarm initiating devices have been restored to norma and the reset switch located at the control panel actuated.

Battery backup power shall be as required per applicable codes.

Access Control System

Card readers shall be provided for all exterior doors of each building at the WTP facility, and wellfield structures with doors and locks.

The existing access control system for the high service pump station shall be integrated into the new access control system for the WTP.

The system shall include a minimum of 30 minutes backup UPS power.

Gate Security System and Perimeter Intrusion Detection

The gate security system shall include gate operators, detection loops, intercom, and card reader for each facility vehicular gate.

The perimeter intrusion detection system shall consist of a buried fiber optic cable installed along the entire perimeter fence of the WTP.

The system shall include a minimum of 30 minutes backup UPS power.

The gate intercom stations shall communicate with the WTP control room.

Closed Circuit Television System

The closed circuit television system shall include color cameras with pan/tilt/zoom control at each access gate, throughout the WTP site and in the main process areas. The cameras shall communicate with a central monitoring station located in the WTP control room. The central monitoring station shall include DVD recorders. Power supplies and UPS backup for 30 minutes shall be provided.

Telephone and Page/Party System

Furnish a system of conduits, wiring, backboards, telephone system equipment, outdoor speakers, indoor speakers and page/party handsets for entire facility coverage, At least one page/party speaker and handset shall be located in each indoor and outdoor main process area. At least one telephone outlet shall be located in each electrical room, office, break room, copy room, conference room, shop and laboratory. Multiple telephone outlets shall be furnished in the control room and reception.

11.3 Specific Requirements

11.3.1 Physical Security Requirements

The following sections outline the physical security, personnel protection and communication requirements for the various Project facilities. Because water systems cannot be made immune to all possible threats, the design of the facilities shall address issues of critical asset redundancy, monitoring, response, and recovery to minimize risk.

For all of the Project facilities, basic physical security, personnel protection and communication measures shall be considered by the Company, including site security fences and gates, locks for access ladders, hatches, buildings, gates, and doors; bollards and barriers to prevent vehicle damage;

back-up generators or battery supply for emergency power of alarms, fire alarm systems, communications and life safety devices; and appropriate signage and lighting.

Each Project facility shall include Layers of Protection (LOP), built on the "protection in depth" principal, which requires a defeat of several protective barriers or security layers before a facility/component is compromised.

- For both existing and new facilities associated with the new WTP site development, the site perimeter LOP includes securing the existing perimeter fence with at least one automatic sliding gate at the primary vehicle site entry area. The automatic gate shall have a motorized operator with access card control at the entry stations, remote control, power outage manual override capability, and other features and facilities as described below. Secondary and other vehicle and pedestrian gates shall be manually operated and lockable. Vehicle entry gates shall open slightly more than the full width of the associated access roadway, and protection of gate posts and gate tiebacks provided. Gates, when open or shut, shall be coordinated with propose finished grades to not allow more than 6-in clearance underneath the gate when in a closed position. Gate movement shall be coordinated with proposed finished grades underneath to ensure smooth, continuous operation. Gates in open or closed positions shall be entirely located on the property, and not in right-of-ways.
- Primary vehicle site entry areas LOP shall include access card readers.
- The Company shall incorporate the following design provisions to protect the new WTP buildings and existing facilities.
- Secure perimeter fencing around the WTP site facility for deterrence and protection.
- Provide site access locking features that ensure site access by the local fire department per their recommendations.
- Provide shackled-protected locks to prevent breach with a bolt cutter or fire arm
- Provide bullet-proof rated restricted access signage, including signage restricting access to the site to authorized personnel only
- Provide bullet-proof rated restricted vehicle access signage
- Provide video surveillance via CCTV cameras
- Provide card access/security system.
- Provide fire alarm system
- Provide telephone services
- Provide adequate lighting to increase visibility of areas where potential suspicious activity might occur.

11.3.2 Control System Security Requirements

The Company shall rely on the various automated systems (SCADA, telemetry, HMI, etc.) for the operation and control of the Project facilities. Similar to the concepts mentioned in the preceding section, the management and operational security practices of the Control Systems are crucial.

To mitigate risk, several basic security practices shall be incorporated by the Company for the Control Systems, including the following:

- The equipment shall be housed in an appropriate (i.e., wet versus dry environment) lockable cabinet

- PLCs and computer workstations shall all be equipped with backup uninterruptible power supplies
- Firewall equipment shall be provided to prevent outside hacking into the control system
- Anti-virus software shall be installed and updated routinely (monthly updates at a minimum) when updates are available from the software manufacturer
- An off-site backup storage system shall be provided for the servers and workstations
- All default passwords shall be reset
- Prior to access, individual log-on credentials shall be required
- Log-on shall be configured to match the responsibility level of the Company Employees. A minimum of three (3) levels of security shall be provided (i.e., general/operator, senior operator, system administrator).
- Log files associated with the user's log-on credentials shall be required
- Requirements for appropriate password strength shall be provided (i.e., more "complex" passwords for those with higher access privileges, such as an administrator)
- Immediate removal of access privileges upon voluntary, and especially involuntary, termination shall be required
- An "inactivity timeout" log-out shall be provided to protect the Control System if no one is present in the control room or if the operator has stepped away
- A password to make software programming changes shall be required
- Programmed set-point ranges to reject potentially harmful out-of-range adjustments (especially for chemical dosages) shall be required

11.3.3 Security Equipment Specifications

11.3.3.1 Video Surveillance (CCTV) System – Color

Design, furnish, install, test and place in operating condition a color video surveillance (CCTV) system. Cameras shall be interconnected to the DVR via fiber optics.

Head-end System

Central digital video recorder and accessories: capable of recording video from local cameras; control camera operation; display all cameras on one monitor; Latest Windows operating system; recording resolution variable up to 720 X 480 NTSC; up to 30 images per second per camera record rate; fiber optic interface; accessories: keyboard; mouse; 17 inch color super-high resolution monitor, flat screen; free standing equipment rack and/or console. Multiplexers and/or matrix switcher(s)/controller(s) as required.

Cameras and Housings

Integrated day/night camera, lens, drive and dome system; NTSC signal format, 470 TV lines NTSC resolution; f/1.6 lens; 23X optical zoom/12X digital zoom; low light technology – color 0.08 lux/B&W 0.013 lux; auto iris control; variable speed pan and tilt drive; 1Vp-p video output; built in surge protection; environmental (NEMA 4X/IP66) enclosure with heater and fan. Provide 100% exterior cover around the building(s) exterior including the main entrance and main gate.

Fiber Optic Receivers and Transmitters

Fiber optic receivers and transmitters shall be provided as required to support communications (video and camera control) with cameras.

UPS

Provide UPS: 120VAC in/output as required; 30 minute run time for connected equipment including cameras and fiber optic components; auto self-test; auto voltage regulation; network grade line conditioning with surge protection and filtering; sine-wave output; status indicator LED's, as well as, overload and replace battery indicators; intelligent battery management system; maintenance free sealed leak proof lead acid batteries.

