1. GENERAL

1.1 Background

.1 The City of Winnipeg treats and supplies potable water to a population of approximately 632,000 people. The source of supply for the City of Winnipeg is surface water originating from Shoal Lake. The water is chlorinated at the intake and is conveyed via an Aqueduct to the Deacon reservoir, located just east of the City. The Deacon reservoir consists of four (4) open cells and holds approximately 14 to 28 days supply for the City. Water is rechlorinated as it leaves the reservoir through two branch Aqueducts. The Water Distribution System contains three regional distribution reservoirs and pumping stations.

.2 The City of Winnipeg wishes to enhance the treatment of its potable water. Currently the City is in the process of working toward the commissioning of UV disinfection equipment, which will be located after the Deacon reservoir to assist in inactivation of *Giardia* and *Cryptosporidium*.

.3 The treatment process will be further enhanced by the construction of a filtration plant. The new filtration plant will consist of coagulation with ferric chloride, flocculation, clarification using DAF, ozonation, filtration, followed by disinfection using chlorine, UV light, and chloramination.

.4 Chemical systems required in the treatment process include but are not limited to the following:

.1 Sodium Hypochlorite generation and feeding equipment.

.2 Ferric Chloride offloading, storage, and feeding equipment.

.3 Sodium Hydroxide offloading, storage, and feeding equipment.

.4 Sulphuric Acid offloading, storage, and feeding equipment.

.5 Ammonium Hydroxide offloading, storage, and feeding equipment.

1.2 Requirements

.1 The provisions of this Section shall apply to all equipment except where otherwise indicated.

1.3 Reference Specifications, Codes, and Standards

.1 Equipment shall be in accordance with the latest edition of the following standards, as applicable and as indicated in each equipment Specification:

.1 AGMA

.2 ASTM

.3 ANSI

.4 ASME

.5 AWWA

.6 ASHRAE

.7 AWS

.8 NFPA

.9 NEMA

.10 Manufacturer's published recommendations and Specifications.

.11 General Industry Safety Orders (OSHA).

.12 CSA

.13 ULC

.2 The following standards are referenced in this Section:

.1 ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

.2 ANSI B16.5 - Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys.

.3 ANSI B46.1 - Surface Texture.

.4 ASME B1.20.1 - General Purpose Pipe Threads (Inch).

.5 ASME B31.1 - Power Piping.

.6 ASME B31.3 – Process Piping

.7 AWWA C206 - Field Welding of Steel Water Pipe.

.8 AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm).

.9 ASTM A 48 - Gray Iron Castings.

.10 ASTM A 108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.

1.4 Contractor Submittals

.1 Shop Drawings: Furnish submittals in accordance with Section 01300 – Submittals.

.2 Equipment Installation: Complete all documentation as required within Section 01650 – Equipment Installation.

.3 Manuals: Provide manuals as specified within Section 01730 – Operation & Maintenance Manuals.

.4 Spare Parts List: A spare parts list complete with the name, address, and telephone number of the nearest distributor for each piece of equipment shall be provided. Include current prices for each spare part.

1.5 Quality Assurance

.1 Costs: Pay all costs of inspection, testing, adjustment, and instruction services performed by Manufacturer's representatives. The City will pay for power, chemicals, and water.

.2 Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

.1 Machine Work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1.5 mm for members 10 m or less in length, and not greater than 3 mm for members over 10 m in length.

.2 Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5% of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures.

.3 All materials shall meet the physical and mechanical properties in accordance with the reference standards.

.3 Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:

.1 Surface roughness not greater than 1.575 µ shall be required for all surfaces in sliding contact.

.2 Surface roughness not greater than 6.25 µ shall be required for surfaces in contact where a tight joint is not required.

.3 Rough finish not greater than 12.5 µ shall be required for other machined surfaces.

.4 Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 0.8 µ.

2. PRODUCTS

2.1 General Requirements

.1 Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 85 dBA for one (1) hour exposure per day.

.2 Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical motors, load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Blowers		
centrifugal or vane	1.0	Uniform
lobe	1.25	Moderate Shock
Pumps		
centrifugal or rotary	1.0	Uniform
progressing cavity	1.0	Uniform
Mixers		
Mixer/agitator	1.25	Moderate Shock

.3 Mechanical Service Factors

	Mechanical Service Factors
	Electric Motor
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.00

.4 For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear Manufacturer sizing information.

.5 Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classifications and service factors for flexible couplings.

.6 Welding: Unless otherwise indicated, welding shall conform to the following:

.1 Latest revision of AWWA D100.

.2 Latest revision of AWWA C206.

.3 Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.

.4 Welding shall be by the metal-arc method or gas-shielded arc method as described in the AWS "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

.5 In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 0.8 mm ($^{1}/_{32}$-inch) on the flat.

.7 Protective Coating: Equipment shall be painted or coated as specified within each equipment Specification unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with food grade grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

.8 Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Equipment delivered to the Site with rust or corroded parts shall be rejected.

.9 Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per Manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

.10 Controls: Equipment and system controls shall be in accordance with Division 17 – Instrumentation.

2.2 Equipment Supports

.1 Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10% of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in Manitoba, unless otherwise indicated.

2.3 Couplings

.1 Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the Manufacturer, coupling type shall be Supplied with the respective equipment as follows:

Equipment Type	Coupling Type
Direct or driven pumps	Gear or flexible spring
Single stage centrifugal blowers	Flexible disc pack

.2 Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The equipment Manufacturer shall select or recommend the size and type of coupling required to suit each specific application.

.3 Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, two (2) sets of universal type couplings shall be Supplied and Installed.

.4 Taper-Lock or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.4 Shafting

.1 General: Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

.2 Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B106.1M, - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of two (2) in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and Keyseats.

.3 Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless Supplied as part of an equipment assembly.

.1 Low carbon cold-rolled steel shafting shall conform to ASTM A108, Grade 1018.

.2 Medium carbon cold-rolled shafting shall conform to ASTM A108, Grade 1045.

.3 Other grades of carbon steel alloys shall be suitable for service and load.

.4 Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

.4 Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with two (2) sets of universal type couplings shall be provided.

2.5 Gears & Gear Drives

.1 Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94%. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used.

.2 Gear speed reducers or increasers shall be of the enclosed type, oil or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.

.3 Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.

.4 Material selections shall be left to the discretion of the Manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have two (2) positive seals to prevent oil leakage.

.5 Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be provided when necessary.

.6 Where gear drive input or output shafts from one Manufacturer connect to couplings or sprockets from a different Manufacturer, gear drive Manufacturer shall furnish a matching key taped to the shaft for shipment.

.7 Protect process streams from oil and grease leaks/spills.

2.6 Drive Chains

.1 Power drive chains shall be commercial type roller chains meeting ANSI Standards.

.2 A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

.3 A minimum of one (1) connecting or coupler link shall be provided in each length of roller chain.

.4 Chain and attachments shall be of the Manufacturer's best standard material and be suitable for the process fluid.

2.7 Sprockets

.1 General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

.2 Materials: Unless otherwise indicated, materials shall be as follows:

.1 Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45% carbon range.

.2 Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20% carbon steel.

.3 Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A48, Class 30.

.3 Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

.4 Finish bored sprockets shall be Supplied complete with keyseat and set screws.

.5 To facilitate installation and disassembly, sprockets shall be of the split type or shall be Supplied with Taper-Lock bushings as required.

.6 Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.8 V-Belt Drives

.1 V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.

.2 Unless otherwise indicated, sheaves shall be machined from the finest quality grey cast iron.

.3 Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.

.4 To facilitate installation and disassembly, sheaves shall be provided complete with Taper-Lock or QD bushings as required.

.5 Finish bored sheaves shall be complete with keyseat and set screws.

.6 Sliding motor bases shall be provided to adjust the tension of V-belts.

2.9 Bearings

.1 General: Bearings shall conform to the standards of the AFBMA.

.2 To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

.3 Re-lubricatable type bearings shall be equipped with hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

.4 Lubricated-for-life bearings shall be factory-lubricated with the Manufacturer's recommended grease to insure maximum bearing life and best performance.

.5 Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of five (5) years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life (years)	L-10 Design Life (hours)
	(whichever comes first)	
8 hour shift	10	20,000
16 hour shift	10	40,000
Continuous	10	60,000

.6 Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the Manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

.7 Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing Manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing Manufacturer.

.8 Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the Manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, the Manufacturer shall Supply necessary piping, filters, and valves.

.9 Protect process streams from oil and grease leaks/spills.

2.10 Piping Connections

.1 Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

.2 Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to ANSI B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ANSI/ASME B1.20.1.

.3 Flexible Connectors: Flexible connectors shall be provided in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.

.4 Insulating Connections: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used.

2.11 Gaskets and Packings

.1 Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal".

2.12 Nameplates

.1 Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the Manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.13 Tools and Spare Parts

.1 Tools: Supply one (1) complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of all supplied equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional Work and manufactured by Snap On, Crescent, Stanley, or approved equal. The set of tools shall be neatly mounted in a labelled toolbox of suitable design provided with a hinged cover.

.2 Spare parts shall be Supplied as indicated in the individual equipment Sections. All spare parts shall be suitably packaged in a metal box and labelled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

2.14 Equipment Lubricants

.1 Install food grade lubricants for all equipment during storage and prior to initial testing of the equipment.

3. EXECUTION

3.1 Manufacturer's Representative Field Services

.1 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.

.2 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.

.3 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train O&M staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

.4 The minimum periods of Site attendance are identified in the following table along with the form to be completed on each of these trips.

.5 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

3.2 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer’s Representative and as indicated in the Contract Documents.

.2 The Manufacturer’s Representative shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Manufacturer’s Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

3.3 Equipment Performance Testing

.1 The Manufacturer’s Representative shall ensure that all equipment, including all component parts, operates as intended.

.2 The Manufacturer’s Representative shall demonstrate satisfaction of requirements specified herein.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.4 Training

.1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper O&M of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

END OF SECTION

ON SITE HYPOCHLORITE GENERATION EQUIPMENT INSTALLATION

1. GENERAL

1.1 General Requirements

.1 The Contractor shall provide all services to coordinate installation of all City Supplied Equipment supplied pursuant to Bid Opportunity # 49-2006.

