SECTION 43 32 69

CHEMICAL FEED SYSTEMS
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1	(2004) Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B501	(2003) Sodium Hydroxide (Caustic Soda)
AWWA B703	(2006) Fluorosilicic Acid

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A 48	(2003; R 2008) Gray Iron Castings
ASTM E 1067	(2007) Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels

HYDRAULIC INSTITUTE (HI)

HI 7.1-7.5	(2002) Controlled Volume Metering Pumps
HI 9.1-9.5	(2000) Pumps - General Guidelines for Types, Applications, Definitions, Sound Measurements and Documentation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2005) Standard for Industrial Control and Systems General Requirements
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and

	Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA MG 1	(2007) Standard for Motors and Generators

PLUMBING-HEATING-COOLING CONTRACTORS NATIONAL ASSOCIATION (PHCC)

NAPHCC NSPC	(2003) National Standard Plumbing Code

UNDERWRITERS LABORATORIES (UL)

UL 50	(2007) Standard for Enclosures for Electrical Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G

Detail drawings containing complete piping, wiring, schematic, flow diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for installation, maintenance and operation.

SD-03 Product Data

Chemical Feed Systems; G

Manufacturer's descriptive and technical literature, catalog cuts, performance charts, and pump curves. List of materials, list of equipment, including a complete list of parts and supplies with current unit prices and source of supply. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.

Material Safety Data Sheets

Material safety data sheets, as specified.

Framed Instructions

Installation instructions and framed instructions.

Auxiliary Equipment and Spare Parts

List of parts recommended by the manufacturer to be replaced after 1 and 3 years service.

SD-05 Design Data

Calculations

The equipment anchorage calculations shall be stamped and signed by a registered Civil or Structural Engineer currently licensed in the State of California. Design criteria is as stated on Drawing G-10, Structural Construction Notes.

SD-06 Test Reports

Factory Test Report

A copy of the ASTM E 1067 test report shall be furnished with each fiberglass tank.

Field Testing

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Chemicals

Two copies of certification stating that each chemical supplied meets the specified requirements.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. The instructions shall include as-built drawings of the piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. Flow diagrams shall be included in the instructions.

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble-shooting guides.

1.3 SYSTEM DESCRIPTION

Chemical feed systems shall consist of a chemical supply storage tank (see Section 43 40 02, FIBERGLASS REINFORCED PLASTIC TANK), from which the chemical solution shall be pumped through piping to the point of application. Each chemical feed system shall include controlled volume pumps, tanks, gauges, back pressure regulators, strainers, pressure relief valves, sight glasses and flow metering devices, check valves, and hand valves; Control Panel (supplied 480 VAC, three-phase, 60 Hz), VFD speed

control and interface control logic to Plant Control System.

1.3.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.3.2 Design Requirements

Design and fabrication of the pumps shall be in accordance with HI 7.1-7.5 and HI 9.1-9.5 except as modified herein. Pump stands and platforms shall be adequate to support the pumping system. Perform equipment anchorage calculations in accordance with the design criteria stated on Drawing G-10. Calculating shall be stamped and signed by a Registered Civil or Structural Engineer licensed in the State of California.

1.3.3 Performance Requirements

Capacity and design of the chemical feed systems and accessories shall be suitable for 24-hour full load service in ambient, non freezing conditions.

1.3.4 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.3.5 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.4 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.5 DELIVERY AND STORAGE

Material and equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation, dirt, dust, or other contaminants.

1.6 AUXILIARY EQUIPMENT AND SPARE PARTS

Concurrent with delivery and installation of the specified equipment, auxiliary equipment and spare parts shall be furnished as follows:

a. Spare parts for each different item of material and equipment specified including all of the parts recommended by the manufacturer to be replaced after 1 and 3 years service.

b. For each machine: one extra of each part used that is made from glass, hard rubber, or clear plastic; one extra set of solution-hose connections; one extra set of diaphragms, two filler plug seal washers; two ball checks; two seats; two complete sets of all gaskets; one spare diaphragm for each back pressure regulator; one hydraulic plunger assembly for each different size metering pump; one of each type of material back pressure regulator, with three spare springs and fluorocarbon resin diaphragms for each; one spare diaphragm and air valve for pulsation dampener.

c. For each different size of direct current motor one SCR circuit board with 12 drive motor fuses and 12 SCR controller fuses; overload replacement elements for each size and type of motor.

d. One set of special tools for each type of equipment including calibration devices, and instruments required for adjustment, calibration, disassembly, operation, and maintenance of the equipment.

e. Two pairs of safety goggles and/or face shields, two chemical resistant aprons, and two pairs of chemical resistant gloves in one or more wall mounted steel cases.

f. One assembly tool for tubular diaphragm.

g. One lever type grease gun or other lubricating device for each type of grease required.

h. One or more steel tool cases mounted on the wall in a convenient location complete with flat key locks, two keys, and clips or hooks to hold each special tool.

PART 2 PRODUCTS

2.1 CHEMICALS

The Contractor shall submit Material Safety Data Sheets in conformance with ANSI Z400.1 for each chemical. Chemicals shall conform to the following:

2.1.1 Acids

Citric acid.