System wiring

Type, gauge, insulation, etc. shall be furnished as required and as recommended by the system supplier for a complete and operational system.

Exterior Poles

Pole shall be fabricated to withstand a wind velocity as required by the state building code as well as; the height and drag factors recommended by AASHTO standard specification for Highway Signs, Luminaires and Traffic Signals. The effective projected area of the CCTV equipment shall be accounted for in pole fabrication/selection. Poles shall 20 ft length with integral vibration damper to alleviate harmonic vibration.

Infrared Illuminators

Twin-unit arrangement, long range night vision (1300 ft); high efficiency optics; 695 nm wavelength; high fidelity spot beam pattern; photocell control (dusk to dawn control.

Provide the ability to interface with SCADA, including password protected video screens and offsite monitoring.

Manufacturers

- Pelco/Schneider Electric
- Vicon Industries, Inc
- Honeywell Video Systems
- Bosch Security Systems

11.3.3.2 Card Access System

Design, furnish, install, test and place in operating condition Card Access Security System on all exterior doors and the front gate. The readers shall be proximity type. The system shall have logging and report capabilities.

A PC-based system shall monitor all card readers and card activity for employee/contract parking support. Cards shall be capable of being programmed into several Access Groups. The system shall validate/invalidate card or groups of cards. It shall maintain a card holder database and generate various reports based on card holder, reader number, direction, time and date, or access type. Anti-pass back capabilities shall be provided. System shall automatically lock out cards on a programmable time and date.

11.3.3.3 Communications Page/Party System

Design, furnish, install, test and place in operating condition a Page/ Party System for all indoor areas of the plant and related facilities. The system shall provide both page and party line operation utilizing handset stations located at multiple locations throughout the facility**.** The system shall interface with the plant telephone system. The system should interface with the plant SCADA system to provide multiple tone outputs for various levels of alarms.

11.3.3.4 Gate Security

The gate control system is to be coordinated with the civil and site requirements and shall provide for truck access and emergency vehicle override.

The system shall include: slide gate(s), operators, detection loops and associated hardware, remote gate status indication, control components including intercom and card access control system for use by trucks and vehicles.

Materials

The gate operator(s) for the sliding gate(s) shall be heavy duty, worm gear reduction type with a lever type disconnect to permit manual gate operation. A reversal switch shall be provided for operator protection, an adjustable friction clutch, adjustable limit switches, and contactor type magnetic reversing starter with overload and under voltage protection. The operator enclosure shall be heavy duty, NEMA 4X, all welded construction with a gasket hinged cover with padlock.

Gate closing timer shall be plug-in type with adjustable timer logic which will allow gate to close after both safety loops have been cleared and only after a preset time has elapsed. Time delay modules shall be plug-in type that initiates gate reversal in the event that a vehicle crosses a safety loop during gate closure.

Intercom System

- Intercom master station shall be designed for continuous operation enclosed in a weatherproof enclosure. It may be flush or surface mounted.
- Remote intercom station shall be weatherproof flush mounted in pedestal and include a stainless steel enclosure, hands-free speaker/microphone and push button to signal.
- Interior intercom shall be provided with push button activated control to open and shut gate from a remote location

Dual loop detector relay shall be self-contained, with built-in electronically regulated power supply, solid state components mounted on epoxy printed board, 3-loop frequency setting, lightning protection, interval hold time control, pushbutton reset and be self-tuning.

In-ground loops shall consist of saw cut asphalt or concrete road surface. Loop size, location and construction shall be in accordance with gate supplier recommendations.

11.3.4 Addressable Fire Alarm System

The control panel shall use solid-state components to operate the system. Alarm initiating circuits shall meet NEC requirements for limited energy applications.

Each circuit shall be supervised to provide a trouble condition in the event of an open or short in either circuit. The initiating device circuits and the notification appliance circuits shall be Class ‘A’. They shall allow the receipt of and notifications of alarms even in the event of a single open or a single ground in the circuits.

Manual fire boxes shall be double-action with “LIFT–TO–BREAK” plastic shield.

Automatic ionization type smoke detectors shall be of the dual-chamber, locking type.

Heat detectors shall be of the fixed temperature and rate-of –rise type.

Audio-visual horn/strobe light units shall meet ADA requirements.

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Volume III.A - Section 12

Instrumentation and Controls

12.1 Description of Work

The Project includes a new WTP at the SMH site and wellfield including SCADA and instrumentation for the facilities. The Company shall design and provide all components, system installation services, as well as all required and specified ancillary services in connection with the Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to design, furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, control panels, cabinets, digital hardware and software, redundant servers, operator workstations, remote telemetry units, operator interface terminals, signal and data transmission systems, interconnecting wiring, fiber optic cable, brackets, supports, piping, tubing, valves, mounting hardware, and such accessories as shown, specified, and/or required to provide the functions indicated.

The SCADA control system shall be provided through Emerson Process Management, Water Automation Solutions (formally Bristol Inc), and shall include all digital control system hardware and software described in this section, including but not limited to:

- New PLC (Controlwave) based control panels for distributed control of the new plant processes. The control architecture shall consist of a central main control panel (MCP) in the main control room. Inputs/Outputs (I/O) may be wired to the central control panel or distributed in remote I/O panels as convenient according to the layout of the processes and motor control centers (MCCs).
- Where PLC-based vendor panels are furnished for processes, the vendor PLC shall be networked to the MCP PLC via Ethernet, and the vendor PLCs shall be, where possible, by the same manufacturer as the MCP PLC. The Company shall furnish and configure any protocol interface necessary for the PLC and SCADA HMI to transfer data and commands between the vendor PLC and the plant SCADA system. Vendors are required to provide data information, PLC addresses and engineering units.
- The Human Machine Interface (HMI) shall be a PC based application OpenEnterprise SCADA software by Emerson Process Management, Water Automation Solutions to network the two systems as indicated below. The HMI shall consist of two redundant SCADA servers and two Engineering/Support workstations, located in the SCADA room. Four operator's workstations shall be furnished at the operator's console. Additional workstations shall be furnished on second network for placement in the lab and offices as defined. Four Personal Computers (PCs) shall be furnished for the following functions, weather station, MDWASD internet, security and County telemetry system.
- The main network rack located in the SCADA room shall contain one 48 port Ethernet switch, one 24 port Ethernet switch, one County-Wide network router, two redundant servers, one network attached storage device, fiber optic patch panel and redundant UPS. CAT6 cables shall be pulled from each workstation to the main network cabinet for flexibility in placement of the operator workstations.

