

JEA Water & Wastewater Standards Manual

VOLUME V: Water Treatment Plant
Specifications

January 1, 2022 – Edition

“Foundation for the Future - Water & Wastewater Standards”

THIS PAGE INTENTIONALLY LEFT BLANK

SUMMARY OF MAJOR CHANGES

1. SECTION VII – ELECTRICAL STANDARDS

IV.12.5. Provide motors that meet or exceed EPACT efficiency requirements, bearings with an L10 life rating of 40,000 hours, NEMA frame motors with oversized motor terminal boxes, ODP enclosures for indoor installations, TEFC enclosures in outdoor and below grade installations, TEFC motors with continuous moisture drain and screen that excludes insects.

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

SUMMARY OF MAJOR CHANGES	3
Table of Contents.....	5
SECTION I – INTRODUCTION.....	7
SECTION II – SITE DEVELOPMENT	10
SECTION III – WATER SUPPLY WELLS.....	15
SECTION IV – Ground Storage Tanks	22
SECTION V – High-Service Pumps.....	32
SECTION VI – Disinfection System	40
SECTION VII – Electrical Standards.....	54
SECTION VIII – Instrumentation and Control Standards	70
SECTION IX – Piping Standards	99
SECTION X – Valve Standards	101
SECTION XI – High Service Pump and Chemical Building Standard Layout	103
SECTION XII – On-site Sanitary Lift STation and Sewer, Details and Materials	114
SECTION XIII – Security System Standards.....	116
SECTION XIV – Signage Standards.....	118
SECTION XV – Landscaping and Irrigation System Standards.....	120

Tables

TABLE III.1	WELL DEVELOPMENT SPECIFIC DESIGN CRITERIA.....	15
TABLE IV.1	GROUND STORAGE TANK COLOR CODE REQUIREMENTS.....	30
TABLE VII.1	LOAD REQUIREMENT CATEGORIES.....	55
TABLE VII.2	EQUIPMENT VOLTAGES	57
TABLE VII.3	TOTAL VOLTAGE DROPS ALLOWED	58
TABLE VII.4	VOLTAGE DROP LIMIT	58
TABLE VII.5	DEMAND FACTOR REQUIREMENTS.....	58
TABLE VII.6	MINIMUM FOOT CANDLE LEVELS.....	67
TABLE VII.7	LIGHT SOURCE REQUIREMENTS.....	67

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION I – INTRODUCTION

I. GENERAL

- I.1. JEA's increasing water demands require new facilities and modifications to its existing water treatment plants (WTPs). This standards manual provides consistent, compatible, and uniform guidelines for the design and construction of future potable WTPs and related facilities. More specifically, this document will apply to JEA's following assets:
 - I.1.1. New WTPs.
 - I.1.2. Additions to existing WTPs.
 - I.1.3. Modifications to existing WTPs where economically and structurally feasible.
 - I.1.4. Water re-pump facilities.
- I.2. Design criteria are presented for JEA's standard water treatment facilities; however, specific design criteria may vary from one facility to another depending on the quality of the raw water supply in the area.
- I.3. This manual is intended to be a living document that will require periodic updating to reflect changes in technology and new standards and materials. As equipment technologies improve, the recommended lists of approved equipment suppliers must also be updated to ensure that JEA has the best equipment available.
- I.4. All referenced Exhibits are located in Standards Volume 5A.

II. JEA'S STANDARD WATER TREATMENT PROCESS

- II.1. The goals of the treatment process at each of JEA's WTPs are as follows:
 - II.1.1. Reduce total sulfide to meet regulatory requirements (≤ 0.3 mg/L prior to disinfection) and for improved taste and odor.
 - II.1.2. Limit finished water turbidity.
 - II.1.3. Disinfect and maintain appropriate disinfectant residuals throughout the distribution system.
 - II.1.4. Control disinfection by-products (DBPs).
- II.2. A typical process flow diagram of a standard WTP and minimum require hydraulic profile components is provided in **Exhibit I.1**. JEA's standard treatment processes for potable water are as follows:
 - II.2.1. Raw-water pumping from the Floridan aquifer.
 - II.2.2. Tray aeration for total sulfide removal followed by storage and ventilation to further reduce total sulfide within a covered ground storage tank.
 - II.2.3. Injection of liquid sodium hypochlorite into sulfide-stripped water for disinfection.

JEA Water and Wastewater Standards

- II.3. The disinfection treatment process shall achieve 4-Log virus inactivation, unless otherwise specified by JEA, per Florida Administrative Code (F.A.C.) 62-550.828.
- II.4. In addition to JEA's standard treatment process, each WTP shall be designed with the capability to install future treatment technologies.

III. HIGH-SERVICE PUMPING

- III.1. After the treatment processes are completed, the finished water is pumped to the distribution system via a high-service pump station.

IV. REGULATIONS

- IV.1. In addition to the guidelines presented in this document, the designer should be aware of, and utilize, the most recent edition of JEA's *Water and Sewer Standards Manual*. At a minimum, all designs for JEA's WTPs must meet the requirements of the following regulatory agencies where applicable:
 - IV.1.1. The St. John's River Water Management District (SJRWMD) is responsible for all permits related to the construction of raw water supply wells and the Environmental Resources Permit (ERP) for stormwater management.
 - IV.1.2. Duval County Health Department, St. Johns County Health Department, Nassau County Health Department, Clay County Health Department, and the Florida Department of Environmental Protection (FDEP) have approval authority for on-site septic systems and on-site sewage lift stations and also, issue the Certificate of Completion (COC).
 - IV.1.3. The United States Army Corps of Engineers has approval authority for wetlands management.
 - IV.1.4. The City of Jacksonville Development Management Group provides Plan Review approval, which is required before a Building Permit can be obtained.
 - IV.1.5. The FDEP issues permits related to WTP modification and design.
 - IV.1.6. Nassau County Building Department reviews and inspects building plans and construction before a building permit can be obtained.
 - IV.1.7. The St. Johns County Development Review Committee (DRC) provides plan reviews and inspections for land development within St. Johns County.
 - IV.1.8. Clay County's Development Review Management Group provides Development Review services for Land Development Code compliance.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION II – SITE DEVELOPMENT

Site development at each specific WTP site will require the development of a Stormwater Management Plan (SMP) and site plan.

I. STORM WATER MANAGEMENT PLAN

- I.1.** A conceptual SMP for the WTP site must incorporate the total build-out of the site, not just the initial construction phase (if the facility is to be constructed in phases). The conceptual SMP will address the stormwater treatment and conveyance associated with the construction and operation of the proposed facility. The primary issue in the SMP will be the requirements for managing stormwater runoff and matching post-development stormwater peak flows to pre-developed stormwater peak flows. Any existing drainage easements across the site must also be addressed in the SMP.

The following components of the stormwater management plan are addressed below:

- I.1.1. Onsite drainage.
- I.1.2. Offsite drainage.
- I.1.3. Tailwater conditions.
- I.1.4. Wetland impacts.

I.2. ONSITE DRAINAGE

The onsite drainage design shall be based on the ultimate build-out of the total site area. The required stormwater treatment (Rule 40C-42 of the SJRWMD) shall be provided in one or more on-site stormwater ponds, as required. Appropriate peak flow attenuation and treatment of the storm water shall be achieved with the stormwater pond(s).

I.3. OFFSITE DRAINAGE

The WTP site will likely be surrounded by existing or future development. Therefore, limiting offsite drainage is required. All drainage plans must maximize the available space for WTP structures and operation. Earthwork and grading shall be used to limit offsite drainage. The proposed site layout should account for offsite drainage in both the stormwater pond and conveyance system.

I.4. TAILWATER CONDITIONS

Design of the stormwater management system for the WTP site must be performed in conjunction with the surrounding areas. Tailwater conditions with respect to existing drainage elements must be taken into account. If water surface elevations of existing drainage elements are significantly lower than the ground surface elevation of the WTP site, then the seasonal high groundwater elevation should be used for the purpose of estimating backwater effects to the site.

I.5. WETLAND IMPACTS

Impacts to existing wetlands will be determined on a case-by-case basis. All efforts shall be made to minimize the impact to wetlands on the proposed WTP site, while maximizing the available space for development of the WTP components. Existing wetlands may be integrated into the storm water management plan, if appropriate. An Environmental Resources Permit (ERP) shall be prepared as part of the SMP. The designer should be aware of the impact of the degree of wetlands mitigation required when preparing the construction budget and schedule for the project.

JEA Water and Wastewater Standards

II. SITE PLAN

II.1. SITE LAYOUT

- II.1.1. Exhibit II.1 provides a generic WTP site layout with major yard piping. Actual site layouts shall be specific to meet the particular project requirements and shall address, as a minimum, the following issues:
- II.1.2. Initial and future construction.
- II.1.3. Facility access by operators and chemical delivery vehicles.
- II.1.4. Noise abatement.
- II.1.5. Site aesthetics.

II.2. INITIAL AND FUTURE CONSTRUCTION

- II.2.1. Site plan development shall include both the intended initial facilities and future expansion of the WTP. Future expansion will include both expansion in WTP capacity, as well as the potential future treatment processes.
- II.2.2. In general, WTPs are not intended to have public access. The WTP entire site shall have restricted entry; however, the entry gate shall be located far enough inside the property line to allow the largest anticipated vehicles (typically, chemical delivery trucks) to pull completely out of the public access road so as not to restrict traffic.

II.3. ACCESS TO FACILITIES

- II.3.1. Access to all facilities at the WTP shall be included in the site plan. As appropriate, the access road may be designed for single-direction traffic. A paved perimeter road around the entire site shall be included where possible and reasonable. Paving of roadway access to future facilities may be postponed until construction of those facilities, although layout of these future access roadways shall be shown as part of the site plan development during initial design. Roadway geometry and turning radii must allow all large chemical delivery vehicles (WB-50) to adequately navigate the entire site and to not block the driving path for other vehicles (i.e. chemical delivery truck blocking in other vehicles).
- II.3.2. Roadway access shall be provided to all raw water well sites. As appropriate, this access may be established from the WTP property to the well site or from some other access point to the well site. Roadway access to the well sites don't require pavement; however, design of the road bed shall be sufficient to withstand the loads associated with maintenance vehicles which may be necessary to pull a well pump. Where appropriate, the access road shall be constructed of 8 inches of crushed stone (FDOT No. 57 stone) underlain with geo-textile fabric.

II.4. NOISE ABATEMENT

- II.4.1. Noise abatement measures shall be included in the facility design as necessary to ensure the facility meets all applicable noise regulations. Noise abatement measures typically include specifying low-noise equipment, enclosing the emergency generator in a self-contained housing,

JEA Water and Wastewater Standards

and housing all high-service pumping equipment within a building. Additional noise abatement measures include equipment placement and layout, noise barrier installation, and operational restrictions. Noise abatement measures must be developed on a project-specific basis as necessary to ensure the overall noise emissions from the facility comply with the applicable noise regulations.

- II.4.2. Local noise regulations have been adopted by the Jacksonville Environmental Protection Board and are specified in Rule 4, "Noise Pollution Control". The allowable sound pressure levels from a facility are a function of the time of day and the zoning/land use of the adjacent and nearby properties. Daytime hours are defined as 7:00 a.m. to 10:00 p.m. and nighttime hours are defined as 10:00 p.m. to 7:00 a.m. The zoning and land use of the adjacent and nearby properties is classified based on the Standard Land Use Coding Manual (SLUCM), which designates land activities by means of numerical codes for use in the regulations. If the WTP site is located outside of the Jacksonville city limits, noise abatement shall be provided to meet all required noise regulations of the governing authority.
- II.4.3. The regulations include an exception for sound emitted from a permitted source where the permit contains special noise level limits. The City of Jacksonville's Air Quality Division determines and approves the need for noise permits for facilities before any facet of permitting to construct or operate is initiated. Such permits may include special noise emission limits for the permitted source.

II.5. SITE AESTHETICS

Site aesthetics must be developed on a case-by-case basis, and shall be appropriate for the surrounding area. At a minimum, site landscaping shall comply with all the requirements of the Jacksonville Landscape Code or landscape requirements of the appropriate governing authority. Selection of landscaping elements shall be made with the intent of minimizing special maintenance requirements. For facilities located in heavily industrialized areas, landscaping may be limited to only those portions of the site visible to the public. Efforts should be made to preserve existing trees on the site, as long as they do not impact the layout and operation of the facilities. Preservation of existing trees along the site property line is encouraged for both site aesthetics and for noise abatement. New trees shall not be planted over or near WTP piping. Odor abatement will be addressed on a case-by-case basis, coordinate with JEA as required.

II.6. GEOTECHNICAL INVESTIGATION

A geotechnical investigation shall be performed as part of the site development process. This investigation shall consist of the following components:

- II.6.1. Recommendations for the design and construction of the stormwater pond(s) to meet the design objectives, including permeability of the soil and percolation rates. Percolation rates shall be provided for at least three hydrostatic levels in the ponds.
- II.6.2. Soil Borings showing depth, thickness and composition of soil, which will be excavated, provide foundation support, or will be appreciably stressed by the intended construction.
- II.6.3. Depth of groundwater below grade.
- II.6.4. Recommendations for foundation types, allowable bearing capacities or foundation capacities, and foundation design criteria.

JEA Water and Wastewater Standards

- II.6.5. Recommendations for soil related construction conditions, site preparation, fill construction, excavation slopes and ground water control.
- II.6.6. Earthwork construction criteria, including the suitability of cut soils for reuse as fill.
- II.6.7. Unsatisfactory soil conditions and recommended remedial measures.
- II.6.8. Anticipated excavation conditions.
- II.6.9. Estimates of immediate, long-term and differential settlements.
- II.6.10. Recommendations for support of slabs-on-grade.
- II.6.11. Recommendations for sub-grade support values and pavement design and construction.
- II.6.12. Recommended lateral earth pressures for below grade walls and earth retaining structures.
- II.6.13. Unified Soil Classification System visual classification of boring logs.

II.7. PROPERTY OWNERSHIP

When property must be acquired for a WTP, well site, or water main, JEA will be responsible for obtaining ownership of the property. No preliminary site investigations or surveys should be conducted without the permission of JEA and the property owner. Construction mobilization shall not occur until JEA has obtained property ownership.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION III – WATER SUPPLY WELLS

I. AQUIFER DEVELOPMENT CRITERIA

- I.1.** The aquifer shall be developed using the geographic location of the proposed well site. Specific design criteria developed for the north and south grids of JEA's service area are as shown in Table III.1.

Table III.1 Well Development Specific Design Criteria

SPECIFIC CRITERIA	NORTH GRID	SOUTH GRID
Well Spacing, minimum	1,000 ft	1,000 ft
Well Depth, maximum	1,300 ft	1,100 ft
Well Pumps	2,500 gpm*	2,000 gpm
Aquifer Production Zones	Upper & Lower	Upper

* May be increased on site specific basis.

- I.2.** Effects on the adjacent, existing wells should be assessed during the planning stage for new wells.
- I.3.** Well capacity shall be provided for the WTP's maximum day flow (MDF) capacity and an additional minimum redundancy factor of twenty percent above the MDF. Initial and future WTP flows shall be determined by JEA.

II. WATER SUPPLY WELLS CASING REQUIREMENTS

- II.1.** Production wells shall have a 30-inch surface casing installed through the shallow unconsolidated sediments and a 20-inch final casing installed to the top of the upper Floridan aquifer. The 20-inch final casings should extend from the land surface into competent limestone for a minimum of 5-feet. Construction shall be completed by drilling a nominal 18-inch-diameter open borehole section through the upper Floridan on the south grid and lower Floridan on the north grid. Actual casing diameters, lengths and final well depths shall depend on site-specific hydrologic conditions. In some instances, a final casing diameter that is smaller (or larger) than 20 inches may be warranted.
- II.2.** Lithologic descriptions of drill cuttings shall be provided for every 10 feet of drilling. A field analysis of water samples for chloride, specific conductance, temperature, and pH shall be conducted at 20-foot intervals when advancing through of the open-hole section beneath the 20-inch diameter final casing. Field water samples shall be collected from the drill stem's discharge during reverse-air drilling of the open-hole section.
- II.3.** The production well shall be developed to remove all sediment and fines from the well. Development shall be conducted by air lifting the well from the bottom using a sufficient air supply that will rigorously develop the well. Discharge from the well during air lifting procedures should be a minimum of 500 gallons per minute. Following well development, the well shall be disinfected in accordance with AWWA C654.
- II.4.** All drilling and testing procedures implemented during well construction activities shall be in accordance with all requirements of the SJRWMD and other applicable regulatory agencies.

JEA Water and Wastewater Standards

III. WATER SUPPLY PUMPING SYSTEMS

III.1. GENERAL

Water supply pumps shall be of a vertical line-shaft turbine type with an electric vertical hollow-shaft motor, operating at a nominal speed of 1800 rpm. The pump shall also be of a water-lubricated type suitable for raw water service in a vertical groundwater well. Sample taps shall be located before the check valve and after the pump discharge head. In accordance with AWWA Standards, the pump and well water shall be initially disinfected by chlorination. All materials and coatings in contact with water shall be National Sanitation Foundation (NSF) 61, FDEP approved and with no measurable lead content. A typical plan and section of a well pumping system is provided in **Exhibit III.1**.

III.2. OPERATING CONDITIONS

Operating conditions shall be developed for well-specific conditions and required flow and pressure performance requirements for each well pump.

III.3. PUMP HEAD

III.3.1. The discharge head shall be made of high-grade cast iron, ASTM A48 Class 30. Fabricated steel shall be allowed only with the approval of JEA. The base shall have a companion flange threaded for the column pipe diameter as listed in the operating conditions. The outlet shall be above-grade, flanged, and sized to meet the flanged discharge pipe diameter as listed in the operating conditions. The outlet shall have a 1/2 inch NPT tapped connection for a pressure gauge. A stainless steel (SS) nameplate with the operating conditions and bowl and impeller data stamped into it shall be attached to the head with SS fasteners.

III.3.2. The stuffing box shall be made of cast iron with 316 SS split-type packing glands, studs, and nuts, and furnished with five rings of graphited synthetic-fiber packing. The bearing shall be bronze, Type C89835 or equal. To protect the motor from excess spray, the rubber slinger shall be furnished with the stuffing box to be secured to the shaft above the packing gland. The head shall have a threaded connection in the stuffing box location to connect a drain pipe. The drain pipe shall be sufficiently sized to prevent clogging and be routed to a drain area adjacent to the well pad. The drain area shall prevent accumulation of standing water.

III.3.3. The pump shall be furnished with a two-piece top shaft. The head shaft passing through the stuffing box shall be made of Type 416 SS meeting ASTM 582. It shall be precision-ground, balanced, and polished with a surface finish better than 40 RMS. Shaft length shall be sized to accommodate the length of the top column pipe plus the height of the head through the stuffing box so that the couplings are easily accessible at the head and the first column pipe joint.

III.3.4. The pump supplier (or installer) shall provide a companion flange to connect the discharge head to the well casing flange and a threaded connection to connect to the pump column. This companion flange shall be sized to set the discharge head at the required height above the well casing flange and shall be a minimum of 1-foot and 2-inches between flanges. The layout shall be submitted to JEA for confirmation, but, generally, the companion flange shall have standard 150-lb flat flanges. The diameter shall be equal to the well casing (typically 18-inch or 20-inch). The lower flange shall have six holes cut through it: one to match the column pipe outer diameter (OD), plus two for acidization ports, one air/vacuum valve access port, and two water level sensor ports. The access ports shall include couplings to be flush mounted with the top of the flange and welded into place. Furnish square head SS pipe plugs for each coupling.

JEA Water and Wastewater Standards

III.4. COLUMN ASSEMBLY

- III.4.1. Column pipe shall be furnished in sections not exceeding a nominal 10 feet, connected by threaded sleeve couplings, of nominal diameter listed in the operating conditions. The top and bottom sections shall not be more than 5 feet in length. Column shall be manufactured of ASTM A53 Grade B steel pipe, Schedule 40 (Standard) for nominal diameters of 10 inches and less. The pipe ends shall be threaded, 8 threads per inch with 3/16 inch taper per foot thread and faced parallel to butt against the centering spiders so the assembled sections are accurately aligned.
- III.4.2. Line shaft shall be made of Type 416 SS meeting ASTM 582. It shall be precision ground, balanced and polished with a surface finish better than 40 RMS. Each shaft length shall be straight, not exceeding 0.005 inches out in total indicator reading per 10-foot section. Shaft diameter shall be a minimum of 1-1/2 inch for pumps rated at 100 or more, and 1-3/16 inch for pumps rated less than 100 HP, unless otherwise approved by JEA. Line shaft shall be furnished with one SS coupling for each section of shaft. Couplings shall be machined from solid SS bar and have left hand threads (10 or 12 TPI) that will tighten during pump operation.
- III.4.3. Bearing retainers (spiders) shall be furnished for each column & shaft section. The spiders shall be made of Nickel Aluminum Bronze or Type 304 SS and designed to drop in the column couplings and be retained by the butted ends of the column pipe. Shaft bearings shall be a cutlass neoprene rubber retained in the spider by a shoulder on each end of the bearing, designed for water lubricated operation with the appropriate shaft diameter.

III.5. PUMP CONSTRUCTION

- III.5.1. Bowl assembly shall consist of flanged type bowls constructed of close grained cast iron conforming to ASTM A48 class 30. The bowls shall be free of blow holes, sand holes or other faults and accurately machined and fitted to close tolerances, and capable of meeting or exceeding Hydraulic Institute hydrostatic pressure ratings. The intermediate bowls shall have enamel lined waterways for maximum efficiency and wear protection. All intermediate bowls shall be of identical design for interchangeability. A discharge bowl shall be sized and threaded to connect the bowl assembly to the discharge column. All the bowls, including the suction and discharge bowl, shall be fitted with Vesconite HiLube composite sleeve bearings by Vesco Plastics. The bowls shall be assembled using all Type 316 SS bolting. A SS nameplate with the operating conditions and bowl and impeller data stamped into it shall be attached to the bowl with SS fasteners. The bowl suction and discharge sizes shall be compatible with the column pipe specified for each pump.
- III.5.2. Impellers shall be constructed of Type 316 SS. No silica bronze alloy impellers shall be allowed. Impellers shall be free from defects and accurately cast, machined, filed and polished for premium efficiency and minimum vibration. Impellers shall be balanced to grade G6.3 of ISO 1940 as a minimum. The pump curves and efficiencies provided shall include any derating for SS, if appropriate. Impellers shall be secured to the bowl shaft with tapered split Type 416 SS bushings (collets). The impeller trim for multiple stage pumps shall be identical for each stage. A letter shall be submitted with the pumps at delivery, confirming the impeller trim.
- III.5.3. The bowl shaft shall be constructed from Type 416 SS meeting ASTM 582. It shall be precision ground, balanced and polished with a surface finish better than 40 RMS.

JEA Water and Wastewater Standards

- III.5.4. The pump shall be tested by the factory after trimming and assembly and a curve of the operating conditions including flow, head, efficiency, and horsepower shall be plotted and submitted to JEA for approval prior to shipping any materials. The test shall be a non-witnessed test, but JEA reserves the right to reject the test and witness any retesting at its own cost.
- III.5.5. Field testing shall be performed by the Pump Manufacturer to indicate that the pump and motor conform to the operating conditions of an accepted factory performance test. If pump performance does not generally agree with the factory test results, corrective measures shall be taken or the pump replaced with a pump that satisfies the required conditions.
- III.5.6. After installation and field testing of the pump, perform vibration testing and analysis meeting the requirements of ANSI/HI 9.6.4.

III.6. SUCTION PIPE AND STRAINER

- III.6.1. Vertical turbine pump assemblies shall not be provided with a suction pipe (tailpipe), unless listed in the operating conditions. When required, the suction pipe shall have a minimum inside diameter and weight equal to or larger than that of the discharge column pipe.
- III.6.2. A suction strainer shall be furnished with each pump assembly. It shall be made of Type 316 SS, threaded to the suction bowl. The cone strainer shall have a free area of at least four times the flow area of the suction pipe. Basket strainers are not acceptable.

III.7. PUMP MOTOR

- III.7.1. A vertical hollow-shaft motor shall be supplied that meets NEMA Design B guidelines and the horsepower as listed in the operating conditions. Motor shall be inverter duty rated and have a 1.15 service factor, and be sized to be non-overloading anywhere along the pump curve, not including the service factor. Well pump motor frames shall be cast iron construction. Motor shall be warranted by the factory for a period of one (1) year after startup and acceptance by JEA.
- III.7.2. Motor shall be nominal 1800 rpm. Motors shall be 60 hertz and 3 phase service. It shall be of Weather Protected 1 (WP1) construction, and include non-reverse ratchets, SS stamped nameplate, space heaters, lifting lugs, oil sight gauge, top cover and an oversized junction box.
- III.7.3. Motor shall be furnished with a Type 416 SS shaft, adjusting nut, locking screws, drive coupling and key. Shaft diameter and length shall be coordinated to fit motor and pump furnished.
- III.7.4. Lubricating oil shall be supplied in quantity to fill the motor. The motor shall be filled by the equipment supplier with oil only after shipping and installation to well pump is complete and prior to startup. Motor oil shall meet ISO 68, SAE 20 standards, and shall be Monolec® Turbine Oil No. 6403 only, manufactured by Lubrication Engineers, Inc., Fort Worth, Texas.
- III.7.5. Refer to Section VII, Electrical Standards, for additional motor requirements.

IV. DISCHARGE PIPING

- IV.1. Air/Vacuum valve shall be provided on the well head flange. Valve assembly drain piping shall be Sch 80 PVC with long radius elbows, and routed to a drain to allow infiltration of drainage and prevent accumulation of standing water. Discharging of water on the concrete pad is not acceptable.

JEA Water and Wastewater Standards

- IV.2.** Air release valve shall be provided downstream of the discharge head. Valve assembly drain piping shall be Sch 80 PVC, long radius elbows, and routed to a drain to allow infiltration of drainage and prevent accumulation of standing water. Discharging of water on the concrete pad is not acceptable.
- IV.3.** Pressure gauge and digital transmitter shall be provided.
- IV.4.** Pipe, valves and fittings shall be supported by concrete type pipe supports.

V. INSTRUMENTATION AND CONTROL STANDARDS

- V.1.** Production wells are to be controlled and monitored remotely from a PLC at a central location. Production well remote monitoring shall include pumping flow rate, discharge pressure, pumping water levels, well pump run time (daily), and measurements of raw water conductivity. Also, continuous amp draw shall be monitored whenever the pumps run.
- V.2.** Instrumentation and controls shall include provisions for alarms with minimum and maximum setpoints for well flow, conductivity, pressure, well drawdown, and others as required on a case-by-case basis. The alarm is intended to alert JEA staff that there is a potential issue with the well so that appropriate action can be taken. The minimum and maximum set-points shall be project specific and set on a set on a case-by-case basis during design in coordination with JEA.
- V.3.** For a detailed description of additional water supply wells instrumentation and control standards, including flow measurement devices and approved manufacturers, refer to Section VIII Instrumentation and Controls Standards.
- V.4.** Communication: Fiber optic cable to be used when wells are within one mile. Fiber is run from PLC to control panel. Radio to be used when greater than 1 mile, but shall be evaluated on a case-by-case basis.
- V.5.** Ring-Star Topology for well communication shall be evaluated on a "case-by-case" basis.

VI. SITEWORK

- VI.1.** Wellhead, piping supports, panels, and instruments shall be located on a concrete slab. All surface facilities shall be enclosed within a chain link fence topped with three strands of barbed wire. In some cases, JEA may elect to utilize a concrete block wellhouse with a chain link fence roof to prevent entry to the enclosure.
- VI.2.** Minimum well site shall be 200 feet by 200 feet. Wellhead protection requirements are established by the SJRWMD and the Duval County Health Department. As part of the well permitting process, potential impacts to adjacent existing wells shall be evaluated.
- VI.3.** Exhibit III.1 presents a drawing of the typical JEA water supply well.
- VI.4.** Site layout should allow access to the well pump by a crane such that the well pump and column can be removed for maintenance.
- VI.5.** Landscaping shall be provided as required by ordinance and to provide a visual buffer. Grassing of the site shall be per JEA's Water and Wastewater Standards Manual (current edition), Section 441.

VII. PERMITTING

- VII.1.** Water supply wells require two FDEP permits:

JEA Water and Wastewater Standards

VII.1.1. Specific Permit to Construct Potable Water System (PWS) Components.