2.1.2 Bases

AWWA B501 caustic soda.

2.1.3 Disinfecting Agents

AWWA B300 hypochlorites.

2.1.4 Miscellaneous

Threshold inhibitor, corrosion inhibitor, 25% sodium bisulfite, 19% aqueous ammonia, RO concentrate (sample pump).

2.1.5 Prophylaxis

AWWA B703 hydrofluosilicic acid.

2.2 CONTROLLED VOLUME PUMPS

Pumps shall be controlled volume pumps as defined by HI 7.1-7.5. Each pump shall be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and shall be capable of continuous operation at rated capacity. Accuracy shall be plus or minus 2 percent over a 100 to 1 range from the required maximum capacity to the minimum pumping rate. Net positive suction head required shall not exceed 90 percent of the net positive suction head available, as installed. Construction shall be as simple as practicable to provide equipment isolation, bypass and reliable service and to be readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

Each controlled volume pump and its appurtenances (including, but not limited to, pulsation dampener, back pressure sustaining valve, pressure relief valve, ball check valves, calibration column, pressure indicator/switch/transmitter, diaphragm valves and piping) and control panel shall be provided as a package system. For each application, the controlled volume pump shall have a maximum stroking speed of 116 strokes per minute.

Bearings shall be tapered roller or needle type. Gearing shall be polished steel or bronze worm type. Mount bearings and internal working parts in weather-resistant gear box with moving parts oil flooded.

Lubricant shall be nontoxic food grade quality. Manufacturer shall provide all lubricant required for plant startup.

The pump hydraulic system shall automatically relieve gases, and compensate for process condition upsets. The system shall not allow the pumping diaphragm to stretch or operate beyond its normal range. Motors shall be squirrel-cage induction or permanent magnet direct current type as noted or shown and shall have CISD-TEFC or TENV enclosures per NEMA MG 1.

2.2.1 Base Feed System

The following shall be provided for sodium hydroxide caustic soda solution delivery.

a. Concentration: 50 percent.

b. Number of pumps: 2.

c. Type of pump: hydraulically coupled diaphragm.

d. Configuration: Simplex.

e. Controls: Automatic manual speed adjustment with manually adjustable stroke length positioner.

f. Feed/flow rate: Minimum 0.1 gph; maximum 3.0 gph at 120 psi.

g. Back pressure at point of injection: 45 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 46 psig. Regulators shall be of Type 316 stainless steel construction with diaphragms.

h. Suction valve cartridge: Single ball check.

i. Discharge valve cartridge: Single ball check.

j. Materials of construction allowed for wetted parts: Type 316 stainless steel, with compression molded PTFE diaphragm.

k. Ball check valves shall be Type 316 stainless steel.

l. Pressure relief valve shall be Type 316 stainless steel with PTFE diaphragm.

m. Pulsation Dampener shall be polypropylene.

n. Injection quill shall be Type 316 stainless steel.

o. Motor shall be 1/2-hp, 460-volt, 3-phase, 60 hz, TEFC, inverter duty.

2.2.2 Disinfecting Agent Feed Systems

The following shall be provided for hypochlorite solution delivery.

a. Concentration: 0.8 percent.

b. Number of pumps: 2 for upstream of clearwell; 2 for downstream of clearwell; 2 for upstream of Fe/Mn Removal System.

c. Type of pump: hydraulically coupled diaphragm.

d. Configuration: Simplex.

e. Controls: Automatic speed adjustment with manually adjustable stroke length positioner.

f. Feed/flow rate:

1. Minimum 15 gph; maximum 100 gph for upstream of clearwell at 120 psi.

2. Minimum 15 gph; maximum 100 gph for downstream of clearwell at 120 psi.

3. Minimum 30 gph; maximum 250 gph for upstream of Fe/Mn Removal System at 12- psi.

g. Back pressure at point of injection: Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open as shown below. Regulators shall be of Hastelloy C construction with PTFE diaphragms.

1. Set at 45 psig and adjusted to crack open at 46 psig for upstream of clearwell.

2. Set at 110 psig and adjusted to crack open at 111 psig for downstream of clearwell.

3. Set at 100 psig and adjusted to crack open at 101 psig for upstream of Fe/Mn removal.

h. Suction valve cartridge: Single ball check.

i. Discharge valve cartridge: Single ball check.

j. Materials of construction allowed for wetted parts: Hastelloy C with compression molded PTFE diaphragm.

k. Ball check valves shall be Hastelloy-C.

l. Pressure relief valve shall be Hastelloy-C with PTFE diaphragm.

m. Pulsation Dampener shall be PVDF.

n. Injection quill shall be Kynar.

o. Motors shall be 460-volt, 3-phase, 60 hz, TEFC, inverter duty.

1. 1-hp for upstream of clearwell.

2. 1-hp for downstream of clearwell.

3. 2-hp for upstream of Fe/Mn removal.