.2 The Contractor shall comply with all Division 1 requirements.

.3 The Contractor shall supply and install all components, connections, accessories, etc. as specified in the Contract Documents, required to complete the installation of the City Supplied Equipment.

.4 All equipment furnished by the Supply Contractor will conform to the requirements set forth in Bid Opportunity # 49-2006.

1.2 Work by Contractor

.1 This Section covers the work necessary by the Contractor to coordinate installation of the sodium hypochlorite generation system described in Bid Opportunity # 49-2006.

.2 Unloading and installation of the City Supplied Equipment and accessories at the Site.

.3 All external conduit and wiring between separate equipment, shall be supplied and installed by the Contractor.

.4 The Contractor shall touch-up any shipping or installation damage to any paint/coating finishes, following installation.

.5 Concrete equipment pads and grouting.

.6 Prior to operation and performance verification of the Sodium Hypochlorite Generation System, the Contractor shall clean and disinfect all process piping and tanks in accordance with Section 15200-000 – Process Piping.

.7 Performance Verification assistance.

1.3 Work by Supply Contractor

.1 The Supply Contractor is responsible for supplying the on site sodium hypochlorite generation equipment as specified in Bid Opportunity # 49-2006. This includes, but is not limited to, proper sizing, testing, and performance of the onsite sodium hypochlorite generation equipment.

.2 Supply Contractor to provide services for onsite sodium hypochlorite generation equipment installation as specified in Bid Opportunity # 49-2006.

.3 The Supply Contractor will provide samples and complete descriptive specifications for the on site sodium hypochlorite generation equipment with submittals.

.4 The Supply Contractor will provide services for on site sodium hypochlorite generation equipment Performance Verification and services including installation assistance, inspection, equipment testing, start-up, installation certification and training of City personnel.

1.4 References

.1 Supply Contractor will install the on site sodium hypochlorite generation equipment to conform to the latest editions or revisions in effect at the time of the bid submission of the applicable, codes, standards, and regulations from the following regulating bodies:

.1 ANSI

.2 ASME

.3 ASTM

.4 Canadian Electrical Code

.5 IEEE: 519 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

.6 AWWA – B604.

.7 AWS

.8 CSA

.9 ESA

.10 ISA

.11 NFPA

.12 EEMAC

.13 Local codes, by-laws, and regulations.

.14 NEMA

.2 Specific regulations for each package are listed within the individual Specifications.

1.5 Submittals

.1 Submittals by Contractor shall be made as required in Section 01300 – Submittals.

.2 Complete all documentation in accordance with Section 01650 – Equipment Installation, and 01210 – City Supplied Equipment.

2. PRODUCTS

2.1 Electrical

.1 All electrical work shall comply with requirements of Divisions 16 and 17.

2.2 Mechanical

.1 All mechanical work shall comply with requirements of Divisions 9, 11, and 15.

.2 Piping shall comply with requirements of Section 15200 – Process Piping, including all Subsections.

.3 Valves shall comply with requirements of Section 15202 – Process Valves and Operators.

.4 All valves shall include factory-mounted operator, actuator, hand wheel, chain wheel, and accessories for a complete operation. All manual valves mounted 1.8 m above finished floor shall have operator extensions or chains located at an elevation of 1.2 m from the finished floor.

3. EXECUTION

3.1 Delivery of Equipment and Installation - General

.1 The on site sodium hypochlorite generation equipment shall be installed by the Contractor in accordance with the equipment Manufacturers' written recommendations and directions and requirements of Bid Opportunity # 49-2006.

.2 Contractor shall coordinate delivery, handling, storage and installation of equipment as per Section 01210 – City Supplied Equipment and Section 01650 – Equipment Installation, and complete all required Forms with the Supply Contractor and Contract Administrator.

.3 All on site sodium hypochlorite generation equipment will be received by the Contractor at the Site and unloaded in accordance with the Project Master Schedule. The Contractor shall arrange for a representative of the Contract Administrator to be present at the Site during the unloading to inspect the delivered on site sodium hypochlorite generation equipment and witness the unloading process, and take samples as required. The Supply Contractor will notify the Contractor of any special items necessary for unloading, including water supply and drainage requirements as described in the Supply Contractor installation procedures submittal. Supplying these special items for unloading shall be the responsibility of the Contractor.

.4 The Supply Contractor will provide printed procedures as a certified shop drawing submittal prior to delivery, for installation of all on site sodium hypochlorite generation equipment to the Contractor and Contract Administrator.

.5 Prior to operation and performance verification of the Sodium Hypochlorite Generation System, the Contractor shall clean and disinfect all process piping and tanks in accordance with Section 15200-000 – Process Piping.

3.2 Performance Testing

.1 The Supply Contractor shall coordinate all demonstration, functional running, and performance testing requirements with the Contract Administrator and Supply Contractor as per Division 1, including but not limited to Section 01650 – Equipment Installation, Section 01664 – Training, Section 01670 – Commissioning, Section 01210 – City Supplied Equipment, and as outlined in Bid Opportunity # 49-2006.

.2 Supply Contractor will provide assistance during performance tests, document results, and provide instructions to the Contractor who will operate the equipment as required to perform tests.

END OF SECTION

CHEMICAL SPECIALTIES

1. GENERAL

1.1 SCOPE OF WORK

.1 The Contractor shall Supply and Install:

.1 Eight (8) chemical fill station cabinets, including valves, control devices and all appurtenances, complete and operable, arranged and wired as shown in the Contract Documents. The fill station cabinets shall be of the wall-mounted type as shown on the Drawings and shall be NEMA 4X enclosures with hinged door and lock.

.2 Three (3) chemical rail car unloading arms.

.3 Two (2) chemical rail car access gangways.

.4 Two (2) rail car chemical containment systems.

1.2 References

.1 The following is a list of standards that may be referenced in this Section:

.1 CAN/CGSB-41.22-93

.2 ASTM D3299

.3 ASTM D2563

.4 API 650 latest edition

.5 NSF International, Standard 61 - Drinking Water System Components

.6 ASME

.7 ANSI

.8 ASTM

.9 CSA

.10 SSPC

.11 Manitoba Building Code

.12 OSHA

.2 FRP containment systems shall conform to the following reference standards:

.1 CAN/CGSB-41.22 Fibreglass-Reinforced Plastic Corrosion-Resistant Equipment

.2 ANSI B16.5 Pipe Flanges and Flanged Fittings

.3 ASTM C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service

.4 ASTM C582 Standard Specification for Contact-Molded RTP Laminates for Corrosion Resistant Equipment

.5 ASTM D2563 Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts

.6 ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

.7 ASTM D2584 Standard Test Method for Ignition Loss of Cured Reinforced Resins

.8 ASTM D3299 Standard Specification for Filament Wound Glass-Fibre-Reinforced Thermoset Resin Corrosion-Resistant Tanks

.9 ASTM D4097 Standard Specification for Contact-Molded Glass-Fibre-Reinforced Thermoset Resin Corrosion-Resistant Tanks

.10 ASTM E1067 Standard Practice for Acoustic Emission Testing of Fibreglass Reinforced Plastic Resin (FRP) Tanks/Vessels

1.3 Submittals

.1 Shop Drawings

.1 Complete catalogue information, descriptive literature, specifications, and identification of materials of construction.

.2 Detailed drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

.3 Materials used for chemical fill station cabinets, containment systems, unloading arms, and gangways.

.4 Method of fabrication, including industry standards governing fabrication, quality control.

.5 Layout, overall dimensions, required clearances and description of equipment.

.6 Attachment of equipment, services, auxiliary equipment, accessories.

.7 Load conditions, design criteria, critical strain values, design factors and similar items used in manufacturing.

1.4 Shipment, Protection, and Storage

.1 Ship pre-assembled to the degree possible.

.2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion, or weathering of components.

.3 Identify all other special storage requirements.

1.5 Quality Assurance

.1 Provide equipment and materials of highest quality and best suited to requirements. Provide materials and finishes in contact with chemicals that are resistant to chemicals or chemical vapours.

.2 Supply, without additional cost, appurtenances not shown on drawings or specified which are found necessary to complete every portion of equipment specified so that equipment functions as intended by specifications.

1.1 Related Work Specified Elsewhere

.1 Section 15200-000 – Process Piping

2. PRODUCTS

2.1 General

.1 At the end of each product description is a list of Acceptable Manufacturers, and where specified, models. This acceptance does not in any way relieve the Contractor or Manufacturer from providing models that meet all requirements of these specifications, and that fit within the piping and equipment layout shown in the Contract Drawings. The Contractor shall have the Manufacturer confirm that equipment meets all requirements of the specifications before including the price in their bid.

2.2 Chemical Fill Station Cabinets

.1 The Ferric Chloride, Sodium Hydroxide and Sodium Hypochlorite chemical fill stations shall be Supplied and Installed to meet the following requirements:

.1 Fibreglass-reinforced NEMA 4X enclosure with sealed seams and no holes or knockouts

.2 Seamless foam-in-place gasket for watertight and dust tight seal

.3 Integral padlocking hasp in each latch

.4 Sized accordingly to house the equipment shown on the Contract Drawings.

.2 The Sulphuric Acid and Ammonium Hydroxide chemical fill stations shall be Supplied and Installed to meet the following requirements:

.1 14 gauge Type 316L stainless steel bodies and doors.

.2 Seams shall be continuously welded and ground smooth with no holes or knockouts.

.3 Seamless foam-in-place gasket for watertight and dust tight seal.

.4 Stainless steel door clamp assembly complete with hasp and staple for padlocking.

.5 Bonding provision on Door. Grounding stud on body.

.3 Sized accordingly to house the equipment shown on the Contract Drawings.

.4 Manufacturers:

.1 Hoffman

.2 Or approved equal

2.3 Unloading Arms

.1 Each unloading arm shall:

.1 Be engineered to work with gangways and cages.

.2 Be manufactured in the material required to work with the chemicals shown on the Contract Drawings.

.3 Have swivels with o-rings, bearing, seals and lubrication suitable to the chemical being handled.