VII.1.2. Generic Permit of Discharge of Groundwater

VII.2. Coordinate FDEP permit applications with JEA.

VIII.ACCEPTABLE MANUFACTURERS

VIII.1. These manufacturers periodically change and should be verified with the purchasing department of JEA.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION IV – GROUND STORAGE TANKS

I. GENERAL

- I.1.** In JEA's standard treatment process, ground storage tanks serve the following purposes:
- I.1.1.** Tray aerators are mounted on top of the storage tanks for initial stripping of total sulfide which is released as hydrogen sulfide from the raw water. Tray aerators also serve to add dissolved oxygen to the raw water.
 - I.1.2.** Ventilation is provided on top of the tanks to continually renew the atmosphere above the water in the tanks in order to remove hydrogen sulfide above the water surface. This encourages further reduction in the total sulfide concentration of the water through continual volatilization of total sulfide as hydrogen sulfide.
 - I.1.3.** The tanks provide storage volume for raw water that will be conveyed via piping to the high service pump station. Raw water will be disinfected downstream of ground storage tanks in the piping from the tank to the high service pump station.
- I.2.** Typical plans and sections of a ground storage tank are presented on **Exhibit IV.1, IV.2, and IV.3.**
- I.3.** The ground storage tank and all associated accessories described in this Section shall all be provided by the tank manufacturer.

II. DETAILS

- II.1.** A minimum of two ground storage tanks shall be provided at each WTP. If the WTP is to be constructed in phases where the first phase only includes one ground storage tank, provide sufficient space and planning for the future ground storage tank(s). Each ground storage tank shall be provided with a tray aerator for total sulfide removal. If possible, each tray aerator shall be capable of treating and hydraulically conveying the maximum flow from all well pumps serving the water treatment plant with one tank out of service. If this is not possible, confirm the acceptable minimum flow per tray aerator with JEA. Piping to and from the ground storage tanks shall allow the tanks to be operated either in series or in parallel. In addition, the piping layout shall allow for each tank to be bypassed for routine maintenance. Raw water piping to the tanks shall be designed to achieve equal flow splitting between the tanks without the use of special flow control valves.

II.2. CALCULATIONS

- II.2.1.** Storage shall be provided for a minimum of four hours at MDF or as required by the governing authority. This requirement is based upon a minimum holding time for oxidation of total sulfide not removed by aeration. The calculation for sizing storage facilities based on sulfide oxidation is as follows:

$$\text{Storage Capacity for Sulfide Oxidation (Million Gallons)} = \text{MDF} \times 4/24$$

- II.2.2.** An additional requirement of storage facilities is the ability to provide water during peak demand periods when demands exceed the capacity of the water treatment plant's well-field. The calculation for sizing storage facilities based on demands is as follows:

$$\text{Storage Capacity for Peak Demands (Million Gallons)} = 2 \times (\text{PHF} - \text{MDF}) \times 6/24$$

JEA Water and Wastewater Standards

II.2.3. Both sizing calculations shall be performed and the largest calculated storage capacity of the two methods shall be utilized.

II.3. Initial and future water treatment plant flows shall be coordinated with JEA.

II.4. Sufficient space for future ground storage tanks shall be reserved on the WTP site if future increases in capacity will result in additional storage volume being required to meet the criteria listed in II.1 and II.2.

II.5. Ground storage tanks shall be designed as pre-stressed concrete tanks. The tanks shall be located at an elevation that will allow operators to completely drain the tanks for cleaning and maintenance. Ground storage tank drain and overflow piping shall be routed to the WTP's stormwater system. The drain and overflow piping shall meet all air-gap and backflow requirements as dictated by the Florida Department of Environmental Protection (FDEP). Tank diameter and side-water depth shall be designed to achieve a cost-effective construction price and so as not to require excessive pumping heads from the raw water supply well pumps.

II.6. The ground storage tank elevation relative to the high service pump station shall have adequate submergence (meeting Hydraulic Institute Standards) and net positive suction head (NPSH) such that the entire tank volume is usable without the use of a vacuum priming system.

II.7. The total height of each ground storage tank may be restricted depending on location. Final height of the ground storage tank to be coordinated with and approved by JEA.

II.8. All wetted components and materials of the ground storage tank and accessories shall be NSF 61 compliant.

II.9. All components and materials shall be suitable for corrosive environment consisting of hydrogen sulfide off-gas.

III. ACCESSORIES

III.1. Accessories to be provided with each ground storage tank shall include, as a minimum, the following:

III.1.1. Under all circumstances and all projects, all tanks shall be constructed with staircase and lightning protection bosses. These bosses allow for current and future installation considerations.

III.1.2. All access to the ground storage tank shall be lockable, including any staircases, ladders, surface aerator access ways, and hatches.

III.1.3. An aluminum staircase allowing access to the top of the ground storage tank domes conforming to all Occupational Safety and Health Administration (OSHA) requirements. The top platform shall include a mounting bracket for lighting. A lockable aluminum gate shall be located at top of the staircase leading to the ground storage tanks. For safety concerns, the gate shall swing toward the tank. If the WTP is to be constructed in phases with only one ground storage tank and space for a future tank, incorporate provisions so the staircase can be connected to the future tank.

III.1.4. When applicable, the staircase shall be located between the two ground storage tanks with an aluminum bridge connecting the staircase to both tanks. The bridge design shall consider all applicable wind loading requirements and shall not be greater than 25-feet in length, unless otherwise approved by JEA.

JEA Water and Wastewater Standards

- III.1.5. A non-slip surface and aluminum guardrail (3-foot and 6-inch tall) on the dome of the tank from the bridge landing to the entrance of the tray aerator.
- III.1.6. A 3-foot and 6-inch tall aluminum guardrail to be provided around the perimeter of the tank dome. The guardrail shall include aluminum toe-board brackets.
- III.1.7. A fiberglass interior tank ladder with Type 316 stainless steel safety post and Type 316 stainless steel safety climb device, belt and rail extension. The side rails shall be punched to receive rungs and rungs shall be mechanically secured to the side rails. The ladder shall conform to all OSHA requirements.
 - III.1.7.1. A locking aluminum box adjacent to the roof hatch to store the safety climb device rail extension and safety climb belt.
- III.1.8. A fiberglass roof hatch with a main clear opening of 6-feet square and an internal, hinged, 3-foot square clear opening hatch.
- III.1.9. Precast concrete roof overflows (eyelids) with 24 X 24 mesh (Type 316 stainless steel) insect screen. Overflows shall be located a minimum of 18-inches inside of the guardrail surrounding the tank to facilitate insect screen replacement. The number of overflows for each tank shall be sufficient to meet the total raw water-pumping rate assuming no water is being withdrawn from the tanks by the high service pumps.
- III.1.10. An overflow pipe installed inside the tank at the high water level. The pipe shall be sized to handle the entire raw water flow to the tank assuming that no water is being withdrawn by the high service pumps. The overflow pipe shall be braced from the sidewall or dome of the storage tank. All metallic components of the overflow pipe and bracing which are in contact with the water in the tank shall be coated with a system suitable for contact with potable water and a corrosive environment (hydrogen sulfide laden off-gas) or shall be Type 316 stainless steel.
- III.1.11. Two stainless steel wall manway frames and covers. Manway cover shall include a swing hinge. The manway shall have a minimum clear opening of 3-feet high by 5-feet wide. Manway's to be located for ease of access to the tank drains. Maximum height from the bottom of the manway opening to the interior footer shall be 2 foot-0 inches. Maximum height from the bottom of the manway opening to exterior grade shall be 1 foot-0 inches.
- III.1.12. A concrete curb or precast cylinder in the dome for mounting a 4-inch flanged by plain end Type 316 stainless steel roof pipe. The roof pipe shall have a blind flange on the exposed end above the roof. The roof pipe shall be used for insertion of instruments into the storage tank. Instruments shall include high and low level float switches inside of the ground storage tank. The high level float switch shall be set to alarm at the tank overflow and the low level switch shall be set to alarm at the tank low water level. Concrete curb or precast concrete cylinder shall be located as close to the access bridge and access hatch as is feasible.
- III.1.13. A concrete curb in the dome for mounting a future ultrasonic level transmitter. The curb shall be located so as to provide the appropriate clearance angle for the ultrasonic signal to the water surface inside the storage tank. Concrete curb shall be located as close to the access bridge as is feasible. In addition to the concrete curb, a flanged wall pipe located on the side wall near the bottom of the tank elevation, shall be provided for mounting a permanently installed static pressure level transmitter. The mounting height of the static pressure level transmitter shall be as close to

JEA Water and Wastewater Standards

the bottom of the tank as is feasible, coordinate with JEA and tank manufacturer for appropriate height.

- III.1.14. Ground storage tank fiberglass sight liquid level indicator to be located facing towards the WTP control room. The indicator shall be white with 4-inch black numerals and 2-foot gradations. The level target shall be red fiberglass. The indicator numbering shall set the zero mark even with the top of the tank wall with the 'FULL' level at the bottom of the indicator.
- III.1.15. A Type 316 stainless steel vortex baffle at the entrance to the outlet pipe. The vortex baffle shall meet all requirements of the Hydraulic Institute Standards.
- III.1.16. No special architectural elements will be required for the exterior of the tanks unless specifically directed by JEA on a case-by-case basis. Refer to the Protective Coatings (Paragraph X of this Section) below for color and other coating requirements.
- III.1.17. A stainless steel nameplate mounted on the outside of the tank at eye level. Information of the on the nameplate shall include: tank manufacturer, usable volume in million gallons (MG), side-water depth, inner diameter in feet, date of tank substantial completion, warranty end-date, and interior coating system. Nameplates shall not be made until after substantial completion is attained.
- III.1.18. Valves shall have tag markers that coordinate with the as-built and record drawings, refer to Section X, Valves.

IV. TRAY AERATORS

- IV.1.** A perforated tray natural draft aerator shall be provided at the peak of the dome of each ground storage tank. The aerators shall be constructed of fiberglass-reinforced plastic (FRP), suitable for contact with potable water and a corrosive environment (hydrogen sulfide laden off-gas). All fasteners shall be Type 316 stainless steel. The base of each aerator shall be a watertight circular FRP catch basin of such height and diameter as will ensure adequate capacity and proper ventilation at all tray levels and prevent splashing of water outside the basin. A drain shall be provided for ease in cleaning the catch basin.
- IV.2.** The anchoring of the aerator assembly shall designed to match the wind loads of the ground storage tank with the exception of the screen panels which shall be designed to detach.
- IV.3.** Each aerator assembly shall be sized for the plant's maximum daily flow (maximum number of well pumps operating). If this is not possible or reasonable, coordinate with JEA for approval and to determine acceptable aerator assembly sizing. Consideration for parallel and in-series operation of the ground storage tanks shall be taken into account.
- IV.4.** The trays shall surround and be anchored to the inlet pipe. The inlet pipe shall include a flanged connection below the aerator assembly and inside of the tank to facilitate its removal in the future. Each aerator shall have a minimum of seven tiers, with a minimum vertical separation of 10 inches between tiers as well as the bottom tier and catch basin floor. In addition, a minimum of 12 inches of vertical separation shall also be provided between the aerator roof and the top tier of trays. If height restrictions do not allow for seven tiers, coordinate with JEA for approval of a lower quantity of tiers. The exact size and shape to be determined by the Engineer and ground storage tank supplier. The number of trays per tier shall be sufficient for the structural loading associated with the diameter of the aerator and the maximum volume of water loaded onto each tier.

JEA Water and Wastewater Standards

- IV.5.** A minimum clearance of 30 inches shall be provided between the catch basin curb and the outer edge of the trays. Any openings in this clearance area shall be covered in FRP grating for operator access to the trays. The entire area out to the catch basin curb shall be covered with a roof. The circular sidewalls of the aerator shall consist of the roof columns together with fiberglass louver panels to block sunlight from entering the aerator and 24 by 24 mesh vinyl coated FRP screening, resulting in a complete screened enclosure capable of preventing entry of birds, animals, and insects. The louvers shall be located inside of the screen. Each louver and screen panel shall be removable to provide operator access into the aerator enclosure.
- IV.6.** Operator access to the aerator shall be provided with a hinged door. Hinges shall be Type 316 stainless steel, suitable for a corrosive environment (hydrogen sulfide off-gas). The access door shall also include provisions for a padlock for security, as noted above. Bolt and nut type access doors shall not be acceptable.
- IV.7.** The aerator shall include downcomer openings with fiberglass plugs and 1-1/2 inch fiberglass grating. The quantity and size of the downcomers shall be designed for the maximum potential flow with one ground storage tank out of service. The diameter of each downcomer shall be a minimum of 10-inches. The bottom of the aerator assembly shall slope to each downcomer. Downcomer piping shall extend within the tank dome by a minimum of 3-inches such that water does not run down the inner sides of the dome.
- IV.8.** A hose rack and bib to be provided at the top of the stairs near the entrance to the dome for periodic cleaning. The hose rack and bib shall be provided to match the JEA Standard Pump Station Construction Details – Miscellaneous Details for the 1-1/2 inch Hose Station Detail.

V. VENTILATORS AND INTAKE HOODS

- V.1.** Each storage tank shall be provided with a minimum of two axial flow roof ventilators. These axial flow roof ventilators shall be designed to run continuously to replenish the atmosphere above the water in the ground storage tank so as to promote additional total sulfide removal through volatilization as hydrogen sulfide. Axial flow roof ventilators shall be self-supporting, vertical-discharge, 0.125-inch aluminum continuous welded seam construction, and direct-drive units. The unit shall be designed to protect the shaft, drive, and bearings from the corrosive nature of moist, hydrogen sulfide-laden air. The propeller shall be vane axial style of A319 aluminum alloy, solid one-piece construction and dynamically and statically balanced in accordance with ISO 1940-1973. Guide vanes shall be integrally welded with the outer housing providing a substantial weldment. All axial flow roof ventilators shall include a welded aluminum stack cap with Type 316 stainless steel hardware and mechanically fastened gasket with insect-proof seal when fan is not operating. The stack cap shall direct the discharged air stream upward. The unit shall be designed with a self-supported swing-out maintenance door for accessibility of the motor and propeller. A weep hole shall be provided in the recessed gutter to drain rainwater from the stack cap.
- V.2.** Axial flow roof ventilator motors shall be UL listed suitable for severe mill and chemical duty, TEFC, premium efficient with IEEE-841 rating.
- V.3.** The roof ventilation system shall be sized to achieve a minimum theoretical air exchange rate of 36 air changes per hour (ACH) using the volume of the reservoir and dome above the operating high water level. This shall be achievable at the maximum allowable pressure drop across the axial flow roof ventilators. Confirm ventilation system sizing with tank manufacturer.
- V.4.** The location of the axial flow roof ventilators and intake hoods shall maximize offset and shall be confirmed with the tank manufacturer and JEA. Tank manufacturer shall coordinate location of axial flow roof ventilators and intake hoods with supplier and JEA.

JEA Water and Wastewater Standards

- V.5.** The ventilation system shall include curbs on the top of the dome with intake hoods that are adequately sized to allow makeup air into the headspace of the ground storage tank such that a negative pressure is never observed under all potential operating conditions. Intake hoods shall be fabricated of welded aluminum, 0.125-inch material for curb cap, throat and hood. Support structure of hoods shall be 2-inch X 2-inch X 1/4-inch welded aluminum angle. The intake hood shall include a Type 316 stainless steel mesh (24 by 24) on gasketed frame panels. Screen panels shall be easy access and open via Type 316 stainless steel clamps with a Type 316 stainless steel piano hinge. All assembly hardware shall be Type 316 stainless steel.

VI. BAFFLING

- VI.1.** A minimum of two octagonal baffles shall be provided to minimize dead flow zones in the storage tank. Baffle walls shall be configured to force the flow of water in opposite directions in each subsequent concentric circle. Baffle walls shall be an octagonal geomembrane curtains. The interior baffle shall be oriented such that downcomers fully discharge inside of it. The ground storage tank foundations for and walls shall be designed to resist all forces from the baffle wall curtains. Appropriate supports and curtain stabilizers shall be provided and designed by the ground storage tank manufacturer.
- VI.2.** Each storage tank shall be drained through a single drainpipe. However, separate drain inlets (total of five) shall be provided in each of the concentrically baffled areas of the tank to facilitate draining of the tank.
- VI.3.** Sample piping and valves shall be provided such that the middle, intermediate and outlet of the ground storage tank can be sampled. The sample piping inside of the tank shall be Sch 80 PVC with valves as described in Section X, Valve Standards. Sample piping located outside of the tank shall be Sch 40, Type 316 stainless steel and provided with appropriate insulation to prevent freezing. Sample piping valves shall be clearly labeled with bronze nameplates, mounted to the side of the ground storage tank. Threading is not permitted at the sample piping outlet.

INNER SAMPLE POINT

INTERMEDIATE SAMPLE POINT

OUTER SAMPLE POINT

VII. GROUNDING

- VII.1.** The tanks shall be grounded in accordance with Section VII Electrical Standards.

VIII. LIGHTNING PROTECTION

- VIII.1.** The tanks shall be provided with lightning protection in accordance with Section VII Electrical Standards.

IX. OVERFLOW AND DRAIN STRUCTURE

- IX.1.** A concrete overflow and drain structure, separate from the ground storage tank, will be provided to receive and convey from the overflow and drain pipes to the on-site stormwater management system. **Exhibit IV.2** provides a general detail of the overflow and drain structure.

JEA Water and Wastewater Standards

- IX.2.** Piping from the overflow shall be conveyed to the overflow and drain structure with an air-gap of two diameters above the top of the structure, refer to FDEP and 10 State Standards for requirements. The air gap shall include a gooseneck and flanged, Type 316 stainless steel screen (24 X 24 mesh). The drain piping shall include an isolation valve (normally closed) upstream of the overflow and drain structure and duck-bill style check valve on the drain outlet.
- IX.3.** The overflow and drain structure shall convey the overflow or drain water to the on-site stormwater management system. The baffle wall elevation shall be set such that the tank can completely drain.
- IX.4.** The overflow and drain structure shall have two compartments. The first compartment shall receive the water from overflow and drain piping and the second compartment shall receive water from the first compartment via a rectangular weir. The second compartment shall convey the water to the on-site stormwater management system. The first compartment is intended to capture solids from the ground storage tank, so they are not conveyed to the stormwater system. The first compartment shall include a sump, sump pump, and guide rails. An accessible outdoor rated electrical outlet shall also be provided for sump pump operation.
- IX.4.1.** Sump pump guide rails shall be Type 316 stainless steel and mounted to the sump wall to accept the portable pump. Guide rail sizing will accommodate the portable pump. A Type 316 stainless steel hoisting cable and hook will be provided to secure the pump at the top of the sump. Hoisting cable and hook will each be capable of supporting the pump weight.

X. PROTECTIVE COATINGS

- X.1.** All interior and exterior surfaces of ground storage tanks shall be painted. The coatings of the tank shall be coated by the tank supplier and the tank supplier shall have system responsibility for all interior coatings. Coatings shall be applied by coating manufacturer approved applicator.
- X.2.** Interior Coatings Requirements
- X.2.1.** All interior coatings shall be approved for contact with potable water and conforming to NSF 61.
- X.2.2.** Underside of dome and interior walls (full height)
- X.2.2.1.** Surface preparation: Sweep blast to CSP5.
- X.2.2.2.** Surfacer across the interior wall and dome surface to fill all bug holes and coat all peaks: Sherwin-Williams Dura-Plate 2300 at 1/16-inch to 1/8-inch above all peaks; or Tnemec Series 218 at 1/16-inch to 1/8-inch above all peaks.
- X.2.2.3.** Conduct a detailed inspection of the surfacer application paying attention to bug holes that have not been properly covered.
- X.2.2.4.** Apply a second application of surfacer (Sherwin-Williams Dura-Plate 2300; or Tnemec Series 215) to areas where bug holes are discovered. Assume 1,000 square feet of surfacer is required per tank.
- X.2.2.5.** Prime Coat: Sherwin-Williams Dura-Plate UHS OAP Blue at 4.0 to 7.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.2.6.** Apply a third application of surfacer (Sherwin-Williams Steel Seam FT910; or Tnemec Series 215) to areas where bug holes are discovered. Assume 500 square feet of surfacer is required per tank.

JEA Water and Wastewater Standards

- X.2.2.7. Stripe Coat: All concrete edges and sharp points shall be coated with a brush or roller to within 3-inches of the edge with Sherwin-Williams Dura-Plate UHS Gold Primer 5.0 to 8.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.2.8. Top Coat: Sherwin-Williams Duraplate UHS White at 18-22 mils DFT; or Tnemec Series 22 at 4.0 to 6.0 mils DFT.
- X.2.2.9. "Holiday" test the entire surface.
- X.2.2.10. Repair any pinholes with Sherwin-Williams Duraplate UHS; or Tnemec Series 22.

X.2.3. INTERIOR FLOOR

- X.2.3.1. Surface preparation: Sweep blast to ICRI CSP3.
- X.2.3.2. Prime Coat: Sherwin Williams Tank Dura-Plate UHS OAP Blue Primer at 4.0 to 7.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.3.3. Apply surfacer (Sherwin-Williams Steel Seam FT910; or Tnemec Series 215) to areas where bug holes are discovered. Assume 200 square feet of surface is required per tank.
- X.2.3.4. Stripe Coat: All concrete edges and sharp points shall be coated with a brush or roller to within 3-inches of the edge with Sherwin-Williams Dura-Plate UHS Primer Gold at 4.0 to 6.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.3.5. Top Coat: Sherwin-Williams Dura-Plate UHS White at 18-22 mils DFT; or Tnemec Series 22 at 18-28 mils DFT.

X.2.4. All interior metal surfaces included pipes and pipe supports

- X.2.4.1. Surface preparation: Pressure wash at 4,000 psi and abrade primer with sandpaper to develop a surface profile.
- X.2.4.2. Prime Coat: Sherwin-Williams Dura-Plate UHS OAP Blue primer at 4.0 to 6.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.4.3. Stripe Coat: All edges and sharp points shall be coated with a brush roller to within 3 inches of the edge with Sherwin-Williams Dura-Plate UHS Primer Gold 4.0 to 6.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.4.4. Spot Prime: Dura-Plate UHS Primer Gold at 4.0 to 6.0 mils DFT; or Tnemec Series 20 HS at 4.0 to 6.0 mils DFT.
- X.2.4.5. Top Coat: Sherwin-Williams Duraplate UHS White at 18-22 mils DFT; Tnemec Series 22 at 18-22 mils DFT.

X.3. EXTERIOR COATINGS REQUIREMENTS

- X.3.1. Provide an elastomeric breathable coating for the exterior of the tank (walls and dome). Exterior coating shall be a modified waterborne acrylate applied to two coats.
 - X.3.1.1. Surface preparation: Remove all contaminants by power washing per SSPC-SP1.
 - X.3.1.2. First Coat
 - X.3.1.2.1. Tnemec 156 Enviro-crete – 5 mils DFT; or
 - X.3.1.2.2. Sherwin-Williams, Loxon XP (smooth) – 6 mils DFT.

JEA Water and Wastewater Standards

X.3.1.3. Second Coat

X.3.1.3.1. Themec Series 156 Enviro-crete – 5 mils DFT; or

X.3.1.3.2. Sherwin-Williams, Loxon XP (smooth) – 6 mils DFT.

Table IV.1 Ground Storage Tank Color Code Requirements

LOCATION	TANK TYPE	COLOR CODE
Dome	Potable, Raw, or Reclaimed	Federal Standard 33617
Walls	Potable, Raw, or Reclaimed	Federal Standard 33617
Top of Wall Ring	Potable	Federal Standard 25230
	Raw	Federal Standard 34058
	Reclaimed	Pantone Color 522C

- X.4.** Manufacturers' recommendation for surface preparation, primer, and coatings shall be strictly adhered to.
- X.5.** Interior coating system shall be warranted for ten years of substantial completion and exterior coating system shall be warranted for five years of substantial completion. The tank manufacturer shall provide a warranty letter naming JEA as beneficiary and documenting that coatings were applied in accordance to the coating manufacturer's recommendations and the beginning and end dates for the warranty period.
- X.6.** The shotcrete on the interior of the tank shall be brought to an even plane meeting all requirements of the coating manufacturer.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION V – HIGH-SERVICE PUMPS

I. INTRODUCTION

High-service pumps deliver pressurized finished water into the distribution system. Design criteria for selecting high service pumps will be developed according to JEA input and may consist of criteria established by future flow demand projections, transmission system modeling, or other components.

Criteria for high-service pump selection and design consists of the following:

- I.1.** Initial average daily flow (ADF).
- I.2.** Initial peak hour Flow (PHF).
- I.3.** Future ADF.
- I.4.** Future PHF.
- I.5.** Minimum flow conditions.
- I.6.** Discharge pressure range.
- I.7.** Firm capacity pump redundancy.
- I.8.** Variable frequency drive (VFD) capabilities.

II. STANDARDS

The following standards will be utilized for the design of the high-service pumps.

- II.1.** National Sanitation Foundation (NSF).
- II.2.** American Bearing Manufacturers Association (ABMA).
- II.3.** American National Standards Institute (ANSI).
- II.4.** American Society for Testing Materials (ASTM).
- II.5.** American Water Works Association (AWWA).
- II.6.** Hydraulic Institute (HI) Standards.
- II.7.** Occupational Safety and Health Administration (OSHA).

III. PRELIMINARY PUMP SELECTION

- III.1.** The high-service pumps shall be capable of meeting minimum and maximum flows as required by JEA. A firm capacity shall be provided for the required maximum flow. A plan shall be developed to enable the pump station to meet potential future minimum and maximum flows. Future flows can be met by replacing small pumps with large pumps or leaving empty slots for future pumps in the initial construction phase. Pump selection criteria shall consider the following:

JEA Water and Wastewater Standards

- III.1.1. Minimum and maximum system curves shall be developed to better understand the total head (TH) conditions to be met by the candidate pump(s) at the design flow conditions.
- III.1.2. Candidate pump(s) should meet most, if not all, of the flow and TH conditions within the pump's preferred operating range (POR), defined as 80 percent to 120 percent of the best efficiency point (BEP) flow on the pump curve. Expected flows outside the POR shall be within the acceptable operating range (AOR) as identified by the pump manufacturer.
- III.1.3. The net positive suction head available (NPSHa) at design flows shall be analyzed and compared with the net positive suction head required (NPSHr) of the candidate pump(s). The minimum NPSHa:NPSHr ratio greater shall meet the requirements of the Hydraulic Institute (HI) Standards.
- III.2. All new pumps shall be designed for VFDs. See Section VII "Electrical Standards" for acceptable manufacturers.
- III.3. A sequencing plan to operate the high service pumps shall be developed.
- III.4. A typical section of the high-service, horizontal split-case pumps are presented in **Exhibit V.1**. An example of the pump room layout in plan view is provided in Section XI.

IV. DESIGN CRITERIA

The high-service pumps shall be located in the high service pump room of the chemical and high service pump station building. The room shall be sized for initial and future pump space requirements.

The pump centerline shall be designed to maximize usable tank volume, while maintaining a reasonable elevation that will allow operation and maintenance personnel to easily access the pump, piping, valves, etc. The NPSHa analysis performed in the pump selection phase shall be coordinated with the pump centerline elevation.

Section XI describes the chemical and high-service pump station building's layout. The following sections describe the elements of design to be considered when selecting the high-service pumps.

IV.1. PIPING LAYOUT

Piping to and from the high-service pumps shall be ductile iron pipe. All below-grade, buried piping shall be mechanically restrained. All above-grade piping and piping in trenches shall be flanged.

Bends on vertical piping shall be accomplished by long radius elbows where possible; tees shall not be installed instead of elbows.

Piping at the pump suction and discharge shall be configured so that the valves and appurtenances are above grade and accessible for maintenance.

IV.2. PUMP TYPES

The pumps shall be JEA approved horizontal, split-case, double-suction centrifugal pumps. Each pumping unit shall have a pump, electric motor, adjustable speed drive where indicated, and all necessary equipment required for proper operation. Shaft seals shall be of the mechanical type. Baseplates and appurtenant equipment shall be as recommended by the equipment manufacturer.

- IV.2.1. All pumps shall be designed to provide water service at sea level, between 40 and 140 degrees F at 100 percent humidity and with a free chlorine residual of 5 mg/L.