2.2.3 Miscellaneous Feed System

2.2.3.1 Corrosion Inhibitor System

The following shall be provided for threshold inhibitor.

a. Concentration: 100 percent.

b. Number of pumps: 2.

c. Type of pump: hydraulically coupled diaphragm.

d. Configuration: Simplex.

e. Controls: Automatic speed adjustment with manually adjustable stroke length positioner.

f. Feed/flow rate: Minimum 0.2 gph; maximum 2.0 gph at 120 psi.

g. Back pressure at point of injection: 100 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 101 psig. Regulators shall be of Type 316 stainless steel construction with PTFE diaphragms.

h. Suction valve cartridge: Single ball check.

i. Discharge valve cartridge: Single ball check.

j. Materials of construction allowed for wetted parts: Type 316 stainless steel,with compression molded PTFE diaphragm.

k. Ball check valves shall be Type 316 stainless steel.

l. Pressure relief valve shall be Type 316 stainless steel with PTFE diaphragm.

m. Pulsation Dampener shall be PVC.

n. Injection quill shall be Type 316 stainless steel.

2.2.3.2 Threshold Inhibitor System

The following shall be provided for corrosion inhibitor solution delivery.

a. Concentration: 100 percent.

b. Number of pumps: 2.

c. Type of pump: Horizontal peristaltic hose pump, capable of operating in either direction without flow variation and running dry without damage to pump or hose.

d. Pump Configuration: direct or close-coupled

e. Pump Housing: Cast iron ASTM A 48 Class 25. Housing shall be supplied with an internally mounted bearing hub and rotor assembly. Gear unit shall be direct coupled to the back of the pump housing and shall be completely isolated from the process fluid and pump lubricant through the sealed bearing hub. Gear unit and drive components shall be serviceable without removal of pump rotor.

f. Pump Rotor Assembly: Cast iron ASTM A 48 Class 25 with two pressing shoes mounted 180 degrees apart and adjustable for varying degrees of compression via flat shims constructed of Type 316 stainless steel. Rotors incorporating rollers or fixed occlusion shoes are unacceptable. Pump rotor shall be independently supported on its own set of ball bearings such that the bearings are located directly under the rotor's load. Bearings shall be supported by the bearing hub located within the pump housing and shall be sealed via a dynamic seal constructed of Buna N and greased for life. No other configuration is acceptable. Pumphead rotor shall be driven and connected to the gearing via a splined shaft, keyed shafts are not acceptable.

g. Pump Gearing: Provide foot mounted helical gearbox (or planetary gearing) with splined output shaft and direct coupled mounting face to the pump housing. Helical gearing shall be 2 or 3 stage with gear reducer housing constructed of cast iron. Gear planetary drive shall be of modular construction (1, 2 or 3 stages) as required with each module consisting of an internal gar meshing with 4 planetary gears mounted on the planet carrier which shall engage with the sun pinion. Construct gears and shafts of alloy steel, planet carriers in modular cast iron or steel and housing of cast iron. Gear reduction shall be designed to match output speed requirement of the pump using 2 or 3 stage gearing and matching torque rating of pump equipment. Gearing shall be classified continuous heavy shock duty, AGMA Class II, 24-hr duty with a minimum of 1.4 service factor.

h. Pump Connectors: Flanged inlet and outlet to ANSI/ASA 150 pounds, galvanized steel (15 microns minimum) and provided with wetted inserts compatible with hyrdofluosilicic acid. Pump hose shall extend from the pumping chamber to allow visual confirmation of hose/flange insert connection, secured to the pump hose via a single band clamp.

i. Pump Hose: Manufactured of three-layer elastomer with an extruded inner wetted layer compatible with threshold inhibitor, four layers of nylon reinforcement, and a Natural Rubber outer layer. Hose outside

diameter shall be machined to maintain a wall thickness within + 0.25 mm tolerance. The hose external surface shall have roughness of Ra 8 + 4µ. Minimum static burst pressure rating of 800 psi and 53-68 shore A durometer. Hose shall be replaceable without cover or pump removal. Pump housing shall contain a NSF-listed food-grade glycerin based hose lubricant blended to provide a medium for cooling and lubrication. Provide a threaded drain plug at the lowest point of the pumping chamber to allow the complete drainage of lubricant.

j. Pump Cover: Cast Iron ASTM A 48 Class 25, fitted with a fixed window to view direction of rotation of the pump and marked with a minimum lubricant registration mark. Cover shall be retained to the housing by no more than four hex head bolts and shall be equipped with two grips to allow quick and easy removal for replacement of the pressing shoes or shim adjustment. Pump cover shall be sealed to the pumphead via a captive Buna-N quadring seal and pump hardware shall be Type 316 stainless steel.

k. Pump Support Frame: Torsion free and made of formed hot dipped galvanized steel (15 microns minimum). Welded steel or modular adjustable frames are not acceptable.

l. High Lubricant Leak Detector: Float type magnetic reed switch, rated at 50VA, to detect leakage of pumped product into the pump housing. Mount switch near the top of the pump and on the rear of the pump housing. Supply sensor Normally Closed with the ability for field adjustment to Normally Open.

m. Revolution Sensor: Provide inductive type sensor, rated at 4.5 VA, to detect rotor revolutions. Mount the sensor on the rear of the pump housing.

n. Feed/flow rate: Minimum 0.1 gph; maximum 1.0 gph.

o. Back pressure at point of injection: 45 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 46 psig. Regulators shall be of Type 316 stainless steel construction with PTFE diaphragms.

p. Pressure relief valve shall be Type 316 stainless steel with PTFE diaphragm.

q. Pulsation Dampener shall be PVC.

r. Injection quill shall be Type 316 stainless steel.

s. Motors shall be 1/2-hp, 460-volt, 3-phase, 60 hz, TEFC, inverter duty.