- Provide all programming of the MCP PLC for control and monitoring of the plant processes and remote wellfield facilities.
- Provide all HMI configuration of process and alarming screens, databases, trends, and reports. Provide a historian server for long term storage of process data for trending and planning purposes. An operator trained at one facility should be able to understand, navigate, control and monitor processes from a graphical interface environment.
- Provide SCADA communication and graphic screens and database points for power monitoring as outlined in the electrical section.
- Provide interface to video monitoring system in SCADA to permit the embedding of video objects in SCADA screens. Interface software shall be integral to Open Enterprise software.
- Provide annunciation via plant-wide public address (PA) system to alert operators of SCADA monitored alarm conditions throughout the plant. A switch shall be provided to select whether SCADA alarms will be annunciated locally at the control room only or also repeated onto the PA system.
- Furnish an aesthetic control room with new and control room furniture for ergonomic presentation and access to the Operator Workstations. Provide a 55 inch diagonal LED/LCD HDTV-monitor for presentation of an operator selected SCADA screen. One control room PC workstation shall accommodate two active monitors for this purpose.
- The workstation in the plant lab shall be provided with screens to permit the operator to manually enter laboratory data into the SCADA database for trending, reporting, and viewing by operations at the plant (with appropriate password privileges) and wellfields.
- Install a PLC-based polling master panel at the WTP and new remote telemetry units (RTUs) for communication to the following:
    - Raw Water Wells
        - Monitor and control pumps, wellhead pressure/flow/security parameters. I/O includes: pumps (RUN, FAIL, IN-REMOTE statuses) [discrete inputs], system pressure [analog input], flow [analog input], low ambient temperature [discrete input], intrusion alarm [discrete inputs]. Typical all telemetry links:The responsibility to design working communication links from the WTP to the various remote well and wellfield sites shall be the responsibility of the Company. The Company shall perform a radio survey from each remote location to the WTP to identify which frequency is acceptable for radio communication. Other communication media, such as fiber optic cable, may also be considered in the event that the final location of the wells does not permit workable line-of-sight radio paths to the RTUs. Telephone circuits shall not be permitted as a telemetry communication medium.
- Provide hardware and software required to integrate system with the Department's existing SCADA Wide Area Network (WAN). Contractor shall configure the SCADA servers/historian system to interface with all County existing water and wastewater treatment plants control systems. The DCS software shall match the existing County's software, Emerson Process Management, Water Automation Solutions Open Enterprise to create a continuity and ease of database management between the various plants (WTPs and WWTPs).

12.1.1 Supplier Requirements

A Plant Control System Supplier (PCSS) shall be responsible for the design, installation and testing of the Plant Control Systems (PCS) which shall consists of control equipment hardware, software, networking equipment, Programmable Logic Controller (PLC) equipment, field instruments, etc.

Acceptable PCSS are as follows:

- Emerson Process Management/Bristol Inc.
- 1100 Buckingham Street
- Watertown, Ct. 06795
- Attention: Roger Labrecque
- Phone: 860-945-2271

12.1.2 Control Overview

At the WTP, the PLC in each process area shall monitor and control its process based on its connected inputs/outputs (I/O), and on the information available via the connected PCS network. To ensure PLC operation in the event of a network failure, which may isolate it from other information sources, the PLC shall be configured to operate in an autonomous fashion. The PLC-based main control panel (MCP), plant servers, workstations, and other SCADA system resources are connected to each other via Ethernet network switch. All PLCs shall communicate peer-to-peer and to the redundant servers via a redundant fiber optic loop.

12.2 Basic Requirements

12.2.1 Codes and Standards

The Plant Control System and components shall be designed in accordance with all applicable Federal, State and Local Codes and Standards including all amendments thereto including but not necessarily limited to the following:

- National Electrical Manufactures Association Standards
- NFPA 70 - National Electrical Code
- State of Florida Building (Electrical) Code
- International Society of Automation (ISA)
- International Electrotechnical Commission
- IEEE National Electrical Safety Code
- Underwriter's Laboratories, Inc.
- ANSI/NEMA IA 2 Series - Programmable Logic Controllers (PLC)

12.2.2 Design Submittals

The Company shall submit Design Submittals and Documentation to the County Technical Advisor, including the following information:

- Overall system block diagram(s), and preliminary digital hardware placement, preliminary console and equipment panel arrangements and layouts.
- Radio field survey between all remote sites and WTP
- Complete P&IDs for the entire Project
- Control and networking systems architecture diagrams, County standardizes in the Hirschmann 8-port Fast Ethernet switch, model 943 434-003, managed software layer 2 enhanced.

- Overview of software design and organization, including control system and operating personnel interactions and software reliability.
- Complete control descriptions for all Project facilities, systems and equipment
- Equipment information
- Analyzer and instrumentation information
- HMI information
- Plan for implementing system development, assembly, check out, hardware/software performance verification, installation, activation and factory test activities.
- Additional information to show conformance with requirements herein

12.2.3 Construction Submittals

The Company shall submit construction information on the products and materials related to the work in this Section to the County Technical Advisor. In addition, the following information shall be furnished to the County Technical Advisor:

- System block diagram(s) showing:
  - All equipment to be provided.
  - All interconnecting cable.
  - Equipment names, manufacturer, and model numbers.
  - Equipment locations.
- Information for all digital equipment including:
  - Bill of materials with equipment names, manufacturers, complete model numbers and locations.
  - Catalog cuts.
  - Complete technical, material and environmental specifications.
  - Assembly drawings.
  - Mounting requirements.
  - Color samples.
  - Nameplates.
  - Environmental requirements during storage and operation.
- Software submittals should include:
  - Bill of materials with software names, vendors, and complete listings of included software modules.
  - Standard manufacturer's literature describing the products.
  - Description of function of software in Control and Information System.
  - Limitations or constraints of software.
  - Minimum system (processor and memory) requirements.
  - Operation and maintenance requirements.
- Third-party software, including:
  - Operating system.

  - Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.).
  - Control software (block oriented and/or ladder logic).
  - Office-type products, such as spreadsheets, word processors, etc.
  - Database management software.
  - Communications software, including all applicable local and wide area network software.
  - Programmable logic controller programming software (where applicable).
- Software configuration, including:
  - Graphic display organization.
  - Database configuration for operator workstations and database management system.
  - Trends.
  - System security.
  - Formats for all reports, including all required calculations.
  - Intercommunications between software products required to implement system functions.
  - Equipment backup configuration and requirements.
- Information on control strategies:
  - An overall description of the program structure and how it will meet the specified control requirements.
  - A listing of the program.
  - Extensive comments in the listings to describe program steps.
  - Equation and ladder program derivations for all specified control routines.
  - Resource (processor and memory) requirements.
  - A listing of inputs and outputs to the control strategy.
- Information on graphic displays:
  - Submit all graphic displays required to perform the control and operation interface functions to control the various WTP processes.
  - Submit graphic displays to be reviewed by the County at least 60 days prior to commencement of the witness factory testing.
  - The Company shall allow for one major cycle of revisions to the displays prior to the witness factory testing and one minor cycle of revisions following the witness factory test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the County. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions.
  - Two of the required submittals in each revision cycle shall be full color prints of the entire set of displays.
  - Displays shall be printouts of actual process graphics implemented in the system.
- Information on control panels, including:
  - Exterior panel drawings with front and side views, to scale.

  - Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.
  - Panel area reserved for cable access and conduit entry.
  - Location plans showing each panel in its assigned location.
  - Bill of materials with equipment names, manufacturers, complete model numbers and locations.
  - Catalog cuts.
  - Complete technical, material and environmental specifications.
  - Assembly drawings.
  - Mounting requirements.
  - Color samples.
  - Nameplates.
  - Environmental requirements during storage and operation.
  - Panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.
- Information on instruments to be furnished, including:
  - Product (item) name and tag number used herein and on the Contract Drawings.
  - Catalog cuts.
  - Manufacturer's complete model number.
  - Location of the device.
  - Input output characteristics.
  - Range, size, and graduations.
  - Physical size with dimensions, NEMA enclosure classification and mounting details.
  - Materials of construction of all enclosures, wetted parts and major components.
  - Instrument or control device sizing calculations where applicable.
  - Certified calibration data on all flow metering devices.
  - Environmental requirements during storage and operation.
  - Associated surge protection devices.
- Wiring and Loop Diagrams
  - Interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.
  - Electrical interconnection diagrams
  - Loop drawings conforming to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control.
- Process and Instrumentation Diagrams
  - Process and Instrumentation Diagrams, conforming to ISA standards, showing all instrumentation and control equipment, and all monitoring and control functions, for the entire Control and Information System.

- Control and Information System Training Requirements
  - A minimum of 60 days prior to beginning training, submit a detailed training plan for operators, maintenance staff, describing the following:
    - A list of all courses to be conducted.
    - Course content.
    - Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.
    - Course schedules.
    - Qualification and experience of individual (s) providing training.
- Operation and Maintenance Manuals containing instructions necessary for installing, operating, and maintaining equipment.
- Submit application software documentation which contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
- Submit all graphics displays required to perform the control and operator interface functions specified herein.

12.2.4 Performance Standards

General performance requirements for the WTP and wells are outlined in Section 15, and as identified specifically under each component.

12.3 Specific Requirements

12.3.1 SCADA Server

The server system shall be designed to operate in an indoor environment, in an ambient temperature range of 0 degrees to 40 degrees Celsius and a relative humidity of 0-90 percent, non-condensing. The unit shall be capable of operation on supply voltages of 102-132 VAC at 47-63 Hz. The server systems shall consist of a Dell PowerEdge (or better), UPS system with appurtenances and manufacturer's services as specified below.

A common console shall be provided to manage and maintain all server equipment. Console shall be rack mounted and shall include 19-inch TFT rack mount monitor, standard windows keyboard and mouse (gray) on slide out tray and rack mounted 16 channel kvm switch. Refer to **Table 12-1** for details.

Table 12-1 SCADA Server Components

Feature	Description
Processor	Quad Core Intel Xeon E5-2430 15MB Cache, 2.2GHz, 1333MHz
Memory	8GB 667MHz (4X1GB), Single Ranked Fully Buffered DIMMs
Keyboard	Keyboard, USB, Black
Mouse	Optical Mouse, Two Buttons USB, Black
Ports	Rear: 2 x USB 2.0, 1 x serial connector, 1 x video connector, 1 x RJ45 for DRAC 5/I connector Front: 2 x USB 2.0, 1 x video connector; Internal USB Port
Hard Drive	500GB 7.2K RPM SATA 3Gbps HotPlug HardDrive
Hard Drive Controller	PERC6i SAS RAID Controller, 2x4 Connectors, Int, PCIe, 256MB cache, x6 Bkpl
Operating System	Windows Server 2012, Standard Edition, Includes 5 licenses
NIC	On-Board Broadcom 5720 Dual Port 1Gb LOM
Second NIC	Broadcom 5720 DP 1Gb Network Interface Card
CD-ROM or DVD-ROM Drive	Optical Drive Cable, SATA PE2950,PE1950
CD-ROM or DVD-ROM Drive	DVD-RW, SATA, Internal
Documentation Diskette	Electronic Documentation and OpenManage DVD
Additional Storage Products	500GB 7.2K RPM SATA 3Gbps 3.5-in HotPlug HardDrive
Feature	Integrated SAS/SATA RAID 1/ RAID 5, PERC 6/i Integrated
Feature	Universal Sliding Rapid/Versa Rails, includes Cable Management Arm (310-7412)
Service	Dell Hardware Warranty Plus Onsite Service Initial 3 YR
	500GB 7.2K RPM SATA 3Gbps 3.5-in HotPlug HardDrive
	500GB 7.2K RPM SATA 3Gbps 3.5-in HotPlug HardDrive
	500GB 7.2K RPM SATA 3Gbps 3.5-in HotPlug HardDrive
	PERC6/i English Documentation (310-9889)
Productivity Software	MS Office Professional 2010

12.3.2 Operator Workstation

The operator workstations shall be designed to operate in an indoor environment, in an ambient temperature range of 0 degrees to 40 degrees Celsius and a relative humidity of 0-90 percent, non-condensing. The unit shall be capable of operation on supply voltages of 102-132 VAC at 47-63 Hz. The workstations shall consist of a Dell Precision Workstation, UPS system with appurtenances and manufacturer's services as specified below or better. Refer to **Table 12-2** for details.

Table 12-2 Operator Workstation Components

Feature	Description
Processor	Six Core XEON (E5-2620, 2.1GHz, 15M, 7.2 GT/s,Turbo)
Memory	8GB, DDR3, 1600MHz, ECC, 4 DIMMS
Keyboard	Keyboard, USB, Black
Mouse	Optical Mouse, Two Buttons USB, Black
Integrated NIC	10/100/1000 Mbps Ethernet
Second NIC	Dual port 10/100/1000 Mbps Ethernet
Ports	Rear: 2 x USB 2.0, 1 x serial connector, 2 x DVI or 2 x DisplayPort video outputs, 2 x RJ45 Ethernet Front: 2 x USB 2.0
Primary Hard Drive	256 GB Solid State Drive (for OS and applications)
Second Hard Drive	1 TB 7200 rpm SATA 6.0 Gb/s (for data storage)
Operating System	Microsoft Windows® 7 Professional 64 bit with all service packs
Productivity Software	Microsoft Office Professional – Latest version with all service packs.
CD-ROM or DVD-ROM Drive	16X DVD+/-RW, SATA, Internal
Sound Card	Dell integrated audio
Speakers	Dell AX series sound bar to match monitor
Graphics Card	1 GB memory, dual-monitor capable, DVI-I outputs, DisplayPort, HDMI adapter where required
Documentation	Hard Copy Documentation, User's/Installation/Trouble Guide
Support Service	5 Year Basic Limited Warranty and 5 Year Next Business Day Onsite Service, starting on the day after passing the Final Acceptance Tests

Color flat panel active matrix TFT LCD monitors (in quantity as shown on the figures included in Volume III.B Appendix B) shall be furnished by the workstation manufacturer with all accessories and cables required for a complete installation. Monitors shall have the following features present in **Table 12-3**.