JEA Water and Wastewater Standards

IV.3. PUMP SUCTION AND DISCHARGE EQUIPMENT, VALVES, AND APPURTENANCES

- IV.3.1. All pump suction and discharge isolation valves, check valves, and pressure indicators shall be located above grade and accessible for maintenance and replacement.
- IV.3.2. Horizontal split-case centrifugal pumps shall be equipped with a combination vacuum/pressure gauge assembly on the suction line, and a pressure gauge and pressure indicator on the discharge line. A discharge air release valve shall be mounted directly on the pump. The air valve will release air trapped in the pump and piping system during startup. The air release valve discharge shall be routed to a nearby floor drain such that no water is splashed onto the concrete and will be collected in a nearby sump. Refer to Instrumentation and Control Standards for vacuum/pressure gauge requirements.
- IV.3.3. In addition, a rubber flapper swing check valve and butterfly valve shall be installed along the pump discharge. The check valve shall prevent water from rushing back into the pump during shutdown and the butterfly valve be used to isolate the pump. Check valves shall be installed with limit switches to indicate that the check valve is open or closed. Refer to Instrumentation and Control Standards for limit switch requirements.
 - IV.3.3.1. Check valves shall be sufficiently spaced from the butterfly valve such that the butterfly valve disc does not conflict or impede on the check valve.
 - IV.3.3.2. Check valves shall be sized for the design and flow conditions and should not be assumed to be identical to the connected pipe size. If required, reducers shall be provided to achieve the design check valve size.
 - IV.3.3.3. Handwheel diameters shall be a minimum of 12-inches or sized such that the maximum applied torque for operation is 80 lbs-force, whichever is larger.
 - IV.3.3.4. Gate valves will be considered as an alternate on a case-by-case basis and as approved by JEA. If approved, hand-wheel shall be reasonably accessible and horizontal type installation with beveled gear.
- IV.3.4. Piping arrangements, use of standard or long radius elbows, valve placement and shaft orientation, and appurtenant equipment installation for split case pumps shall be as recommended by the Hydraulic Institute and the equipment manufacturer. Bends on vertical piping shall be accomplished by long radius elbows, tees installed in lieu of elbows shall not be acceptable.
- IV.3.5. Refer to Section VIII Instrumentation and Control Standards for flow meter requirements. Flow meters shall be installed with bypass piping to allow for the meter to be serviced or replaced without operational downtime. An example flow meter and bypass assembly is provided in Exhibit V.2.
- IV.3.6. All other fittings, valves and equipment shall be in accordance with JEA Standards including Section IX, Piping Standards and Section X, Valves.

IV.4. DRIVES

All pumps shall be furnished with JEA approved VFDs. If possible, all pumps at the pump station shall be the same type, make and model to ensure all pumps are operating on the same curve. The design of the VFD shall be coordinated with the requirements of the pumping unit. Refer to Section VII "Electrical Standards" for additional requirements.

JEA Water and Wastewater Standards

IV.5. MOTORS

Motors for horizontal split-case pumps shall be mounted with the pump by the pump manufacturer. Refer to Section VII, Electrical Standards for pump motor requirements.

IV.6. PUMP MOUNTING

IV.6.1. Each pump shall be provided with lifting eyebolts or lugs, plugged gauge cock connections at the suction and discharge flanges, tapped and plugged openings for casing and bearing housing vents and drains, and appropriate fittings for adding bearing lubricant.

IV.6.2. The pump coupling shall be sized for continuous operation at full load and at maximum rpm when the misalignment is within the manufacturers' tolerance limit. Coupling design shall permit removal of the pump rotating element without disconnecting the piping, moving the drive unit, or causing axial movement of the coupling halves on the shafts.

IV.6.3. Anchor bolts shall be accurately located and centered in pipe sleeves having an inside diameter approximately 2 1/2 times the bolt diameter and a length approximately 8 times the bolt diameter. A square anchor plate with a thickness of approximately 1/2 the bolt diameter and side dimensions 4 times the bolt diameter shall be welded to the bottom of each sleeve, with the anchor bolt extended through the plate and welded thereto. Base plates shall be provided with adequate openings to facilitate grouting.

IV.7. MATERIALS OF CONSTRUCTION

IV.7.1. All wetted materials shall be NSF 61 approved.

IV.7.2. No components with measurable lead content shall be in contact with pumped fluid.

IV.7.3. Split case pumps shall be bronze fitted using the materials listed below:

IV.7.3.1. Casing Cast iron, ASTM A48.

IV.7.3.2. Casing Wearing Ring Cast iron, ASTM A48; or bronze, ASTM B62.

IV.7.3.3. Impeller SS, ASTM A276 Type 316.

IV.7.3.4. Impeller Wearing Ring SS, ASTM A276 CD4MCU.

IV.7.3.5. Shaft 416 SS.

IV.7.3.6. Shaft Sleeve SS, ASTM A276 Type 316.

IV.7.3.7. Mechanical Seal Cartridge, Split-Type

IV.7.3.8. Bearings ABMA Antifriction L10 average life
.....130,000 hours.

IV.7.3.9. Flexible Coupling Falk "Steelflex" Woods "Sure-Flex"
.....(gear type for larger horsepower).

IV.7.3.10. Baseplate Fabricated Steel.

IV.7.3.11. Anchor Bolts, Nuts and Washers Type 316 SS.

JEA Water and Wastewater Standards

V. TESTING

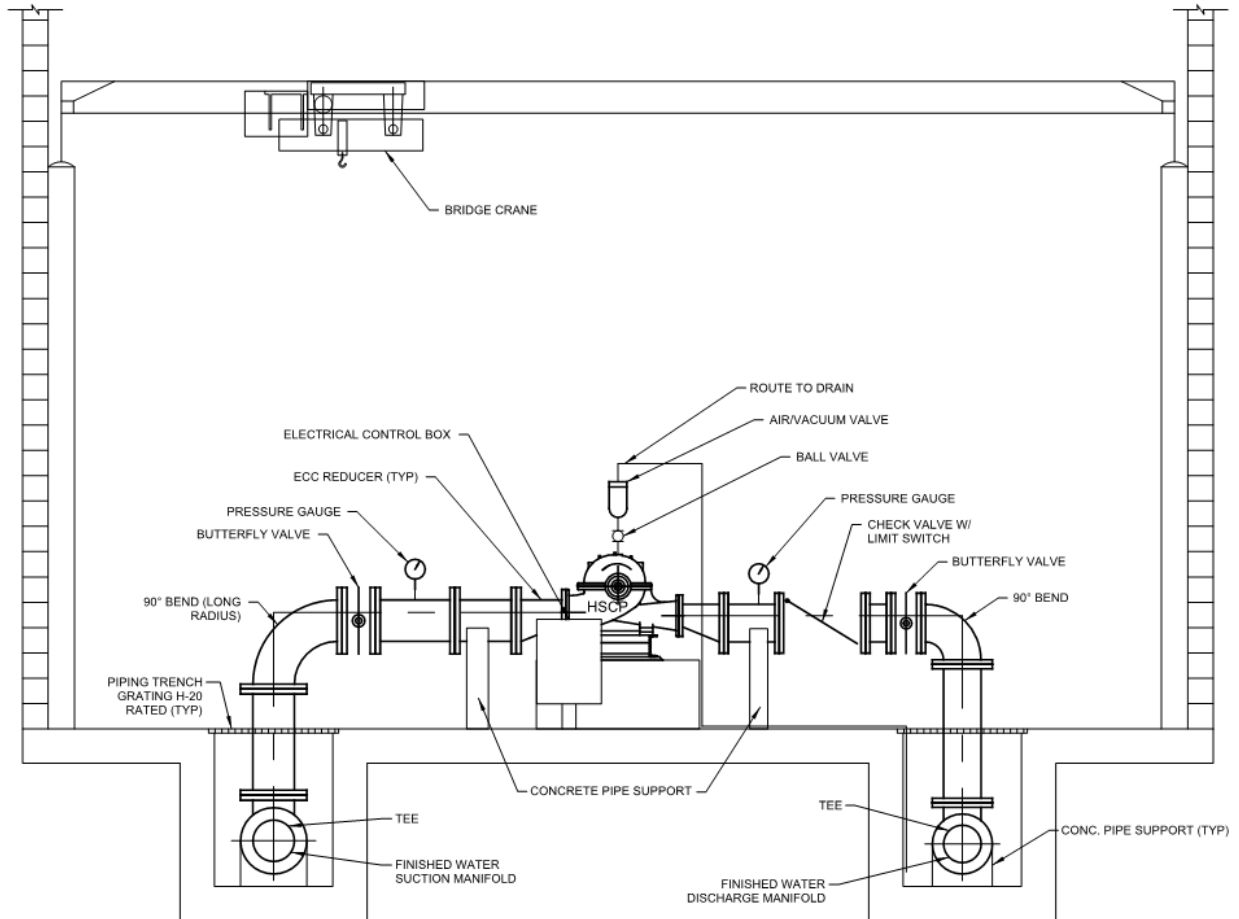
- V.1.** The pump shall be tested by the factory after impeller trimming and assembly and a curve of the operating conditions including flow, head, efficiency, and horsepower shall be plotted and submitted to JEA for approval prior to shipping any materials. The test shall be a non-witnessed test, but JEA reserves the right to reject the test and witness any retesting at its own cost.
- V.2.** Field testing shall be performed by the Pump Manufacturer to indicate that the pump and motor conform to the operating conditions of an accepted factory performance test. If pump performance does not generally agree with the factory test results, corrective measures shall be taken or the pump replaced with a pump that satisfies the required conditions.
- V.3.** After installation and field testing of the pump, perform vibration testing and analysis meeting the requirements of ANSI/HI 9.6.4.

VI. ACCEPTABLE MANUFACTURERS

- VI.1.** These manufacturers periodically change and should be verified with the purchasing department of JEA. All pump materials of construction shall be NSF approved and supporting documentation shall be provided by the manufacturer.

JEA Water and Wastewater Standards

Exhibit V.I Typical Horizontal Split-Case Pump Section



TYPICAL HORIZONTAL SPLIT CASE PUMP SECTION

NTS

NOTES:

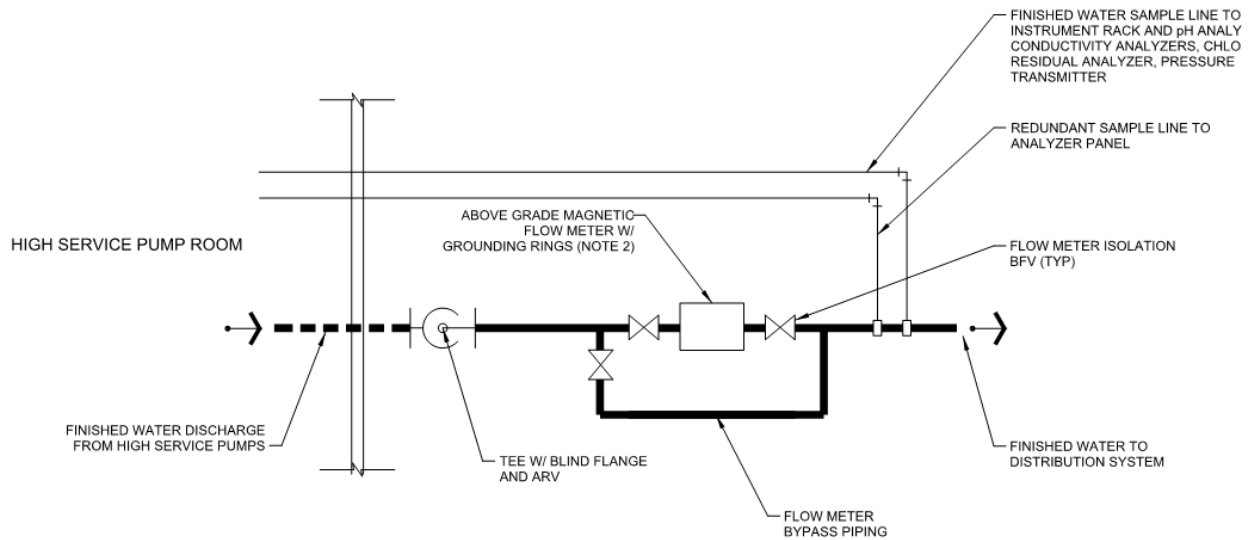
1. SUCTION AND DISCHARGE PIPING TO MEET HYDRAULIC INSTITUTE STANDARDS.
2. THIS SECTION IS INTENDED TO BE GENERIC. ACTUAL PUMP, VALVE, AND PIPING ARRANGEMENT SHALL BE SITE SPECIFIC.

JEA Water and Wastewater Standards

Exhibit V.II Typical High Service Pump Station Above Grade Flow Meter Assembly

NOTES:

1. SIZE, LOCATION, ORIENTATION, AND LAYOUT OF YARD PIPING WILL VARY DEPENDING ON PROJECT SPECIFIC CONDITIONS. COORDINATE LAYOUT WITH JEA.
2. COORDINATE REQUIRED UPSTREAM AND DOWNSTREAM PIPING REQUIREMENTS WITH MAGNETIC FLOW METER MANUFACTURER.



A **ABOVE GRADE FLOW METER ASSEMBLY**
SCALE: NTS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION VI – DISINFECTION SYSTEM

I. INTRODUCTION

I.1. Sodium hypochlorite is used at the JEA Water Treatment Plants (WTP) as the chlorinating agent for disinfection. This section describes design criteria for truck delivered bulk sodium hypochlorite storage and feed facilities. Design considerations consist of the following demands:

I.1.1. Initial Peak Hour WTP Flow.

I.1.2. Initial Maximum Daily WTP Flow.

I.1.3. Initial Average Daily WTP Flow.

I.1.4. Initial Minimum Daily WTP Flow.

I.1.5. Initial Minimum Hour WTP Flow.

I.1.6. Future Peak Hour WTP Flow.

I.1.7. Future Maximum Daily WTP Flow.

I.1.8. Future Average Daily WTP Flow.

I.1.9. Future Minimum Daily WTP Flow.

I.1.10. Future Minimum Hour WTP Flow.

I.1.11. Disinfection Injection Points.

I.1.12. Maximum, Average and Minimum Dosing Concentrations.

Note: WTP flow shall refer to the high service pump discharge flow at the point of connection to the distribution system.

I.2. All tanks, pipes, valves, fittings, gaskets, and appurtenances that come in contact with the sodium hypochlorite shall be NSF 61 approved. All tanks, pipe, valves, fittings, gaskets, hardware, pipe supports, grating, stairs, handrails, pumps, skids, and appurtenances shall be compatible with a maximum 15-percent trade solution of commercial sodium hypochlorite solution.

I.3. Metals in normal contact with sodium hypochlorite solution shall be titanium or Hasteloy C-276. Any metal materials of construction inside the secondary containment area (e.g. pipe support anchors and hardware) shall be 316 stainless steel. No other metals shall be acceptable unless otherwise approved by JEA.

I.4. Refer to Section XI High Service Pump/Chemical Building Layout for additional requirements.

II. FLOWS

II.1. Initial and future WTP flows shall be coordinated with and approved by JEA prior to design; and both flows shall be used to determine whether the system will be constructed in phases or at one time. Designs shall provide provisions to accommodate the future WTP flows.

JEA Water and Wastewater Standards

II.1.1. If injecting downstream of the facility's ground storage tanks, design must meet future peak hourly flow (PHF).

II.2. For phased systems, a construction plan shall be developed for initial and future conditions.

III. STANDARDS

III.1. All materials in contact with potable water or sodium hypochlorite, shall be NSF/ANSI Standard 61, AWWA or FDA approved.

III.2. Chlorine disinfection system design shall be based on meeting the disinfection requirements of Florida Administrative Code 62-555.

III.3. Building Code: Florida Building Code (FBC) – Edition currently adopted by Authority Having Jurisdiction (AHJ).

III.4. Florida Fire Prevention Code.

III.5. NFPA 101 – Life Safety Code.

III.6. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1910 – Occupational Safety and Health Standards.

IV. DISINFECTANT INJECTION POINTS

IV.1. One primary injection point for sodium hypochlorite addition shall be provided. A redundant injection point shall be provided at the injection site. Since sodium hypochlorite will react with total sulfide species to produce elemental sulfur particulate, total sulfide must be removed to below 0.3 mg/L prior to sodium hypochlorite injection. Therefore, the injection point shall be located prior to the high service pump station. In most cases this will be downstream of the ground storage tanks which are designed to remove total sulfide. **Exhibit VI.1** shows a plan, sections, and detail of the primary and redundant injection points. The two injection points shall be located such that they do not compromise the structural integrity of the pipe and are easily accessible, refer to **Exhibit VI.1**, Detail 3.

IV.2. The location of the injection point shall allow for 4-log virus inactivation credits. Suction and discharge piping of the high service pump station shall be sized and routed to accommodate the required contact time at future peak hour flow while maintaining acceptable velocities and layout configurations. Approval is required by JEA if 4-log virus inactivation is not feasible.

IV.3. Sodium hypochlorite shall be conveyed from the sodium hypochlorite feed pumps to the injection point through carrier hosing and secondary containment piping. Containment piping shall be sloped back to the containment area. Provide additional leak detection points with inspection ports as required at low points if entire run of containment piping cannot be sloped to the containment area. The carrier tubing shall be PVC Sch 40 hosing with secondary containment piping. Carrier tubing shall be rated for a working pressure of 150 psi and a maximum pressure equal to the maximum pump pressure. Carrier piping route shall minimize the number of required turns and fittings. Secondary containment bends shall be long radius. The injection points shall be through a corrosion resistant retractable injection quill. The injection quill length shall be adequately sized based on the potable water process pipe. Unions and isolation valves shall be provided to ensure isolation and quill removal. The injection quill shall be easily accessible and fully removable from the vault with no obstructions. All injection quills shall be a minimum of 1-inch in diameter.

JEA Water and Wastewater Standards

Dual containment piping systems with Sch 80 carrier piping may be used on a case-by-case basis with approval from JEA.

IV.4. The two injection points shall be located inside a closed bottom concrete vault with a permanently installed aluminum ladder with safety post. Ladder and safety post shall be compliant with all applicable OSHA regulations. Concrete vault shall be equipped with an H-20 heavy duty traffic rated aluminum gasketed access hatch with a slip resistant surface and safety latches. In the event H-20 heavy duty traffic rated hatches are not provided, bollards shall be provided to restrict vehicular access. Hatches shall be spring assist type for easier opening. Vault shall be equipped with concrete sump and sump pump with check valve and quick connect to remove accumulated water.

IV.4.1. Sump will have a 316 stainless steel submersible pump guide rail mounted to the sump wall to accept the portable pump. Guide rail sizing will accommodate the portable pump. A 316 stainless steel hoisting cable and hook shall be provided to secure the pump at the top of the sump. Hoisting cable and hook shall each be capable of supporting the pump weight. An accessible outdoor-rated electrical outlet shall also be provided for temporary sump pump operation.

V. CHLORINE RESIDUAL ANALYZER

Downstream of the chlorine injection point but prior to leaving the facility, two chlorine residual analyzers shall be provided to measure the free chlorine residual. The chlorine residual analyzers shall continuously measure and transmit free chlorine residual concentrations. The analyzer shall be microprocessor based, reagent-less NEMA 4X, with automatic temperature correction and self-diagnostics. The chlorine sensors shall be of the ampere-metric type, flow-through design with a low flow cell, and pressure corrected. Acceptable manufacturers and additional requirements, including pH and conductivity monitoring, are listed in Section VIII, Instrumentation and Control Standards. The units shall be wall mounted in the High Service Pump Station (HSPS) Room.

V.1. To provide redundancy, two sampling points at the discharge of the high service pumps common header shall be provided. Valves shall be provided such that each sampling point can be isolated for maintenance or replacement, while the other sampling point remains in service to the pH and Free Chlorine Sample and Analyzer Station. Sampling points shall be located close together such that their samples are similar while maintaining sufficient spacing such that the discharge piping is not compromised.

V.2. Chlorine sample point shall be located such that the monitoring station remains in service regardless of HSPS bypass piping.

VI. DOSING REQUIREMENTS

Specific facility dosing requirements shall be confirmed with JEA for each WTP. Typical maximum, minimum and average chlorine dosages for JEA facilities are as follows:

VI.1. Max. Dose-10 mg/L.

VI.2. Ave. Dose-6 mg/L.

VI.3. Min. Dose-4 mg/L.

Refer to **Exhibit VI.2** for chlorine demand requirements and calculations.

JEA Water and Wastewater Standards

VII. COMMERCIAL GRADE BULK SODIUM HYPOCHLORITE SYSTEM AND LAYOUT

- VII.1.** Refer to Section XI, High Service Pump/Chemical Building Standard Layout.
- VII.2.** Commercial grade bulk sodium hypochlorite systems shall be used at existing and new facilities. New commercial grade bulk sodium hypochlorite storage and feed systems shall be located inside a climate controlled building.
 - VII.2.1.** The commercial grade bulk sodium hypochlorite storage tanks shall be located inside a concrete secondary containment basin, sized to hold 110 percent of the largest tank volume.
- VII.3.** Should an indoor sodium hypochlorite storage and feed building be deemed not to be feasible by JEA, the sodium hypochlorite storage and feed system shall be located outside, in a covered containment area. The cover shall be a coated aluminum pre-engineered metal canopy with standing seam metal roof. To reduce UV and heat exposure, standing seam sunshade side panels shall be provided along the top one third of the building height. Sunshade panels shall be removable to allow tank removal and maintenance. The North facing side of the containment area does not require a sunshade side.
 - VII.3.1.** Building doors, roof, and access panels shall be designed such that tanks can be removed and replaced in the future. Removal and replacement of any tank shall be independent of all other tanks in the storage area, such that each tank can be removed or replaced independent of the placement of the other tanks.
 - VII.3.2.** Electrical panels, junction boxes, bollards, and any other permanent items shall not prohibit the removal and replacement. Provide removable bollard type as necessary.
 - VII.3.3.** Outdoor installations shall minimize exposure of storage tanks, instrumentation, and electrical panels to direct sunlight.

VII.4. SUMP PIT

The secondary chemical containment area floor shall slope to a concrete sump pit. The sump pit shall be provided with 1-1/4 inch sump pump discharge piping including a check valve, isolation ball valve, and a quick connect to allow hose connection of a removable sump pump. A portable submersible pump shall be furnished to JEA for each sump. The portable pump shall be installed whenever a leak or spill occurs within the containment for pumping out to a tank truck or other approved disposal method. No other equipment shall be located in the sump (i.e. feed pumps, electrical equipment, etc.).

- VII.4.1.** Each sump shall have a 316 stainless steel submersible pump guide rail mounted to the sump wall to accept the portable pump. Guide rail sizing shall accommodate the portable pump. A 316 stainless steel hoisting cable and hook shall be provided to secure the pump at the top of the sump. Hoisting cable and hook shall each be capable of supporting the pump weight.
- VII.4.2.** Sump shall be large enough to provide sufficient chemical neutralization volume.
- VII.4.3.** Each submersible sump pump shall provide a minimum capacity of 100 gpm and shall be 120V.
- VII.4.4.** GFI with toggle switch (on/off) shall be installed at an elevation above the containment area maximum liquid level to provide power to the pump.

JEA Water and Wastewater Standards

- VII.4.5. Additional requirements for level monitoring are included in Section VIII, Instrumentation and Control Standards.
- VII.4.6. In-plant sanitary sewer drain shall be provided for outdoor installations in the event of stormwater collection in the sump. The design shall incorporate isolation valves and a means to neutralize sodium hypochlorite within the secondary containment prior to disposal.

VII.5. FRP GRATING

Fiberglass reinforced grating shall be provided above the secondary containment volume to allow access throughout the sodium hypochlorite facility. A non-skid fiberglass grating system shall be provided with a minimum grating depth of 2 inches, minimum uniform live load rating of 200 PSF while maintaining a deflection of less than 0.25 inches or L/360, whichever is less. The grating shall also be capable of supporting a concentrated live load of 500 lbs applied over a 12 inch by 1 inch area at the midpoint of the span. Pultruded type shall be required, molded type is not acceptable. FRP structural shapes, plates, and support system shall also be constructed of FRP. Resin for FRP components shall be an acceptable vinyl ester which is integrally resistant (without coatings) to sodium hypochlorite solutions. All mounting hardware and supports shall be FRP to the greatest extent possible. Any metal hardware or anchor bolts required shall be Hastelloy C-276 with hardware compatible with sodium hypochlorite. All stairways to access the containment area shall also be non-skid FRP grating with all Hastelloy C-276 hardware. Any anticipated loads which exceed those listed herein shall be accommodated within the design of the FRP grating system. Grating shall be bonded with epoxy where required, urethane shall not be allowed for bonding of grating for grating associated with the sodium hypochlorite area.

- VII.5.1. All FRP grating shall be supported independently of chemical storage tanks.

VII.6. FILL STATION

- VII.6.1. The fill station shall be located outside of the sodium hypochlorite storage area for ease of access by the chemical delivery supplier.
- VII.6.2. Secondary containment shall be provided for the fill station in the form of a fill box. The fill box shall be a weatherproof enclosure with locking hatch. Any part of the enclosure that comes in contact with sodium hypochlorite shall be compatible for use with sodium hypochlorite. The secondary containment shall be self-containing and include a drain port and sump to capture chemical spills or leaks. Refer to Exhibit VI.1, Detail 2 for additional details.
- VII.6.3. Fill station shall be provided with a 2-inch quick connect coupling at approximately 36-inches above grade and as required by the JEA chemical delivery supplier. Typical fill station piping shall increase from the quick connect coupling to 3-inches and shall be confirmed with the JEA chemical delivery supplier.
- VII.6.4. The fill station shall be clearly labeled to indicate the product it receives.
- VII.6.5. The fill station location shall either allow delivery personnel visual inspection of the sodium hypochlorite storage tank level or include level monitoring adjacent to the fill box.
- VII.6.6. Refer to Section VIII, Instrumentation and Control Standards for fill station panel requirements.

JEA Water and Wastewater Standards

VIII. CHEMICAL STORAGE TANKS

- VIII.1.** Detailed design criteria for sodium hypochlorite storage requirements is presented in **Exhibit VI.2**. These calculations assume a minimum trade percent of sodium hypochlorite of 10-percent. A schematic drawing of a bulk storage system is presented in **Exhibit VI.3** and a general layout of the chemical storage area is presented in **Exhibit VI.4**.
- VIII.2.** The required pounds per day (ppd) of equivalent chlorine demand shall be determined for each WTP based on the future flows at maximum dose. Future flows should be selected based on the location of the primary chlorine injection point. The bulk sodium hypochlorite storage tank(s) shall be sized to hold a 14-day supply of commercial grade product when 85 percent full based on the determined equivalent chlorine demand required. Typical storage facilities shall consist of two flat bottom, vertical, and vented tanks. Each tank shall be sized to hold one half the required capacity for 14 days at 85 percent full. If only one tank is provided during initial construction, the tank shall be sized to hold a 14-day supply at 85-percent full. The tanks shall be compatible to a maximum of 15-percent trade sodium hypochlorite.
- VIII.3.** Each sodium hypochlorite tank shall be furnished with a 316 stainless steel nameplate overlaid on the outside of the tank wall with 1 inch high lettering containing the following: name of tank manufacturer, date of manufacture (month/year), serial number, tank number assigned by JEA, tank capacity, tank diameter, tank height, tank weight, maximum specific gravity, design pressure and temperature, and maximum allowable pressure.
- VIII.4.** Tanks shall be provided with all required hazardous labels installed, including but not limited to DOT and NFPA. Stickers shall be high tack laminated poly.
- VIII.5.** All piping, walkways, stairs, and ladders, shall be independently supported so as not to apply loads to the tank nozzles or the tank itself. Any potential loads due to thermal expansion shall be isolated from the tank.
- VIII.6.** All sidewall connections to the tank shall have a flexible pipe connection after an isolation valve with the exception of the liquid level gauge. Flexible connections shall have titanium or Hastelloy C-276 hardware and Viton gaskets. Flexible pipe connections shall meet the tank manufacturer's recommended flexural requirements. Pipe supports shall be placed after the flexible pipe connection to allow the sufficient tank movement outward when filled. Use of the flexible pipe connections to correct piping misalignments are unacceptable and restrict the connector's intended purpose. During installation, piping shall not be forced into alignment.
- VIII.7.** Ladders shall be vertically supported at the slab foundation or platform. If ladder lugs attached to the tank are provided, they shall only provide lateral support. If the height of the concrete pad is greater than the typical height for a stair riser (7 inches), the ladder shall go to the floor rather than the top of the concrete pad. A ladder cage shall be provided on ladders longer than 20-feet or as required per the most recent OSHA standards. Confirm cage requirement for ladders less than 20-feet in length with JEA.
- VIII.8.** Tank orientation shall provide full access to the ladder and ladder shall be located to provide ease-of-access to tank connections/penetration, level indication, instruments (if any), and fall arrest system at top of tank.
- VIII.9.** Each tank shall include a minimum 5,000 pound vertical track fall arrest system on top of the tank. Fall arrest system shall be OSHA compliant.
- VIII.10.** Vented ball valves shall be provided such that all tanks can be isolated from piping and connections without pipe modifications when tanks are removed and replaced.