2.2.3.3 Sodium Bisulfite System

The following shall be provided for sodium bisulfite solution delivery.

a. Concentration: 25 percent.

b. Number of pumps: 2.

c. Type of pump: hydraulically coupled diaphragm.

d. Configuration: Simplex.

e. Controls: Automatic speed adjustment with manually adjustable stroke length positioner.

f. Feed/flow rate: Minimum 0.5 gph; maximum 10.0 gph at 120 psi.

g. Back pressure at point of injection: 100 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 101 psig. Regulators shall be of Type 316 stainless steel construction with PTFE diaphragms.

h. Suction valve cartridge: Single ball check.

i. Discharge valve cartridge: Single ball check.

j. Materials of construction allowed for wetted parts: Type 316 stainless steel with compression molded PTFE diaphragm.

k. Ball check valves shall be Type 316 stainless steel.

l. Pressure relief valve shall be Type 316 stainless steel with PTFE diaphragm.

m. Pulsation Dampener shall be PVC.

n. Injection quill shall be Type 316 stainless steel.

2.2.3.4 Aqueous Ammonia System

The following shall be provided for aqueous ammonia solution delivery.

a. Concentration: 19 percent.

b. Number of pumps: 2.

c. Type of pump: hydraulically coupled diaphragm.

d. Configuration: Simplex.

e. Controls: Automatic speed adjustment with manually adjustable stroke length positioner.

f. Feed/flow rate: Minimum 0.1 gph; maximum 1.0 gph.

g. Back pressure at point of injection: 110 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 111 psig. Regulators shall be of Type 316 stainless steel construction with PTFE diaphragms.

h. Suction valve cartridge: Single ball check.

i. Discharge valve cartridge: Single ball check.

j. Materials of construction allowed for wetted parts: Type 316 stainless steel with compression molded PTFE diaphragm.

k. Ball check valves shall be Type 316 stainless steel.

l. Pressure relief valve shall be Type 316 stainless steel with PTFE diaphragm

m. Pulsation Dampener shall be PVC

n. Injection quill shall be Kynar

2.2.3.5 RO Concentrate (Sample Pump)

The following shall be provided for RO Concentrate sampler pump.

a. Number of pumps: 1.

b. Type of pump: Horizontal peristaltic hose pump, capable of operating in either direction without flow variation and running dry.

c. Pump Configuration: direct or close-coupled

e. Pump Housing: Cast iron ASTM A 48 Class 25. Housing shall be supplied with an internally mounted bearing hub and rotor assembly. Gear unit shall be direct coupled to the back of the pump housing and shall be completely isolated from the process fluid and pump lubricant through the sealed bearing hub. Gear unit and drive components shall be serviceable without removal of pump rotor.

d. Pump Rotor Assembly: Cast iron ASTM A 48 Class 25 with two pressing shoes mounted 180 degrees apart and adjustable for varying degrees of compression via flat shims constructed of Type 316 stainless steel. Rotors incorporating rollers or fixed occlusion shoes are unacceptable. Pump rotor shall be independently supported on its own set of ball bearings such that the bearings are located directly under the rotor's load. Bearings shall be supported by the bearing hub located within the pump housing and shall be sealed via a dynamic seal constructed of Buna N and greased for life. No other configuration is acceptable. Pumphead rotor shall be driven and connected to the gearing via a splined shaft, keyed shafts are not acceptable.

e. Pump Gearing: Provide foot mounted helical gearbox (or planetary gearing) with splined output shaft and direct coupled mounting face to the pump housing. Helical gearing shall be 2 or 3 stage with gear reducer housing constructed of cast iron. Gear planetary drive shall be of modular construction (1, 2 or 3 stages) as required with each module consisting of an internal gar meshing with 4 planetary gears mounted on the planet carrier which shall engage with the sun pinion. Construct gears and shafts of alloy steel, planet carriers in modular cast iron or steel and housing of cast iron. Gear reduction shall be designed to match output speed requirement of the pump using 2 or 3 stage gearing and matching torque rating of pump equipment. Gearing shall be classified continuous heavy shock duty, AGMA Class II, 24-hr duty with a minimum of 1.4 service factor.

f. Pump Connectors: Flanged inlet and outlet to ANSI/ASA 150 pounds, galvanized steel (15 microns minimum) and provided with wetted inserts compatible with RO concentrate. Pump hose shall extend from the pumping chamber to allow visual confirmation of hose/flange insert connection, secured to the pump hose via a single band clamp.