Table 12-3 Monitor Features

Feature	Description
Size	23" diagonal
Resolution	1920x1080 minimum
Lighting	LED backlit
Signal Inputs	DVI or Displayport, as required to connect to PC
Stand	Height, swivel and tilt adjustable

12.3.3 LCD Display

The control room liquid crystal display (LCD) shall be wall mounted and shall be configured as a monitor for an operator workstation to display plant control system HMI screens, and/or video sources. The display shall be designed for continuous service. The LCD shall include field replaceable components designed for replacement by the end user and shall include a 3 year warranty.

The LCD display shall be designed to operate in an indoor environment with an ambient temperature range of 0 degrees to 35 degrees Celsius and a relative humidity of 20-80 percent, non-condensing. The equipment shall be capable of operation on supply voltages of 100-120 VAC at 60 Hz.

The LCD display shall have the following features as a minimum:

- Resolution: FHD 1080P (1920 x 1080)
- Screen Dimension: 55" Diagonal
- Aspect Ratio: 16:9 widescreen
- Viewing Angle: 178° horizontal; 178° vertical
- Inputs: VGA; HDMI; component (2); composite (1); S-Video; VGA out for tiling
- Response Time: 10ms total typical
- Contrast Ratio: 4000:1
- Backlight life: 50,000 hours to ½ brightness

LCD Display shall be Planar ep55L (or latest model), or approved equal.

12.3.4 Computer Consoles

The Console shall accommodate a variety of computer, operator workstation, communication, and operator interface devices. The design of the Console shall satisfy the functional, ergonomic and aesthetic requirements of the operational working environment. The Console shall be of modular design, facilitating future equipment retrofits and full reconfigurations, without major modifications to structure or exterior elements. The Console system shall employ an open frame concept with horizontal aluminum extrusions bolted to welded tubular steel frames, forming the console structure. The structural frame shall support the exterior panel elements and the various equipment mounting kits and accessories. The exterior panel elements shall be attached to the console structure by means of concealed hardware. Access panels to console interior shall be removable without the use of tools. Modules shall be able to be assembled using standard tools; a set of hand-tools shall be provided. Each individual module shall be rigid and self-supporting to permit individual removal, relocation or modification of adjacent modules. Computer consoles shall be manufactured by Evans Consoles Model Identity, or Winsted.

The Contractor shall provide four computer chairs as specified herein. Chairs shall have swiveling seat, adjustable height back, pneumatic/hydraulic height adjustment, lumbar back support, and rolling casters. Computer chairs shall be as manufactured by Kimball, or United Chair.

12.3.5 Ethernet Network

The Ethernet network topology shall be a dual ring configuration consisting of a combination of twisted pair copper and multiple strand fiber optic cable to accomplish the data transmission requirements. Each connected device shall be equipped with its own network interface units. Bi-directional communications between the network and network connected equipment shall be provided by network interface units. A multilayered peer-to-peer communications protocol shall be employed.

The system shall be based upon two redundant SCADA servers, network storage device, two full development workstations and five additional clients which shall function as operator and lab workstations. The servers shall be configured to provide on-line fully redundant monitoring and control. Each server will be powered from a dedicated UPS system. Each of these servers shall be equipped with two Ethernet interface cards to allow connection to two separate Ethernet network switches. These two Ethernet switches will form the foundation of a redundant fiber-optic network loop, employing Rapid Spanning Tree Protocol (RSTP) throughout the plant, providing a redundant path to each plant process PLC. If a switch or server should fail, there should be only minimal interruption in communications to allow “self-healing” and no loss of control. These main switches each have two fiber optic connections to a patch panel forming two fiber optic loops. Patch panels located throughout the plant process areas, shall be of similar configuration. Fiber optic transceivers shall be provided to transform the necessary Ethernet links into an optical signal suitable for transmission over the fiber optic cable. Fiber optic transceivers shall support Ethernet ring, or point-to-point network topologies as required. The fiber optic cable shall be a single cable with a combination of single and multimode fiber, The County standardized their fiber optic cable with Fiber Optic Corporation.

Each plant process area patch panel shall provide cabling for the two fiber-optic loops and provide connections to two Ethernet switches. Patch cables between the patch panel and the fiber optic device shall be multimode or single mode, and single ceramic terminated fiber optic cable with ST connectors. The PLC chassis in the respective plant process area shall have two Ethernet port connections available per PLC processor, with each port connected to one of the local Ethernet switches. In this manner, failure of one switch at the plant process area will not interrupt communications. Each process area PLC and Ethernet switch shall be powered from its own UPS. The UPS shall be equipped with an SNMP management and remote monitor capability and be accessed, by one or more of the PCS servers, through one of the plant process area switches and information from each UPS shall be displayed on the HMI.

If any of these networks are connected to any non-process network then a firewall and appropriate encryption shall be provided. Configuration of the switch shall be coordinated with the County.

12.3.6 Field Device Designations

Field instruments shall have a permanent stainless steel or other non-corrosive material tag firmly attached and engraved with the instrument tag number provided on each instrument. The instrument tag numbering system will be developed to meet the needs of facility operations. Provide a completed ISA SP-20 instrumentation form and sizing calculations for all instruments proposed for the project.

The wellfield facilities associated with this project, in general, are intended to be remotely and automatically operated in an unattended fashion, with sufficient process parameter measurements and status information to allow safe and accurate control. All devices and systems designed for remote PLC control functions shall be equipped with a Local-Remote selector switch and local hand controls. PLCs shall control starting and stopping of mechanical and process equipment motors only when the respective selector switches are in remote position. PLCs shall control opening and closing of valves and gates when their selector switches are in remote mode. Where variable positioning or speed adjustment is available, PLCs shall control the speed of motors or positioning of valves based on the respective process parameter setpoints.

12.3.7 PLC Control Overview

PLCs shall control the process variations based on PID capabilities. The PLCs shall also provide equipment control with regards to the following conditions:

Safety Shutdowns:

- Personnel safety and equipment protection switch or device contact shall be hardwired in the starter control circuit to provide shutdown in both auto and hand modes.
- Shutdown alarm statuses shall be monitored by the PLCs and alarmed at the HMI SCADA.

- Personnel safety and equipment protection switches and devices shall be provided with double-pole contacts, one for the starter control circuit and the other for SCADA input and alarming.

Origination of Control Contacts:

- For PLC control in remote mode, contacts shall originate from the isolated digital output PLC module.
- For hardwired application, control contacts shall originate from the process switches, control devices, and/or relays.

Hard Wired vs. Software Logic:

- Only the logic required for the auto mode shall be provided with the PLC programming.
- Logic required for both hand and auto modes shall be provided within the control circuit.
- Interlocking of various pieces of equipment required for both hand and auto modes, such as coordinated operation of pump discharge valves, shall be provided by the individual control circuits and not through the PLCs.