.4 Be tested for leaks and manufacturing defects prior to shipping and installation.

.2 Manufacturers:

.1 OPW

.2 Or approved equal

2.4 Railcar Access Gangways

.1 Each gangway shall include the following:

.1 Capable of supporting 225 Kg.

.2 Shall be constructed of epoxy coated steel and be suitable for caustic environments.

.3 Bumper guards to protect the tank car.

.4 Be capable of being stored out of the rail car envelope.

.5 Be customizable to work with the unloading arms.

.6 Each gangway design shall be sealed by a Professional Engineer registered in the Province of Manitoba.

.7 Each gangway shall have an adjustable torsion spring balancing system.

.8 Each gangway shall be designed and manufactured to fit in the allotted space as shown on the Contract Drawings.

.2 Manufacturers:

.1 SafeRack

.2 Or approved equal

2.5 Railcar Chemical Containment Systems

.1 The railcar chemical containment pan shall be manufactured to the dimensions shown on the Contract Drawings.

.2 The railcar containment pan shall be constructed of FRP in accordance with but not limited to the following:

.1 Resins

.1 Resins used for FRP specialties exposed to view will contain a minimum of 3% antimony trioxide or other fire retardant agent and will have flame spread of 25 or less based on ASTM E84. Add agents to structural wall only, not to the corrosion layer.

.2 Resin to be selected by fabricator, subject to approval of the Contract Administrator and suitable for intended service.

.3 Liner resin: premium grade and corrosion resistant

.4 Structural wall resin may be of different chemical resistance, subject to conditions of service and approval of Contract Administrator.

.5 The Contract Administrator will review the fabricator's choice of resin/catalyst before fabrication begins to verify compliance to the resin Manufacturer's recommended procedures.

.6 Add UV absorbers to surfacing resin to improve weather resistance for externally installed ducting and equipment.

.7 Add no thixotropic agent to resins used for a corrosion barrier. Thixotropic agent in the proportion and of the type recommended by the resin manufacturer may be added for viscosity control of resins not used for a corrosion barrier.

.1 The quantity of thixotropic agent added must not interfere with visual inspection of the laminate.

.8 Fabricate components using the resins specified in the pertinent section. Unless specified otherwise, use the same resin throughout all laminates of that component.

.9 Resins must meet flame spread requirements.

.10 No other fillers, including pigments, dyes and colorants, are permitted, unless reviewed and approved in writing by the Contract Administrator.

.11 Repair any damage to the paint coat occurring during installation promptly, restoring the paint coat to the original condition.

.2 Reinforcement

.1 Use commercial grade corrosion-resistant borosilicate glass for reinforcement.

.2 Unless otherwise specified, provide Type C glass 0.25 mm thick protective veil surfacing mat with silane finish and styrene-soluble barrier for interior and exterior surfaces.

.3 Surfacing veils for applications where the glass may be attacked by compounds in the process is a suitable spun-laced synthetic organic entangled fibre fabric, such as Nexus, not less than 500 µ in thickness, backed by chopped strand in a Type A resin.

.4 Unless otherwise specified, provide Type E glass, 0.45 kg/m^2 with silane finish and a styrene-soluble binder for chopped strand mat.

.3 Manufacturers

.1 Nemato Inc.

.2 Or approved equal

3. EXECUTION

3.1 Installation by Contractor

.1 Installation will be by the Contractor in accordance with the Manufacturer's printed installation instructions.

3.2 Field Finishing by Contractor

.1 Provide field finishing with touch ups for equipment as specified in Section 09901 – Painting and Finishing – Process Mechanical.

3.2 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square, and true within tolerances specified by the Manufacturer's Representative and as indicated in the Contract Documents.

.2 The Contractor shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Contractor shall fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

3.3 Equipment Performance Testing

.1 The Contractor shall ensure that the equipment, including all component parts, operates as intended.

.2 The Contractor shall demonstrate satisfaction of requirements specified herein.

.3 The Contractor shall fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.5 Training

.1 The Contractor shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

END OF SECTION

CHEMICAL STORAGE TANKS

1. GENERAL

1.1 Intent of Section

.1 A general description of the equipment is given herein. It is intended that the Contractor provide all components of the systems described in order that the tanks perform in the manner intended.

.2 Supply and Install storage tanks as described herein for ferric chloride, sulphuric acid, sodium hydroxide, and aqua ammonia chemical feed systems.

1.2 References

.1 The following is a list of standards that may be referenced in this Section:

.1 CAN/CGSB-41.22-93

.2 ASTM D3299

.3 ASTM D2563

.4 API 650 latest edition.

.2 FRP Tanks shall conform to the following reference standards:

.1 CAN/CGSB-41.22 Fibreglass-Reinforced Plastic Corrosion-Resistant Equipment

.2 ANSI B16.5 Pipe Flanges and Flanged Fittings

.3 ASTM C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fibre-Reinforced Structures Intended for Liquid Service

.4 ASTM C582 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment

.5 ASTM D2563 Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts

.6 ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

.7 ASTM D2584 Standard Test Method for Ignition Loss of Cured Reinforced Resins

.8 ASTM D3299 Standard Specification for Filament Wound Glass-Fibre-Reinforced Thermoset Resin Corrosion-Resistant Tanks

.9 ASTM D4097 Standard Specification for Contact-Molded Glass-Fibre-Reinforced Thermoset Resin Corrosion-Resistant Tanks

.10 ASTM E1067 Standard Practice for Acoustic Emission Testing of Fibreglass FRP Tanks/Vessels

1.3 Design Requirements

.1 Design tanks, including resin selection (for FRP tanks), wall thickness, methods and locations of support, and stiffener requirements. Design shall be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.4 Submittals

.1 Shop Drawings

.1 Materials used for FRP tanks including:

.1 Type of resin, percent ratio of resin and fibreglass.

.2 Wall thicknesses.

.3 Sequence of layers of glass reinforcement showing thicknesses of cure stages.

.2 Materials used for Steel tanks including:

.1 Type of steel and composition.

.2 Wall thicknesses.

.3 Welding procedures and x-ray inspection reports.

.3 Method of fabrication, including industry standards governing fabrication, quality control.

.4 Layout, overall dimensions, required clearances and description of equipment.

.5 Attachment of equipment, services, auxiliary equipment, accessories.

.6 Tank bottom.

.7 Load conditions, design criteria, critical strain values, design factors and similar items used in manufacturing specified tank.

.8 Accessories: Manways, nozzles, liquid level indicator and similar items.

.9 Materials, methods of fabrication, quality control, catalyst-curing system, type and minimum thickness of chemically-resistant veil (barrier) on tank interior, and other pertinent data on materials, fabrication and similar items.

.2 Provide shop drawings for the tanks signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.5 Quality Assurance

.1 Provide equipment and materials of highest quality and best suited to requirements. Provide materials and finishes in contact with chemicals that are resistant to chemicals or chemical vapours.

.2 Supply, without additional cost, appurtenances not shown on drawings or specified which are found necessary to complete every portion of equipment specified so that equipment functions as intended by specifications.

1.1 Related Work Specified Elsewhere

.1 Section 15200-000 – Process Piping

2. PRODUCTS

2.1 Ferric Chloride Tanks

.1 The Ferric Chloride tanks specified herein shall be premium grade vinyl ester corrosion resins and shall meet or exceed all requirements of ASTM D1998.

.2 The corrosion liner shall have a “C” glass veil and 2 plies of 1.5 oz mat. The corrosion liner and main structure resins shall be Derakane 411 with the main structure consisting of alternate plies of mat/woven roving/mat. The last mat/roving/mat layer should be Derakane 510C complete with 3-5% antimony trioxide.

.3 Tanks shall be vertical, flat bottom, flat top with reinforcing rib construction with translucent materials to allow observation of liquid level.

.4 Tank top and bottom shall be constructed integral with the side walls.

.5 Tanks shall be fabricated according to the dimensions shown on the Drawings with provisions for side manholes, flanges for venting to atmosphere, tank inlet, tank overflow to drain, tank outlets to pump and drain and level sensor.

.6 The tank should be fabricated to design standard CAN/CGSB-41.22.93.

.7 The tanks should meet the quality control standard level 2 as required by CAN/CGSB-41.22.93.

.8 The same fire-resistant premium grade resin shall be used throughout the entire wall section of each tank. Resin shall not contain pigments, dyes, colorants or fillers except as specified hereinafter.

.9 Tank tops shall be constructed with a non slip surface.

.10 Each storage tank shall be post-cured with dry heat in accordance with the resin Manufacturer's recommendation.

.11 Each storage tank drawing shall be sealed by a Professional Engineer registered in the Province of Manitoba.

.12 Tank Support and Restraint System

.1 Each tank and its associated attachments shall be structurally adequate for all tank design criteria specified herein.

.2 Provide hold down lugs, complete with plate, anchor bolts, nuts, and washers for proper anchoring of the tank. Actual number of hold down lugs shall be calculated with the tank empty.

.3 Provide a neoprene spacer beneath the plastic tank to minimize the risk of an object piercing the bottom of the tank. Size the neoprene spacer to suite tank size.

.13 Fabrication and Features:

.1 Tank shall be of the types and sizes shown on the Drawings and specified herein.

.2 Flanged Nozzles: All pipe connections shall be flanged and made by hand lay-up method. Pipe connections shall be of the same material as tank. Flanges shall be flush type, conical gussetted, reinforced with strength requirements of 2,050 Newton-Meters of bending and 2,700 Newton-Meters of torque, flat face, conforming to ANSI B16.5 150 lb drilling. Flanges shall be flat and true to a tolerance of plus or minus 1.5 mm. Flanges shall be either parallel or perpendicular to tank straight shell, as shown. Press molded flanges are not permitted nor are threaded fittings.

.3 Chemical metering pump suction nozzle for the storage tank shall be of the siphon drain type extending to within 50 mm of the tank bottom.

.4 Invert of overflow pipes shall be located a minimum of 150 mm or as shown on the Drawings below the seam line separating the dish-top from the vertical side walls.

.5 The tank shall be Supplied with a top vent connection. Vent connection shall be located at tank top and the vents shall terminate through the roof in a gooseneck.