g. Pump Hose: Manufactured of three-layer elastomer with an extruded inner wetted layer compatible with RO concentrate, four layers of nylon

reinforcement, and a Natural Rubber outer layer. Hose outside diameter shall be machined to maintain a wall thickness within + 0.25 mm tolerance. The hose external surface shall have roughness of Ra 8 + 4µ. Minimum static burst pressure rating of 800 psi and 53-68 shore A durometer. Hose shall be replaceable without cover or pump removal. Pump housing shall contain a NSF-listed food-grade glycerin based hose lubricant blended to provide a medium for cooling and lubrication. Provide a threaded drain plug at the lowest point of the pumping chamber to allow the complete drainage of lubricant.

h. Pump Cover: Cast Iron ASTM A 48 Class 25, fitted with a fixed window to view direction of rotation of the pump and marked with a minimum lubricant registration mark. Cover shall be retained to the housing by no more than four hex head bolts and shall be equipped with two grips to allow quick and easy removal for replacement of the pressing shoes or shim adjustment. Pump cover shall be sealed to the pumphead via a captive Buna-N quadring seal and pump hardware shall be Type 316 stainless steel.

i. Pump Support Frame: Torsion free and made of formed hot dipped galvanized steel (15 microns minimum). Welded steel or modular adjustable frames are not acceptable.

j. High Lubricant Leak Detector: Float type magnetic reed switch, rated at 50VA, to detect leakage of pumped product into the pump housing. Mount switch near the top of the pump and on the rear of the pump housing. Supply sensor Normally Closed with the ability for field adjustment to Normally Open.

k. Revolution Sensor: Provide inductive type sensor, rated at 4.5 VA, to detect rotor revolutions. Mount the sensor on the rear of the pump housing.

l. Feed/flow rate: 1.5 gpm at 15 feet.

m. Motors shall be 3/4-hp, 115-volt, 1-phase, 60 hz, TEFC.

2.2.4 Prophylaxis Feed System

The following shall be provided for hydrofluosilicic acid solution delivery.

a. Concentration: 25 percent.

b. Number of pumps: 2.

c. Type of pump: Horizontal peristaltic hose pump, capable of operating in either direction without flow variation and running dry without damage to pump or hose.

d. Pump Configuration: direct or close-coupled

e. Pump Housing: Cast iron ASTM A 48 Class 25. Housing shall be supplied with an internally mounted bearing hub and rotor assembly. Gear unit shall be direct coupled to the back of the pump housing and shall be completely isolated from the process fluid and pump lubricant through the sealed bearing hub. Gear unit and drive components shall be serviceable without removal of pump rotor.

f. Pump Rotor Assembly: Cast iron ASTM A 48 Class 25 with two pressing

shoes mounted 180 degrees apart and adjustable for varying degrees of compression via flat shims constructed of Type 316 stainless steel. Rotors incorporating rollers or fixed occlusion shoes are unacceptable. Pump rotor shall be independently supported on its own set of ball bearings such that the bearings are located directly under the rotor's load. Bearings shall be supported by the bearing hub located within the pump housing and shall be sealed via a dynamic seal constructed of Buna N and greased for life. No other configuration is acceptable. Pumphead rotor shall be driven and connected to the gearing via a splined shaft, keyed shafts are not acceptable.

g. Pump Gearing: Provide foot mounted helical gearbox (or planetary gearing) with splined output shaft and direct coupled mounting face to the pump housing. Helical gearing shall be 2 or 3 stage with gear reducer housing constructed of cast iron. Gear planetary drive shall be of modular construction (1, 2 or 3 stages) as required with each module consisting of an internal gar meshing with 4 planetary gears mounted on the planet carrier which shall engage with the sun pinion. Construct gears and shafts of alloy steel, planet carriers in modular cast iron or steel and housing of cast iron. Gear reduction shall be designed to match output speed requirement of the pump using 2 or 3 stage gearing and matching torque rating of pump equipment. Gearing shall be classified continuous heavy shock duty, AGMA Class II, 24-hr duty with a minimum of 1.4 service factor.

h. Pump Connectors: Flanged inlet and outlet to ANSI/ASA 150 pounds, galvanized steel (15 microns minimum) and provided with wetted inserts compatible with hyrdofluosilicic acid. Pump hose shall extend from the pumping chamber to allow visual confirmation of hose/flange insert connection, secured to the pump hose via a single band clamp.

i. Pump Hose: Manufactured of three-layer elastomer with an extruded inner wetted layer compatible with hydrofluosilicic acid, four layers of nylon reinforcement, and a Natural Rubber outer layer. Hose outside diameter shall be machined to maintain a wall thickness within + 0.25 mm tolerance. The hose external surface shall have roughness of Ra 8 + 4µ. Minimum static burst pressure rating of 800 psi and 53-68 shore A durometer. Hose shall be replaceable without cover or pump removal. Pump housing shall contain a NSF-listed food-grade glycerin based hose lubricant blended to provide a medium for cooling and lubrication. Provide a threaded drain plug at the lowest point of the pumping chamber to allow the complete drainage of lubricant.