Control Modes:

- In LOCAL mode, pieces of equipment shall be controlled manually, completely bypassing the PLC. Switching to the LOCAL mode will reset all associated REMOTE control failure alarms.
- In REMOTE mode, pieces of equipment shall be controlled by the PLC. SCADA shall have the capability to control the pieces of equipment via the PLC.
- Local emergency shutdown pushbuttons shall override both manual and PLC control.

PLC control and monitor functions shall be based on a single processor design, robustly sized and protected as practically possible from electrical surge and environmental events. Assignment of PLCs shall be on a “per process” or “per packaged unit process” basis.

All process signals such as level, pressure, flow, turbidity, pH, etc., shall be monitored by the SCADA system. Where process signals are shown or specified to have a local indicator, it shall display in Engineering Units, matching the associated HMI display.

Remote site installations shall be equipped with intrusion detection devices and arm/disarm methods for authorized staff entry. Unauthorized detection shall be transmitted to the WTP HMI for operator notification.

Equipment status and alarm conditions shall be connected to the PLCs, and monitored through SCADA including:

- Control power on
- Control mode selections
- Timing function status
- Alarm conditions, such as overload, temperature, vibration, and pressure
- Motor run
- Motor off
- Position limits
- Analog speed values
- Analog position values

Equipment malfunction shutdown/alarm conditions shall illuminate at the MCC or the panel indicating lights and shall provide digital inputs to the PLC. Emergency stop activation or other such protective devices shall provide alarm input signals to the PLC for indication and recording at SCADA.

12.3.8 PLC Accessories and Properties

The PLCs shall also provide the following accessories and properties:

- PLC's shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all required features and functions.
- Provide automatic control/monitoring and provide distributed I/O interface for the SCADA system. Collected information will be communicated to the HMI servers and workstations located elsewhere in the PCS network. Similarly, commands initiated from the HMI shall be executed by the respective PLC.
- WTP installations shall employ the ControlWave micro for small packaged mechanical and process equipment control and the ControlWave for major process areas. Where possible, PLC based vendor panels shall employ ControlWave microprocessor for compatibility with the Ethernet communication protocol.
- Processors and associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or software configuration shall be used to select processor operating mode.
- PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output.
- Controller power supplies shall be designed specifically to compliment and integrate with the controller and I/O subsystem.
- Digital inputs shall be powered by either 24 VDC or 120 VAC, but not both, optically-isolated, channel-to-channel.
- Digital outputs shall be isolated dry relay contacts rated for either 24 VDC or 120 VAC, but not both, for hardwired circuit operation.
- Local and remote Input/output hardware shall be hot swappable plug-in modules in associated I/O rack assemblies mounted on DIN rails.
- Optically isolated, channel-to-channel, analog inputs shall be 4-20 mA DC signals from powered transmitters or 24 VDC looped powered from the PLC cabinet.
- Analog input circuits shall be isolated, 14-bit resolution type, capable of receiving 4-20 mA signals. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC.
- Analog outputs shall be isolated 4 to 20 mA DC signals.
- Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which can be disconnected to permit removal of a module without disturbing field wiring. Terminals shall be suitable for accepting up to and including No. 14 AWG wire.
- PLCs shall utilize the IEC 61131 standard for languages. Each PLC should have the capability to run all five of the standard IEC 61131 languages simultaneously. The County as standardized and prefers the use of function block diagram.
- Each rack shall have a minimum of three (3) spare slots.

- Each module shall have twenty-five (25) percent spare channels. These spare channels shall be wired to terminal blocks the same as field connected I/O channels.

12.3.9 Field Instruments

Field instrumentation shall have the following properties:

- Instrument transmitters shall be provided with Hart protocol when available.
- Complex instrument (i.e. power monitors) shall be provided with Modbus protocol when available.
- Field instruments requiring power shall be suitable for 120 VAC 60 Hertz. Instrument 120 VAC circuits shall be fed from the instrument 120/208 VAC, 3 -phase panelboards.
- All field instruments requiring 24 VDC shall be looped powered where possible.
- All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals which are established standards for the water and wastewater industries.
- All electronic instrumentation shall be of the microprocessor, all solid-state type and shall utilize linear transmission signals of 4 to 20 mA DC. Signals between instruments within the same panel or cabinet shall also utilize linear transmission signals of 4 to 20 mA DC.
- Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based analog signals will be allowed.
- All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as recommended by the manufacturer.
- All indicators and recorder readouts shall be linear in process units, unless otherwise noted.
- Electronic equipment shall be of the latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, in-so-far as possible and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC approved.
- All transmitters' output signals shall include signal and power source isolation.
- All transmitters shall be provided with either integral indicators or close coupled conduit body mounted, line powered indicators calibrated in process engineering units matching the associated HMI display. Indicators shall have an accuracy of two percent of full scale or better.

The following instrument types shall be applied as stated unless specific applications characteristics dictate otherwise.

Flow instruments

- Ultrasonic flow meters for raw and finished water metering –GE Panametrics DF868 series transit-time flow meter with clamp-on transducers, or equal.
- Magnetic flow meters for most applications – Endress+Hauser Promag 50W Series flowtube with remote transmitter, or equal.
- Coriolis or magnetic flow meters for low chemical flow applications – Coriolis -MicroMotion F-Series with remote 2400S transmitter; Magnetic – Endress+Hauser Promag 50H Series flowtube with remote transmitter, or equal.
- Thermal dispersion mass flow meters for air and gas applications – Fluid Components International Model ST98 Series, or equal.
- Venturi meters– Cast Iron: Primary Flow Signal (PFS) HVT-CI, BIF Model 20181 Series, or equal; Insertion type: FPS HVT-PI or equal.
- Thermal dispersion flow switches – Fluid Components International FLT93S Series, or equal.

Level instruments

- Ultrasonic or radar level monitoring system for non-contact applications such as wet wells and chemical tanks – Radar - Ohmart Vega Vegapuls 61 Series; Ultrasonic – Siemens Sitrans L Echomax XPS-Series transducers with HydroRanger 200 transmitter/controller, or equal.
- Ultrasonic level switches for non-contact applications – Siemens Pointek ULS 200 level switches, or equal.
- Pressure transmitters for large water storage tank application – GE Druck 1730 submersible pressure transducer with PTX 1230 transmitter, or equal.
- Float-type level switches for sumps and backup high and low level applications – USFilter 9G-EF mercury-free float switch, or equal.

Pressure instruments

- Capacitance or piezoelectric based pressure transmitters for absolute, gauge, and differential pressure monitoring – Endress+Hauser Cerabar S (absolute and gauge) or Deltabar S (differential), or equal.
- Diaphragm-type differential pressure switches – United Electric Controls 100 Series differential pressure switches, or equal.
- Diaphragm-type pressure switches – United Electric Controls 100 Series pressure switches, or equal.

Temperature instruments

- 4-wire 100-ohm RTD type with 4-20 mA DC temperature transmitters – Minco AS5140 Series (with thermowell) and Minco TT176 transmitter, or equal.
- Ambient compensated filled system temperature switches – United Electric Controls Spectra 12 Series with capillary and bulb, or equal.