JEA Water and Wastewater Standards

VIII.11. LEVEL MONITORING

VIII.11.1. Clear PVC Sch 80 liquid level gauge with 1/2-inch increment labeled shall be provided. Reverse float level gauge shall not be acceptable. Liquid level gauge and overflow pipe shall be oriented towards the fill station to provide visibility during tank filling. Ball valves shall be installed above and below the level gauge to allow isolation. If level gauge is connected to the tank outlet, the ball valve configuration shall allow level gauge isolation, regardless of tank operation. Reverse float level gauges shall not be acceptable. At a minimum, a support shall be provided for every 6-feet of tank sidewall height to maintain level gauge alignment.

VIII.11.2. Additional level monitoring requirements are listed in Section VIII, Instrumentation and Control Standards.

VIII.12. Interior of tanks shall be coated with a medium density polyethylene resin. Resin shall be a minimum of four times the antioxidant properties of standard polyethylene and sufficiently bonded to the interior surface. Delamination or separation of the resin from the tank interior shall not be acceptable.

VIII.13. Dimensional tank drawings shall be provided with the shop drawing submittal package including: location and orientation of the full drain outlet, inlet, openings, manways, fittings, flexible connections, vents, accessories, restraints, and support.

VIII.14. Chemical tank vents shall be sized to release air during pneumatic filling. Vent piping size shall be a minimum of 6-inches.

VIII.15. OUTDOOR INSTALLATIONS

VIII.15.1. Tie down restraints and anchoring of tanks shall be provided.

VIII.15.2. All anchor bolts and tie down restraints shall be Type 316 stainless steel.

VIII.15.3. Shop drawing submittal shall include signed and sealed restraint calculations by a registered, third party engineer in the State of Florida.

VIII.15.3.1. Tank restraint system. Outdoor tanks shall be equipped with a restraint system consisting of multiple cable tie down restraints anchors into the tank equipment pad with anchor plates. Anchor plates and restraint cables shall be 316 stainless steel. Show seismic and wind criteria per Florida Building Code (latest edition), ASCE 7-10 Ch. 15.

VIII.15.4. Mushroom-style vents shall be provided for outdoor tank installations.

VIII.16. INDOOR INSTALLATIONS

VIII.16.1. Tank vent piping for indoor installations shall be routed to the roof of the building. Each vent shall terminate outside with a 90-degree bend facing down with a ¼" mesh polyethylene bug screen. Vents shall not be combined into a common header with the exception of the following:

VIII.16.1.1. The calibration column for each pump and the upstream pump assembly vent.

VIII.16.1.2. The vents for each tank.

JEA Water and Wastewater Standards

VIII.17.The following standards shall apply for polyethylene storage tanks: ASTM D 1998

VIII.18.Tanks shall be manufactured using High Density Cross-linked Polyethylene (HDXLPE) resin and shall contain ultraviolet stabilizer as recommended by the resin manufacturer. Resin color shall be natural.

VIII.19.Tank wall thickness shall be at a minimum in accordance to ASTM D 1998 and sufficient to support its own weight in an upright position.

VIII.20.Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. In no case shall the tank thickness be less than design requirements per ASTM D 1998. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187 inch thick. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$$T = P \times OD/2SD \text{ or } 0.433 \times SG \times H \times OD/2SD$$

Where:	T	=	wall thickness, in.
	P	=	pressure, psi
	SG	=	specific gravity, gm/cc
	H	=	fluid head, ft.
	OD	=	outside diameter, ft.
	SD	=	hydrostatic design stress

VIII.21.Tank shall be designed to be self-cleaning and provide a full drain connection capable of providing complete drainage through the tank sidewall. Tanks shall be installed on an equipment pad or stand to sufficiently accommodate the outlet flange, without impeding or requiring modification to the concrete slab or grating below.

VIII.22.A tank pad/mat shall be provided under each storage tank by the tank supplier. The pad/mat shall be able to adequately handle the pressure of the tank and shall be HDXLPE (unless otherwise approved by JEA) and be compatible with sodium hypochlorite (maximum 15-percent trade solution).

VIII.23.HDXLPE tank manufacturer shall provide a 5-year full replacement warranty for single wall and double wall containment tanks.

VIII.24. FIBERGLASS REINFORCED PLASTIC TANKS

VIII.24.1.If approved by JEA, fiberglass reinforced plastic (FRP) tanks may be used on a case-by-case basis if required for the project.

VIII.24.2.FRP tanks shall be filament wound or contact molded conforming to the following appropriate ASTM specifications: ASTM D3299-00 and D4097-01.

VIII.24.3.Resin used for FRP tanks shall be a commercial-grade, corrosion-resistant Thermoset that has evaluated in accordance with ASTM C-581.

VIII.24.4.Reinforcement shall be as follows:

JEA Water and Wastewater Standards

VIII.24.4.1. Chopped strand mat shall be constructed from chopped commercial-grade E-type glass strands bonded together using a binder. The strands should be treated with a sizing that is chemically compatible with the resin system used.

VIII.24.4.2. Continuous roving shall be a commercial-grade of E-type glass fiber with a sizing that is chemically compatible with the resin system used.

VIII.24.4.3. Woven roving shall be in accordance with ASTM Specification.

VIII.24.4.4. The reinforcement used for the inner surface shall be either a commercial-grade chemical resistant glass surface mat or an organic-fiber surface mat as recommended by the resin manufacturer for the intended service.

VIII.24.5. The laminate comprising the structural tank (bottom, cylindrical shell, and top head) shall consist of a corrosion-resistant barrier comprised of an inner surface, interior layer, and a structural layer. The tank bottom shall be integral with the bottom tank shell. No tank bottom attachment joints are allowed. No patched or repaired hole in the center of the tank bottom resulting from tooling support.

VIII.24.6. The inner surface exposed to the chemical environment shall be a resin-rich layer 0.020 inches thick, reinforced with a suitable chemical-resistant glass fiber surface.

VIII.24.7. The inner surface layer exposed to the corrosive environment shall be followed with a layer composed of resin, reinforced only with non-continuous glass-fiber strands applied. The combined thickness of the inner surface and interior layer shall not be less than 0.10 inches.

VIII.24.8. All accessories described in Paragraph VIII of this Section are required for FRP tanks.

IX. SODIUM HYPOCHLORITE METERING PUMPS

IX.1. All chemical metering pumps for sodium hypochlorite dosing shall be Mechanically Actuated PTFE Diaphragm, positive displacement, motor driven, metering pumps. Hydraulically actuated diaphragm pumps shall not be accepted.

IX.2. Chemical metering pumps shall be driven by a microprocessor and capable of providing the following range: the minimum dose at the minimum hourly flow and maximum dose at the maximum hourly flow. Pumps shall assume 50 percent of the published turndown ratio when designing for low flow conditions. Pump selections and area of footprint should consider the minimum dose at the future minimum hourly flow and maximum dose at the future maximum hourly flow. Sufficient spacing and area of footprint shall be provided for future pumps. Detailed design criteria for the chemical metering pump requirements are presented in **Exhibit VI.2**. The size and number of pumps shall be sufficient to meet the flow requirements in **Exhibit VI.2**.

IX.3. The pump drive mechanism shall not require regular field service or external lubrication. The drive shall ensure the pump discharge phase extends throughout the full period between suction intervals. The motor shall be integral to the pump and supplied with power cord and plug. The pump drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure. The pump enclosure rating shall be to IP65 and NEMA 4X standards.

IX.4. The process diaphragm shall be PTFE in its entirety; PTFE-coated diaphragms are not acceptable. Head and valve body material shall be PVC with ceramic ball check material. Wetted gasket material shall be PTFE.

JEA Water and Wastewater Standards

- IX.5.** Suction and discharge valve design shall incorporate double ball arrangement, with direction of flow clearly marked on each check valve and spring-loaded valves available as an option. An integral priming valve shall be incorporated in head design. The back-plate with separation chamber shall have either a safety diaphragm or lip seal and drain hole.
- IX.6.** The pump design shall include an integral removable click stop mounting plate, to allow for flat base mounting.
- IX.7.** The user interface/display shall be backlit LCD, readable at an offset angle of 45 degrees, with selectable on-site positioning for either side or front mounting. The interface shall display the flowrate output in gallons per hour (gph). The interface shall include a lock function to protect against unauthorized changes. A built-in counter shall provide a running total of accumulated strokes, cumulative hours of operation, and dosing flow. The interface shall include a priming button that will initiate a time-selectable prime cycle operating at full capacity without need of attenuating the pump's output set point. All pumps shall be equipped with a local manual or automatic capability.
- IX.8.** Repeatable metering accuracy shall be ± 1.5 percent at least at constant hydraulic conditions throughout the entire output range. The pumps shall be equipped with a slow mode function for use with high-viscosity liquids, which will reduce the suction speed to either 50 percent or 25 percent of maximum capacity to ensure optimal priming and reliability. The pumps shall be equipped with a calibration function which operates the pump for a set number of strokes and displays the anticipated volume, and which allows adjustment to set the calibration relative to drawdown volume.
- IX.9.** The pumps shall be equipped with an analog re-scalable 4-20mA signal input and programmable proportional 4-20mA signal output. The pumps shall also be equipped with input connections for level control and alarm outputs for low-level and empty tank warnings. The pumps shall be equipped with two potential free selective programmable outputs.
- IX.10.** The pumps shall be equipped with 5 menu selectable control modes: Manual, Analog, Pulse (4-20mA), Dosing Timer Cycle, and Batch. The pumps shall be configured to include direct interface provisions for external control devices. The pumps shall be equipped with a real-time clock and seven-day internal week timer to allow for timer control. The pumps shall be PROFIBUS compatible.
- IX.11.** The pump shall be fully tested to meet rated flow and pressure by the manufacturer in the field.

IX.12. WARRANTY

- IX.12.1.** The equipment/system warranty, unless otherwise stated, shall be warranted to be free of defects in material and workmanship for a period of 24 months from the date of substantial completion.

X. SODIUM HYPOCHLORITE METERING PUMP SKIDS

- X.1.** Sodium hypochlorite skids are to be custom-built, mounted assemblies. Vented ball valves shall be provided such that all assembly components herein can be isolated for maintenance and replacement, including each pump assembly and the entire sodium hypochlorite metering skid. A typical sodium hypochlorite metering skid is provided in **Exhibit VI.5**.
- X.2.** Each chemical feed pump skids shall include assembly of the following items:
 - X.2.1.** Clear PVC calibration column with vent and vented ball valve for calibration of chemical metering pumps. The height and diameter of the column shall be sized such that the measureable capacity

JEA Water and Wastewater Standards

of the chamber is approximately 1 minute discharge of each pump at the maximum pumping capacity. Calibration column shall be designed and constructed to be located behind the chemical metering pump.

- X.2.2. Pressure relief valve with vented ball valve for isolation. Pressure relief valve shall discharge to the pump suction piping.
- X.2.3. Diaphragm protected discharge pressure gauge with vented ball valve for isolation. Diaphragm seal material shall be PTFE and suitable for outdoor use and exposure.
- X.2.4. Pulsation dampener with vented ball valve for isolation.
- X.2.5. Back pressure valve.
- X.2.6. Unions on each side of the pump for ease of dismantling.
- X.2.7. Vented ball valves for suction and discharge piping.
- X.2.8. Wye strainer for suction piping.
- X.2.9. Flushing line with quick connect on suction piping.
- X.2.10. Type 316 stainless steel name plate.
- X.3.** Chemical metering pumps shall be located above the secondary storage containment area. Chemical metering pump elevation shall be installed such that the entire sodium hypochlorite tank volume is usable and not limited hydraulically.
- X.4.** The PVC piping associated with the skid mounted system shall be assembled by a certified ASTM D2855 installer(s) for indoor and outdoor systems.
- X.5.** Skid mounted systems located in a building shall be constructed of thermally welded PVC with adequate supports for all equipment and piping and a minimum 1/2 inch drip lip. Forklift truck cut outs shall be provided. All components of the skid-mounted system (pumps, piping, and controls) shall be tested at the factory prior to shipping. PVC weld cement shall be compatible with sodium hypochlorite (15-percent maximum trade solution) and shall be Weld-On 724™ or equal. The skids floor shall include FRP grating as described in VII.6 over a PVC containment basin to collect sodium hypochlorite leaks and spills. Chemical metering pumps shall be located outside and above this basin. Basin shall be sloped to piping and vented ball valve so that it can be drained into the secondary containment area.
- X.6.** Skid mounted systems located in outdoor facilities shall be provided with an enclosure to provide UV and weather protection. Enclosure shall be thermally welded PVC or polypropylene.
 - X.6.1. Enclosure shall have clear, shatter-resistant sliding access panels at the front of the enclosure that are removable.
 - X.6.2. Exhaust fan shall be installed and mounted to the enclosure walls to provide sufficient ventilation. Exhaust fan shall be located in the top third of the enclosure wall height.
 - X.6.3. GFCI outlet with NEMA 4X enclosure shall be installed inside the system enclosure and mounted. GFCI outlet shall be located in the top third of the enclosure wall height.

JEA Water and Wastewater Standards

- X.6.4. Enclosure shall have a PVC containment basin to collect sodium hypochlorite leaks and spills. Chemical metering pump shall be located outside and above this basin. Basin will be sloped to piping and vented ball valve so that it can be drained into the secondary containment area. .
- X.6.5. Enclosure shall be weatherproof and meet structural design standards in accordance with Section XI.
- X.6.6. Enclosure doors shall have piano hinges, and all hinges, latches, and fasteners will be 316 SS.
- X.7. Chemical metering pumps shall be located at the front of the skid assembly for ease of access and visible controls. All assembly items shall be installed with sufficient space between items to ensure access to all assembly components are unobstructed and accessible. Pumps shall be provided with a minimum spacing of 1-foot and 6-inches between pumps.
- X.8. Each skid shall provide a vendor control panel for control of the pumps. The front panel shall include, for each pump, a Local-Off-Remote (LOR) switch, a Start pushbutton, and Stop pushbutton. The panel shall include one Emergency Stop mushroom head pushbutton that stops all pumps. The front panel will have indicators for each pump indicating Pump On, Pump Running, and Pump Fail. All local control panel signals as well as all other pump signals shall be integrated into the plant SCADA control system for remote operation. The panel shall be supplied with a main circuit breaker that disconnects all power to the panel, has a flange-mounted operator, is pad-lockable in the 'Off' position, and interlocks with the panel doors. The interior panel will include terminal strips for landing all external wiring. It will also include relays, timers, and other components as required to provide specified functionality and remote monitoring connections.
- X.9. Pre-assembled chemical feed systems are the responsibility of the pump supplier. The party responsible for the preassembled chemical feed system will be responsible for the supply of all components listed in assembly, including the chemical metering pumps, appurtenances, mounting base, mounting bolts, wiring, pump control panel, and other items as required for a complete and operational pump skid system. All components of the assembly will be compatible with sodium hypochlorite.
- X.10. Each chemical feed system shall be delivered to the site and installed, calibrated, and tested by the pump supplier.

XI. PIPING AND ASSOCIATED EQUIPMENT

Piping, valves, fittings, meters, pumps and all other associated equipment for commercial grade sodium hypochlorite systems shall be compatible with a maximum 15-percent trade percent solution of commercial sodium hypochlorite.

XI.1. SPECIAL CONSTRUCTION REQUIREMENTS

Outdoor sodium hypochlorite facilities without overhead UV protection require CPVC containment type piping to provide enhanced UV protection. All exposed CPVC and PVC containment piping shall be coated to provide UV protection and pipe identification via color coding. Containment piping used for Sodium hypochlorite shall be coated yellow. Sodium hypochlorite piping shall be labeled with adhesive labels with the text "SODIUM HYPOCHLORITE" per ANSI/ASME A13.1. Wrap around flow arrows shall be provided around the full diameter of the pipe at each end of all pipe labels and at all changes in direction.

- XI.2. Sodium hypochlorite will be conveyed from the sodium hypochlorite feed pumps to the injection point through carrier hosing and secondary containment piping; secondary containment piping shall not be required in the secondary containment area. Containment piping shall be sloped back to the containment area sump pit. Provide additional leak detection points with inspection ports as required at low points if

JEA Water and Wastewater Standards

entire run of containment piping cannot be sloped to the containment area. The carrier tubing shall be PVC Sch 40 hosing with secondary containment piping. Carrier tubing shall be rated for a minimum working pressure of 150 psi and a maximum pressure greater than the maximum pump pressure. Carrier piping diameter size shall be coordinated with the metering pump supplier to ensure appropriate velocity and pressure ranges. Carrier piping route shall minimize the number of required turns and fittings. Secondary containment bends shall be long radius. Secondary containment piping shall be Sch 80 (CPVC or PVC) and of appropriate size as recommended by the piping system supplier (2-inch minimum).

XI.3. PIPE INSTALLATION

PVC and CPVC piping shall be installed per manufacturer recommendations. Any PVC or CPVC associated with the sodium hypochlorite system shall be installed by a certified ASTM D2855 installer.

XII. SPECIAL EQUIPMENT AND DESIGN CONSIDERATIONS DUE TO OFF-GASSING

- XII.1.** O&M problems can be created by off gassing of the commercial grade sodium hypochlorite as it naturally decomposes. Problems that frequently occur include the rupturing of ball valves, plastic strainers, PVC pipes, and back pressure devices. Ruptures are caused by gas trapped in an isolated space along the piping system where pressures rise to above working pressure ratings of the equipment.
- XII.2.** To reduce the buildup of gas, venting shall be located along the fill lines at high points and along segments that have the potential of being isolated. Vented ball valves shall be used to reduce the possibility of pressure buildup in valves.
- XII.3.** Chemical metering pumps can be damaged if pressure is allowed to build up within the pumps. Venting shall be located immediately upstream of the chemical metering skid.
- XII.4.** Piping lengths should be kept to a minimum and high points, where gasses can accumulate, should be avoided.
- XII.5.** Skid vent elevations, including calibration column vents, shall be higher than the top of tank dome to ensure no chemical overflows occur through venting.

XIII.ACCEPTABLE MANUFACTURERS

These manufacturers periodically change and should be verified with the purchasing department of JEA.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION VII – ELECTRICAL STANDARDS

I. STANDARDS AND CODES

Electrical design shall conform to the latest editions of the following applicable standards and codes:

- I.1.1. National Electrical Code (NEC)(NFPA 70).
- I.1.2. Standard for Electrical Safety in the Workplace (NFPA 70E).
- I.1.3. National Electrical Safety Code (NESC).
- I.1.4. Life Safety Code (NFPA-101-HB).

Standards and codes of the following organizations shall also govern where applicable:

- I.1.5. American National Standards Institute (ANSI).
 - I.1.6. Illuminating Engineers Society (IES).
 - I.1.7. Recommended Practices for Wastewater Facilities.
 - I.1.8. Instrument Society of America (ISA).
 - I.1.9. National Electrical Manufacturers Association (NEMA).
 - I.1.10. Institute of Electrical and Electronic Engineers (IEEE).
 - I.1.11. Insulated Cable Engineers Association (ICEA).
 - I.1.12. Occupational Safety and Health Act (OSHA).
 - I.1.13. American Society for Testing and Materials (ASTM).
 - I.1.14. Underwriters Laboratory (UL).
 - I.1.15. Environmental Protection Agency Technical Bulletin (EPA-430-99-74-001).
- I.2.** Local codes and ADA standards shall be applied as appropriate. Where the requirements of more than one code or standard are applicable, the more restrictive shall govern. Requirements of applicable codes and standards are not repeated in this section.
- I.3.** Applicable Federal and local codes and UL listing requirements shall be followed for electrical inspection. Exit signs, emergency egress lighting, and emergency lighting power supply shall conform to requirements of the local code authority.
- I.4.** NFPA (70 and 820), EPA-430-99-74-001, and “Recommended Practices for Wastewater Facilities”, should be used to determine if areas should be classified as “explosive hazardous.” The process engineer will determine the types and quantities of vapor that could be present in the air in each space and the Electrical Designer will determine which “hazardous” classification, if any, applies.

JEA Water and Wastewater Standards

II. LOAD ANALYSIS

- II.1.** At the beginning of the project, a preliminary load survey will be prepared to help plan the power distribution system. Normal and redundant loads, as defined by the redundancy requirement, will be kept separate. Major loads, including connected load values, estimated peak demand, and average demand for each building or process area, will be identified on a general layout drawing to establish load center location and size. Because detailed load data will not be available during the early part of the design, preliminary load values will be based on square foot averages and preliminary motor sizes. Redundant and standby units will be excluded from the total connected load to establish the critical load requirements. The load requirement will be tabulated for the categories presented in **Table VII.1**.

Table VII.1 Load Requirement Categories

	CONNECTED LOAD KVA	DEMAND FACTOR	AVG KVA	PEAK KVA	SOURCE
Lighting	XXX	1.0	XX	XX	Sq. ft.
HVAC	XXX	0.8	XX	XX	Mech. info
Process	XXX	0.8	XX	XX	Process info.
General Bldg.	XXX	0.4	XX	XX	Sq. ft.
Special	XXX	X.X	XX	XX	Estimated

- II.2.** At the end of the design phase, the final load will be analyzed using DAPPER, EDSA, or another previously approved computer program and using the same breakdown and detail given for the preliminary analysis. Final computations will be based on the actual loads shown in the drawings, HVAC load on actual motor nameplate horsepower, process load on actual motor nameplate horsepower, general building load on number of receptacles, the connected lighting load, and the actual connected load of special appliances. Provisions will be made for future expansion. All computer output will be incorporated into the project support document.

III. HARMONIC ANALYSIS

- III.1.** Since variable-frequency drives are being used for most variable-speed applications, a harmonic analysis on the power distribution system will be performed to determine the total harmonic distortion at the points of common coupling. All new and existing three phase nonlinear loads will be analyzed. Each engineer will perform a harmonic analysis when the specific design involves the use of three phase nonlinear loads. The points of analysis will be taken at both the primary and secondary terminals of each substation transformer, and at the plant's main service switchgear. The harmonic analysis report will present the results in a format similar to the tables in IEEE 519.
- III.2.** The analysis should examine the effects that harmonics developed by nonlinear loads have on power factor correction capacitors. Do not add power factor correction capacitors to busses directly connected to adjustable-frequency drives unless the capacitors are furnished with tuning filters. Power factor correction should be incorporated in the design of the adjustable-frequency, drive-input filter.

JEA Water and Wastewater Standards

IV. POWER DISTRIBUTION PLANNING

IV.1. GENERAL

The design of the power distribution system for new WTPs and WTP rehabilitations will follow the guidelines in IEEE Standard 141-1993, "Recommended Practice for Electric Power Distribution for Industrial Plants" (the Red Book), and the requirements in "Recommended Practices for Wastewater Facilities."

IV.2. RELIABILITY AND REDUNDANCY REQUIREMENTS

IV.2.1. The guidelines for reliability of the WTP's power distribution system are given in EPA Bulletin 430-99-74-001 and "Recommended Practices for Wastewater Facilities", which will be used for water and wastewater facilities. The distribution system will be designed to provide sufficient redundancy so no single fault or loss of power (caused, for instance, by plant equipment or PLC power failures) will disrupt more than one MCC or bus on a double-ended MCC that serves loads common to a critical unit.

IV.2.2. Loads to critical units are to be supplied from at least two separate MCC's or a double-ended MCC. Each MCC will be served by a power supply circuit that is connected to an independent bus. Medium voltage MCC's will be powered from separate buses in the main medium voltage distribution switchgear or directly from a transformer. Low voltage MCC's will be powered from separate buses in the 480-volt substation serving the building or area. If feasible, 480-volt MCC's serving common loads will be powered from separate buses at different substations.

IV.2.3. Each feeder will have enough capacity to serve all vital components connected to the MCC bus, except the standby unit.

IV.2.4. Non-critical unit loads must be supplied from at least two MCC's or one double-ended MCC. The MCC's should be configured the same as those for the critical unit loads, except that each power substation, MCC and feeder must have the capacity to power the components necessary to pass, treat, or process in accordance with the average design conditions (provided their combined capacity is enough to handle the peak design condition).

IV.2.5. If the costs of redundant electrical equipment are excessive and a non-critical unit can be without power for an extended time without affecting the process or endangering the plant's staff, a single power source and radial distribution system may be used.

IV.3. HAZARDOUS AREAS

The various areas of the plant which may contain hazardous concentration of hazardous gases shall be reviewed against the requirements of NFPA 820, a plan will be developed for dealing with each area. Devices which contain contacts located in hazardous areas should generally be wired intrinsically safe, exception is class I division II areas where hermetically sealed contacts may be installed.

IV.4. MISCELLANEOUS

Provide disconnects where required at process equipment, especially at motor-operated valves. Work with the equipment specified to see if integral disconnects are a standard option. Provide disconnect switches for all HVAC equipment that has any integral controls (i.e. unit heaters, compressors, duct heaters, air handlers, etc.). Provide a local disconnect for all hoisting equipment. For variable frequency drives fed from MCC's, the lockable disconnects at the circuit breaker in the MCC are adequate unless directed otherwise by JEA. In addition to lockout at the breaker, provide a local Lockout-Stop pushbutton station near and

JEA Water and Wastewater Standards

within sight of the motor, located so as not to obstruct or interfere with operation, maintenance, or replacement of the motor or equipment. Wire the maintained-contact pushbutton into the VFD control circuit upstream of all other control devices.

IV.5. DISTRIBUTION VOLTAGE SELECTION

- IV.5.1. Standard grounded systems for plant voltages will be used. One of the following voltages should be selected, depending on load characteristics and location:
- IV.5.2. 13,800 volts, grounded wye, 3-phase (low-impedance grounded).
- IV.5.3. 4,160 volts, grounded wye, 3-phase (low-impedance grounded).
- IV.5.4. 480/277 volts, solidly grounded wye, 3-phase.
- IV.5.5. 208/120 volts, solidly grounded wye, 3-phase.
- IV.5.6. 120/240 volts, solidly grounded, 1-phase.
- IV.5.7. 120 volts, solidly grounded, uninterruptible power supply (UPS).
- IV.5.8. 12 or 120 volts DC, emergency lighting.

IV.6. UTILIZATION VOLTAGES

Table VII.2 provides equipment voltages that should be utilized.

Table VII.2 Equipment Voltages

Fluorescent or LED lighting	120 volts, single-phase
Emergency lighting	12 or 120 volts DC
High-pressure sodium or NMH lighting	120 or 208 volts, single-phase
Convenience outlets	120 volts, single-phase
UPS	120 volts, single-phase
Motor control	120 volts, single-phase
Motors, less than 1/2 hp	120 volts, single-phase
Motors, 1/2 to 800 hp	460 volts, three-phase
Motors, greater than 800 hp	4,000 volts, three-phase

IV.7. VOLTAGE DROP

- IV.7.1. Steady-state voltage drop should be calculated for all heavily loaded or long circuits of 500 feet or more from source to load. Calculations for motor circuits should be developed on the basis of an 80 percent power factor. Design must not exceed the total voltage drops from the 480-volt source bus (excluding site distribution) to the feeder, branch circuit, and transformer as shown in Table VII.3.

JEA Water and Wastewater Standards

Table VII.3 Total Voltage Drops Allowed

Interior lighting	3 percent
Exterior/gallery lighting	5 percent
Motors	5 percent
Receptacles	3 percent
Electrical heaters	4 percent

IV.7.2. The voltage drop should be calculated for starting the motor if the motor exceeds 20 percent of the serving transformer capacity. The drop in voltage (flicker) should meet the limits shown in Table VII.4.

Table VII.4 Voltage Drop Limit

STARTS/HR	PROCESS AREA SECONDARY (%)	PRIMARY SYSTEM (%)	UTILITY SYSTEM (%)
1 or less	15	5	1
2 to 10	10	4	1
Over 10	8	3	1

IV.8. DEMAND FACTORS

IV.8.1. The design must consider the demand factors for sizing switchgear, panel boards, feeder breakers, feeder conductors, and transformers as shown in Table VII.5.