j. Pump Cover: Cast Iron ASTM A 48 Class 25, fitted with a fixed window to view direction of rotation of the pump and marked with a minimum lubricant registration mark. Cover shall be retained to the housing by no more than four hex head bolts and shall be equipped with two grips to allow quick and easy removal for replacement of the pressing shoes or shim adjustment. Pump cover shall be sealed to the pumphead via a captive Buna-N quadring seal and pump hardware shall be Type 316 stainless steel.

k. Pump Support Frame: Torsion free and made of formed hot dipped galvanized steel (15 microns minimum). Welded steel or modular adjustable frames are not acceptable.

l. High Lubricant Leak Detector: Float type magnetic reed switch, rated at 50VA, to detect leakage of pumped product into the pump housing. Mount switch near the top of the pump and on the rear of the

pump housing. Supply sensor Normally Closed with the ability for field adjustment to Normally Open.

m. Revolution Sensor: Provide inductive type sensor, rated at 4.5 VA, to detect rotor revolutions. Mount the sensor on the rear of the pump housing.

n. Feed/flow rate: Minimum 0.02 gph; maximum 2.0 gph at 150 psi.

o. Back pressure at point of injection: 110 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 111 psig. Regulators shall be of Type 316 stainless steel construction with PTFE diaphragms.

p. Pressure relief valve shall be Type 316 stainless steel with PTFE diaphragm.

q. Pulsation Dampener shall be PVC.

r. Injection quill shall be Type 316 stainless steel.

s. Motors shall be 1/2-hp, 460-volt, 3-phase, 60 hz, TEFC, inverter duty.

2.3 MAGNETIC DRIVE CENTRIFUGAL PUMPS

Pumps shall be used to transfer chemicals from their storage tanks to other tanks. Pump shall have magnetically coupled drives that do not require shaft seals. Torque shall be transmitted by a magnetic field from the magnet attached to the motor, through the solid body to the magnet attached to the impeller. The magnetic coupling shall provide overload protection and prevent motor burnout. Design shall allow removal of motor from pump housing without draining the system.

2.3.1 Base Transfer System

The following shall be provided for sodium hydroxide caustic soda solution transfer.

a. Concentration: 50 percent.

b. Number of pumps: 2.

c. Pump capacity: 4 gpm at 25 feet TDH.

d. Materials of construction: 316 stainless steel housing, shaft and impeller; Viton O-rings; Ceramic washers, plastic motor bracket.

e. Motor shall be 1/5-hp, 115-Volt, 1-phase, 60-Hz, TEFC.

2.3.2 Acid Transfer System

The following shall be provided for citric acid solution transfer.

a. Concentration: 50 percent.

b. Number of pumps: 2.

c. Pump capacity: 20 gpm at 25 feet TDH.

d. Materials of construction: 316 stainless steel housing, and impeller; Hastelloy-C shaft, Viton O-rings; Ceramic washers and bushing, plastic motor bracket.

e. Motor shall be 1/3-hp, 115-Volt, 1-phase, 60-Hz, TEFC.

2.3.3 Prophylaxis Transfer System

The following shall be provided for hydrofluosilicic acid solution transfer.

a. Concentration: 25 percent.

b. Number of pumps: 1 installed and 1 shelf-spare.

c. Pump capacity: 7 gpm at 10 feet TDH.

d. Materials of construction: Kynar housing, and impeller; ceramic shaft and washers, Viton O-rings; and bushing, plastic motor bracket.

e. Motor shall be 1/15-hp, 115-Volt, 1-phase, 60-Hz, TEFC.

2.4 CONTROLS

The chemical metering equipment shall be provided with the appurtenances and accessories, as required, for flow capacity adjustment. Manual range adjustment shall be provided on all systems.

2.4.1 Automatic Control

Automatic control shall have the capability to vary feed rate based on signals from a flow meter and/or oxidation-reduction potential (ORP), Chlorine residual analyzer or pH meter.

2.4.1.1 Flow meter and Controller

The chemical dosage shall vary in proportion to the measured flow with the dosage per flow unit manually adjustable.

2.4.1.2 Oxidation-Reduction Potential Probe and Chlorine Residual Analyzer

Oxidation-reduction potential probe and chlorine residual analyzer shall be located where indicated on the drawings. Chemical feed rate shall be variable (trim or backfeed loop) in response to the deviation from set point.

2.4.1.3 pH Probe

pH probe shall be located where indicated on the drawings. Chemical feed rate shall be variable in response (trim or backfeed loop) to the deviation from set point.

2.4.2 For Transfer Pumps

The chemical transfer equipment shall be provided with the appurtenances and accessories, as required.

2.4.2.1 Automatic Control

Pumps shall start and stop automatically based on the signals shown on the drawings, if the HOR switch on the local control panel is set to the Remote position. The pumps shall also start and stop by using the start/stop switch if the HOR switch is set to the Hand position.