Analyzers

- Amperometric chlorine residual sensors - Hach 9184sc, or equal.
- Particle counting systems - Hach 2200PCX, or equal.
- pH transmitters – Probe and transmitter, NEMA 4X with accuracy and repeatability of +/- 0.01 pH, measurement range 0 – 14 pH, Hach or equal.

- Low-range turbidimeters - Hach 1720E, or equal.
- High-range turbidimeters - Hach SOILTAX-sc combination Turbidity and Suspended Solids sensor, or equal.
- Suspended sediment analyzers - Hach SOILTAX-sc combination Turbidity and Suspended Solids sensor, or equal.
- Total organic carbon analyzers (Design Build Contractor to provide two 4-channel instruments and sample sequencers in laboratory connected to process sample piping) - GE/Sievers 900 series, or equal.
- Streaming Current Detectors - Chemtrac SCM2500XRD, or equal.
- Volatile Organic Compound analyzer – Analytical systems International Model 204V, or equal.

Table 12-4 presents a minimum listing of the sampling locations with associated instrumentation and sampling pump requirements for analysis of samples. Include other instruments and/or sample points as necessary to meet water quality regulations and to provide complete and operable facilities.

Table 12-4 Minimum Instrumentation and Sampling Requirements

Sample Point[1]	Description of Process Being Sampled	Instruments Connected to Sample Line	Sample Also Pumped to Laboratory
1	Raw water sample from various wellfield raw water line	pH, Temp, Turb, conductivity, and sample tap	Yes
2	Raw water prior to chemical addition	pH, temp, Turb, sample tap	No
3	Water prior to _______________	pH, Streaming Current Detector, sample tap	No
4	Water prior to	pH, Temp, Turb, sample tap	Yes
5	Individual _______	Turb, sample tap	No
6	Combined	pH, Part, Turb, conductivity, CLR, sample tap	Yes
7	Sampling and analysis as part of the __________	Turb, sample tap	No
8	Composite sample of water from ________	pH, Temp, Turb, sample tap	Yes
9	Membrane permeate	pH, temp, conductivity, sample tap	Yes
10	Finished water at outlet of chlorine contact tank	pH, Temp, CLR, conductivity, sample tap	No
11	Finished water at point of entry to _________	pH, Temp, Turb, CLR, F, sample tap	Yes
12	Membrane Concentrate	pH, Turb, TSS, CLR, temp, sample tap,	No

[1]Additional parameter measurement may be required by the system supplier
CLR - Residual ChlorinePart - Particle counter
pH - Hydrogen Ion Concentration
Temp – Temperature
Turb – Turbidity
F – fluoride

12.3.10 Field Instrument Installation

Use the following installation procedures for the field instruments:

- All work shall be executed in full accordance with codes, local rulings, ordinances and regulations.
- Direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instruments shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure

transmitters, 5-valve manifolds for calibration, testing and blowdown service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

- All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibration and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.
- Field instruments requiring either power supplies or line power shall be provided with local electrical shutoffs, fuses and surge protection as required.
- Brackets and hangers required for mounting of equipment shall be provided and installed in a workmanlike manner and not interfere with any other equipment.
- The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment. However, in no case shall more than one ground point be employed for each shield.
- All instruments exposed to sunlight shall have sun shields installed, completely covering/protecting from UV and heat.

12.3.11 Enclosures and Panels

A local control panel shall be provided at each remote facility and at each process area. All enclosures and panels shall be UL 508A listed.

Indoor, air conditioned or climate controlled area panels shall be continuously welded, seamless NEMA 12 enclosures with either single or multiple door construction. Panels shall have full size 10-gauge mounting plates. Panels shall have forced air ventilation with filtered louvered openings. Enclosures and panels shall be located in control rooms or if not available, in electrical rooms. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC) shall be provided with a folding laptop programmer shelf on the inside of the door.

Outdoor panels shall be as a minimum Type 316 stainless steel NEMA 4X construction. Door latches for NEMA 4X cabinets shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure. Panels located outside fence-secured areas shall be fitted with padlockable latch kits. All panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC) shall be provided with a folding laptop programmer shelf on the inside of the door. All outdoor panels shall be furnished with a sun shield, completely covering/protecting from UV and heat. Outdoor panels should not exceed maximum component temperature ratings. The Company should submit heat calculations.

Nameplates shall be provided for all mounted equipment. The nameplates shall be constructed of black and white laminated, phenolic material having engraved letters extending through the white face into the black layer. Nameplates shall be attached to panels by self-tapping screws. Relays, instruments, etc. mounted inside the panel shall be identified with similar nameplates.

Operator Interface Terminals (OIT), where identified, shall be a 12-inch color TFT LCD graphic screen user interface with touch-screen and function keys, and connected to the PLC via the local Ethernet network.

24 VDC power supplies shall be sized for 50 percent load utilization under current design completion. Where loads are critical in nature, provide redundant power supply configurations.

UPSs shall be furnished for each control panel for powering:

- PLC
- OIT
- Local Network Switches and media converters
- 24 VDC regulated power supply
- Capacity to power the connected load for at least one hour
- 120 VAC UPS bypass circuit via a transient voltage surge suppressor for backup of UPS with "Normal-Bypass" selector switch.

UPSs shall be the on-line single-phase PWM-type, UL 1778 listed. UPS equipment shall include rectifier/charger, pulse-width-modulation inverter, static transfer switch, maintenance bypass switch, AC input disconnect, controls, indicators, battery, and appurtenances. The UPS shall be a true on-line power source so that whatever the quality of the incoming power, the pure sinewave output shall be provided to the loads. The UPS shall be provided with a 120 VAC input power cord with a NEMA-type plug and NEMA-type 120 VAC output receptacles in the back.

The UPS shall have one Ethernet SNMP communication port. The card shall be installable during any state of UPS operation (On, Standby, or Off states). The UPS shall be furnished with a relay interface card to provide contact closures for remote monitoring of alarm conditions, delivering signals for Low Battery, UPS Fault and On UPS. The contacts shall be rated for 120 VAC or 24 VDC at 1A. The UPS shall be APC PowerWare series, Liebert UPStation GXT series or equal.

120 VAC wiring shall be connected using the following procedures:

- All I/O 120 VAC circuits shall be from the instrumentation panelboards which are fed from isolation-type transformers as described above.
- A toggle switch, 20A single-pole, in an enclosure rated for the area classification shall be provided adjacent to each instrument requiring 120 VAC power.
- Each 120 VAC field instrument 120 VAC circuit shall be protected by a 15A single-pole circuit breaker.
- Within control panels, individual 120 VAC circuits powered from the UPS shall be protected by DIN-mounted circuit breakers.