Table VII.5 Demand Factor Requirements

SERVICE	DEMAND FACTOR
Lighting	1.0 x connected load
Emergency lighting	1.0 x connected load
Air conditioning equipment	0.8 x connected load
Ventilation equipment	0.8 x connected load
Drainage pumps and ejectors	0.5 x connected load
Convenience receptacles	1.5 ampere, each
Process loads	0.8 x connected load

IV.8.2. The connected load should be used for sizing all branch circuits.

IV.9. BRANCH CIRCUITS

IV.9.1. Connected load and NEC requirements must be used for sizing branch circuit breakers and conductors, except for motor loads. Designs should follow these guidelines:

IV.9.2. A minimum wire size of No. 12 American Wire Gage (AWG) copper must be used for lighting and receptacle branch circuits. No. 10 AWG or larger should be used if a larger conductor is required because of voltage drop.

JEA Water and Wastewater Standards

- IV.9.3. Lighting and receptacle loads must not be combined on the same branch circuit.
- IV.9.4. The number of convenience receptacles on any one branch circuit should be limited to five duplex in process areas and six duplex in other areas.
- IV.9.5. Critical process instrumentation loads should be connected to a UPS.

IV.10. UNIT SUBSTATIONS

- IV.10.1. The layout design of the unit substations will follow the guidelines in IEEE's Red Book.
- IV.10.2. Plant power supply redundancy requirements may be met by providing two independent sources or by providing one utility source and an engine-generator system on-site. See Exhibit VII.2.
- IV.10.3. All plant distribution switchgear and MCC units will be constructed in the "double ended" concept. This means that each switchgear line or MCC will have two main protective devices, one associated with each of two incoming main power supply circuits, and one bus tie switching device which allows the two halves of the main bus to be powered independently. Under normal operating conditions, the bus tie switch is open and each half of the bus is powered by one of the incoming power supply circuits. If necessary, the bus tie switch can be closed and one main protective device can be opened and the entire bus powered by the operative incoming main power supply circuit.
- IV.10.4. The two main and bus tie circuit breakers will be key-interlocked to prevent more than two of the three circuit breakers or switches being closed at any time.
- IV.10.5. Electrical loads will be distributed evenly between the two buses.
- IV.10.6. Each main circuit breaker or protective device will have solid-state, three-phase metering for volts, amps, kilowatts, power factor, and I-square-t data. The metering system will be capable of recording peak demand, fault data, and other data.
- IV.10.7. The metering equipment will provide a Profinet or Profibus output signal for remote monitoring of any of the metering parameters recorded.
- IV.10.8. Transformers will be fully redundant and sized to carry all essential and non-critical loads connected to both sides of the bus. Transformers will have line surge protection, cooling fans, automatic fan controls, and temperature-sensitive alarms.

IV.11. DISTRIBUTION SYSTEM EQUIPMENT PREFERENCES

- IV.11.1. The following types of equipment shall be used for the medium- and low-voltage distribution systems:
 - IV.11.1.1. Power Transformers: Indoor type shall be silicone filled or cast coil dry type. Outdoor type shall be liquid-filled pad-mounted or substation class. Cooling fans or provision for fans will be included on all power distribution transformers. Transformers with secondary voltages of 480 volt 3-phase shall be limited in size to 1,500 kVA, where possible, and specified with 5.75 percent impedances to limit fault currents. Transformers that supply 208Y/120-volt lighting requirements and indoor transformers that supply 480Y/277-volt power distribution requirements shall be dry type and

JEA Water and Wastewater Standards

suitable for the area in which they are to be located. Transformers which include a small panel board in the same enclosure (mini-power center) shall not be used indoors, a small transformer with a separate panel board shall be used in these cases. All silicone or other liquid filled transformers located indoors should be provided with liquid confinement in accordance with the National Electrical Code.

- IV.11.1.2. Medium Voltage Switchgear: 15 kV class, indoor or outdoor non-walk-in, metal-clad switchgear, 2-high construction with vacuum circuit breakers and copper bus will be used. Switchgear will be fitted with transducer modules to provide remote status indication and control of circuit breakers. Power house structure is recommended for outdoor switchgear. Single-high construction is recommended for all engine-generator switchgear.
- IV.11.1.3. Medium Voltage Motor Control: Draw-out type vacuum contactors with current limiting fuses in NEMA Type 1 one gasket enclosure for indoor application, two-high construction.
- IV.11.1.4. Low Voltage Switchgear: 600-volt, indoor or outdoor non-walk-in, metal-clad switchgear, 2-high construction with draw-out vacuum circuit breakers and copper bus will be used. Vacuum circuit breakers to be used for 480-volt applications as well. Switchgear will be fitted with transducer modules to provide remote status indication and control of circuit breakers. Power house structure is recommended for outdoor switchgear. Single-high construction is recommended for all engine-generator switchgear.
- IV.11.1.5. Low Voltage Switchboard: 100 percent rated, insulated case, individually mounted circuit breakers with solid-state trip for mains and feeders 600 amperes and larger. Smaller feeder breakers shall be molded case with solid state trips. See the manufacturer's data contained hereinafter for additional information. Depending on the size and rating of the switchboard, back access may be required.
- IV.11.1.6. Low Voltage Motor Control Center: Smart/intelligent, indoor, class II, type B wiring motor control center (MCC) will be used. If the MCC is a service entrance device, a neutral pad is needed to comply with National Electrical Code requirements. Supply circuit to MCC's will be 480 volts, three-phase, 3-wire (no neutral bus is required since there will be no line-to-neutral 277-volt loads). MCC's will have copper phase buses and a 400-ampere copper ground bus. Overloads will be non-ambient-compensated unless such compensation is needed, for instance, at submerged pumps. MCC's will be 20 inches deep. All solenoid valves, thermal devices, etc. that need to be operated when the motor is on shall be powered from the motor starter control power transformer (CPT). Where this is done, call out the need for additional CPT capacity on the control diagrams. Some spares and spaces should be allowed (on the order of 5 percent spares and 10 percent spaces) in addition to the identifiable spares required for known future equipment. Allow space for at least one future vertical section at each MCC. Additional requirements recommended for motor starters are heavy duty, oil-tight, 30.5 mm control and indicating devices, LED type indicating lights, and supplemental auto position contact for indication at the plant control system that the device has been placed in the auto position. Push-to-test type indicating lights should be supplied.
- IV.11.1.7. Low Voltage Motor Control Center Main Circuit Breakers: 100 percent rated molded case with solid state trips.
- IV.11.1.8. Low Voltage Motor Control Center Branch Circuit Breakers (other than combination motor starters): molded case thermal magnetic.

JEA Water and Wastewater Standards

IV.11.1.9. Low Voltage Feeder Circuit Breakers in MCC-s and Power Distribution Panel-boards, 400-ampere and Larger: molded case solid-state trip, 100 percent rated. Smaller circuit breakers shall be molded case thermal magnetic.

IV.11.2. Equipment shall have adequate momentary and interrupting capacity to withstand fault currents that may occur at the point in the system where the equipment is applied. Each circuit breaker that is located immediately downstream from the secondary main on a 480Y/277-volt secondary transformer shall be equipped with ground fault protection unless that circuit breaker is rated 200 amps or less. Each circuit breaker protecting a motor of 100 horsepower or more shall be equipped with ground fault protection. Ground fault protection on motors shall be instantaneous type and ground fault protection on main breakers and feeder breakers shall be equipped with time delay setting and restraint systems.

IV.12. MOTORS

IV.12.1. Motor enclosure shall be suitable for the environment in which they are installed. All motors shall have a service factor of 1.15. All motors driven from adjustable frequency drives shall be inverter-duty rated in accordance with NEMA MG1 Part 31, shall be capable of being continually pulsed at the motor terminals with a voltage of 1600 volts ac, and shall be rated for such applications.

IV.12.2. All motors 25 HP and larger shall be provided with integral space heaters. The heaters shall be designed to operate on 120V ac power from the associated motor starter.

IV.12.3. Lifting lugs shall be provided on all motors larger than 100 pounds.

IV.12.4. Motors smaller than 1/2 horsepower shall be designed to operate on 120V, single-phase. Motors 1/2 HP to 800 HP shall be designed to operate on 460V, three-phase. Motors larger than 800 HP shall be designed to operate on 4,160V, three-phase.

IV.12.5. Provide motors that meet or exceed EPACT efficiency requirements, bearings with an L10 life rating of 40,000 hours, NEMA frame motors with oversized motor terminal boxes, ODP enclosures for indoor installations, TEFC enclosures in outdoor and below grade installations, TEFC motors with continuous moisture drain and screen that excludes insects.

IV.12.6. All high service pump and well pump motors shall be inverter duty.

IV.13. MOTOR PROTECTION AND CONTROL

IV.13.1. Branch circuit protection for motors shall be provided by thermal magnetic breakers with adjustable magnetic trips.

IV.13.2. Motor control center type construction shall be used where multiple three-phase motors are located in the same general area.

IV.13.3. Each motor shall be provided with thermal overload protection in all ungrounded phases. Controller-overload relays shall have external manual reset.

IV.13.4. Internal temperature detectors embedded in motor windings shall be specified for motors of 100 hp and larger and all motors 10 hp and larger that are powered by an adjustable frequency drive. Temperature detectors in motors smaller than 100 hp shall be thermostat type. 480 volt motors

JEA Water and Wastewater Standards

100 hp and larger shall have thermistors, and resistance temperature detectors (RTD) shall be provided in all medium voltage motors. Multi-function protective relays for overload, phase protection, and ground fault protection shall also be provided on large motors.

- IV.13.5. For motors with motor starters as part of an integral package, the overload protection will be in the motor starter. For fractional horsepower equipment not normally requiring motor starters, manual motor starters with overload protection will be added. Some small equipment such as ceiling fans will have overload protection integral with the motors.
- IV.13.6. All motor control circuits shall operate at 120 volts and shall be supplied by individual control power transformers fused both in the primary and secondary sides.
- IV.13.7. Electrical motor starter control shall normally consist of LED indicating lights, pushbuttons, or switches. Devices connected with process controls, such as timers and auxiliary relays, shall be provided in instrumentation and control panels or operated by a programmable logic controller as part of its internal control logic.
- IV.13.8. Variable frequency drives (VFDs) see Volume 1 Section 495 for detailed VFD requirements and specifications.

IV.14. PANELBOARDS

- IV.14.1. Panelboards fed from MCC's shall be 480 volt, three wire. Panelboards functioning as service entrance devices or distribution from a separately derived system shall be 480Y/277-volt, three-phase, and four-wire type with the main circuit breaker sized to match the supply transformer capacity.
- IV.14.2. Lighting panelboards shall be 208Y/120-volt, three-phase, four-wire type with the main circuit breaker sized to match the lighting transformer capacity.
- IV.14.3. Panelboards shall be surface mounted in process areas and flush mounted in office or other finished areas.
- IV.14.4. Separate panelboards shall be provided to supply power to instruments and control panels where the equipment to be supplied requires an uninterruptible power supply. Where two 480-volt power supplies are available, an automatic transfer switch shall be provided to supply power to the lighting panelboard transformers from either 480-volt source. If feeder breakers are not local (near the transfer switch) provide disconnect switches in the same area to facilitate maintenance.
- IV.14.5. Equip each panelboard with a minimum of 20 percent spare breakers with spaces, bus work, and terminations to complete the standard size panelboard.
- IV.14.6. Panelboard schedules shall show the circuit description, protective device trip rating, number of poles, rating of main lugs or main circuit breaker, neutral bus size, ground bus size, and interrupting rating of breakers. Computer-generated panelboard schedules shall be included in the design.
- IV.14.7. Provide a separate circuit breaker for instruments that perform the same function on parallel flow streams, such as generator controls, fuel control instruments, etc. Instruments of different types that are all associated with the same flow stream may be connected to the same branch circuit to simplify the design.

JEA Water and Wastewater Standards

IV.14.8. Identify all branch circuits or feeders on the drawings with the panelboard and device protecting the individual circuit or feeder.

IV.15. CONVENIENCE RECEPTACLES

IV.15.1. Convenience receptacles for general service shall be spaced not more than 40 feet apart inside all process building and 75 feet apart in outside process areas and shall be located on the surface of walls or columns. Receptacles shall be located as needed in commercial areas. In addition, provide receptacles at all air conditioning units and air handling units as required by NEC.

IV.15.2. Where wash-down is expected, specify outlets to be located 48 inches above the floor so that weatherproof receptacles will not be required. All receptacles located outdoors shall be twist lock type and will not be ground fault protected.

IV.16. GROUND FAULT

Ground fault systems will be zero sequence type. Facilities will be provided for testing the ground fault circuit by secondary current injection, with or without tripping and for indicating the occurrence of a ground fault. Current and time trip levels shall be adjustable. In general, this means that ground fault will have to be supplied external to the circuit breaker. Motor ground fault shall be an instantaneous trip.

IV.17. POWER FACTOR

Power factor correction capacitors shall be applied to correct power factor to 95 percent at all motor starters for motors rated 30 hp and larger. Capacitor banks shall generally be located on top of motor control centers. Calculate conductor sizes in accordance with NEC 460 which requires conductor ampacity to be the larger of 135 percent of capacitor FLA, or 1/3 of motor branch circuit ampacity. Show capacitors connected between the motor starter contactor and the overload heaters on the one-lines and control diagrams. Capacitors shall not be applied where they will be connected to a bus that also supplies adjustable frequency drives. Power factor correction shall be added to a bus that also supplies adjustable frequency drives if the capacitors are tuned away from the resonance frequencies of the drive.

IV.18. RACEWAYS

IV.18.1. Specific types of raceway shall be chosen for use in various locations in the facility based on moisture, temperature, exposure to damage, corrosion, voltage, and cost. An underground duct bank consisting of concrete-encased, rigid aluminum conduit PVC-coated rigid aluminum conduits shall be provided for all circuits that are routed outside of buildings on the site. The following systems shall be grouped in separate duct-banks:

IV.18.1.1. Power wiring above 600 volts.

IV.18.1.2. Power and discrete control wiring below 600 volts.

IV.18.1.3. Process instrumentation analog and communication wiring, including 24-volt discrete signals, intrinsically safe circuits and LAN/Data Highway computer circuits shall be routed in steel conduit. Intrinsically safe circuits and computer circuits shall be carried through handholes and manholes in conduit.

IV.18.2. Duct banks shall include a minimum of two spare conduits. Underground raceways that are not installed in a duct bank shall be direct-buried, Schedule 80 PVC conduit with aluminum "elbows". All cables and conduits shall be clearly tagged and labeled in all handholes, manholes, and panels to allow maintenance personnel to clearly identify all cables and conduits entering and leaving the

JEA Water and Wastewater Standards

associated piece of equipment. The buried main power feed and all buried conduit under roads shall be concrete encased.

IV.18.3. The following general guidelines shall be used for raceway sizing, selection, and installation:

IV.18.3.1. Conduit shall be size based on XHHW-2 insulation for sizes below No. 6 AWG, and THW insulation for all other wiring 600 volts and below.

IV.18.3.2. The minimum diameter of exposed conduit in all areas shall be 3/4 inch. Exception may be made for short distances from a junction box to a device which has a 1/2-inch knock-out provided by the manufacturer of the device.

IV.18.3.3. Concealed conduits shall not be smaller than 1-inch.

IV.18.3.4. Raceways in duct banks shall not be smaller than 2-inches.

IV.18.3.5. Raceways requiring access shall be installed in cable trays in process areas.

IV.18.3.6. Raceways not requiring access shall be concealed in process areas.

IV.18.3.7. Raceways installed in corrosive process areas such as chlorine and storage areas shall be Schedule 80 PVC. Conduit supports, fasteners, and fittings in corrosive areas shall also be non-metallic.

IV.18.3.8. Raceways in walls and ceilings of control rooms, offices, and all areas with finished interiors shall be concealed.

IV.18.3.9. Embedded and buried nonmetallic conduits shall be converted to aluminum conduit before exiting from masonry or earth and aluminum shall be used at all bends. Conduits turning out of concrete shall be coated with a coal tar from two inches below the surface of the concrete to two inches above the surface.

IV.18.3.10. The number of conduit bends shall be limited to an equivalent of 270 degrees on all runs.

IV.18.3.11. Exterior, exposed conduit shall be PVC-coated aluminum rigid conduit, except in corrosive areas where sunlight-resistant Schedule 80 PVC or stainless steel rigid conduit shall be used.

IV.18.3.12. Exterior, underground, concrete-encased conduit shall be aluminum or PVC coated rigid aluminum.

IV.18.3.13. Interior, concealed conduit shall be electrical metallic tubing (EMT) in frame construction and finished ceiling spaces.

IV.18.3.14. Conduits in Class I, Div. 1 or 2 hazardous locations shall be rigid aluminum. Conduit seals shall be provided where conduits are routed from classified to non-classified locations, and prior to entrance of conduits into electrical enclosures containing ignition sources.

IV.18.3.15. All wires in handholes and panels shall be tagged.

IV.19. BOXES AND CABINETS

IV.19.1. Junction boxes, pull boxes, outlet boxes, and electrical equipment cabinets and enclosures shall be NEMA 1 sheet steel in indoor dry, air-conditioned spaces.

JEA Water and Wastewater Standards

- IV.19.2. Junction boxes, pull boxes, outlet boxes, and electrical equipment cabinets and enclosures shall be NEMA 12 sheet steel in indoor dry, non-conditioned spaces.
- IV.19.3. Junction boxes, pull boxes, outlet boxes, and electrical equipment cabinets and enclosures shall be NEMA 4X Type 316 stainless steel in indoor damp or wet spaces, and in exterior spaces.
- IV.19.4. Junction boxes, pull boxes, outlet boxes, and electrical equipment cabinets and enclosures shall be NEMA 4X FRP or PVC in corrosive spaces.
- IV.19.5. Junction boxes, pull boxes, outlet boxes, and electrical equipment cabinets and enclosures shall be NEMA 7 explosion-proof in Class I, Div. 1 and 2 hazardous locations.

IV.20. WIRE AND CABLE

- IV.20.1. For medium voltage power conductors, or cables, use stranded copper, 15 kV insulated, shielded, XLPE or EPR insulated conductor for all medium voltage circuits up to 13.8 kV.
- IV.20.2. For all lighting and power wiring of 600 volts and below, use copper conductors. Solid conductors shall be used for No. 10 AWG and smaller where required by wiring devices. Stranded conductors shall be used for other applications.
- IV.20.3. The current carrying capacity of conductors shall be based on 75°C insulation ratings. Conductors No. 12 and No. 10 AWG and smaller shall have THHN/THWN insulation, larger conductors shall have XHHW-2 insulation. NEC requires that 60 C column be used for cable size No. 14 AWG through No. 1 AWG unless the equipment the cable is terminating at is listed and identified for use with conductors that have a higher rating (Article 110-14(c)).
- IV.20.4. Individual No. 14 AWG conductors shall be used for discrete control circuits, unless it is practical to use multi-conductor cables to group control circuits.
- IV.20.5. Twisted-shielded pair control cable with 16 AWG individual stranded copper conductors and an aluminum mylar tape shield around the pair shall be used for analog signals. Multi-pair cables shall be used where grouping of circuits is practical. This also applies to twisted shielded triad cables.
- IV.20.6. Conductors from variable frequency drive (VFD) outputs to motors shall be VFD-rated cables designed specifically for that purpose. Cables shall consist of three copper phase conductors and three copper equipment ground conductors, individually insulated and furnished with an overall foil and braid shield and PVC outer jacket.
- IV.20.7. All cables shall be clearly tagged and labeled in all handholes, manholes, and panels to allow maintenance personnel to clearly identify all cables entering and leaving the associated piece of equipment.

IV.21. GROUNDING

- IV.21.1. Load centers shall be bonded to a grounding electrode, which may consist of a building steel column that is bonded to the underground rebar, or a made electrode system (triad or connection to ground loop around the building). In addition, ground rods shall be driven outside all buildings to supplement the ground electrode where the supply transformer size for that building exceeds 150 kVA.

JEA Water and Wastewater Standards

- IV.21.2. Grounding electrodes of ground mats or embedded rods and cables will be specified to have a maximum resistance to ground of 3 ohms. 4/0 AWG copper conductor, (a minimum) for interconnecting ground rods and connection to transformers and switchgear will be used.
- IV.21.3. The parts of all electrical equipment, devices, panelboards, and metallic raceways that do not carry current shall be connected to the ground conductors. The transformer neutrals of wye-connected transformers shall be solidly grounded through a grounding conductor connected to the grounding system. The neutrals of medium voltage wye-connected transformers shall be low resistance grounded.
- IV.21.4. A ground wire shall be installed in all raceways that contain power conductors at any voltage. 600 volt insulated equipment grounding conductors shall be installed in all medium voltage circuits.
- IV.21.5. Noise and transient occurrence is often caused by faulty grounds. Appropriate safeguards must be included to ensure grounding equipment is located at the proper places and not located where there should be none. Basic code requirements are referenced in the specifications, but not always practiced in the field. Grounding requirements should be included in the electrical drawings; field testing and inspection should be emphasized.

IV.22. LIGHTNING PROTECTION SYSTEM

- IV.22.1. A lightning protection system shall be installed at each new facility on all aboveground structures. The lightning protection system shall be designed and installed to meet all the requirements of LPI 175 and 176, UL 96 and 96A, and NFPA 780.
- IV.22.2. The complete system shall bear the UL 96 Master Label C. The materials used on the lightning protection system shall be compatible with the materials used with the building and/or other structure that the lightning protection system is installed on.
- IV.22.3. Lightning protection systems shall be retrofitted for rehabilitation projects on a case-by-case basis; confirm with JEA for each rehabilitation project.

IV.23. STANDBY POWER GENERATION

- IV.23.1. Refer to the current edition of JEA's Facilities Standards Manual, Division 26.32.13 for diesel engine generator requirements.
- IV.23.2. Where required, a standby generator shall be installed at the facility. The generator shall be sized to run the loads as determined by the design engineer.
- IV.23.3. A fuel filling station shall be located at grade. Water supply shall be provided adjacent to the generator set.
- IV.23.4. The required capacity shall be evaluated on a case-by-case basis to account for future conditions.

IV.24. LIGHTING

- IV.24.1. Lighting levels in all areas of the facility shall be calculated following the procedures recommended in the Illumination Engineering Society (IES) handbook. For large areas use the "Zonal Cavity Calculations" method. The foot-candle level resulting from the actual fixtures to be installed shall be documented. Where computer programs are used, the output from the program will be the

JEA Water and Wastewater Standards

documentation of the calculations. In general, the following minimum foot-candle levels shall be as shown in Table VII.6.

Table VII.6 Minimum Foot Candle Levels

AREA	FOOT-CANDLE
Office	70
Process, inside	50
High Service Pump Station, inside	75
Process, outside	5
Storage, inside	10
Walkway	5
General site	1

IV.24.2. Table VII.7 presents the general types of light source shall be used to provide the proposed foot-candle levels.

Table VII.7 Light Source Requirements

AREA	LIGHT SOURCE
Office	LED
Process, inside to 14 feet mounting height	LED
Process, above 14 feet mounting height	LED
Storage, inside	LED
Walkway, inside	LED
Walkway, outside	LED
General site	LED

IV.24.2.1. LED lighting in process and walkway areas shall be controlled by a motion sensor with an adjustable delay such that the lighting is instantly energized upon area entry from any exterior door.

IV.24.2.2. Buildings with outdoor lighting will use LED luminaries' with individual photocells. All luminaries will have individually fused ballasts. Site lighting must take into consideration operator's visibility at all gates and doors. Site lighting must also take neighboring properties (ex. residential) into consideration.

IV.24.2.3. High bay lighting fixtures that are not easily accessible (such as over high service pumps) shall be equipped with lowering devices to facilitate re-lamping.

IV.25. MISCELLANEOUS SYSTEMS

IV.25.1. Fire alarm systems shall be included in the building as required by applicable codes.

IV.25.2. Telephone jacks shall be provided in all offices, work areas, and near exits throughout the facility.

IV.25.3. Data Highway computer circuits and fiber optic instrumentation circuits shall be defined by the I&C design and shown on the Electrical drawings.

JEA Water and Wastewater Standards

- IV.25.4. Motion detectors, card readers, and cameras shall be located at all entrances to the facility as established by JEA.
- IV.25.5. For the "soft start" devices serving the wells, JEA requires an automatic reset timer to restart the motor after a phase imbalance-caused shut down. See **Exhibit VII.3**.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION VIII – INSTRUMENTATION AND CONTROL STANDARDS

I. INTRODUCTION

The following sections describe the design criteria and instrument control standards for JEA WTPs.

I.1. PURPOSE

- I.1.1. This Instrument and Control System Design and Standards package defines compatibility and consistency for Instrumentation and Control Systems to be implemented throughout all JEA WTPs. Compatibility and consistency will enable JEA to cost effectively leverage the knowledge of Operations and Maintenance staff and help manage maintenance costs throughout the water department.
- I.1.2. Criteria are presented at minimal acceptable levels to ensure systems operational integrity while maintaining the ability to design and implement automation cost effectively.

I.2. INCLUSIONS

This document provides criteria for Instrument and Control systems that include:

- **Physical Design Criteria:**

- I.2.1.1. The criteria provide guidelines and specifications for the physical design of control sub systems and component interfaces. The physical criteria are intended to establish a minimal level of acceptable quality for equipment and workmanship.

- **Instruments and Field Control Equipment:**

- I.2.1.2. The criteria provide instrument and control equipment standards. This includes field-mounted instruments, control devices, interfacing devices, transmitters, wiring, termination, panels, and other physical design components.

- **Documentation and Conventions:**

- I.2.1.3. The criteria provide conventions and standards for creating and controlling drawings and equipment tagging. Documentation standards include content, structure, and format for drawings, databases, Input/Output (I/O) lists, control strategies, application software, and Operations & Maintenance manuals.

- **Control Systems Hardware and Software:**

- I.2.1.4. The criteria provide guidelines for control systems hardware and software to ensure compatibility and consistency between interconnected systems.

I.3. EXCLUSIONS

Controls and control related devices not directly responsible for process operations are not included in the criteria. Examples are lighting, power distribution, and heating, ventilation and air conditioning (HVAC) controls.

JEA Water and Wastewater Standards

I.4. PACKAGED SYSTEMS

- I.4.1. Packaged systems for certain processes may, by specific requirement for functionality or product, include their own control system. In cases where packaged systems do not conform completely to the design criteria, at a minimum, the interface to JEA control systems should conform to these criteria.
- I.4.2. Packaged systems for similar processes or purpose shall be provided by the same manufacturer, whenever possible, to maintain the philosophy of consistency and compatibility between systems.

II. PHYSICAL DESIGN CRITERIA

This section defines the physical design criteria for plant control and instrumentation systems for JEA.

II.1. COLOR CODING OF PILOT DEVICES

Unless noted otherwise, use the following color code for lenses of indicating lights.

FUNCTION	COLOR
On or Open	Red
Off or Closed	Green
Alarms	Amber
Automatic or Remote	White
Manual or Local	Yellow
Local	White

II.2. NAMEPLATES

- II.2.1. All individual panels, instruments, and panel-mounted devices shall be provided with nameplates. Use plastic laminate nameplates having engraved white letters on a black background.
- II.2.2. Individual control switches and pushbuttons shall have customized legend plates which indicate function and conforms to the tagging and naming convention described herein.

II.3. ACCESSIBILITY AND MOUNTING

- II.3.1. All control equipment shall be mounted in an easily accessible location for both operations and maintenance. Equipment or piping shall not have to be removed to access controls. All controls shall be mounted within five feet of finished floor.
- II.3.2. All NEC clearance requirements shall be met for the appropriate voltage level.
- II.3.3. All equipment and instrument tubing shall be rigidly installed. It is intended that after installation a slight to moderate pressure on the installed device shall not move it and in no circumstance should it sway back and forth if pressure is suddenly removed.
- II.3.4. Instruments shall not be installed in underground vaults unless an above grade installation is not feasible. For example, a remote read dial on a flow meter on a buried pipe should be installed above grade while the meter must remain below grade in a vault. Instruments shall be accessible

JEA Water and Wastewater Standards

for maintenance purposes. Any variances from above grade installations shall be approved by JEA.

II.4. AMBIENT ENVIRONMENT

II.4.1. Design for an ambient temperature range of 10 to 105 degrees F. Maximum continuous duration below 32 degrees F shall be assumed to be 8 hours.