2.5 DRIVES

2.5.1 For Controlled Volume Pumps

The metering pumps shall be supplied with and driven by electric motor with variable frequency drives.

2.5.2 For Transfer Pumps

The transfer pumps shall be supplied with and driven by alternating current electric motors.

2.5.3 Electric Motor Drive

Electric motor shall be of sufficient capacity to operate the chemical metering equipment under all operating conditions without exceeding their rated nameplate current or power, or their specified temperature limits. The motors shall have starting characteristics and ruggedness necessary under the actual conditions of operations or clean-up procedures used in the areas where they will be located. Alternating current motors with power rating of 1/3 hp or less shall be 115 volts, single-phase, 60-Hz service; motors with power rating in excess of 1/3 hp shall be 460 volts, three-phase, 60-Hz service.

2.6 CALIBRATION STANDPIPES

Each set of chemical metering equipment shall be provided with a calibration standpipe for measuring pump capacity. The standpipe shall allow convenient observation of the change of fluid level for at least 2 minutes at full stroke and maximum speed settings below the overflow elevation, and shall be Pyrex for sulfuric acid and lucite for other chemicals, equipped with a flanged connection to the pump manifold and an end cap fitted with a vacuum breaker and ball valve for air venting. The standpipe shall be permanently calibrated in gallons and liters and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.7 VALVES

2.7.1 Metering Pump Valves

The metering pump shall be equipped with adjustable internal vacuum and pressure relief valve, hydraulic oil refill valve, and automatic air bleed valve. The relief valve shall be adjustable over the full pressure range of the pump and shall be preset at the factory.

2.7.2 Suction and Discharge Valves

Suction and discharge valve cartridges shall be fitted with ball checks that open to full pipe diameter.

2.7.3 Back Pressure Valve

Back pressure regulating valve shall be installed on the pump discharge at the injection point, and factory adjusted to crack open at the indicated pressure. Valve shall be full closing without pressure from an external source to prevent siphoning from chemical storage container. Valve shall throttle to maintain a minimum pressure upstream of the valve to ensure accurate metering pump operation. If upstream pressure drops below minimum setting, valve will close.

2.7.4 Pulsation Dampeners

Pulsation dampeners shall be suitably sized for the displacement of each pump. Pulsation dampeners shall have a diaphragm separating the upper chamber from the lower chamber. The upper chamber shall be charged with compressed air to 50 percent of the expected line pressure. The diaphragm shall be of molded construction and shall prevent the air charge from being dissolved in the process fluid. The upper chamber shall be equipped with a tire valve type charging valve and air pressure gauge. An air line and air hose with pressure regulator and hand-operated, lever-type valve suitable for charging the pulsation dampers shall also be provided.

2.8 PRESSURE GAUGES

Gauges shall be diaphragm type with Bourdon tube and diaphragm compartments filled completely with oil, and shall be made of materials suitable for the application. Diaphragm seals shall be installed at each gauge connection to isolate gauges from corrosion, sludge or other hazards of the process fluid. Seal material shall be compatible with the oil in the gauge and the process fluid.

2.9 INJECTORS

Injectors for chemical solution shall be introduced into the pipeline mains by means of a an injector (quill) that disperses the chemical into the process line at or near the center line of that pipe. An integral check valve shall be incorporated in the quill assembly to prevent back mixing.

2.10 PIPING

2.10.1 Backflow Preventer

Backflow prevention devices or air gaps shall be provided on tank fill lines in accordance with NAPHCC NSPC.

2.10.2 Chemical Solution Piping

Provisions shall be incorporated to allow solution piping to be conveniently and safely bled of trapped air and minimize infiltration of air bubbles. Chemical solution piping shall be in accordance with Section 40 05 13 PIPELINES, LIQUID PROCESS PIPING.

2.10.3 Plumbing

Water piping, drain, waste and vent piping shall be in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.11 ELECTRICAL WORK

Electric motor-driven equipment shall be provided complete with motor, motor starter or controller, and controls. Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.11.1 Variable Frequency Drives

Variable frequency drives shall be provided in accordance with Section 26 29 23, VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 volts.

2.11.2 Control and Protective Devices

Manual or automatic control and protective or signal devices required for the operation and any control wiring required for controls and devices shall be provided. Motor controls shall conform to NEMA ICS 1 or NEMA ICS 2. Equipment shall be prewired to the maximum practicable extent. Control cabinets shall conform to the requirements of UL 50, NEMA 250, NEMA 4X, Type 316 stainless steel.

2.11.3 Drive Unit

2.11.3.1 For Controlled Volume Pumps

Drive unit shall include separate control panel with speed indication in percent, HAND/OFF/REMOTE selector switch, and manual adjustable potentiometer for adjustment of pump speed when in HAND position. Drive shall accept external 4-20 mA dc control signal to provide linear adjustment of pump speed form zero to 100 percent when in REMOTE position. Provide common FAULT and RUNNING discrete output signals. Provide 4-20 mA analog output signal for drive speed. LCP shall also have power ON and pump RUNNING indicator lights, START and STOP push buttons. Provide pilot lights and alarm contacts shown on Drawings.