The following procedures shall also be followed to protect the field instruments:

- Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure. The units shall be as manufactured by Telecommunications Industries Inc.; Joslyn; Leviton; or equal.
- Protection of all 120 VAC instrument power supply lines shall be provided. Enclosures/panels and groups of field instruments regardless of location (indoor or outdoor), shall be protected by

isolation transformers and surge suppressors. Individual field instruments shall be protected by individual gas tube surge suppressors or metal oxide varistors (MOVs).

- All signal lines when they enter or leave a building shall be protected through the use of gas tube surge arrestors, and Zener diode protectors. These shall be provided at both ends of the signal lines and as close to the instruments as possible.

12.3.12 PLC and HMI Programming

Consistent and standard program development methods shall be utilized for both HMI and PLC programming efforts. PLC and HMI programming shall be done in accordance with the following standards:

- The Company shall establish a tagging convention based on the Water Treatment Plant (WTP) process area. Enhancement of the defined records through the use of descriptive naming shall be applied in a concise and consistent manner.
- The Company shall create a control strategy for every process and area of the WTP. PLC programming shall be developed based on the control descriptions provided, and expanded where needed to address the specific operational concerns of the process in question. Program development shall be in a uniform IEC-61131 program language.
- PLC programming shall be structured in its development to maximize the ease of troubleshooting and maintenance. Development of "re-usable" program sections or sub-routines shall be encouraged. Complete and verbose commenting shall be provided as part of each program section, delineating the input, logical function, and outputs of each section developed.
- Review of program development progress shall be provided at the 25, 50, 75, and 100 percent milestones.
- All equipment, pumps and motors shall have the number of starts and runtime tracked in the PLC and indicated on the HMI. Runtime and number of starts shall be provided with the ability to reset each independently from the HMI. Runtime shall be transferred automatically to the SCADA with current, yesterday's (24 hours) data.
- All motors or pumps that have been called to start in an automatic mode shall alarm a Start-Fail Alarm should it not respond within an adjustable time period.
- Each Start-Fail Alarm time period shall be independently adjustable on a pump-by-pump or motor-by-motor basis.
- All analog alarms shall have an adjustable set-point available on the HMI.
- Analog Alarm Set-point adjustments on the HMI shall be grouped by process area.
- All equipment that is placed out-of-service (locally or remotely), or into a Lockout/Stop mode, shall report such status to the HMI.
- All alarming shall be accomplished within the associated PLC as opposed to the HMI, since alarm logic is an integral part of various control algorithms. The HMI shall not be used to facilitate alarming. All alarms shall be monitored, recorded, and annunciated by the HMI.
- Each alarm which requires an operator acknowledgement shall have the Acknowledge-Bit sent from the HMI reset to an off condition within the PLC, once the alarm is no longer present.
- Switching of the field LOCAL – REMOTE selector to the LOCAL position shall reset all associated AUTO control mode failure alarms.

12.3.13 SCADA Generated Reports

Provide a set of operational, maintenance and regulatory related report documents as required for informed and convenient operation of the facilities. The reporting method shall make use of the following capabilities of the SCADA system:

- The system shall be able to generate reports from on-line historical data files.
- Reports shall be initiated automatically based upon time of day or manually upon operator request.
- User interface displays for report generation shall be developed with easy recall of reports by entering time:day:year target values.
- User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).
- It shall be possible to print quality tags alongside the value.

The SCADA system to generate, as a minimum, the following specific reports:

12.3.13.1 Shift Operation Summary Report

In operator-adjustable time interval Shift Operation report shall summarize plant and wellfield operation from midnight through the last complete hour of operation. The operator shall be capable of adjusting the time-stamp resolution of data (i.e., secondly, hourly, monthly, etc.).

The report format shall consist of the following:

- Correct Date
- Facility Name
- Report Name
- Page Number
- Group Headings
- Subheadings
- Point Identifications
- Engineering Units

This report shall be printed on demand from any operator work station for any point in the system.

12.3.13.2 Daily Operation Summary Report

The daily operation report shall summarize plant operation for the previous day. The report shall be generated, on demand, after the previous days' laboratory analysis results have been entered. The printed information shall be the stored values (not averages) including scanned, lab, and manually entered data using an operator-defined time-stamped resolution.

The report format shall consist of the following:

- Correct Date
- Facility Name
- Report Name
- Page Number
- Group Headings
- Subheadings

- Point Identifications
- Engineering Units

The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point and stored. Values for which there are no data available shall be identified with a special character. Thus, only values which are actually zero shall be printed as such. The daily operation summary report shall be available for printing on demand, as often as preferred.

12.3.13.3 Monthly Operation Report (MOR) Summary

The monthly operation report summary shall summarize plant operation for the previous calendar month. The report shall be generated on demand from the operator work station, usually after all laboratory results for the previous month have been entered.

The report format shall be arranged so that the first several pages shall conform to the requirements of the state regulatory agencies and may be separated from the rest of the monthly operation report for transmittal to the regulatory agency.

The report format shall be similar to the daily operation summary report and shall consist of the following:

- Month and Year
- Plant Name
- Report Name
- Page Number
- Group Headings
- Subheadings
- Point Identifications
- Engineering Units

The report format shall be similar to the daily operation summary report and shall consist of the following: Monthly minimum, average, maximum, and totals, where applicable, shall also be printed for each column of points printed. The monthly operation summary report shall be available for printing on demand.

12.3.13.4 Annual Operation Summary Report

The annual operation summary report shall summarize plant operation for the previous calendar year. The report shall consist of scanned data, lab data, and manually entered data using an operator-adjustable time-stamped resolution. Format of the report shall be identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

12.3.13.5 Chemical Usage Reports

Chemical usage reports shall compare the pump output over a period of time with day tanks level drop and alert of any significant discrepancies. Chemical usage reports should summarize amount of chemical used and project when current chemical supply would be depleted. Chemical system reports shall be included for each of the chemical systems

12.3.13.6 Equipment Runtime Report

Report shall summarize the number of runtime hours for all of the rotating motorized equipment in the plant. Reports shall be for current month and year.

12.3.13.7 Electrical Usage Report

Report shall provide in a tabular format the power consumption of the plant. The following signals shall be monitored at main switchgears using the County standard Siemens 9610 power quality meters and downstream the Siemens 9360 power monitor. As a minimum, the following information shall be monitored and recorded:

- Phase to phase Current and Voltage
- Phase to Neutral Current and Voltage
- Average line Current and Voltage
- Phase to phase total harmonic distortion Current and Voltage
- Frequency
- Power (Real, Reactive and Apparent)
- Power Factor
- Energy (Watt hours and VAR hours)

12.3.13.8 Factory Testing and Reporting

Factory Testing and Reporting requirements shall provide the following for the Instrumentation and Controls:

- It is the responsibility of the PCSS to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified. The PCSS shall provide factory testing prior to shipment of the equipment and also testing of the equipment once installed in the field.
- Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. Copies of the sign off test procedures, forms and checklists will constitute the required test documentation.
- Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.
- The PCSS shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

Prior to shipment of the equipment the following tests are required:

- Unwitnessed Factory Test (UFT)
- Witnessed Factory Acceptance Test (WFT)