II.4.2. The area surrounding ground storage tank vents shall be considered corrosive due to hydrogen sulfide.

III. PROGRAMMABLE LOGIC CONTROLLERS, HUMAN MACHINE INTERFACE AND SCADA

III.1. OVERVIEW

Remote operation of water treatment facilities from the Ridenour administration building is supported by JEA's water SCADA system. JEA configures the software required to support this SCADA system including Programmable Logic Controller (PLC) and Human Machine Interface (HMI) applications software. Absolute addressing during PLC programming shall be used unless otherwise specifically approved. See **Exhibits VIII.4, VIII.5, VIII.6 and VIII.7.**

III.2. SIGNAL ISOLATION AND I/O

III.2.1. Unless otherwise indicated or required for a specific application, all PLC I/O shall meet the following:

III.2.1.1. Discrete inputs shall be 120 VAC.

III.2.1.2. Discrete outputs shall be isolated 120 VAC. Interposing relays shall be provided for all circuits where the current exceeds the PLC output rating or there is a need to expand the number of contacts available.

III.2.1.3. All Analog inputs shall be isolated 4-20 mA. Except for 4 wire transmitter loops, power supplies for all 4-20 mA signals shall be provided by the control panel.

III.3. DISTRIBUTE I/O BETWEEN MODULES

To comply with the general philosophy that there be no single point of failure, I/O for related equipment shall terminate on different I/O modules. For example, if there are 4 pumps, terminate digital inputs for two pumps onto one I/O module, and digital inputs for the other two pumps on a separate I/O module.

III.4. LOCAL HUMAN MACHINE INTERFACE REQUIREMENTS

Equipment and HMI software shall be consistent with JEA's current standards for hardware and software. At least 1 HMI is to be provided at each water treatment plant. Unless otherwise specified, JEA will provide the programming of all Siemens displays. In the event that JEA does not do the HMI programming, absolute addressing shall be used unless otherwise specifically approved and faceplates shall not be used unless otherwise specifically approved.

III.5. NETWORKS

Communication links between the treatment plant PLC and its associated raw water well PLC's shall use the Siemens Sinaut protocol. I/O associated with onsite wells may be directly wired to the treatment plant PLC. PLC remote I/O shall use the Profibus DP or Profinet protocol as determined by JEA. The

JEA Water and Wastewater Standards

communication link between the treatment plant PLC and the associated raw water well PLC's shall be served by a fiber ring topology and redundancy provided as required by JEA.

The treatment plant PLC and local HMI shall provide for an Ethernet TCP/IP interface to JEA network hardware. JEA will provide network hardware for remote SCADA applications. Remote or distance applications will be determined by JEA for network fiber or radio communications.

IV. CONTROL HIERARCHY

IV.1. CONTROL HIERARCHY AND NAMEPLATES

Two primary levels of operational control exist for all equipment and systems: Local and AUTO. In general, an "HAND-OFF-AUTO" field switch shall be provided at each piece of equipment. This switch shall provide local manual control for each field device or selection of PLC control.

HAND	The field device shall be energized (Local control).
OFF	The field device shall be de-energized (Local control).
AUTO	The field device shall be controlled by the PLC. PLC control can be either PLC automatic or PLC manual.

IV.1.1. DEFINITIONS

IV.1.1.1. LOR is typically used for equipment that is located large distances away from controls and actuator (ex. remote raw water wells).

IV.1.1.2. HOA is typically used for equipment located at the WTP and nearby.

V. HARD WIRED CONTROL, INTERLOCKS, AND WIRING

V.1. EQUIPMENT PROTECTION AND SAFETY

V.1.1. All equipment and motor control sequencing logic or process interlocks shall be accomplished by the PLC and not by devices hardwired into the equipment starters. It is intended that interlocks such as low water cutoff be provided through the plant control system and not be hardwired to individual starters with the exception of E-Stop safety interlocks.

V.1.2. In general, only those protective devices which are required for equipment protection and personnel safety shall be hardwired directly into the individual equipment controller or starter, and not rely on the plant control system.

V.1.3. Any equipment which is shutdown by this type of device shall have individual indicating lights on the equipment controller indicating specifically what caused the failure. A common trouble light is not acceptable. All shutdowns of this nature shall require a manual reset at the equipment controller. The actual protective instruments should be of the automatic reset type. Individual, isolated contact outputs shall be provided to indicate each cause of failure to the PLC. Contact outputs shall be directly from the sensing device without interposing relays where feasible.

V.1.4. These interlocks shall be operational in all control modes.

V.2. LOCAL MANUAL CONTROL

All equipment shall be provided with local manual control which overrides the plant control system, but not hardwired interlocks. It is intended that this is to be used primarily for maintenance functions and not operation of the process.

JEA Water and Wastewater Standards

V.3. AUTOMATIC CONTROL

It is intended that all automatic control and equipment sequencing be accomplished through the plant PLC's. It is intended that all equipment sequencing for motor restart after a power outage be programmed into the PLC, hardwired time delay relays in individual starters are not required.

V.4. MAINTAINED VERSUS MOMENTARY CONTROLS

It is intended that all discrete outputs from the PLC's to individual equipment controllers be maintained contact outputs such that seal in contacts are not required in the control circuit.

V.5. PLC MONITORING OF EQUIPMENT STATUS

As a minimum, each equipment controller and control station shall provide isolated, maintained contacts to the PLC to monitor each of the following:

V.5.1. Equipment Running/Stopped.

V.5.2. Equipment in Auto and ready to operate (where applicable).

V.5.3. Equipment Fail.

V.6. CONTROL OF ADJUSTABLE SPEED DRIVES

For consistency with other plant controls, it is desirable that:

V.6.1. Speed drive communication and control is preferred via PROFIBUS or PROFINET. Speed control signals from the PLC system may be of the 4-20 mA signal type if there is no alternative. The speed must be continually variable and not raise or lower speed via discrete outputs.

V.6.2. Hardwired manual speed control and indication of variable speed drives only be provided on the variable speed drive itself, not locally at the equipment.

V.6.3. If adjustable speed drives are not controlled via PROFIBUS or PROFINET, an isolated 4-20 mA signal of speed indication to the PLC system must be provided.

V.7. VALVE CONTROL

V.7.1. Local manual controls and position indication shall be provided for all valves.

V.7.2. For non-modulating valve control, individual, isolated, maintained Open and/or Close output contacts shall be provided from the PLC system for control. Provide interposing relays and control schemes as required. Full open and full closed valve position shall be wired to the PLC from isolated auxiliary position limit switch contacts on the valve.

V.7.3. In general, limit switches are not required on solenoid valves.

V.7.4. For modulating valve control, the PLC shall provide an isolated 4-20 mA control signal. Provide interface to valve as required. The valve shall provide an isolated 4-20 mA signal to the PLC indicating actual valve position.

V.7.5. For solenoid valves without limit switch contacts, the current state of the command signal and feedback of the OPEN/CLOSE/AUTO hand switch position shall be used to infer a valve position.

JEA Water and Wastewater Standards

V.8. PLC MONITORING OF ANCILLARY SYSTEMS

- V.8.1. The PLC shall monitor alarms from all ancillary systems included with the project such as fire alarms systems, security systems, leak detection systems, eye wash stations, local alarms, fuel tanks, containment areas, etc.
- V.8.2. Auxiliary, isolated, 120 volt, 5 amp contacts shall be provided from these systems for interface to the PLC system.

V.9. PLC MONITORING OF POWER SYSTEM

- V.9.1. Power monitoring shall be provided at all utility electrical feeds to the water treatment facility and all wells. The power monitoring device shall communicate to the plant or well PLC as a Profibus DP Slave or Profinet Slave. All software and interface hardware to allow communication between the PLC and the power system monitoring device shall be provided as required. As a minimum, the following functions are required to be monitored through the PLC from each power monitoring device:
 - V.9.1.1. RMS value of Individual Phase Currents(3).
 - V.9.1.2. RMS value of Individual Three Phase Voltage, L-L(3).
 - V.9.1.3. Power Factor.
 - V.9.1.4. kW.
 - V.9.1.5. kWh.
 - V.9.1.6. kVA.

V.10. MONITORING OF CONTAINMENT AREAS, PITS AND VAULTS

Provide level indicators to detect the presence of liquid in containment areas, pits and vaults. Liquid presence shall be alarmed via the PLC.

VI. CONTROL PANELS

VI.1. GENERAL

- VI.1.1. Control Panels located indoors shall be painted steel, NEMA 12. Enclosures shall be provided with corrosion inhibitors.
- VI.1.2. Outdoor Control Panels shall be aluminum, white powder coated, NEMA 4X, unless otherwise noted herein. Outdoor enclosures shall be provided with sunshields, thermostatically controlled space heaters, and corrosion inhibitors.
- VI.1.3. Control Panels indoors shall be 316 stainless steel, NEMA 4X.
- VI.1.4. Control Panels located at indoor sodium hypochlorite storage and pump facilities shall be FRP, NEMA 4X.
- VI.1.5. Provide louvers, forced ventilation, or air conditioners as required to prevent temperature build-up within the enclosure and maintain equipment within equipment temperature ratings as required.

JEA Water and Wastewater Standards

VI.1.6. Use green colored wire for the ground wire on power circuits.

VI.1.7. All control panels shall be provided with nameplates.

VI.2. PANEL POWER DISTRIBUTION, I/O, AND LOOP POWERING PRACTICES

VI.2.1. Individual fuses shall be provided for each 4-20 mA signal loop.

VI.2.2. Individual fuses shall be provided for each group of discrete inputs for a common piece of equipment.

VI.2.3. See sections on Lightning/Surge Protection and UPS requirements.

VI.3. TERMINATION OF WIRING

VI.3.1. All PLC I/O wiring shall be terminated on removable terminal strips on the individual PLC modules that permit removing I/O modules without disconnecting the wiring. Tag and mark all terminal blocks and individual wiring.

VI.3.2. All wiring from the field shall terminate on separate numbered terminal blocks.

VI.3.3. Separate groups of terminal blocks shall be provided for the following:

VI.3.3.1. Discrete inputs.

VI.3.3.2. Discrete outputs.

VI.3.3.3. Analog inputs.

VI.3.3.4. Analog outputs.

VI.3.3.5. Each different voltage level shall be separated on different terminal strips located at least 6 inches apart.

VI.3.3.6. Each different voltage source within the panel.

VI.3.3.7. All outside voltage sources of a like voltage level should be grouped together, and shall also be labeled and provided with individual disconnects.

VI.4. CONDUIT ENTRY

In general, floor standing indoor panels shall be designed for conduit entry through the top. All cabling shall be neatly coiled and securely fastened away from equipment and entrance doors rather than lying in the bottom of the enclosure. In wet or corrosive areas use flex or seal-tight and seal both ends of conduit to ensure water/air tight.

VI.5. PILOT DEVICES AND CONTROLS

VI.5.1. Pilot devices and controls shall be rated Oiltight/Watertight, heavy duty. Miniature type devices are not acceptable.

VI.5.2. Where contacts switch 115 volt signals, provide contacts rated 10 amps at 115 volts ac minimum. Where contacts switch low voltage dc signals, provide contact material of gold or gold flashing over silver and rated 1 A at 28 Volts dc.

JEA Water and Wastewater Standards

VI.5.3. Pilot lights shall be of the transformer type utilizing low voltage lamps. Pilot lights shall either be of the push to test type, or a common lamp test button shall be provided on the panel. Pilot lights shall allow for lens and bulb replacement through the front of the unit.

VI.6. RELAYS AND TIMERS

VI.6.1. Where contacts switch 115 volt signals, provide contacts rated 10 amps at 115 volts ac minimum.

VI.6.2. Where contacts switch low voltage dc signals, provide contact material of gold or gold flashing over silver and rated 1 A at 28 Volts dc.

VI.7. 4-20 MA LOOP INDICATORS

Indicators shall be of the digital panel mounted type, rather than the analog gauge type. Indicators for all ground storage tank levels, finished water flow and pressure shall be provided in one location inside a building. These indicators shall be operational during PLC outage.

VI.8. UNINTERRUPTIBLE POWER SUPPLY (UPS) REQUIREMENTS

VI.8.1. All PLC's, computers, network switches, and communications equipment shall be powered by an uninterruptible power supply. Each UPS shall provide at least 30 minutes of backup power at full load. Each UPS shall provide 6 24 VDC discrete signals to the PLC for status indication.

VI.8.2. UPS receptacles to be color coded 'orange' and identified as for UPS supplied equipment only.

VI.8.3. The UPS shall be powered by the emergency generator bus such that in the event of a power failure the UPS is functional for the duration the emergency generator is operating.

VI.8.4. Printers, copiers, or individual instruments are not to be connected to the UPS system.

VI.8.5. It is not required that auxiliary control panel components such as space heaters, receptacles, fans, etc. be connected to UPS power.

VII. SURGE PROTECTION

VII.1. ANALOG SIGNAL LINE SURGE PROTECTION

All 4-20 mA signal loops which have any portion outside a protective building shall be provided with a surge protective device at each end of the loop.

VII.2. ANTENNAE LINE SURGE PROTECTION

All antenna cable shall have surge protective devices at the radio end of the cable.

VII.3. NETWORK SURGE PROTECTION

VII.3.1. All Profibus DP network communications shall be provided with surge protective devices.

VII.4. POWER SUPPLY SURGE PROTECTION

Instruments requiring an external power source shall have surge protection on the power supply provided by one of the following means:

VII.4.1. Connection to an Uninterruptible Power Supply.

JEA Water and Wastewater Standards

VII.4.2. Separate surge protective device at each device.

VII.4.3. Connection to a lighting panel which has a surge protective device located at the lighting panel.

VII.4.4. All UPS systems shall be provided with surge protective devices at the UPS.

VII.5. METHODS AND PREFERRED DEVICES

VII.5.1. Surge protection methods and devices shall be approved by the JEA.

VIII. CABLING, COMMUNICATION MEDIA, AND MISCELLANEOUS COMPONENTS

VIII.1. GENERAL

VIII.1.1. All cabling shall be installed in conduit or cable tray. Individual conduit runs shall be kept to a minimum and control cabling may be combined in common conduits and routed to centralized terminal boxes to the greatest extent possible. Wherever combined control cables are split out of a common conduit, a terminal box shall be provided. Note that different control voltages shall not be combined.

VIII.1.2. Exposed aerial cable and wiring methods outdoors are not acceptable.

VIII.1.3. To minimize the effects of lightning and surges, underground control and communication cabling routed outside the building confines shall meet the following requirements:

VIII.1.3.1. Underground or outdoor communication media on site shall utilize fiber optic cable where possible.

VIII.1.3.2. Where control systems are located off site (e.g. raw water wells), spread spectrum radios may be used for the communication media.

VIII.1.3.3. Where individual control or monitoring signals must be routed outside, minimize the routing lengths. Evaluate cost effectiveness of installing a separate remote I/O cabinet near the monitored equipment.

VIII.2. CONDUCTOR LABELING

Wire labels shall be provided for each individual conductor and multiconductor assemblies at all termination points including termination/junction boxes. Wire tags shall be Snap-On or slip-on PVC wire markers with legible machine printed markings and numbers. Do not use adhesive or taped on tags. Labeling of "through" wiring at pull boxes shall not be required.

VIII.3. FIBER OPTIC CABLE

VIII.3.1. All fiber optic cable shall be installed with at least 50 percent spare conductors.

VIII.3.2. All fiber optic cable (including spares) shall be terminated or spliced in fiber optic patch panels. Provide patch cables as required. All Patch panels indoors shall be provided with NEMA 12 enclosures, all panels outdoors shall be located in NEMA 4X enclosures.

VIII.3.3. General fiber optic cable requirements:

VIII.3.3.1. Suitable for the installed environment.

JEA Water and Wastewater Standards

- VIII.3.3.2. Color-coded fibers according to EIA/TIA-598.
- VIII.3.3.3. Color-coded buffer tubes according to EIA/TIA-598.
- VIII.3.3.4. Furnish buffer tubes of a single layer nylon construction or of a material with similar mechanical performance.
- VIII.3.3.5. Fillers may be included in the cable core to lend symmetry to the cable cross section where needed.
- VIII.3.3.6. Apply binders with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes:
 - VIII.3.3.6.1. Provide binders that are:
 - VIII.3.3.6.1.1. Non-hygroscopic.
 - VIII.3.3.6.1.2. Non-wicking (or rendered so by the flooding compound).
 - VIII.3.3.6.1.3. Dielectric with low shrinkage
- VIII.3.3.7. Provide a minimum of 1 ripcord under the cable sheath.
- VIII.3.3.8. Provide the high tensile strength Aramid yarns, Kevlar, and/or fiberglass helically stranded evenly around the cable core:
 - VIII.3.3.8.1. No metallic elements whatsoever are allowed in non-armored cable.
- VIII.3.3.9. Mark the jacket or sheath with:
 - VIII.3.3.9.1. Manufacturer's name.
 - VIII.3.3.9.2. The words "Optical Cable".
 - VIII.3.3.9.3. Year of manufacture.
 - VIII.3.3.9.4. Sequential meter marks.
 - VIII.3.3.9.5. Repeat markings every 1-meter.
 - VIII.3.3.9.6. The actual length of the cable to be within 1 percent of the length marking.
 - VIII.3.3.9.7. The marking must be in a contrasting color to the cable jacket.
 - VIII.3.3.9.8. The height of the marking:
 - VIII.3.3.9.8.1. Approximately 2.5 millimeters.
- VIII.3.3.10. General performance characteristics:
 - VIII.3.3.10.1. Rated tensile load of the cables:
 - VIII.3.3.10.1.1. Indoor/Outdoor:
 - VIII.3.3.10.1.1.1. Short Term: 1,330 N
 - VIII.3.3.10.1.1.2. Long Term: 400 N
 - VIII.3.3.10.1.2. Outdoor:
 - VIII.3.3.10.1.2.1. Short Term: 2,600 N
 - VIII.3.3.10.1.2.2. Long Term: 800 N
 - VIII.3.3.10.2. Non-armored fiber optic cables: Compressive load withstand of 220 N/cm applied uniformly over the length of the cable.

JEA Water and Wastewater Standards

- VIII.3.3.10.3. Armored fiber optic cables: Compressive load withstand of 440 N/cm applied uniformly over the length of the cable.
- VIII.3.3.10.4. The average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm for a cable subjected to this load:
 - VIII.3.3.10.4.1. With no measurable increase in attenuation after load removal.
- VIII.3.3.10.5. Test in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cable," except that the load must be applied at the rate of 3 millimeters to 20 millimeters per minute and maintained for 10 minutes.
- VIII.3.3.10.6. Capable of withstanding 25 cycles of mechanical flexing at a rate of 30 within 1 cycles/minute.
- VIII.3.3.10.7. The average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm at the completion of the test.
- VIII.3.3.10.8. For armored cables, any visible cracks causing separation of the armor and propagating more than 5 millimeters constitutes failure.
- VIII.3.3.10.9. Outer cable jacket cracking or splitting observed under 10X times magnification, constitutes failure.

VIII.4. SHIELDED TWISTED CABLING

- VIII.4.1. Shielded twisted pair cabling shall be used for all analog signal loops.

VIII.5. MULTI-CONDUCTOR CONTROL CABLE

- VIII.5.1. Multi-conductor control cabling shall be used for all discrete signal wiring.
- VIII.5.2. Multi-conductor control cable shall be used over single conductor control cable due to ease of identifying individual conductors by color as well as individual conductor labeling.
- VIII.5.3. Each multi-conductor control cable should provide at least 25 percent spare conductors.

VIII.6. LOCAL AREA NETWORK AND TELEPHONE CABLE AND COMPONENTS

- All LAN and telephone cabling and components shall be listed, tested, and rated as "Category 5e" or greater.

VIII.7. CONFIGURATION SOFTWARE AND HARDWARE

- JEA shall have a working copy of all configuration software and hardware required to configure, maintain or troubleshoot and instrumentation components provided on each project. Any items not in JEA's possession prior to a project shall be provided as a part of the project.

IX. FIELD MOUNTED INSTRUMENTATION

IX.1. GENERAL

- This section describes the criteria for furnishing, installing, and placing into operation field-mounted instrumentation. Instruments shall be of the latest available proven technology. Included are references to nationally recognized standards to be met or exceeded in design. The steps included for successful

JEA Water and Wastewater Standards

installation and integration of field mounted instruments are covered in this section. **Exhibit VIII.1** presents a list of instrumentation, equipment and functions associated with JEA water plant design. All instruments of the same type supplied on a single project shall be the same series or model.

IX.2. STANDARDS

The following standards shall apply for field mounted instrumentation:

- IX.2.1. Instrument Society of America, ISA-S50.1 current edition.
- IX.2.2. Underwriter Laboratories, UL508, standards for industrial control equipment.
- IX.2.3. National Electrical Manufacturers Association (NEMA), Pub. No. 1CS-6, enclosures for industrial controls and systems.
- IX.2.4. National Fire Protection Association (NFPA), Std. 70, current edition, National Electric Code (NEC).

IX.3. SUBMITTALS

The following information should be submitted for approval for each model instrument provided to ensure conformance to the established criteria:

- IX.3.1. Manufacturer's design and performance specification data and descriptive literature.
- IX.3.2. Equipment dimensioning and installation requirements and recommendations.
- IX.3.3. Required and optional accessory lists.
- IX.3.4. Electrical/pneumatic signal and power connection diagrams.
- IX.3.5. Operation and maintenance manuals for each type instrument after product approval.
- IX.3.6. Calibration certifications from the manufacturer for each calibrated instrument.
- IX.3.7. In addition, the following information for each instrument should be included with the submittal:
 - IX.3.7.1. Tag number and description.
 - IX.3.7.2. Complete model number.
 - IX.3.7.3. Data sheets and catalog literature edited to indicate specific items provided.
 - IX.3.7.4. Mounting details for all typical installation requirements and special details for non-typical applications.
 - IX.3.7.5. Methods and materials required for installation. Include power and signal connection details.
 - IX.3.7.6. List of parts subject to wear, recommended spare parts, and spare parts provided.
 - IX.3.7.7. Other specific submittal information as specified in the particular instrument specification.

JEA Water and Wastewater Standards

IX.4. SYSTEM PERFORMANCE AND DESCRIPTION

Instrumentation for water plant control systems shall be provided with the following functionality. The functionality may be built in to the instrument or provided as ancillary equipment.

- IX.4.1. Instruments shall return automatically and immediately to accurate measurement upon restoration of power after a power failure, except where specifically noted.
- IX.4.2. Open and short circuit protection shall be provided, except for two-wire transmitters.
- IX.4.3. Two-wire transmitter power supplies shall be provided in control panels or enclosures with receiver/indicator/re-transmitter as required.
- IX.4.4. Unless served by Fieldbus, instrument transmitters shall produce isolated 4-20 mAdc analog signals.
- IX.4.5. Instruments shall have coated printed circuit boards to prevent damage by dust, moisture, fungus, and airborne contaminants.
- IX.4.6. Complete mounting hardware, floor stands, wall brackets, or instrument racks.
- IX.4.7. Linear, direct reading indicators unless otherwise specified.
- IX.4.8. Enclosures NEMA rated for the environment. In hazardous areas, the NEC Class, Group, and Division as shown or specified shall be met. In areas subject to flooding, submergence rated enclosures shall be provided.
- IX.4.9. Use single source manufacturer for each instrument type. Use the same manufacturer for different instrument types whenever possible.
- IX.4.10. Provide instrumentation of rugged construction designed for site conditions.
- IX.4.11. Provide only new, standard, first-grade materials throughout, conforming to standards established by Underwriter's Laboratories (UL), Inc., and so marked or labeled, together with manufacturer's brand or trademark.

IX.5. INSTALLATION

- IX.5.1. Unless readily accessible for viewing and calibration from floor elevation, electrical transmitters shall not be mounted on process piping. Mount equipment on instrument racks, stands or in enclosures near the sensor at a level that permits viewing from floor elevation.
- IX.5.2. Instrumentation and auxiliary devices shall be installed to be accessible for maintenance. Space between instruments, equipment, and piping shall be provided for ease of removal and servicing. Panel layouts shall include ergonomic factors associated with maintaining the equipment.
- IX.5.3. Generally, instrumentation shall be installed to be accessible from floor level or grade. Leak detectors which should measure gasses near the ceiling shall be located at grade with sample tubing and fans designed to bring ambient gasses from the ceiling area to the instrument. If not possible, provide permanent ladders or platforms for instrumentation that must be installed in overhead locations.

JEA Water and Wastewater Standards

- IX.5.4. A 16 gauge 304 stainless steel tag with 3/16 inch engraved letters shall be attached to each primary element, transmitter, and readout. The tag shall include the instrument number and description. The manufacturer name and model number should be included if not discernible on the instrument.
- IX.5.5. Sample or impulse line systems shall be designed to minimize dead time and protect against adverse accumulation of air.

IX.6. DOCUMENTATION

- IX.6.1. A single sheet shall be provided for each primary element sensor and electronic indicator/analyzer/transmitter of each instrument uniquely specified. These sheets shall be used to document instrument installation and testing.
- IX.6.2. The following information shall be included for each certification sheet:
 - IX.6.2.1. Plant name.
 - IX.6.2.2. Tag number and description.
 - IX.6.2.3. Manufacturer.
 - IX.6.2.4. Model and serial number.
 - IX.6.2.5. Date, time and person who performed calibration.
- IX.6.3. Calibration data to include:
 - IX.6.3.1. Input, output, and error at 0, 25, 50, 75, and 100 percent of span for analog instruments.
 - IX.6.3.2. Switch setting, contact action, and deadband, if applicable, for discrete elements.
 - IX.6.3.3. Space for comments.
 - IX.6.3.4. Certification by installer and acknowledgment by Contractor and date.

IX.7. LEVEL MEASUREMENT

- IX.7.1. Level elements materials of construction shall be compatible with chemicals in wetted contact.
- IX.7.2. Use ultrasonic level transmitters or hydrostatic pressure transmitters where level measurement of ground storage, reservoirs, and chemical tanks is required.
 - IX.7.2.1. All ultrasonic level transmitters that are provided shall be microprocessor-based devices with external keypads, LCD display, and shall be programmable without the use of potentiometers.
 - IX.7.2.2. All hydrostatic pressure transmitters that are provided shall have housing suitable for its intended environment with 4-20mA signal output to a local digital display if not provided on the unit itself.
- IX.7.3. Use level electrodes and level electrode relays where required for backup point. If space is not available, such as in sumps, provide encapsulated ball type float switches.

JEA Water and Wastewater Standards

- IX.7.3.1. Ball type float will be Type 316 stainless steel or polypropylene, maximum 3-inches in diameter. Mercury switches are not acceptable. Wiring will be in flexible waterproof PVC cable from switch to junction box terminals without splices.

IX.8. PRESSURE MEASUREMENT

- IX.8.1. Pressure measurement devices include pressure instruments used for monitoring pressure, inferred level from pressure, and inferred flow from differential pressure, pressure switches, and pressure gauges.
- IX.8.2. The following criteria apply to pressure measurement devices:
 - IX.8.2.1. Instrument tubing is required to be 316 stainless steel unless otherwise required by the fluid being monitored. Consideration should be given to flexible SS for high traffic areas. All instrument tubing is to be sloped at a 1:12 slope and be rigidly mounted. Blow off lines with isolation valves are required to remove sediment and air.
 - IX.8.2.2. Pressure snubbers or pulsation dampeners shall be provided with all pressure measurement devices where pressure fluctuations could provide inaccurate readings or damage instruments.
 - IX.8.2.3. Diaphragm seals are required where isolation from the process is desired such as for all chemical feed applications.
 - IX.8.2.4. Isolation valves are required for all instruments.
 - IX.8.2.5. Two way valve manifolds are required on all pressure transmitters to facilitate calibration without removing instrument.
 - IX.8.2.6. Three way valve manifolds are required on all differential pressure transmitters to facilitate calibration without removing instrument.
 - IX.8.2.7. All transmitters are required to provide local direct reading indicators.
 - IX.8.2.8. Heat tracing for all outdoor liquid lines shall be required per contract specifications.

IX.9. PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTERS

Differential Pressure transmitters used for flow measurement shall be provided with integral square root extraction.

IX.10. ANALYSIS PROBES AND TRANSMITTERS

- IX.10.1. Toroidal type conductivity transmitters shall be provided on each raw water well and downstream of each chlorine or hypochlorite injection point. A "hot retractable" type of installation shall be provided.
- IX.10.2. A chlorine analyzer transmitter, pH transmitter and temperature probe shall be appropriately located downstream of each chlorine or hypochlorite injection point. The instrument shall be used to measure free chlorine.
- IX.10.3. Flow through type elements shall be used.