.6 Each tank shall be Supplied with a flanged connection for fill lines. Fill line connections shall be located at tank top. Fill lines shall extend down to within 450 mm of the tank bottom. Each tank shall also be Supplied with a valved drain line and siphon extension.

.7 Top Manway: Top manway shall provide a minimum 600 mm tank opening, provide a port and bar type hinge, a grip handle, a drip lip and raised collar laminated into the tank top. The top manway shall include an EPDM gasket. All galvanized steel bolts, nuts and washers shall be epoxy coated

.8 Side Manway: 750 mm diameter flanged tank access side manhole and cover, double reinforced with centre line 900 mm above tank bottom with flexible PVC, EPDM gaskets, epoxy coated, galvanized steel bolts, nuts and washers.

.9 The tank shall be Supplied with sufficient number of pipe supports molded to the tank interior and exterior wall to restrain the fill lines. The number of supports shall be as recommended by the tank manufacturer but shall not be less than two.

.10 Lifting Lugs: Constructed of FRP or Type 316L stainless steel and capable of withstanding weight of empty tank. A minimum of four lugs shall be Supplied per tank. Lifting lugs shall be attached to tank wall with hand-laid laminate equal to or greater than the tank wall thickness. Lifting lugs shall be so constructed to prevent tear-out of hole when in use.

.11 Tank bottom corners shall have a bottom 90 mm knuckle radius for maximum resistance against hydrostatic pressure. Thickness of knuckle shall be equal to the combined thickness of the shell wall and the bottom.

.12 For each tank, Supply and Install two (2) labels clearly identifying chemical and tank capacity.

.14 Fittings

.1 Each Ferric Chloride Tank will have ANSI B16.5 Class 150 flanged pipe connections for:

.1 50 mm diameter suction pipe

.2 50 mm diameter fill pipe

.3 75 mm diameter fill pipe

.4 100 mm flanged ultrasonic level sensor connection

.5 100 mm diameter overflow pipe

.6 50 mm diameter tank bottom drain

.7 50 mm diameter pressure sensor connection

.8 200 mm diameter vent connection

2.2 Sodium Hydroxide Storage Tank

.1 The Sodium Hydroxide tanks specified herein shall be premium grade vinyl ester corrosion resins and shall meet or exceed all requirements of ASTM D1998.

.2 The corrosion liner shall have two (2) synthetic (Nexus) veil and 2 plies of 1.5 oz mat. The corrosion liner and main structure resins shall be Derakane 411 with the main structure consisting of alternate plies of mat/woven roving/mat. The last mat/roving/mat layer should be Derakane 510C complete with 3-5% antimony trioxide.

.3 Tanks shall be vertical, flat bottom, flat top with reinforcing rib construction with translucent materials to allow observation of liquid level.

.4 Tank top and bottom shall be constructed integral with the side walls.

.5 Tanks shall be fabricated according to the dimensions shown on the Drawings with provisions for side manholes, flanges for venting to atmosphere, tank inlet, tank overflow to drain, tank outlets to pump and drain and level sensor.

.6 The tank should be fabricated to design standard CAN/CGSB-41.22.93.

.7 The tanks should meet the quality control standard level 2 as required by CAN/CGSB-41.22.93.

.8 The same fire-resistant premium grade resin shall be used throughout the entire wall section of each tank. Resin shall not contain pigments, dyes, colorants or fillers except as specified hereinafter.

.9 Tank tops shall be constructed with a non slip surface.

.10 Each storage tank shall be post-cured with dry heat in accordance with the resin Manufacturer's recommendation.

.11 Each storage tank drawing shall be sealed by a Professional Engineer registered in the Province of Manitoba.

.12 Tank Support and Restraint System:

.1 Each tank and its associated attachments shall be structurally adequate for all tank design criteria specified herein.

.2 Provide hold down lugs, complete with plate, anchor bolts, nuts, and washers for proper anchoring of the tank. Actual number of hold down lugs shall be calculated with the tank empty.

.3 Provide a neoprene spacer beneath the plastic tank to minimize the risk of an object piercing the bottom of the tank. Size the neoprene spacer to suite tank size.

.13 Fabrication and Features:

.1 Tank shall be of the types and sizes shown on the Drawings and specified herein.

.2 Flanged Nozzles: All pipe connections shall be flanged and made by hand lay-up method. Pipe connections shall be of the same material as tank. Flanges shall be

flush type, conical gussetted, reinforced with strength requirements of 2,050 Newton-Meters of bending and 2,700 Newton-Meters of torque, flat face, conforming to ANSI B16.5 150-pound drilling. Flanges shall be flat and true to a tolerance of plus or minus 1.5 mm. Flanges shall be either parallel or perpendicular to tank straight shell, as shown. Press molded flanges are not permitted nor are threaded fittings.

.3 Chemical metering pump suction nozzle for the storage tank shall be of the siphon drain type extending to within 50 mm of the tank bottom.

.4 Invert of overflow pipes shall be located a minimum of 150 mm below the seam line separating the dish-top from the vertical side walls or as shown on the Drawings.

.5 The tank shall be Supplied with a top vent connection. Vent connection shall be located at tank top and the vents shall terminate through the roof in a gooseneck.

.6 Each tank shall be Supplied with a flanged connection for fill lines. Fill line connections shall be located at tank top. Fill lines shall extend down to within 450 mm of the tank bottom. Each tank shall also be Supplied with a valved drain line and siphon extension.

.7 Top Manway: Top manway shall provide a minimum 600 mm tank opening, provide a port and bar type hinge, a grip handle, a drip lip and raised collar laminated into the tank top. The top manway shall include an EPDM gasket. All galvanized steel bolts, nuts and washers shall be epoxy coated

.8 Side Manway: 750 mm diameter flanged tank access side manhole and cover, double reinforced with centre line 900 mm above tank bottom with EPDM gaskets, epoxy coated, galvanized steel bolts, nuts and washers.

.9 Each tank shall be Supplied with sufficient number of pipe supports molded to the tank interior and exterior wall to restrain the fill lines. The number of supports shall be as recommended by the tank manufacturer but shall not be less than two.

.10 Each tank shall be Supplied with a sufficient number of supports molded to the bottom interior surface of the tank to support the submersible heaters.

.11 Lifting Lugs: Constructed of FRP or Type 316L stainless steel and capable of withstanding weight of empty tank. A minimum of four lugs shall be Supplied per tank. Lifting lugs shall be attached to tank wall with hand-laid laminate equal to or greater than the tank wall thickness. Lifting lugs shall be so constructed to prevent tear-out of hole when in use.

.12 Tank bottom corners shall have a bottom 90 mm knuckle radius for maximum resistance against hydrostatic pressure. Thickness of knuckle shall be equal to the combined thickness of the shell wall and the bottom.

.13 For each tank, Supply and Install two (2) labels clearly identifying chemical and tank capacity.

.14 Fittings

.1 Each Sodium Hydroxide Tank will have ANSI B16.5 Class 150 flanged pipe connections for:

.1 50 mm diameter suction pipe

.2 50 mm diameter fill pipe

.3 75 mm diameter fill pipe

.4 100 mm flanged ultrasonic level sensor connection

.5 100 mm diameter overflow pipe

.6 50 mm diameter tank bottom drain

.7 50 mm diameter pressure sensor connection

.8 200 mm diameter vent connection

.9 3 to 150 mm diameter heater pipe

.10 50 mm diameter temperature transmitter pipe

2.3 Quality Control

.1 Three (3) inspections of fabrication facility will be made by Contract Administrator to check and assess resin formulation and control, fabrication methods and procedures, quality-control procedures.

.2 Inform Contract Administrator of following inspections:

.1 Arrange first visit before fabrication begins to review materials, quality control procedures and to discuss testing procedures.

.2 Arrange second visit when first shell is complete to verify laminate quality and thickness and to test nozzle cut-outs.

.3 Arrange final inspection for finished tanks to check critical dimensions, nozzle elevations and orientations, areas with high stress concentrations (lower knuckle radius) and testing of resin cure.

.3 Hydrostatically test tanks in factory by filling with water for minimum period of two hours to allow testing of nozzles, manholes and to ensure tanks are sound before

shipping. Test pressure to reflect design specific gravity of liquid contents specified under design conditions.

2.4 Sulphuric Acid Storage Tank

.1 General

.1 Each tank shall be designed to comply with the requirements of the API Standard 650, latest edition.

.2 Tank materials of construction to be 316L stainless steel.

.3 Each tank bottom to be double welded butt joints. The shell to bottom joints to be full penetration joints with reinforcing fillets. Shell horizontal and vertical joints to be full penetration welds.

.4 Minimum thickness of tank bottoms to be 12.5 mm.

.5 Corrosion allowance for tank and fitting materials to be 3.2 mm thickness.

.6 Supply and Install all fittings for the tanks as shown on the Drawings and as required for instrumentation.

.7 750 mm diameter flanged tank access side manhole and cover, with gasket and fasteners. Centre line of tank access 900 mm above tank bottom.

.8 600 mm diameter flanged access manhole and cover on tank top, with gasket and fasteners.

.9 Provide and pay for the services of an independent radiographic inspection agency to carry out inspection. Submit reports to the Contract Administrator.

.10 Supply 100% radiography of tank bottom welds, vertical shell welds and T-joints in the shell. For horizontal shell welds, provide spot radiography using 432 mm film length, minimum 2 per each horizontal weld.

.11 Repair or replace and re-radiograph all unacceptable welds at the Contractor's cost.

.12 For each tank, Supply and Install two (2) labels clearly identifying chemical and tank capacity.

.13 Fittings

.14 Each Sulphuric Acid Tank will have ANSI B16.5 Class 150 flanged pipe connections for:

.1 50 mm diameter suction pipe.

.2 50 mm diameter fill pipe.

.3 75 mm diameter fill pipe.

.4 150 mm flanged ultrasonic level sensor connection.

.5 100 mm diameter overflow pipe.

.6 50 mm diameter tank bottom drain.

.7 50 mm diameter pressure sensor connection.