2.11.3.2 For Transfer Pumps

A local control panel with power supply as required; switches, pushbuttons, indicating lights, alarms, flow indication, discrete inputs and outputs, 4-20 mA signals, as shown on the drawings shall be provided.

2.12 EQUIPMENT APPURTENANCES

Bolts, nuts, anchors, washers and all other types of supports necessary for the installation of the equipment shall be galvanized steel, cadmium plated or Type 316 stainless steel.

2.13 FACTORY PAINTING

Factory painting shall conform to manufacturer's standard factory finish, provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Coating shall be not less than 1.75 mils thick.

2.14 FACTORY TEST REPORT

Factory examination of fiberglass tanks shall be in accordance with ASTM E 1067 prior to shipping. A copy of the corresponding test report shall be furnished with each tank.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Chemical Feeding Equipment

Controlled volume pumps, transfer pumps, equipment, and appurtenances shall be installed to provide a complete and integrated system in accordance with the instruction of the manufacturer and under the direct supervision of the manufacturer's representative.

3.1.2 Pipe, Tubing, Hangers and Supports

The installation of pipes and tubes shall be in accordance with Section 40 05 13 PIPELINES, LIQUID PROCESS PIPING.

3.2 FIELD PAINTING

Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and top-coated with the manufacturer's standard factory finish provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Equipment which did not receive a factory finish shall be painted as specified in Section 09 90 00.00 40 PAINTING AND COATING. Coating shall be not less than 1.75 mils thick. Piping identification shall be as specified in Section 09 90 00.00 40 PAINTING AND COATING. Pipe carrying materials not listed in Section 09 90 00.00 40 PAINTING AND COATING shall be marked in accordance with ASME A13.1.

3.3 FIELD TESTING

3.3.1 Controlled Volume Pumps

After installation of each controlled volume pump, operating tests shall be carried out to assure that the chemical metering installation operates properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted. Reports of all tests shall be submitted prior to final acceptance of the installation.

Pumps shall be tested to demonstrate that the pumps are capable of operating without vibration or leakage. Testing shall be performed at the maximum design flow rate and at half the design flow rate. Testing shall be demonstrated while controlled and operated in all feasible modes with the pumps operated singly and in unison. The response of each pump shall be plotted on curves for the various operating pressures encountered and the results shall be compared to the curves shown on the manufacturer's published pump data. If control characteristic curves are not available at the time of testing, the pump manufacturer's service engineer shall generate such curves for each pump. Pump curves shall graphically depict the pump displacement at 25, 50, 75, and 100 percent of motor speed for VFD equipped pumps, and at 25, 50, 75, and 100 percent of maximum stroke position for all pumps. Curves shall be generated only for the specified back pressure.

3.3.1.1 Time, Volume and Pumping Pressure

Pumps shall be tested by filling the calibrated standpipe furnished by the Contractor with chemical and measuring the outage, with all other equipment valved off. The time, volume and pumping pressures shall be recorded.

3.3.1.2 Test Pressure

Tests shall be carried out at pressures shwon for back pressure valve settings for each application. Back pressure valves shall be manually controlled for this testing, and shall be reset as necessary after testing. The time to deliver a given quantity of chemical at a given stroke and speed setting shall be the same at all pressures.

3.3.1.3 Flow

Pumps shall be tested to demonstrate zero gpm flow at a zero stroke or speed setting. Failure to meet this test will be cause for rejection.

3.3.1.4 Synchronization

The pumps shall be operated for a period of 4 hours to demonstrate that the double diaphragm systems do not lose their synchronization. Loss of synchronization shall also be cause for rejection and the pump shall be repaired or replaced as necessary. Repaired or replaced equipment shall be fully retested.

3.3.2 Transfer Pumps

After installation of each transfer pump, operating tests shall be carried out to assure that the chemical transfer installation operates properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted. Reports of all tests shall be submitted prior to final acceptance of the installation.

Pumps shall be tested to demonstrate that the pumps are capable of operating without vibration or leakage. Testing shall be performed at the maximum design flow rate and at half the design flow rate. Testing shall be demonstrated while controlled and operated in all feasible modes with the pumps operated singly and in unison. The response of each pump shall be plotted on curves for the various operating pressures encountered and the results shall be compared to the curves shown on the manufacturer's published pump data.

3.3.3 Chemical Waste

Chemicals wasted during testing procedures shall be neutralized to achieve a pH value between 6.5 and 9.5 and a chlorine concentration of not more than 1 percent (10,000 mg/L). All chemicals wasted during testing procedures shall be routed through the treatment process at a rate that the process can assimilate without upset.

3.4 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams shall be posted where directed. Condensed operating instructions shall be posted as specified above.

3.5 FIELD TRAINING

The Contractor shall conduct a field training course for designated operating, maintenance and supervisory staff members. Training shall be provided for a total period of 16 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the Operating and Maintenance Instructions.

-- End of Section --