JEA Water and Wastewater Standards

IX.11. FLOWRATE MEASUREMENT

- IX.11.1. All flowmeters will be provided with valving and piping for flow meter bypass, with the exception of clamp-on ultrasonics, allowing continuous operation during flowmeter maintenance.
- IX.11.2. Chemical flows shall be measured using clamp-on ultrasonic flow meters where feasible. Chemical flow meter to alarm when flow meter measurement is zero but pumps are "on".
- IX.11.3. All meters shall be installed above grade and accessible. If application requires meters to be located below grade, meters shall be housed in a vault for easy access.
- IX.11.4. Venturi tube or electromagnetic flowmeters shall be used for finished water flow metering where feasible. Flowmeters will be sized not to exceed manufacturer requirements for maximum flow velocity at desired insertion length.
- IX.11.5. All flowmeters shall be located to provide the required upstream and downstream straight run piping requirements.
- IX.11.6. Electromagnetic flowmeters will not be placed in piping high points to avoid air accumulation and measurement inaccuracies.

IX.12. TRAINING

- IX.12.1. Comprehensive training by a manufacturer's representative for each instrument type shall be provided to Operations and Maintenance personnel. Training schedules and sessions shall be coordinated to accommodate all relevant JEA personnel.
- IX.12.2. All training sessions are to be videotaped and the digital file turned over to JEA upon completion of the training.

IX.13. WARRANTY

- IX.13.1. Warranty agreements for instrumentation, controls, materials, workmanship and installation are to be provided.
- IX.13.2. Replacement parts are required to be furnished and installed during the startup/warranty period for any defective component at no additional contract cost to JEA.
- IX.13.3. Spare parts consumed during the startup/warranty period, are required to be replaced immediately after use, to restore the spare parts inventory with new equipment at no additional cost to JEA.

X. DOCUMENTATION STANDARDS

X.1. GENERAL

This section describes the various types of documents that shall be provided to design, develop, and record Instrumentation and Control Systems. The purpose is to establish documentation standards that provide consistency in content and format throughout the Utility.

JEA Water and Wastewater Standards

X.2. P & IDS

P &IDs are fundamental documents for conveying piping, process, instrumentation, and control information. P &IDs shall depict the following information:

- X.2.1. Process equipment.
- X.2.2. Major process piping.
- X.2.3. Auxiliary process piping.
- X.2.4. Field sensing elements, transducers, analyzers, transmitters, etc.
- X.2.5. Functional representations of controls, equipment, etc.
- X.2.6. Panel instrumentation (including front and back of panel items such as control stations, process variable indicators, switches, indicating lights, alarms, relays and signal conditioners).
- X.2.7. Input/output (I/O) signals to the control system.
- X.2.8. Functional representation of signal interconnections for instrumentation, controls, and equipment.

X.3. EQUIPMENT P&ID

- X.3.1. Equipment to be monitored or controlled shall be shown as well as major non-monitored or non-PLC/RTU controlled equipment, manual routing or isolation valves, or other equipment that is important for understanding the operation of the process.
- X.3.2. P&IDs shall be used as the basis for developing control strategies, input/output point lists, instrument schedules, control panel layouts, schematics, loop diagrams, electrical ladder diagrams and termination diagrams.
- X.3.3. Process piping, tanks and equipment shall be laid out on P &IDs so that process flow is shown left to right and top to bottom. Representations of tanks and other equipment not shown on a P&ID symbols sheet shall be shown in section (side view) and identified with text.
- X.3.4. A layered concept using vertical hierarchy spacing shall be used to distinguish between various controlled locations. Field instruments and equipment balloons shall be placed immediately above or adjacent devices. Balloons representing field controls, motor controls and panel controls shall be located directly above the field devices at a separate level. I/O symbols and tags shall be located above at the highest level. Control levels and locations shall be identified with labels at the side of the drawing or by labels enclosed in solid boxes.
- X.3.5. Typical illustrations shall be used when there are multiple equipment items on a drawing that have identical monitoring and control functions. The use of typicals is encouraged whenever it increases drawing clarity by reducing duplication. Loop numbers must be listed within the typical box.
- X.3.6. The P &IDs shall show a functional representation of Control Panel equipment, valve actuators, variable speed drives, packaged controls and controls containing special interlocks. Control panels may be included in a Motor Control Center (MCC) or may be standalone units depending upon the application. The equipment and controls shall be shown as a box containing interlock symbols and signal function labels. Only the necessary signal interconnections shall be shown. Separate

JEA Water and Wastewater Standards

electrical schematics or ladder diagrams shall be used to define the interlock requirements or illustrate detailed wiring.

- X.3.7. The P&IDs shall illustrate only a limited amount of control and monitoring logic. P&ID logic representation shall be limited to safety and process interlocks with a short note describing their function.
- X.3.8. Instruments and control devices shall be tagged in accordance with ISA Standard S5.1 – Instrumentation Symbols and Identification.
- X.3.9. When creating a control scheme that commands a field device to operate, the designer must use a single output from the PLC/RTU and a single dashed line on the P&ID to show the connection to the field device. For example, a pump motor uses a single, maintained PLC/RTU contact (digital output or DO) and runs as long as that contact is closed. A variable speed or position device uses a single analog output (AO), indicating a 4-20 mA speed or position demand signal, and a single maintained contact (DO) as a run command for motors.
- X.3.10. When the design must interface with existing equipment that operates on the pulse-to-start, pulse-to-stop (or pulse-to-increase, pulse-to-decrease) principle, two digital output symbols shall be employed. There shall be two dashed lines showing the PLC/RTU to field device connection. The two separate functions shall then be identified in text on the P&ID drawing (i.e., start and stop).
- X.3.11. Signal lines shall be arranged to indicate the electrical signal path. For example, signal lines shall indicate that a remote/manual switch selects between a PLC/RTU control output and a hand switch output as alternate sources of control.
- X.3.12. Only a limited number of signal lines shall be shown within boxes representing MCC's, Control panels, valve actuators, variable speed drives, packaged controls or control interlocks. Specific wiring diagrams or ladder diagrams shall be used to provide more detail.
- X.3.13. Interlock symbols shall be shown on the P&ID's. Interlock symbols are diamond shaped with a capital "I" inside and a number next to them referencing a short explanatory note at the bottom of the sheet. Details of the interlocks shall be shown on electrical wiring and ladder diagrams.

X.4. INSTRUMENTATION AND CONTROL LOOP TAGGING

- X.4.1. A tagging scheme based on ANSI/ISA S5.1 Instrumentation Symbols and Identification is required.
- X.4.2. The tagging scheme shall include the following in the order presented; each separated by a dash:
 - X.4.2.1. An ISA symbol identifier.
 - X.4.2.2. A unit process number.
 - X.4.2.3. A loop number.
 - X.4.2.4. A number to distinguish identical parallel loops.
- X.4.3. An additional alphanumeric qualifier may be appended to the tag to elaborate on the ISA symbol identifier (e.g. to indicate what type of analysis).

JEA Water and Wastewater Standards

X.5. LOOP DIAGRAMS

- X.5.1. Loop diagrams shall be developed in accordance with ANSI/ISA-S5.4.
- X.5.2. Loop diagrams shall be used to represent analog signal loops. Discrete signal wiring shall be shown in ladder format. Loop diagrams shall depict the following information:
 - X.5.2.1. Location of each device, such as area, panel, PLC rack.
 - X.5.2.2. Instrumentation, equipment, and component descriptions; include manufacturers and model numbers.
 - X.5.2.3. Signal ranges and calibration information including set point, alarm, and shutdown values.
 - X.5.2.4. I/O type and address.
- X.5.3. Loop diagrams shall depict the complete wiring of the control loop. References to other shop drawings for continuation of wiring shall not be acceptable, except where such references are contact inputs or relay outputs.
- X.5.4. Show all terminations including I/O modules with identification of interconnecting cables, wires, terminal numbers, power supplies, grounds, shielding, surge suppression, and field devices.

X.6. PANEL DRAWINGS

- X.6.1. Panel drawings illustrate the physical configuration of the control panels and PLC enclosures, including devices and equipment mounted on or in them. All equipment, footprints, cutouts and panels shall be drawn to scale.
- X.6.2. Panel drawings shall illustrate a frontal elevation view of the control panel with side views if required for equipment mounting. The frontal elevation view shall clearly identify the physical size and configuration of the panel, as well as the scale.
- X.6.3. Front panel mounted devices shall be illustrated on the enclosure door and identified by nameplates. Interior mounted devices shall also be shown and identified by nameplates. All devices shall be functionally grouped and arranged symmetrically on and inside the panel to enable maintenance personnel to easily locate the control devices.
- X.6.4. A nameplate engraving designation schedule shall appear on the panel drawings to provide the required engraving and device identification.
- X.6.5. The NEMA type of each enclosure shall be identified on elevation drawings.
- X.6.6. A Bill of Material schedule shall appear on the drawing to identify the device along with its size, color, material and other specifications required to construct the panel.

X.7. LADDER WIRING DIAGRAMS

- X.7.1. Ladder Wiring diagrams be provided for all panels. Ladder diagrams shall show the interconnecting wiring for any and all devices using relay logic either in, on, and connected to panel including physical devices such as relays and their contacts, lamps, hand-switches, motor starters, sensing devices with contact outputs, etc.

JEA Water and Wastewater Standards

- X.7.2. All devices shall be represented by distinctive shapes that indicate their functions. If a standard shape does not adequately describe the device, a simple box may be employed and the function described in text.
- X.7.3. All devices shall have distinctive tag numbers or alphanumeric identifiers. For example, CR1 and TR2 mean Control Relay #1 and Timer Relay #2, respectively. Devices that are also shown on the P&ID shall have the same tag number.
- X.7.4. All rungs of a ladder shall be numbered in ascending order, on the left. The number shall be a four-digit number. The first two digits mimic the Drawing Sheet number on which the ladder appears, although leading zeros are not shown. The last two digits indicate the rung number beginning with 01 at the top.
- X.7.5. Devices with functional parts shown elsewhere on the ladder (i.e., relay coils and their contacts) shall be cross-referenced on the right with the rung number(s) of where those parts may be found.
- X.7.6. Devices shall have short, narrative descriptions, on the right, indicating their functional roles in the ladder. Examples include "Start Timer", "High Level Trip", "Run Status", etc.
- X.7.7. All devices shall be shown in the de-energized or "shelf" state.
- X.7.8. The supply voltage and its source shall be shown at the top.
- X.7.9. All devices related to the diagram shall be shown whether they are panel, PLC/RTU or field mounted. Inter-connections at terminal strips in the panel or junction boxes shall be shown. Wire numbers, colors, terminal numbers, PLC/RTU I/O points, grounds, etc. shall be shown.
- X.7.10. Wires intended for conduit runs shall be shown as dashed lines.

X.8. EQUIPMENT DATA SHEETS

Instrument Data Sheets shall be provided for all equipment and components. Data sheets shall include the following information, as applicable:

- X.8.1. Instrument tag number.
- X.8.2. Instrument type.
- X.8.3. Instrument location.
- X.8.4. Manufacturer and model number.
- X.8.5. Size and scale range.
- X.8.6. Set points.
- X.8.7. Materials of construction.
- X.8.8. Power requirements.
- X.8.9. Mounting type.

JEA Water and Wastewater Standards

X.8.10. NEMA rating.

X.8.11. Options included.

X.8.12. Hardcopies of all configuration parameters for instruments shall be provided. Switch settings shall be documented.

X.9. PLC I/O LISTS

X.9.1. The design and as-built drawings shall indicate by module the PLC rack number, slot number and point number of each I/O point and shall also indicate in plain language its intended purpose.

X.10. OPERATIONAL AND MAINTENANCE MANUALS

X.10.1. Operational and Maintenance (O&M) Manuals are required in both hard copy and electronic file. Electronic O&M files shall be compatible with the control system workstations provided with the system.

X.10.2. Operations and Maintenance Manuals shall include the following:

X.10.2.1. Details of I&C System component interfaces including instrumentation, control panels, communications, site modifications, and wiring details.

X.10.2.2. Provide details for operations and maintenance procedure for all instruments and package systems.

X.10.2.3. I&C System component and hardware details including locations, addressing, switches, and jumper settings.

X.10.2.4. Record documents including "as-built" P &ID's, Panel drawings, Ladder wiring diagrams, loop diagrams. Instrument data sheets and system test results.

X.10.2.5. Record drawings that depict site modifications.

XI. TEST PROCEDURES AND DOCUMENTATION

XI.1. GENERAL REQUIREMENTS

XI.1.1. This section describes the test procedures and documentation for JEA Water Treatment Facility control systems and sub systems.

XI.1.2. All tests may be witnessed by a designated representative of JEA. All test schedules shall be coordinated with JEA staff and the Engineer.

XI.1.3. A minimum of two week notice shall be required prior to the performance of all tests.

XI.1.4. The control system construction Contractor shall develop and submit test procedures and documentation forms to JEA for approval.

XI.1.5. A copy of the signed off completed test documentation shall be provided to JEA upon completion of each test.

JEA Water and Wastewater Standards

XI.2. FACTORY DEMONSTRATION TEST

Control systems and sub systems are required to be tested at their assembly location referred to as "factory" prior to delivery. Factory tests are intended to demonstrate the functional performance of individual control systems components as well as the integrated components in simulated field conditions.

- XI.2.1. Hardware and software components of the control systems shall be tested.
- XI.2.2. Hardware components include fabricated control panels, process controllers, I/O modules, communications equipment, computer workstations, packaged control systems and network devices.
- XI.2.3. The hardware components shall be tested to demonstrate proper installation, configuration, and functionality as intended to be used in the control system.
- XI.2.4. Hardware component tests shall verify power wiring, controls wiring, I/O wiring, panel lights, switches, and indicators.
- XI.2.5. Tests shall include an overall inspection of workmanship and panel assembly including; wiring, grounding, shielding, termination, labeling, mounting, and clearances.
- XI.2.6. The control systems components shall be interconnected at the factory demonstration tests to simulate actual field conditions. Performance of all hardware components shall be verified using simulated inputs and outputs. Test voltages shall be the same as actual field conditions.
- XI.2.7. Any deficiencies discovered at the Factory prior to delivery to the job site shall be corrected. All failed tests shall be repeated at no additional cost to JEA.
- XI.2.8. Signed test forms and checklists shall be distributed to JEA immediately upon completion of the tests.

XI.3. FIELD TEST (OPERATIONAL READINESS TEST)

- XI.3.1. Prior to control system start up, an Operational Readiness Test (ORT) shall be performed to inspect, test, and document the entire system is ready for operation.
- XI.3.2. The control system construction Contractor shall check and test the entire instrumentation and control system for proper installation, wiring, power, calibration, function, and adjustment on a component-by-component and loop-by-loop basis.
- XI.3.3. The ORT shall be performed in coordination with the JEA.
- XI.3.4. All Owner furnished work, if applicable, shall be included in the ORT.
- XI.3.5. The control systems Contractor shall conduct and coordinate the ORT. The Contractor shall provide documentation for loop status reports and instrument/equipment calibration sheets upon completion of each calibration and loop test.
- XI.3.6. An ORT loop status report shall include:
- XI.3.7. Treatment facility name & date.

JEA Water and Wastewater Standards

- XI.3.8. Loop number & description.
- XI.3.9. Equipment tag numbers.
- XI.3.10. Checklist and signoff for each component: tag identification, installation, wiring, calibration, adjustment, and functional.
- XI.3.11. Checklist and signoff for each loop, loop wiring and I/O device interface/termination.
- XI.3.12. I/O signals for loop is operational through the I/O device or PLC.
- XI.3.13. Total loop operational.
- XI.3.14. Space for comments.
- XI.3.15. Instrument/equipment calibration sheets shall include:
- XI.3.16. Facility name & date.
- XI.3.17. Loop number & description.
- XI.3.18. Equipment tag numbers or I/O module address.
- XI.3.19. Manufacturer / Model number / Serial number.
- XI.3.20. Calibration data for components and I/O modules including scaled signal range, scaled engineering units, 0, 25, 50, and 100 percent signal comparison to engineering unit range.
- XI.3.21. Summarize the operational readiness of the component or I/O module.
- XI.3.22. Sign off.
- XI.3.23. Space for Comments.

XI.4. PERFORMANCE ACCEPTANCE TEST

- XI.4.1. After successful completion of the ORT and all deficiencies are corrected, the construction Contractor shall conduct and manage a Performance Acceptance Test (PAT). The test shall be coordinated with the JEA to include all JEA Furnished Work.
 - XI.4.1.1. The PAT shall be witnessed by the JEA or a represented acting on the behalf of the JEA.
 - XI.4.1.2. The PAT shall include local and manual tests for each loop before proceeding to remote and automatic modes. The test shall use actual system equipment and process variables.
 - XI.4.1.3. Verification of equipment performance by means of disconnecting signal wires and simulating signals shall be acceptable only when direct operation of the equipment is not possible for reason of safety or disruption of online processes.
- XI.4.2. Documentation of the PAT shall be completed for each control loop. The PAT documentation shall include:

JEA Water and Wastewater Standards

- XI.4.2.1. Facility name & date.
- XI.4.2.2. Loop number & functional description.
- XI.4.2.3. Clear and concise description of the PAT procedure.
- XI.4.2.4. Indicate acceptable test results that shall verify proper performance.
- XI.4.2.5. Document actual PAT results.
- XI.4.2.6. Sign off section. Contractor, Owner representative/Witness.
- XI.4.2.7. Space for comments.

XII. DISINFECTION INSTRUMENTATION & CONTROL STANDARDS

XII.1. CHEMICAL DOSING

XII.2. The disinfection control system shall be capable of continual PID control in automatic via the plant PLC. In automatic mode, the adjustable dose setpoint shall be provided via SCADA. The local control mode shall be selectable via a selector switch on or attached to each chemical pump. Should the measured free chlorine residual differ from the chlorine residual setpoint, the sodium hypochlorite dose shall be increased or decreased by an operator adjustable percentage of the dose setpoint.

XII.3. The deviation in residual chlorine from setpoint acts proportionally on the speed of the chemical pump(s) via PID functionality. This is cascaded to an additional PID control with the flow rate acting on a final manipulation of the pump speed command.

XII.3.1. The metering pumps shall operate in a lead/lag system. While in operation, if the lead pump runs at an operator adjustable maximum percent capacity, for an adjustable maximum time period, the control system shall call for the lag 1 pump. Once the lag pump is called to run, the lead shall reduce speed and all operating pumps shall modulate speed together to provide the required sodium hypochlorite flow rate. A sodium hypochlorite flow meter shall be provided and will be used for monitoring/totalizing purposes only and shall not be used to control the metering pumps.

XII.4. CHLORINE MONITORING STATION

XII.5. Process Analyzers: The Chlorine Monitoring Station shall have two independent analyzer systems each with independent sampling points, to provide calibration reliability and redundancy. The plant PLC shall select the desired chlorine analyzer for residual control. SCADA shall generate an operator adjustable percent deviation alarm from these redundant signals. There shall also be residual alarms for each chlorine analyzer in the PLC and SCADA. Each analyzer system shall include one chlorine analyzer, one pH analyzer. At a minimum, one system shall be provided with a conductivity analyzer.

XII.5.1. The Chlorine Monitoring Station shall continuously measure and transmit free chlorine residual concentrations to SCADA. There shall be a flow switch at each analyzer.

XII.5.2. The chlorine analyzer shall be microprocessor based, reagent-less IP66, with automatic temperature correction and self-diagnostics. The chlorine sensors shall be of the ampere-metric type, flow-through design with a low flow cell, and pressure and temperature corrected.

JEA Water and Wastewater Standards

XII.6. Chlorine injection, **SODIUM HYPOCHLORITE PUMPS AND RESIDUAL MONITORING PROBES SHALL BE APPROPRIATELY SPACED TO PRODUCE A 2 MINUTE MAXIMUM FEEDBACK LOOP TIME DURING AVERAGE DAY FLOWS.** Sample point to analyzer shall be 2 minute feedback loop time maximum. Injection point to sample point shall be 2 minute feedback loop time maximum.

XII.7. Process variables shall be visible from SCADA displays in the control room and locally via Siemens HMI in the sodium hypochlorite facility. HMIs located outdoors shall be suitable for outdoor application.

XII.8. SODIUM HYPOCHLORITE FACILITY

XII.9. Sodium Hypochlorite Pumps

XII.9.1. Refer to Chemical Dosing requirements and Exhibit VIII.2.

XII.9.2. Pumps shall have start, stop, speed control, reset control and HOA status via a Profinet or Profibus connection. Only for retrofit projects will analog controls be allowed with notification to JEA. The pump controller shall monitor operation status (Running/Failed), and speed. Local HOA switches shall allow for local manual operation and display shall allow operator to locally view the pump flow rate in gallons per hour (gph), a calculated value using pump speed.

XII.9.3. Cumulative flow of all pumps shall be displayed on a single flow meter. The flow meter will be placed downstream of the pumps and in the combined chlorine flow header line.

XII.10. Sodium hypochlorite tank level shall be monitored with a hydrostatic pressure level device. Level elements shall alarm in SCADA at low level. Tank shall also be provided with a clear liquid level sight gauge. Reverse float liquid level gauge shall not be acceptable. Refer to the Disinfection Section for more additional requirement.

XII.11. The nearby sodium hypochlorite fill station shall have a Fill Station Panel. Panel shall include the following for each tank:

XII.11.1. Level monitor local readout display of each tank level.

XII.11.2. Audible alarm and light indication for tank high level.

XII.11.3. Alarm reset button.

XII.12. Storage area sump shall have two float switches per sump, with a high level and high-high level alarm back to SCADA.

XII.13. Leak detection shall be provided by the tank supplier for all double wall contained tanks. Leak Detection shall alarm in the SCADA system and be visible locally via red/green LED light indication. Optical leak detection shall be provided, ultrasonic technology is not permitted for this application.

XIII. HIGH SERVICE PUMPS

XIII.1. The High Service Pumps deliver pressurized finished water into the distribution system. JEA's standard setup of these Pumps includes a single flow meter on the combined discharge header of the station.

XIII.2. Refer to **Exhibit VIII.1**, **Exhibit VIII.3**, I&C Equipment and Function List for specifics on vacuum/pressure gauge requirements.

JEA Water and Wastewater Standards

XIII.3. Refer to Section XI, High Service Pump/Chemical Building Layout for additional requirements.

XIII.4. PLC MONITORING OF CHECK VALVES

XIII.5. Limit switches shall be placed on all check valves located on the discharge of each pump. The switch outputs shall be wired to the PLC controlling the pump.

XIII.5.1. If the limit switch indicates that the check valve is closed, or almost closed, the pump/motor circuit is tripped off after an adjustable duration of time has lapsed. The point at which the limit switch trips out the pump/motor circuit shall consider anticipated flow rates, pipe size, and limit hydraulic surge in the system.

XIII.5.2. If the limit switch indicates a fail status, the pump will shut down. Pump will not be allowed to restart until an adjustable time delay has elapsed. This is to protect the pump from over cycling due to a temporary limit switch scenario.

XIII.6. CONTROL OF HIGH SERVICE PUMP STATION PUMPS

XIII.7. MANUAL MODE:

The operator manually turns pumps off and on. In addition, the operators will manually adjust the speed of the pumps with variable speed drives. The pumps on VFDs will have minimum speed setpoints. In manual mode, the speed cannot be adjusted below the minimum speed setpoint. Operators adjust the pump speeds to achieve the desired station discharge pressure. Pressure indication is located on the suction of each pump. The discharge piping is manifolded together showing the collective discharge pressure on each indicator.

XIII.8. PRESSURE MODE:

When in the pressure mode, the system start, stops, and modulates pumps as required to achieve the pressure setpoint. The pressure setpoint is based on the main header discharge pressure. The pressure measurement on each pump will alarm if the pressure is too low or too high. If the pressure on each individual pump reaches a high-high value, the pump will shut down.

XIII.9. PUMP OPERATION

JEA uses a combined discharge header flow meter showing the discharge flow of the station from all operating pumps. Each High Pressure Pump Station will have between 3 and 8 pumps. All new pumps or replacement pumps will be provided with VFDs of the same size allowing all the pumps to operate on the same curve. If existing pumps are constant speed, they will typically consist of a larger pump and smaller jockey pump.

XIII.9.1. SINGLE PUMP OPERATION (VFD ONLY):

XIII.9.1.1. Minimum pump flowrate: This value will be adjustable.

XIII.9.1.2. Maximum flowrate: This value will be adjustable. If the pump does not reach the pressure setpoint but the pump is at 100 percent speed for 5 minutes, a second pump will turn on.

XIII.9.1.3. VFD pumps will alternate operation whenever a pump shuts down and later when a single pump is called to operate. The pump that was not previously operating will be automatically selected. A single VFD driven pump will only operate alone for 24 hours after which the system will automatically switch to the other VFD pump. A final option

JEA Water and Wastewater Standards

for pump alternation will be for the pumps to be cycled in such a way that the operating hours are balanced between the two VFD pumps. The operator shall have the ability to select either of these three types of operation. The same modes apply for the constant speed pumps although the constant speed pumps will only start after the VFDs are running.

XIII.9.2. TWO PUMP OPERATION (2 VFDS ONLY):

- XIII.9.2.1. Minimum allowable pump flowrate: two pumps will never operate below this flowrate. This value will be adjustable.
- XIII.9.2.2. Minimum desired pump flowrate: two pumps will normally not operate below this flowrate. This value will be adjustable.
- XIII.9.2.3. Maximum desired pump flowrate: Two pumps will normally operate up to this flowrate (no matter what the TDH). If the two pumps do not reach the flow setpoint but both pumps are at 100 percent speed for 5 minutes, the third pump will turn on. This value will be adjustable.
- XIII.9.2.4. Maximum allowable pump flowrate = Two pumps will never operate over this flowrate (no matter what the TDH). This value will be adjustable.

XIII.9.3. THREE PUMP OPERATION (2 VFDS AND 1 CONSTANT SPEED):

- XIII.9.3.1. Minimum allowable pump flowrate = three pumps will never operate below this flowrate. This value will potentially change depending on the selected pumps. This value will be adjustable.
- XIII.9.3.2. Minimum desired pump flowrate = three pumps will normally not operate below this flowrate. This value will potentially change depending on the selected pumps. This value will be adjustable.
- XIII.9.3.3. Maximum pump flowrate = There are no limitations on three pumps operating. Both VFDs can be 100 percent speed and the constant speed pump can be operating.

XIII.9.4. INDIVIDUAL PUMPS:

- XIII.9.4.1. No pump will run below a given minimum flowrate.
- XIII.9.4.2. No pump will run above a maximum flowrate (except for the constant speed pumps).
- XIII.9.4.3. A single constant speed pump will not operate unless the operator does it in manual mode. If this scenario occurs an alarm will be issued stating that single constant speed pump is operating and the system is inefficient.
- XIII.9.4.4. No alarm will be issued when two constant speed pumps are operated manually at the same time.

XIV. WATER SUPPLY WELLS INSTRUMENTATION & CONTROL STANDARDS

XIV.1. Raw water flow shall be continuously measured and totalized using an electromagnetic or venture flow meter. The transmitter shall provide a local indication of the continuous flow in gallons per minute (gpm). The PLC shall provide the totalization of the flow.

XIV.2. Production well water level elements shall measure and transmit water levels in wells. The water level element shall be a submersible pressure transducer in a PVC stilling tube. It shall terminate in a termination

JEA Water and Wastewater Standards

enclosure, NEMA 4X rated, with signal conditioner, moisture protection and terminal strip. Process display shall be a digital field meter with 4-20 mA output to PLC.