.8 200 mm diameter vent connection

.2 After fabrication, the tanks shall be hydrostatically tested by filling them with water. Any leaks disclosed shall be repaired by welding. Notify the Contract Administrator ten (10) Business Days in advance so that he can witness the testing. Upon completion of repairs, the tanks shall be re-tested for leaks. All costs associated with re-testing and witnessing shall be paid for by the Contractor.

.3 Manufacturers

.1 Westeel

.2 Or approved equal

2.5 Aqua Ammonia Storage Tank

.1 General:

.1 Each tank shall be designed to comply with the requirements of the API Standard 650, latest edition

.2 Tank materials of construction to be 316L stainless steel.

.3 Each tank shall be designed to with stand a maximum pressure of 200 kPa.

.4 Each tank bottom to be double welded butt joints. The shell to bottom joints to be full penetration joints with reinforcing fillets. Shell horizontal and vertical joints to be full penetration welds.

.5 Minimum thickness of tank bottoms to be 12.5 mm.

.6 Corrosion allowance for tank and fitting materials to be 3.2 mm thickness.

.7 Provide all fittings for the tanks as shown on the drawings and as required for instrumentation.

.8 750 mm diameter flanged tank access side manhole and cover, with gasket and fasteners. Centre line of tank access 900 mm above tank bottom.

.9 600 mm diameter flanged access manhole and cover on tank top, with gasket and fasteners.

.10 Provide and pay for the services of an independent radiographic inspection agency to carry out inspection. Submit reports to the Contract Administrator.

.11 Supply 100% radiography of tank bottom welds, vertical shell welds and T-joints in the shell. For horizontal shell welds, provide spot radiography using 432 mm film length, minimum 2 per each horizontal weld.

.12 Repair or replace and re-radiograph all unacceptable welds at the Contractor's cost.

.13 For each tank, Supply and Install two (2) labels clearly identifying chemical and tank capacity.

.2 Fittings:

.1 Each Aqua Ammonia Tank will have ANSI B16.5 Class 150 flanged pipe connections for:

.1 50 mm diameter suction pipe.

.2 50 mm diameter fill pipe.

.3 2 to 150 mm flanged ultrasonic level sensor connection.

.4 50 mm diameter tank bottom drain.

.5 75 mm diameter pressure / vacuum relief connection.

.6 150 mm diameter vent connection.

.7 50 mm diameter vent drain connection.

.8 50 mm diameter pressure sensor connection.

.3 After fabrication, the tanks shall be hydrostatically tested by filling them with water. Any leaks disclosed shall be repaired by welding. Notify the Contract Administrator ten (10) Business Days in advance so that he can witness the testing. Upon completion of repairs, the tanks shall be re-tested for leaks. All costs associated with re-testing and witnessing shall be paid for by the Contractor.

.4 The Contractor shall Supply and Install pressure and vacuum relief valves, mounted on the steel tanks as shown in the Drawings. The valve body shall be Supplied with 150 lb ANSI standard flanges. The valve shall be set to open at 138 kPa (20 psi) inside tank pressure or a 3 ounces vacuum.

.5 Manufacturers:

.1 Westeel

.2 Or approved equal

3. EXECUTION

3.1 Tank Installation

.1 Before installation of tanks, complete the tank bases, including the chemical resistant coating on the concrete tank base.

.2 Supply and Install neoprene spacer beneath each tank.

3.2 Tank Hydrostatic Testing

.1 Fill the tanks with potable water to the underside of the roof and leave full for a period of forty eight (48) hours. Check for leakage and monitor levels. Repair and re-test if any leaks are found until leak tight. Bear all costs for repair and re-testing.

.2 Water for testing will be available from the City. The Contractor to Supply and Install all equipment and piping necessary to fill and drain the tanks. Dispose of the water in a manner approved by the Contract Administrator.

.3 Clean and dry all tank, pickle and passivate before acceptance by the City for filling with chemical.

3.3 Manufacturer's Representative Field Services

.1 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.

.2 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.

.3 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

.4 The minimum periods of Site attendance for each tank Supplied are identified in the following table along with the form to be completed on each of these trips.

.5 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

Item	Description	Total number of business days	Form
1	Equipment Delivery	1	100
2	Installation Assistance	1	101
3	Witnessing of Equipment Installation	1	102
4	Assistance in Equipment Performance Testing	1	103
5	Operator and Maintenance Training	1	T1

3.4 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer's Representative and as indicated in the Contract Documents.

.2 The Manufacturer's Representative shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation**.**

3.5 Equipment Performance Testing

.1 The Manufacturer's Representative shall demonstrate satisfaction of requirements specified herein.

.2 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.6 Training

.1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

3.7 Supplements

.1 Supplements listed below, follow "End of Section" and are part of this Section. This includes the following:

.1 Data Sheets – Ferric Chloride Storage Tanks

.2 Data Sheets – Sulphuric Acid Storage Tanks

.3 Data Sheets – Sodium Hydroxide Storage Tanks

.4 Data Sheets – Aqua Ammonia Storage Tanks

END OF SECTION

SUPPLEMENT 1 – FERRIC CHLORIDE STORAGE TANKS

PARAMETER	VALUE
Tag No. (s)	TK-S110A, TK-S120A, TK-S130A, TK-S140A
Tank Diameter (m)	4.0 m
Tank Height (m)	8.5 m
Tank Commodity	Ferric Chloride
Commodity Concentration	39%
Commodity Specific Gravity	1.34
Tank Material	FRP
Acceptable Manufacturer	Structural Glass Ltd. Approved equal

N/A – not applicable.

SUPPLEMENT 2 – SULPHURIC ACID STORAGE TANK

PARAMETER	VALUE
Tag No. (s)	TK-S210A, TK-S220A
Tank Diameter (m)	4.0
Tank Height (m)	8.5
Tank Commodity	Sulphuric Acid
Commodity Concentration	93%
Commodity Specific Gravity	1.83
Tank Material	316L Stainless Steel
Acceptable Manufacturer	Westeel Approved equal.

N/A – not applicable.

SUPPLEMENT 3 – SODIUM HYDROXIDE STORAGE TANKS

PARAMETER	VALUE
Tag No. (s)	TK-S310A, TK-S320A, TK-S330A, TK-S340A
Tank Diameter (m)	4.0 m
Tank Height (m)	8.5 m
Tank Commodity	Sodium Hydroxide
Commodity Concentration	50%
Commodity Specific Gravity	1.54
Tank Material	FRP
Acceptable Manufacturer	Structural Glass Ltd. Approved equal

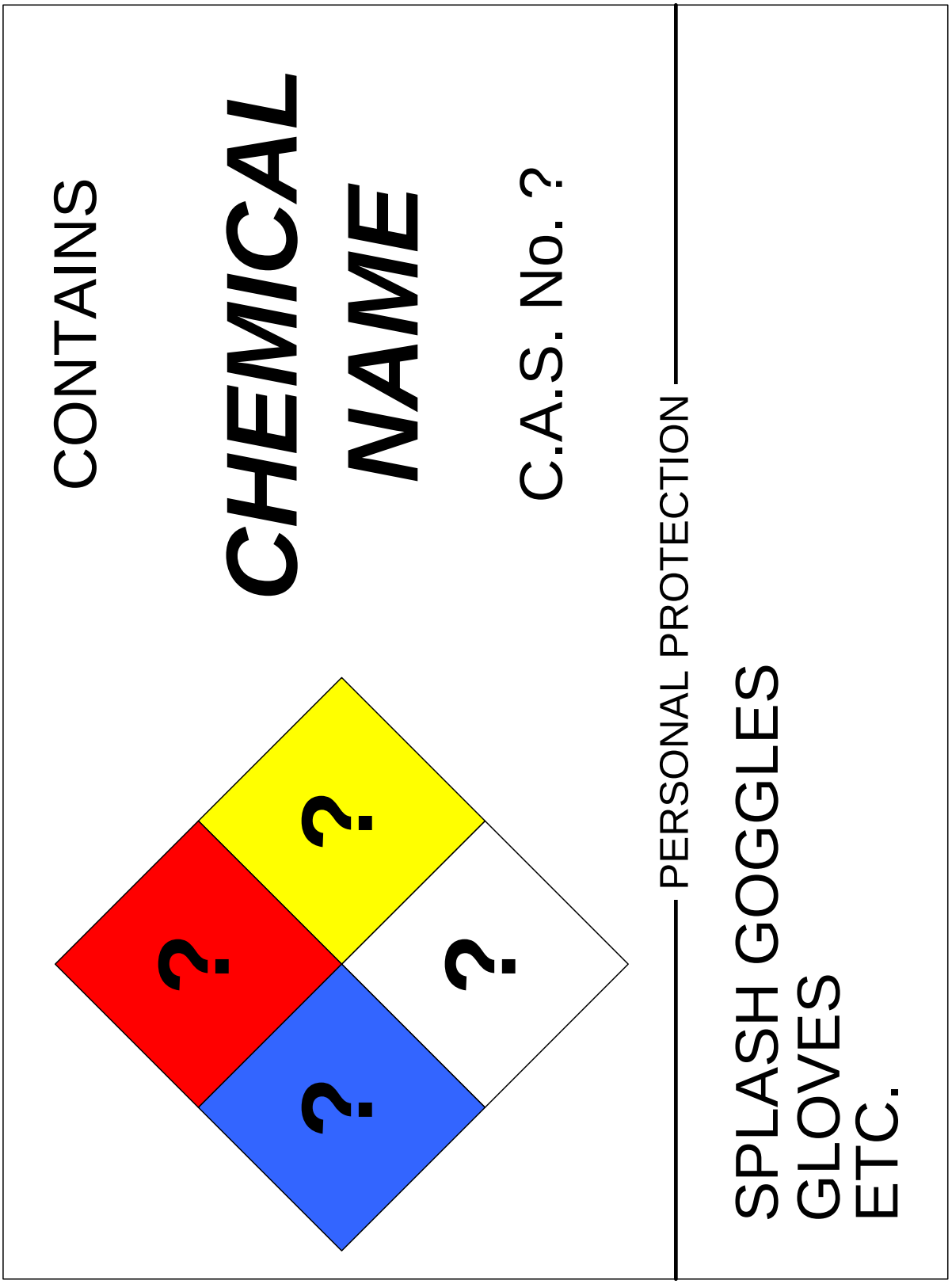
N/A – not applicable.

SUPPLEMENT 4 – AQUA AMMONIA STORAGE TANK

PARAMETER	VALUE
Tag No. (s)	TK-S410A, TK-S420A
Tank Diameter (m)	3.0 m
Tank Height (m)	5.5 m
Tank Commodity	Aqua Ammonia
Commodity Concentration	19%
Commodity Specific Gravity	0.925
Tank Material	316L Stainless Steel
Acceptable Manufacturer	Westeel. Approved equal.

N/A – not applicable.

SUPPLEMENT 5 – TYPICAL TANK SIGNAGE



1. GENERAL

1.1 Scope of Work

.1 Supply, installation, testing, and Performance Verification of skid-mounted, pre-piped, pre-wired and pressure tested chemical feeding equipment shown and specified, complete with metering pumps, control panels, piping, strainers, valves, calibration columns, frames and accessories to feed chemicals, complete and operable, in accordance with the requirements of the Specifications.

1.2 References

.1 Pumps shall be in compliance with the appropriate sections of the following codes:

.1 NSF International, Standard 61 - Drinking Water System Components

.2 AGMA

.3 AISC, American Institute of Steel Construction.

.1 Type 416 Stainless Steel.

.2 Type 1035 Steel.

.3 Type 1045 Carbon Steel.

.4 Type 4140 Alloy Steel.

.4 AISI

.5 ABMA

.6 ASME

.7 ANSI

.8 ASTM:

.1 A48/A48M, Standard Specification for Gray Iron Castings.

.2 A53/A53M, Standard specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 A276, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.

.4 A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

.5 B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 B148, Standard Specification for Aluminum Bronze Sand Castings.

.7 B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

.10 Canadian Electrical Code

.11 CSA

.12 EEMAC

.13 ESA

.14 IEEE

.15 ISA

.16 NEC

.17 NEMA

.18 NFPA

.19 SSPC

.20 Manitoba Building Code

.21 Canadian Plumbing Code.

.22 OSHA

1.3 Definitions

.1 Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.4 Contractor Submittals

.1 Shop Drawings:

.1 Make, model, weight, and horsepower of each equipment assembly.

.2 Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

.3 Performance data curves showing head, capacity, and pump efficiency over the entire operating range of the pump.

.4 Detailed drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

.5 Power and control wiring diagrams, including terminals and numbers.

.6 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.

.7 Materials of construction

.8 Describe related appurtenances

.2 Quality Control Submittals:

.1 Factory Functional and Performance Test Reports.

.2 Manufacturer's certification of compliance that the factory finish system is identical to the requirements specified herein.

.3 Special shipping, storage and protection, and handling instructions.

.4 Manufacturer's printed installation instructions.

.5 Suggested spare parts list to maintain the equipment in service for a Period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.6 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

.7 Operation and maintenance manual.

1.5 Shipment, Protection, and Storage

.1 Ship pre-assembled to the degree possible.

.2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion or weathering of components.

.3 Identify all other special storage requirements.

2. PRODUCTS

2.1 General

.1 Supplements at the end of this Section list Acceptable Manufacturers, and where specified, models. This acceptance does not in any way relieve the Contractor or Manufacturer from providing models that meet all requirements of these specifications, and that fit within the piping and equipment layout shown in the Drawings.

.2 The supply of gear pumps under this Section shall come from a single Manufacturer.

2.2 Pump Skids

.1 General:

1. The pumps shall come with factory fabricated pump skids as shown in the P&IDs and described herein. The pumping skids includes metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, low flow switches, check valves, and all associated piping and fittings, in accordance with the Drawings.

2. The ferric chloride, sulphuric acid and sodium hydroxide pump skids shall each contain three (3) pumps. The pump skids shall be constructed of steel frames and shall be sized appropriately to fit in the designated location in their respective chemical feed rooms, as shown on the Drawings.

3. All components of the chemical feed pump skids including pump, speed controller, motor, and related appurtenances unit shall be pre-plumbed and pre-wired.

4. All actuated valves shall have 120/1/60 power supply

.2 Accessories:

.1 Supply and Install inline flow meters to measure the chemical flow from each metering pump. Flow meter shall be capable of accurately measuring flows as shown in the Supplements at the end of this Section. Flow meter wetted components to be chemically resistant to service being used. Meters to meet Division 17 Specifications.

.2 Each pump skid shall be Supplied with pre-piped calibration column and pressure relief valve. The calibration column shall be constructed of material which is compatible with the chemical and shall be complete with a vented top cap and shall be graduated in milliliters.

.1 Be responsible for selecting pumps, motors and VFDs which will be capable of meeting the head, pressure, and max/min. flow and accuracy requirements of the system. Take

into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation free output flow.

.3 The driven magnet shall be an encapsulated assembly mounted on the end of the pump shaft. The drive magnet assembly shall rotate around the containment can as a result of the magnetic force.

.4 Each pump shall be of the suction shoe design.

.5 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application. Construct the pump of the following materials:

.1 Pumps: hardened titanium construction

.2 Wear plates: ceramic

.3 Shafts: ceramic

.4 Gears: Teflon or Ryton

.6 Supply and Install pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.

.7 Supply and Install pumps suitable for connection to a VFD.

.8 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC). Motors shall be VFD rated.

.9 A local control panel for each pump skid shall be Supplied and Install as shown on the Drawings. Each panel will include a 4 to 20 mA loop powered speed indicator wired direct from the VFD output, start/stop switch and push buttons to raise and lower the speed of the pump. Refer to typical starter schematic for details.

.10 Supply and Install motors suitable for 600 V/3 phase/60 Hz power supply.

.11 Supply and Install a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant FRP or chemically resistant epoxy coated carbon steel. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

.12 Supply and Install lubricants of the type recommended by the equipment Manufacturer in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, start-up and operation prior to Substantial Performance. Lubrication systems and lubrications shall be certified to ANSI/NSF Standard 61, to be compatible with potable water use.

2.3 Pumping Accuracy

.2 Supply a minimum pumping accuracy of ±5% over the operating full range for each combined pump, motor and variable frequency controller system.

.3 Combined pump, motor and VSD controller system to be capable of a minimum of 100:1 flow control turndown.

2.4 Piping and Valves

.1 Supply and Install Schedule 80 PVC piping and valves for the ferric chloride and sodium hydroxide pumping skids and in accordance with Section 15200 – Piping Insulation. Supply and Install flanges on the inlet and outlets to the skid.

.2 Supply and Install 316L stainless steel piping and valves for the sulphuric acid pumping skid and in accordance with Section 15200 – Piping Insulation. Supply and Install flanges on the inlet and outlets to the skid.

.3 Supply and Install valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 15202 – Process Valves and Operators.

.4 Supply and Install instrumentation and flow meters in accordance with Division 17.

2.5 Pump Skid Operation

.1 The Ferric Chloride feed pumps shall operate as follows:

.1 Two duty and one standby pump delivers ferric chloride to the two parallel raw water headers at the pretreatment area of the WTP.

.2 The control of the ferric chloride flow is based on the flow proportional to the totalized raw water flow signal for that train, from each of the four individual basin inlet flow meters in that train. There is one duty ferric chloride pump per train and the PLC uses the totalized flow signal from each train to provide flow proportional chemical dosing control of one duty ferric chloride metering pump. If an entire train is turned off at the Master PLC, the duty ferric chloride dosing pump assigned to that train is locked out.

.2 The Sulphuric Acid feed pumps shall operate as follows:

1. Two duty and one standby pump deliver sulphuric acid through an injector within each of the two parallel raw water headers at the pretreatment area of the WTP.

.2 The control of the sulphuric acid flow is based on the flow proportional to the totalized raw water flow signals from each of the eight basin inlet flow meters. Similar to ferric chloride pumps if the entire train is turned off at the Master PLC, the duty sulphuric acid dosing pump is locked out.

.3 The Sodium Hydroxide feed pumps shall operate as follows:

.1 Two duty and one standby pump delivers sodium hydroxide to the line upstream of the Clearwell for pH and alkalinity adjustment.

.2 The sodium hydroxide dosage varies depending on the pH and alkalinity of the water. A compound control loop based on the totalized water flow from the chlorine contact channel and chlorine contact channel effluent pH are used to control the sodium hydroxide feed pumps to maintain a user-defined pH set point between 7.5 and 7.8. A compound loop process controller with feed forward capabilities (based on the totalized effluent flow rate) and feedback capabilities (based on the average pH of treated water) will provide control of the duty metering pump.

.4 The pump Manufacturer shall Supply and Install all wiring and conduit within each skid package. Cables between skids shall be Supplied and Installed as described in Division 16.

2.6 Factory Finishing

.1 Supply and Install, prime, and finish coat in accordance with Section 11901 – Factory Applied Protective Coatings, or request a deviation for approved equal at Shop Drawing submittal for Manufacturer's standard coating.

2.7 Spare Parts and Maintenance Materials

.1 Supply the following spare parts for each pump skid:

.1 One (1) service set (including gears, shoes, bearings (if required) and O–rings).

.2 One (1) set of ceramic wear parts.

.2 Supply a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator's request, provide a price for the listed parts.

3. EXECUTION

3.1 Installation by Contractor

.1 Installation will be by the Contractor in accordance with the Manufacturer's printed installation instructions. Installation includes but is not limited to:

.3 Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

.4 Connect suction and discharge piping without imposing strain to pump flanges.

3.2 Field Finishing by Contractor

.1 Provide field finishing with touch ups for equipment as specified in Section 09901 – Painting and Finishing – Process Mechanical.

3.3 Field Quality Control by Contractor

.1 Functional Tests: Conduct on each pump.

.1 Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

.2 Flow Output: Measured by WTP instrumentation and storage volumes.

.3 Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

.2 Performance Test: In accordance with Hydraulic Institute Standards and/or more stringent requirements as described herein for operating conditions indicated in supplemental equipment data sheets.

3.4 Manufacturer's Representative Field Services

.1 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.

.2 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.