- XIV.3.** Well discharge pressure shall be measured by a local manual pressure gauge and electronic digital pressure transducer. The digital meter shall transmit the pressure reading to the PLC.
- XIV.4.** Well pump run time shall be monitored on a daily basis, with run time charts indicating time of day and length of time during each operation. This calculation shall be performed in the PLC.
- XIV.5.** A fluid specific conductivity meter shall continuously measure conductivity of the raw water flow. The transmitter shall provide a local indication of conductivity and a current output of measured conductivity. The unit of measurement shall be micro-siemen-ohms. The conductivity measurement shall be transmitted through the PLC.
- XIV.6.** In general, JEA desires to utilize fiber optic cable (rather than radio) for well sites within approximately one mile of the WTP. Beyond one mile, radio communication shall be used. . Transmitting radios shall be of spread spectrum type to provide digital communication through radio frequencies in the 900-928 MHz band. Prior to design, confirm communications standards with JEA.
- XIV.7.** Programmable logic controllers (PLC) shall be used at each well for process monitoring and control of conventional panel mounted equipment such as relays. The PLC shall contain a central processing unit (CPU), power supply, local and remote input/output modules; local and remote base controllers, communications modules, and factory assembled interconnecting cables if applicable. All components shall make a complete and totally operational system. Hardware shall be configured so that installed channels/points shall exceed the quantity on the I/O list by at least 15 percent. The system shall provide monitoring of operationally significant parameters at wells and provide ability to remotely start/stop the well pump.
- XIV.8.** Refer to Section III Water Supply Wells for additional requirements.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION IX – PIPING STANDARDS

I. PIPING

- I.1. Piping standards define the piping materials to be used within JEA WTPs. A standard piping schedule is contained in **Exhibit IX.1**, which describes the type of pipe material to be used for each treatment process.
- I.2. Test pressures shall be 1.5 times the maximum anticipated operating pressure for the pipe, such as pump shutoff head or peak surge pressure. Refer to the JEA's *Water and Wastewater Standards Manual* for specific pipe materials and construction standards.
- I.3. Above grade ductile iron piping shall have flanged joints. Below grade piping shall be restrained mechanical joint type.
- I.4. Pipes for chemical service shall be rated and compatible for the specific chemical concentration and application.
- I.5. All above grade pipes that are 2.5-inch diameter or smaller and exposed to outside temperatures shall be insulated.
- I.6. Pipes shall be labeled using Brady Snap-On labels or equal.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION X – VALVE STANDARDS

I. VALVE STANDARDS

- I.1. This section provides a description of standard valves used in JEA WTP design. Valves are identified by valve sizes, process location and valve type. In addition, all standard gate, butterfly, check valves, ball valves, and backflow prevention devices shall be in accordance with JEA'S standards manual entitled, *Water and Sewer Standards Manual*. Acceptable manufacturers for these valves are identified in aforementioned manual and should be referenced, since standardization of manufacturers for valves periodically change. **Exhibit X.1** presents JEA standard valves for WTP design.
- I.2. Valve actuators and handwheels/chainwheels shall be sized such that a handwheel/chainwheel will require a maximum rim/chain pull of 80 lbs.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XI – HIGH SERVICE PUMP AND CHEMICAL BUILDING STANDARD LAYOUT

I. GENERAL

- I.1. The high-service pump station and chemical system shall be located in a single building, unless otherwise specified by JEA. This building shall also house an operator's control room, a unisex toilet, and electrical equipment room associated with the following: high service pumps, chemical feed systems, and the ground storage tanks. In addition, if any raw water well pumps are located on the treatment plant site, the electrical equipment for these pumps shall also be located in this building if distances between the building and the well pump are not excessive. Fire protection shall be provided in accordance with regulations and local requirements of the Fire Marshall. Illuminated exit signs as well as all OSHA required signage shall be provided (e.g., confined space entry, hazardous materials, hearing protection, etc.).
- I.2. The building shall be designed to house all pumping and chemical feed systems through the plant's build-out. A standard building layout with major piping is shown on **Exhibit XI.1**.
- I.3. If laboratory samples are to be taken in the building, an ice maker shall be provided. A sink near the chlorine residual monitoring station shall also be provided. Refer to JEA's Facilities Standard Manual, current edition, for additional requirements.
- I.4. Equipment and drains shall be located to minimize drain piping length. Drain piping from process areas and other utility areas such as analyzers, air release valve discharge, ice machine condensate, bathroom drains, and any other equipment requiring drain piping shall be run to the building sump and terminated such that no splashing on concrete floors occurs. Floor drains shall be a minimum diameter of 4-inch and include bronze grate.
- I.5. All lighting shall be LED and meet the minimum foot-candle requirements in Section VII, Electrical Standards, ensuring safe lighting inside and outside building.
- I.6. Refer to JEA's Facilities Standard Manual, current edition, for additional building requirements.

II. BUILDING STRUCTURAL AND ARCHITECTURAL STANDARDS

II.1. STANDARDS

- II.1.1. Building Code: Florida Building Code (FBC) – Edition currently adopted by Authority Having Jurisdiction (AHJ).
- II.1.2. Florida Fire Prevention Code.
- II.1.3. JEA's Facilities Standards Manual.
- II.1.4. NFPA 101 – Life Safety Code.
- II.1.5. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1910 – Occupational Safety and Health Standards.

JEA Water and Wastewater Standards

- II.2. The exterior walls for the High Service Pump and Chemical Building shall be constructed of 12 by 8 by 16-inch CMU block with split-face exterior. Interior walls shall have high-build epoxy coating over block filler.
- II.3. The roof structure for the High Service Pump and Chemical Building shall consist of pre-cast concrete double-tee beams. Building and roof shall be in accordance to the Florida Building Code, edition as adopted by the AHJ. The roofing system shall be in accordance to JEA's Facilities Standards Manual, complete with insulation, flashings and accessories. The roof system shall meet UL Class "A" rating and FM I-90 wind uplift classification. The roofing system shall slope to roof drains, gutters, or conductor-heads with minimum slope to maintain roofing manufacturer's warrantee. The underside interior surface of the double-tees shall receive similar epoxy coating as the interior wall surfaces.
- II.4. All openings in CMU walls (door, window, louvers) shall be within a tolerance of 1/4-inch on all sides and shall meet JEA's Facilities Standards Manual.
- II.5. Interior finishes in the High Service Pump/Chemical Building shall be as follows:
 - II.5.1. Vinyl composition tile flooring and 24-inch by 24-inch suspended acoustical ceiling system in Restroom and Control Room meeting JEA's Facilities Standards Manual.
 - II.5.2. Concrete stain on floors.
 - II.5.3. High-build epoxy coating on walls and seamless epoxy coating.
- II.6. All exterior doors shall be lockable and meet JEA's Facilities Standards Manual. JEA will supply the final cores.
- II.7. All interior doors shall be push bar type with the exception of the restroom and control room, which shall be passage type and shall meet JEA's Facilities Standards Manual.
- II.8. Provide an OSHA approved aluminum ladder with safety cage on High Service Pump/Chemical Building to allow access to the roof.
- II.9. Roll-up doors must be NEMA 12 materials of construction.
- II.10. Provide a 12-foot high drop ceiling in the Electrical Room meeting JEA's Facilities Standards Manual.
- II.11. Provide JEA standard bollards to protect transformer, emergency diesel engine-driven general and fuel tank(s). Bollards shall be fixed or removable, as required. Bollards shall also be included at strategic locations to protect the building and other above grade piping and equipment as necessary.

III. HIGH SERVICE PUMP AREA

- III.1. A single room shall be provided to house all high service pumps. As noted in Section V, High Service Pumps, horizontal split-case centrifugal pumps shall be used for high service pumping. The pumps shall be lined up in a single row, with a suction header on one side of the pumps and a discharge header on the opposite side. An examples of the layout of the high service pump room is presented in **Exhibit XI.1**.
- III.2. Refer to Section V, High Service Pumps for additional requirements.
- III.3. The suction and discharge headers shall each be installed in a concrete trench. H-20 grating shall be provided over the trench to provide a continuously open walking surface in this room. A roll-up door shall

JEA Water and Wastewater Standards

be provided at one end of the room, sufficiently large for a flatbed truck to drive through. Sufficient space shall be provided between the pumps and this roll-up door for a truck to back enough of its bed inside the building to enable loading of a single pump. Instrumentation for the roll-up door shall be designed such that the door will automatically open in the event that the trench floods. The door shall operate on a dedicated float switch in the trench area and alarm via the local PLC to SCADA and back to JEA Ridenour WTP. All control logic for the automatic door opening shall reside in the local PLC.

- III.4. The discharge piping flowmeter assembly shall be installed outdoors and above grade to allow for accessibility and maintenance, unless otherwise specified by JEA.

III.5. BRIDGE CRANE

- III.5.1. A motor operated bridge crane shall be provided in the room to allow removal of any pump or exposed (in trench) piping component. The bridge crane shall extend to the end of the building to allow placement of any equipment onto the bed of a truck. Bridge crane shall be installed at a height that allows equipment to be lifted and carried over other equipment as necessary to the bed of a truck.

- III.5.2. Bridge crane hoist shall be cable type, chain type shall not acceptable.

- III.5.3. Refer to ventilation fan requirements for bridge crane design considerations.

III.6. VENTILATION

- III.6.1. Placement shall consider accessibility for maintenance as well as operation of the bridge crane. Fan placement shall not prohibit the operation or movement of the bridge crane. Accessibility should consider ladder or rolling stair case access requirements, without obstructions or restrictions.

- III.6.2. Direct drive fans are to be operated to meet a building temperature setpoint. The temperature set point will trigger the first fan to turn on with additional fans turning on as needed. See JEA's Facilities Standards Manual for additional fan requirements.

- III.6.3. Wall louvers shall be placed at a minimum 24-inches above finished floor elevation to prevent grass clippings and other debris from entering the building.

- III.7. The room shall be designed to house all anticipated high service pumps, both for the initial phase of construction as well as for any planned future expansions to capacity. Equipment pads for the future pumps shall be sized and installed with the initial construction. Suction and discharge headers shall be sized for the future anticipated peak hour pumping capacity. Suction pipe connections shall be installed with the initial construction for all future pumps. On the discharge header, blind-flanged spool pieces shall be installed for the connection to future pumps. Defer terminating any spool pieces above the grating, until such time as additional pumps are required, to eliminate possible tripping hazards.

- III.8. Dual sump pumps shall be provided in one of the piping trenches and shall operate based on water level in the trench. Provide an interconnecting pipe between the sump and the opposite pipe trench so that any drainage from that trench will flow to the sump pumps.

- III.9. Analyzers for finished water quality (refer to Section VI, Disinfection System and Section V, High Service Pumps), shall be mounted on the wall in the High Service Pump room near the sump to minimize drain piping. Analyzers shall be located such that the disinfection loop time is minimized.

JEA Water and Wastewater Standards

- III.10.** Provide a minimum of two hose bibbs and hose racks inside the pump room to facilitate wash down of the floors and equipment. Number and location of hose bibbs shall take into account the size of the room and location of equipment.
- III.11.** A non-skid fiberglass grating system shall be provided with a minimum grating depth of 2 inches, minimum uniform live load rating of 200 PSF while maintaining a deflection of less than 0.25 inches or L/360, whichever is less. The grating shall also be capable of supporting a concentrated live load of 500 lbs applied over a 12 inch by 1 inch area at the midpoint of the span. Pultruded type shall be required, molded type is not acceptable. FRP structural shapes, plates, and support system shall also be constructed of FRP. Resin for FRP components shall be an acceptable vinyl ester. All mounting hardware and supports shall be FRP to the greatest extent possible. Any metal hardware or anchor bolts required shall be 316 stainless steel. Any anticipated loads which exceed those listed herein shall be accommodated within the design of the FRP grating system. If traffic rated grating is required, stainless steel shall be provided. Grating shall be installed such that bridge crane is capable of lifting it out of place for trench access and maintenance.
 - III.11.1.** Signage shall be provided, at each roll-up door, indicating the maximum loading requirements of the grating system.

IV. SODIUM HYPOCHLORITE AREA

- IV.1.** As indicated in Section VI, Disinfection System, liquid sodium hypochlorite will be used as the primary disinfectant at all JEA facilities.
- IV.2.** All hypochlorite solution storage tanks and metering pump assemblies, shall be located in an enclosed climate controlled building with a recessed cast-in-place concrete floor to provide secondary containment. Above grade walls shall be constructed of standard split face CMU block. FRP landing and stairs shall be provided as necessary to access the containment area from both inside and outside the building.
- IV.3.** Tanks and metering pump assemblies shall be installed on equipment pads integral to the concrete cast in place slab. All piping to and from the tanks shall be located within the secondary containment area with FRP grating above to provide a continuously open walking surface area.
 - IV.3.1.** Provide a protective coating to all concrete surfaces including the floor and walls inside the containment area as follows:
 - IV.3.1.1.** Prime with 8-10 mils DFT Sherwin Williams GP3830 Resuprime MVT Primer or 4-8 mils DFT Tnemec Series 201 Epoxoprime.
 - IV.3.1.2.** Intermediate coat with 10-12 DFT Sherwin Williams GP3741 Novo-Flo Epoxy or 6-12 mils DFT Tnemec Series 237 Power-Tread. Intermediate coat shall be applied in two coating applications.
 - IV.3.1.3.** Finish coat with 10-12 mils DFT Sherwin Williams GP3741 Novo-Flo Epoxy or 6-12 mils DFT Tnemec Series 282 Tneme-Glaze.
 - IV.3.1.4.** Surface preparation and application shall be per coating supplier recommendation.
 - IV.3.1.5.** Additional coatings requirements are provided in JEA's Water and Wastewater Standards (most recent edition) – Section 447.
- IV.4.** Provide at least one safety shower inside the containment area and one safety shower outside the building in the area of the fill station. All outdoor safety showers shall be freeze proof. Provide at least one hose bib and hose rack inside the containment area and outside the building in the area of the fill station (if located

JEA Water and Wastewater Standards

outside of the building). The containment area floor shall slope to a concrete sump pit, see Section VI – Disinfection System for additional sump pit requirements.

- IV.5.** The chemical metering pumps shall be located in the same area and elevation as the chemical storage tanks. Appropriate access shall be made available to facilitate installation and removal of the metering pump assembly. All equipment shall be mounted on equipment pads.
- IV.6.** A fiberglass base shall be provided at the vent outlets on the roof to protect the roofing system from sodium hypochlorite off-gas.

V. ELECTRICAL EQUIPMENT ROOM

- V.1.** All electrical equipment associated with mechanical equipment in the High Service Pump and Chemical Building shall be located in a separate room. Space shall be provided for all anticipated future electrical equipment, including variable frequency drives for future pumps. This room shall be air-conditioned with a 12-foot drop ceiling and dedicated system. Exterior doors on either end shall be provided to facilitate installation and removal of equipment. In addition, man-doors to the interior of the building and into the high service pump station room shall be included.
- V.2.** The finished floor elevation of the electrical room shall have a higher elevation than that of the pump room floor to prevent electrical room flooding. An apron at the electrical room door or around the electrical room wall shall be considered to reduce tripping hazards.

VI. OPERATIONS AREA

- VI.1.** Provide a Control Room and unisex restroom for use by the operators. The control room and restroom areas shall have a suspended ceiling and shall be air-conditioned. HVAC system for control room and bathroom shall be separate from the HVAC system for the electrical equipment room.
 - VI.1.1.** Furnishings to be provided in the control room shall include a filing cabinet, desk, book shelf, rolling office chair, and a guest chair.
 - VI.1.2.** Coordinate drain pipe routing with JEA; provide on-site sanitary lift station as required per JEA direction.
- VI.2.** Bathrooms shall be located near drain piping to reduce pipe lengths. If bathroom is accessible through an exterior door, it shall only be accessible from the interior side.
 - VI.2.1.** Bathrooms shall include soap dispensers, paper towel dispenser, and a supply of the expendables.
- VI.3.** The control room and restroom floor shall have a higher elevation than that of the pump room floor to prevent control room flooding. An apron at the control room door or around the control room wall shall be considered to reduce tripping hazards.
- VI.4.** If control room is constructed with available space above, provide ladder access to the roof of this area and handrails to surround the space. Space above the control room shall be load bearing to allow the space to be used for storage. Ventilation fans and bridge crane shall not impede access to storage area above control room. Accessibility should consider ladder or rolling stair case access requirements, without obstructions or restrictions.

JEA Water and Wastewater Standards

VII. BUILDING PLUMBING AND FIRE PROTECTION SYSTEMS

This section addresses the design requirements for building plumbing and fire protection systems for JEA's WTPs.

VII.1. CODES AND STANDARDS

Building plumbing and fire protection systems design shall conform to the requirements of the listed codes and standards and any supplementary requirements of the authorities having jurisdiction:

- VII.1.1. Standard Plumbing Code/latest edition.
- VII.1.2. Uniform Fire Code/latest edition.
- VII.1.3. Nation Fire Code/latest edition (NFPA).
- VII.1.4. Supplementation requirements of the City of Jacksonville.

VII.2. BUILDING PLUMBING/FIRE PROTECTION

- VII.2.1. Water pressure from potable water system to buildings shall be a minimum of 55 psi.
- VII.2.2. Separate water services shall be required for potable building water and fire protection.
- VII.2.3. Light duty hose valves for building interior and exterior wash-down shall be 3/4 inch globe valves with hose thread adapters.
- VII.2.4. Medium duty hose valves for interior and exterior wash-down shall be 1-inch globe valves with hose thread adapters.
- VII.2.5. Hose valves subject to freezing shall be non-freeze type.
- VII.2.6. Floor drains and hub drains that have infrequent use shall have primed P-traps. Water source for trap priming shall be protected by a reduced pressure zone backflow preventer.
- VII.2.7. Each building shall have a minimum of one service sink and one drinking fountain.

VII.3. BUILDING PLUMBING PIPING SYSTEMS

VII.3.1. POTABLE COLD WATER (W1)

- VII.3.1.1. Pipe 3-inches and smaller, above floor, Schedule 80 PVC pipe.
- VII.3.1.2. Pipe 3-inches and smaller, below floor, Schedule 80 PVC pipe.
- VII.3.1.3. Pipe 4-inches and larger, cement lined ductile iron pipe.

VII.3.2. NON-POTABLE COLD WATER (W2) (DOWNSTREAM FROM REDUCED PRESSURE ZONE BACKFLOW PREVENTER)

- VII.3.2.1. Pipe 3-inches and smaller, above floor, Schedule 80 PVC pipe.
- VII.3.2.2. Pipe 3-inches and smaller, below floor, Schedule 80 PVC pipe.
- VII.3.2.3. Pipe 4-inches and larger, cement lined ductile iron pipe.

JEA Water and Wastewater Standards

VII.3.3. POTABLE HOT WATER (HW)

VII.3.3.1. Above floor, Schedule 80 CPVC pipe.

VII.3.4. SANITARY DRAIN (D)

VII.3.4.1. Above floor, Schedule 40 PVC.

VII.3.4.2. Below floor, Schedule 40 PVC.

VII.3.5. SANITARY VENT (V)

VII.3.5.1. Above floor, Schedule 40 PVC.

VII.3.5.2. Below floor, Schedule 40 PVC.

VII.3.6. WET PIPE FIRE SPRINKLER SYSTEM

VII.3.6.1. 3-inches and smaller, Schedule 40 black steel pipe.

VII.3.6.2. 4-inches and larger, cement lined ductile iron pipe.

VII.4. BUILDING PLUMBING FIXTURES AND EQUIPMENT

VII.4.1.1. Refer to JEA's *Facilities Standards Manual* for acceptable plumbing fixtures and equipment.

VII.5. EMERGENCY SAFETY EQUIPMENT

Combination safety shower/eyewash units will be installed in all chemical areas. Access to these units shall be unobstructed.

VII.6. CROSS CONNECTION CONTROL

VII.6.1. Cross connection control will be provided in accordance with the Standard Plumbing Code and JEA's *Facilities Standards Manual*. As an example, reduced pressure zone backflow preventers will be installed for the following, as a minimum:

VII.6.1.1. Main building cold water service.

VII.6.1.2. Water supply for mechanical equipment and instruments.

VII.6.1.3. As separation between Potable Cold Water and Non-potable Cold Water.

VII.6.2. Backflow preventers outside shall be placed in an insulated enclosure.

VII.7. FIRE PROTECTION

VII.7.1. Fire protection system for buildings will be determined during the design phase. Design, layout and installation of all fire protection systems will be the responsibility of the Fire Sprinkler contractor. Plumbing drawings shall show fire sprinkler water supply into each building, location of fire sprinkler rise and fire department connection, and detail of the water riser.

VII.7.2. Performance specifications for automatic fire sprinkler systems shall be provided and shall list in detail the building to be protected, type of fire sprinkler systems, and design criteria for each building fire sprinkler system. Design criteria shall include building hazard occupancy rating, gpm/sq. ft. density rating, and area of sprinkler operation. In addition, specifications will include all

JEA Water and Wastewater Standards

equipment and material required for each fire protection system. Specifications may include the following systems, as required by the building served:

- VII.7.3. Wet Pipe Fire Sprinkler System for heated buildings.
- VII.7.4. Dry Pipe Fire Sprinkler System for unheated buildings.
- VII.7.5. Chemical Dry System in pump room (NFPA 2001 – FM 200).
- VII.7.6. All building fire protection design requirements shall be coordinated with the authorities having jurisdiction prior to completion of building design.

VIII. HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS

VIII.1. GENERAL

- VIII.1.1. Systems shall be as specified in JEA's Facilities Standards Manual (current edition), Division 23.81.23.
- VIII.1.2. HVAC equipment, ductwork and air distribution devices serving corrosive areas shall be provided with protective coatings and/or constructed from corrosion resistant materials such as fiberglass reinforced plastic, or stainless steel. In addition, comply with JEA's Facilities Standards (current edition), Division 23.05.50.
- VIII.1.3. Outdoor condensing units shall be located adjacent to the building served on a concrete equipment pad. Units coils shall be dip coated with a corrosion and moisture resistant film barrier that will protect the coils from caustic airborne deposits and corrosive fumes that may be present in the plant environment. Evaporators and condensers shall have copper coils.
- VIII.1.4. Control systems shall be stand-alone electric or microprocessor based electronic type as required to accomplish system sequences. Refer to JEA's Facilities Standards (current edition), Division 23.09.13 for thermostat requirements.
- VIII.1.5. All electric motors will be high efficiency type, where available.
- VIII.1.6. All heating units shall be electric.

VIII.2. DESIGN CONDITIONS

Outside Design:

Summer: 96 deg. F. DB, 77 deg. F. WB.

Winter: 29 deg. F.

Elevation: 26 feet above sea level.

Air-Conditioned Areas:

Summer: 80 deg. F DB 42 percent RH (*).

Winter: 60 deg. F.

Heated & Ventilated Areas:

Summer: max. 104 deg. F DB.

Winter: min. 60 deg. F DB.

JEA Water and Wastewater Standards

Relative humidity will not be tightly controlled and will fluctuate between 40 and 60 percent.

VIII.3. CODES AND STANDARDS

Codes Adopted and Enforced by the City of Jacksonville

Access	Florida Accessibility Code/latest edition
Building	Standard Building Code/latest edition
Electrical	National Electrical Code/latest edition
Energy	State of Florida Energy Efficiency Code/latest edition
Fire	Standard Fire Prevention Code/latest edition and Jacksonville ordinance code/latest edition, titles 8 and 12
Mechanical	Standard Mechanical Code/latest edition
Plumbing	Standard Plumbing Code/latest edition
Safety	Life Safety Code NFPA 101/latest edition

Standards

ASHRAE	Fundamentals Handbook/latest edition
ASHRAE	Std. 62. Ventilation for Acceptable Indoor Air Quality/latest edition
SMACNA	Duct Construction Standards, Metal and Flexible/latest edition
NFPA 13	Fire Sprinkler Systems, Installation/latest edition
NFPA 90A	Air Conditioning and Ventilating Systems/latest edition

VIII.4. BUILDING ENVELOPE R-VALUES

Building envelope R-Values will be designed to meet the requirements of the most recent Building Envelope Requirements in the International Energy Conservation Code (IECC).

VIII.5. SPECIFIC BUILDING CRITERIA

▪ Electrical Room/Control Rooms/Bathroom (HVAC):

Heating:	Electric heater housed in indoor air handling unit.
Ventilation (Fresh air):	20 cfm/person, 2 cfm/ft ² for restroom/janitor.
Exhaust:	Roof mounted, centrifugal up-blast fans to handle the exhaust of the toilet rooms.
Air Conditioning:	Electric, direct expansion, split-system air handling units; number as required for effective zone temperature control. The return air shall be ducted back to the air-handling unit.
Environment:	Non-corrosive, high internal heat gain for Electrical Room, high outside air quantity required for Control Room when in use, high ventilation air quantity required for restroom.
Ductwork:	Galvanized steel with fiberglass blanket or rigid fiberglass board insulation.

▪ Hypochlorite Chemical Area:

Heating:	Electric heater housed in indoor air handling unit.
----------	---

JEA Water and Wastewater Standards

Ventilation (Fresh air):	Min: 1.0 cfm/ft ² . Max: As required for heat removal.
Exhaust	Roof mounted fiberglass exhaust fans.
Air Conditioning:	Electric, direct expansion, split-system air handling units; number as required for effective zone temperature control. The return air shall be ducted back to the air-handling unit. System shall be designed for corrosive environment (chlorine off-gas).
Environment:	Corrosive, chlorine off-gas.
Ductwork:	Fiberglass Vinyl Ester or Aluminum.

▪ **High Service Pump Room:**

Heating:	Corrosion resistant electric heaters.
Ventilation:	Continuous via intake through louvers and exhaust through roof mounted aluminum, centrifugal exhaust fans. Min: 1.0 cfm/ft ² . Max: As required for heat removal.
Environment:	Non-corrosive, heat internal heat gain from pump motors.
Ductwork:	Galvanized steel with fiberglass blanket or rigid fiberglass board insulation.
Dampers:	Galvanized steel, manual dampers to be closed before storms or if the pumps shut down during cold day.

IX. ACCEPTABLE MANUFACTURERS

Refer to JEA's *Facilities Standards Manual* for acceptable manufacturers for the equipment in the section related to facilities.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XII – ON-SITE SANITARY LIFT STATION AND SEWER, DETAILS AND MATERIALS

Refer to JEA's *Water and Wastewater Standards Manual* for the latest requirements for sanitary lift stations.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XIII – SECURITY SYSTEM STANDARDS

I. SECURITY SYSTEM

- I.1. Fencing shall be provided around the perimeter of WTPs and well sites.
- I.2. Sites located in commercial or residential areas shall be enclosed using 6-foot ornamental fencing where the site is visible to the general public, and 6-foot black vinyl chain link fencing at other locations where public visibility is low.
- I.3. Sites located in industrial areas shall be enclosed using a 6-foot black vinyl chain link fencing.
- I.4. Gate sizing will be determined by location and access requirements. Gates 20-foot and smaller shall be manual butterfly (double swing) type. Gates larger than 20-foot shall be cantilever type with hydraulic slide gate operator. Personnel access gates shall be a minimum of 4-foot wide.
- I.5. All fencing materials and installation procedures shall be in accordance with JEA's Security Standards (current edition) and JEA's Water and Wastewater Standards Manual (current edition), Section 492.
- I.6. Card readers, gate operators, security systems (fire, smoke, motion detectors, security beams) and cameras to be provided by JEA security. Construction contractor is responsible for coordination of this equipment with JEA and installation of required conduit, concrete pads and other required appurtenances.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XIV – SIGNAGE STANDARDS

I. SIGNAGE

- I.1. JEA has developed standard signage for main panel sign, safety panel, and monument signs. This signage is shown on **Exhibits XV.1, XV.2, XV.3 and XV.4**.
- I.2. Information and safety signs shall be located for high visibility and minimum restriction of the working area around walkways and equipment. Signage shall conform to the details given on **Exhibits XV.1, XV.2, XV.3, and XV.4** for Main Panel Signs, Safety Panels, and brick or CMU Monument Signs.
- I.3. Signage for Hazardous Materials shall conform to NFPA No. 704 and No. 49. Signs shall be placed at entrances to space where hazardous materials are stored, dispensed, handled, and on the sides of stationary tanks.
- I.4. All signage shall meet the requirements of OSHA.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XV – LANDSCAPING AND IRRIGATION SYSTEM STANDARDS

I. LANDSCAPING AND IRRIGATION SYSTEM

- I.1. Landscaping shall be provided to comply with the local government's tree protection ordinance and landscape requirements. Planting materials acceptable to JEA are summarized on **Exhibit XV.1**. Conceptual representations of landscape planting schemes for a water treatment plant site and a wellhead site are shown on **Exhibits XV.2** and **XV.3**.
- I.2. Refer to JEA's Water and Wastewater Standards Manual (current edition), Section 441 – Grassing.
- I.3. An irrigation system shall be provided for all trees, shrubs, and sodded areas.
- I.4. Trees shall not be planted over or near WTP piping.

THIS PAGE INTENTIONALLY LEFT BLANK