.3 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

.4 The minimum periods of Site attendance as total number of business days for all equipment are identified in the following table along with the form to be completed on each of these trips.

.5 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

Item	Description	Total number of days	For m
1	Equipment Delivery	1	100
2	Installation Assistance	1	101
3	Witnessing of Equipment Installation	2	102
4	Assistance in Equipment Performance Testing	4	103
5	Operator and Maintenance Training	4	T1

3.5 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer's Representative and as indicated in the Contract Documents.

.2 The Manufacturer's Representative shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

3.6 Equipment Performance Testing

.1 The Manufacturer's Representative shall ensure that each pump, including all component parts, operates as intended.

.2 The Manufacturer's Representative shall demonstrate satisfaction of requirements specified herein.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

2.8 Training

.1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

3.8 Supplements

.1 The supplements listed below, following "End of Section," are a part of this Specification.

.2 Data Sheets:

.1 Ferric Chloride Gear Pumps: Tag Nos. P-S160A, P-S170A, P-S180A

.2 Sulphuric Acid Gear Pumps: Tag Nos. P-S230A, P-S240A, P-S250A

.3 Sodium Hydroxide Gear Pumps: Tag Nos. P-S350A, P-S360A, P-S370A

END OF SECTION

SUPPLEMENT 1 – FERRIC CHLORIDE GEAR PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S160A, P-S170A, P-S180A
No. of Pumps	2 duty, 1 standby
Commodity	Ferric Chloride
Specific Gravity	1.34
Concentration (%)	39
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour) per Pump	60
Maximum Volumetric Flow Rate (litres/hour) per Pump	660
Backpressure (kPa) (excludes losses internal to pump)	250
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/day)	60 - 660
Fluid Temperature Operating Range (◦C)	0.5 - 25
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for VFD	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Micropump Series 220

N/A – not applicable.

SUPPLEMENT 2 – SULPHURIC ACID GEAR PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S230A, P-S240A, P-S250A
No. of Pumps	2 duty, 1 standby
Commodity	Sulfuric Acid
Specific Gravity	1.83
Concentration (%)	93
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour) per Pump	6
Maximum Volumetric Flow Rate (litres/hour) per Pump	225
Backpressure (kPa) (excludes losses internal to pump)	350
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/day)	6 – 225
Fluid Temperature Operating Range (◦C)	0.5 – 25
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for VFD	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Micropump Series 220

N/A – not applicable.

SUPPLEMENT 3 – SODIUM HYDROXIDE GEAR PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S350A, P-S360A, P-S370A
No. of Pumps	2 duty, 1 standby
Commodity	Sodium Hydroxide
Specific Gravity	1.54
Concentration (%)	50
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour)	435
Maximum Volumetric Flow Rate (litres/hour) Combined Duty Pumps	1,425
Backpressure (kPa) (excludes losses internal to pump)	250
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/day)	100 - 1500
Fluid Temperature Operating Range (°C)	12-30
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for VFD	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Micropump Series 220

N/A – not applicable.

PERISTALTIC PUMPS – SKID MOUNTED

1. GENERAL

1.1 Scope of Work

.1 Supply, installation, testing, and Performance Verification of skid-mounted, pre-piped, pre-wired and pressure tested chemical feeding equipment shown and specified, complete with metering pumps, control panels, piping, valves, strainers, calibration columns, frames and accessories to feed chemicals, complete and operable, in accordance with the requirements of the Specifications.

1.2 References

.1 The following is a list of standards which may be referenced in this Section:

.1 ABMA

.2 NEMA: MG 1, Motors and Generators.

1.2 Definitions

.1 Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.3 Contractor Submittals

.1 Shop Drawings:

.1 Make, model, weight, horsepower, and cross sectional details and colour brochures of each equipment assembly.

.2 Complete catalog information, descriptive literature, Specifications, and identification of materials of construction.

.3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

.4 Detailed Drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

.5 Power and control wiring diagrams.

.6 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.

.7 Factory finish system.

.8 Size, length and spacing of anchor bolts or attachment to the foundations or supports.

.9 External utility requirements air, water, power, etc for each component.

.10 Control Panel external face layout and inter layout drawings and electrical wiring diagrams.

.2 Quality Control Submittals:

.1 Factory Functional and Performance Test Reports.

.2 Manufacturer's certification of compliance that the factory finish system is identical to the requirements specified herein.

.3 Special shipping, storage and protection, and handling instructions.

.4 Manufacturer's printed installation instructions.

.5 Suggested spare parts list to maintain the equipment in service for a period of five (5) years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.6 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

.7 O&M manual.

1.3 Shipment, Protection, and Storage

.1 Ship pre-assembled to the degree possible.

.2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion or weathering of components.

.3 Identify all other special storage requirements.

1.4 Responsibility of the Pump Manufacturer

.1 The pump Manufacturer is responsible for the selection, co-ordination and performance of the metering pumps, motors, and control stations which will be capable of meeting the head, pressure, accuracy and flow requirements specified herein. The pump Manufacturer is responsible for the selection, co-ordination and performance of the appurtenances.

.2 All major components (pumps and accessories) shall be supplied as a Vendor Package unless specified otherwise.

2. PRODUCTS

2.1 General

.4 Supplements at the end of this Section list Acceptable Manufacturers, and where specified models. This acceptance does not in any way relieve the Contractor or Manufacturer from providing models that meet all requirements of these specifications, and that fit within the piping and equipment layout shown in the Drawings.

.5 The supply of peristaltic pumps under this Section shall come from a single Manufacturer.

2.2 Pumping Requirements

.1 Take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 Minimum turn-down ratio: 1:100

.3 Supply a minimum pumping accuracy of +2% of the full range for each pump package

1.4 Pump Skids

.1 General

1. The pumps shall come with factory fabricated pump skids as shown in the P&IDs and described herein. The pumping skids includes metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, low flow switches, check valves, and all associated piping and fittings, in accordance with the Drawings.

2. The aqua ammonia pump skid shall contain two (2) pumps. The pump skid shall be sized appropriately to fit in the designated location in their respective chemical feed rooms, as shown on the Drawings.

3. Construct the pump parts in contact with the commodity being pumped from materials suitable for the application.

4. The aqua ammonia pumps shall be the positive displacement, peristaltic type, self-priming unit. The pump shall consist of a spring loaded single pump head and flexible extruded tubing.

5. Peristaltic pumping action shall be created by the compression of the flexible tube between the pump head rollers and track, inducing forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components. Pumps shall be dry self priming, capable of being run dry without damaging effect to pump or tube.

6. Pump head shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Supply and Install two spring–loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pump head.

7. Supply and Install 316L SST clamps for each tube connection

8. Supply lubricants of the type recommended by the equipment Manufacturer in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, start-up and operation prior to Substantial Performance. Lubrication systems and lubrications shall be certified to ANSI/NSF Standard 61, to be compatible with potable water use.

9. All components of the chemical feed pump skids including pump, speed controller, motor, and related appurtenances unit shall be pre-plumbed and pre-wired.

10. All actuated valves shall have 120/1/60 power supply

.2 Accessories

1. Supply and Install inline flow meters to measure the chemical flow from each metering pump. Flow meter shall be capable of accurately measuring flows as shown in the Supplement at the end of this Section. Flow meter wetted components to be chemically resistant to service being used. Meters to meet Division 17 Specifications.

2. Each pump shall be Supplied with pre-piped calibration column and pressure relief valve. The calibration column shall be constructed of material which is compatible with the chemical and shall be complete with a vented top cap and shall be graduated in milliliters.

3. Supply and Install pumps suitable for connection to VFD.

4. Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC). Motors shall be VFD rated.

5. A local control panel for each pump skid shall be Supplied and Installed as shown on the Drawings. Each panel shall include a 4 to 20 mA loop powered speed indicator wired direct from the VFD output, start / stop switch and push buttons to raise and lower the speed of the pump. Refer to typical starter schematic for details.

6. Supply and Install motors suitable for 600 V/3 phase/60 Hz power supply.

7. Supply and Install a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant FRP or chemically resistant epoxy coated carbon steel. Provide sufficient

strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

8. Supply lubricants of the type recommended by the equipment Manufacturer in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, start-up and operation prior to Substantial Performance. Lubrication systems and lubrications shall be certified to ANSI/NSF Standard 61, to be compatible with potable water use.

1.5 Piping and Valves

.1 Supply and Install 316L stainless steel piping and valves for the aqua ammonia pumping skid and in accordance with Section 15200 – Piping Insulation. Supply and Install flanges on the inlet and outlets to the skid.

.2 Supply and Install valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 15202 – Process Valves and Operators.

.3 Supply and Install instrumentation and flow meters in accordance with Division 17.

1.6 Pump Skid Operation

.1 The Aqua Ammonia feed pumps shall operate as follows:

.1 One duty and one standby pump will deliver aqua ammonia to the line upstream of the Clearwell for chloramine formation.

.2 The amount of aqua ammonia added will vary depending on the target chloramine residual and the chlorine to ammonia ratio selected. A compound control loop based on the totalized water flow from the chlorine contact channel and the chlorine residual level (at the Clearwell inlet) will be used to control the aqua ammonia feed pumps to maintain a user-defined chlorine to ammonia feed ratio.

.2 The pump Manufacturer shall Supply and Install all wiring and conduit within a skid package. Cables between skids shall be Supplied and Installed as described in Division 16.

1.7 Factory Finishing

.1 Prepare, prime, and finish coat in accordance with Section 11901 – Factory Applied Protective Coatings, or request a deviation for approved equal at Shop Drawing submittal for Manufacturer's standard coating.

1.8 Spare Parts and Maintenance Materials

.1 Supply the following spare parts for each pump skid:

.1 One spare pump head assembly and rotor per pump

.2 Supply three 15 m continuous rolls of specified tubing size

.3 Two spare sets of tubing quick disconnects per pump

.4 Two (2) extra rollers per pump

.2 Supply a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator's request, provide a price for the listed parts.

3. EXECUTION

3.1 Installation by Contractor

.1 Installation will be by the Contractor in accordance with the Manufacturer's printed installation instructions.

3.2 Field Finishing by Contractor

.1 Provide field finishing with touch ups for equipment as specified in Section 09901 – Painting and Finishing – Process Mechanical.

3.3 Field Quality Control by Contractor

.1 Functional Tests: Conduct on each pump.

.1 Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

.2 Flow Output: Measured by WTP instrumentation and storage volumes.

.3 Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

.2 Performance Test: In accordance with Hydraulic Institute Standards and/or more stringent requirements as described herein for operating conditions indicated in supplemental equipment data sheets.

3.4 Manufacturer's Representative Field Services

.1 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.

.2 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.

.3 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the

testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

.4 The minimum periods of Site attendance as total number of business days for all equipment are identified in the following table along with the form to be completed on each of these trips.

.5 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

Item	Description	Total number of business days	Form
1	Equipment Delivery	1	100
2	Installation Assistance	1	101
3	Witnessing of Equipment Installation	1	102
4	Assistance in Equipment Performance Testing	1	103
5	Operator and Maintenance Training	1	T1

3.5 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer’s Representative and as indicated in the Contract Documents.

.2 The Manufacturer’s Representative shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Manufacturer’s Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

3.6 Equipment Performance Testing

.1 The Manufacturer’s Representative shall ensure that each pump, including all component parts, operates as intended.

.2 The Manufacturer’s Representative shall demonstrate satisfaction of requirements specified herein.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.7 Training

.1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

3.8 Supplements

.1 The supplements listed below, following "End of Section," are a part of this Specification.

.2 Data Sheets:

.1 Aqua Ammonia Feed Pumps: P-S430A, P-S440A

END OF SECTION

SUPPLEMENT 1 – AQUA AMMONIA FEED PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S430A, P-S440B
No. of Pumps	1 duty, 1 standby
Commodity	Aqua Ammonia
Specific Gravity	0.925
Concentration (%)	19
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour) per Pump	11.8
Maximum Volumetric Flow Rate (litres/hour) per Pump	95
Backpressure (kPa) (excludes losses internal to pump)	150
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/day)	10 - 100
Fluid Temperature Operating Range (◦C)	0.5 - 25
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for Variable Frequency Drive	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Verderflex VF10 Ponndorf

N/A – not applicable.

FACTORY APPLIED PROTECTIVE COATINGS

1. GENERAL

1.1 Work Included

.1 Supply and application of all factory applied prime coats or factory applied finish coats, where specified, for equipment and products supplied by the Contractor.

1.2 Submissions

.1 With the equipment Shop Drawings, submit details of the coating systems to be applied.

1.3 Quality Assurance

.1 This Specification is intended to be a minimum reference standard. The Contractor may submit for review alternative coating systems for specific items of equipment which provide equal or better corrosion protection and maintenance service than those specified herein.

2. PRODUCTS

2.1 Surface Preparation

.1 Immersion Service: After degreasing, dry blast all ferrous components to a white metal finish in accordance with SSPC-SP5 to a degree of cleanliness in accordance with NACE No. 1 and obtain a 1.3 mm (50 µ) blast profile.

.2 Non-immersion Service: After degreasing, dry blast all ferrous components to a near white finish in accordance with SSPC-SP10 to a degree of cleanness in accordance with NACE No. 3 and obtain a 1.3 mm (50 µ) blast profile.

2.2 Coating

.1 Provide three (3) coats of polyamide epoxy coating, NSF 61 approved potable grade, 0.08 mm (3 mils) minimum dry film thickness per coat.

2.3 Assembly

.1 For items which are to be bolted together before shipment, clean surfaces and coat before the parts are assembled.

.2 Continuous weld all welded connections, sealing the mating surface completely. On completion of the welding and fettling, treat all weld seams with phosphoric acid solution. Rinse and thoroughly dry before the prime is applied.

.3 Where dissimilar metals are mated insulate the mating surfaces from one another to provide protection against corrosion. Insulate bolts, nuts, washers, and rivets in a similar manner.

.4 Use 304 stainless steel or better for all nuts, bolts, washers and similar fittings for immersion service. For non-immersion service, use 304 stainless or zinc or cadmium plated nuts, bolts, washers, and similar fittings. Clean and coat the inner face of non-threaded bolt holes as required for other surfaces.

3. EXECUTION

3.1 General

.1 Apply coatings in accordance with coating Manufacturer's instructions.

3.2 Inspection

.1 Notify the Contract Administrator two (2) weeks before commencing the protective coating to permit the inspection by the Contract Administrator of the surface preparation and protective coating application.

3.3 Protection

.1 Protect all coated equipment adequately against damage, dust, moisture, and scratching during shipment, off-loading and storage on-site. If, in the opinion of the Contract Administrator, the coating is damaged during shipment to the extent that touch up would not be satisfactory, return and re-coat the equipment at the Contractor's cost.

.2 Make good damage to coatings occurring at any time prior to the application of any further coatings.

3.4 Application Conditions

.1 Apply all factory applied coatings under controlled conditions, in a dust-free atmosphere at a temperature of between 10 and 20°C, and a relative humidity should not exceed 80%.

END OF SECTION

DESIGN AND OPERATING DESCRIPTION

1. GENERAL

.1 This Section is included for reference, to provide the Contractor with an understanding of the Work.

2. INTRODUCTION

.1 A number of chemicals are required for the treatment processes at the WTP. Many of these chemicals require significant storage and hence will be delivered and stored in bulk quantities. Chemical delivery will be either by rail cars or by tanker truck delivery. Provisions for both railcar unloading and road truck unloading will be provided. A new bulk chemical storage building will be built close to the WTP. Specifically, the following chemicals will be stored in the bulk chemical storage building:

.1 Ferric Chloride

.2 Sulphuric Acid

.3 Sodium Hydroxide

.4 Aqua Ammonia

.2 A summary of the bulk chemical properties to be used in the WTP is as follows:

Chemical	Conc. (%)	Specific Gravity	Viscosity (Centipoise)	Freeze/Melting Point (°C)	Boiling Point (°C)	pH
Ferric Chloride	39	1.34	10 at 20°C & 12.1 at 7°C	-45	110	<1.0
Sulphuric Acid	93	1.83	20 at 30°C & 40 at 10°C	-32	276	<1.0
Sodium Hydroxide	50	1.54	80 at 20°C & 40 at 30°C	12	140	>14
Aqua Ammonia	19	0.925	10	-72	27.2	10.6

.3 The bulk chemical building will consist of six rooms; four of them for the bulk chemical storage and the others for the electrical control room and ancillary systems (steam and air units). The building will be located adjacent to the rail line, north of the main WTP. The building will also be attached to the main WTP via an overhead walkway which will allow the operators to move easily from one building to the other.

.4 Each of the rooms in the chemical building housing the chemical storage tanks will also include the chemical feed system which will be tied into the respective chemical suction header so that each bulk chemical tank can supply chemicals to the pumps. The feed system

will be skid mounted and include duty/standby pumping and piping. The pumps will pump the chemicals to the respective locations of the process train through the pipes which will run through the overhead walkway extending from the bulk chemical building to the WTP.

3. DESIGN DESCRIPTION

3.1 Chemical Delivery and Unloading Description

.1 Chemical delivery frequency will vary depending upon the season. A summary of the bulk chemical delivery frequency in winter is as follows:

Item	Volume of Chemical Required per Week (m^3/week)	Delivery Method	Delivery Unit Weight (kg)	Delivery Volume (m^3)	Delivery Units Required per Week
Ferric Chloride	125	Rail Car/ Road Tanker	80,000/ 22,000	60/16	2/7.8
Sulphuric Acid	38	Rail Car/ Road Tanker	80,000/ 22,000	50/12	0.76/3.2
Sodium Hydroxide	125	Rail Car/ Road Tanker	80,000/ 29,000	53/20	2.4/6.3
Aqua Ammonia	12	Road Tanker	22,000	25	0.5
Total					5.2/17.8

.2 A summary of the bulk chemical delivery frequency in summer is as follows:

Item	Volume of Chemical Required per Week (m^3/week)	Typical Delivery Method	Delivery Unit Weight (kg)	Delivery Volume (m^3)	Delivery Units Required per Week
Ferric Chloride	188	Rail Car/ Road Tanker	80,000/ 22,000	60/16	3/12
Sulphuric Acid	58	Rail Car/ Road Tanker	80,000/ 22,000	50/12	1.2 4.8
Sodium Hydroxide	184	Rail Car/ Road Tanker	80,000/ 29,000	53/20	3.5/9.4
Aqua Ammonia	19	Road Tanker	22,000	25	0.8
Total					7.7/27

.3 The rail car unloading description is as follows:

.1 An unloading platform and gangway will be used for rail car unloading to provide access to the dome connections and to ensure a safe operation. The unloading station located on the rail side of the building will include an elevated station.

.2 Railcar unloading will be undertaken through the top connection on the railcar. Compressed air will be used to pad the railcar, and transfer the chemicals to the storage tanks. The compressed air will be supplied from the compressors present in the mechanical room of the Bulk Chemical Storage Building.

.3 Depending on how long the shipment sits before offloading winter deliveries, rail cars of chemicals like sodium hydroxide may require heating as it freezes at 12ºC. Hence, the rail car unloading station will have provisions for steam heating.

.4 Chemical unloading will be manually controlled. A control panel, located next to the unloading platform stairs, will contain the unloading controls.

.4 The truck unloading description is as follows:

.1 Truck unloading stations shall be Supplied and Installed adjacent to the facility road to allow for tanker truck deliveries. These unloading stations will be spaced to allow for multiple trucks to unload at one time.

.2 Procedures for unloading tanker trucks are similar to those for unloading rail cars except that the drivers of the tanker trucks are responsible for their own unloading. Compressed air will be used to transfer the chemicals to the storage tanks.

.3 Chemical unloading will be manually controlled. A control panel, located next to the unloading station, will contain the unloading controls.

.4 A spill sump with a bottom drain will be provided below the unloading for spill collection. Spills flow into the containment area in the chemical storage building.

3.2 Chemical Storage Description

.1 The chemical storage description is as follows:

.1 All storage tanks are located inside the Bulk Chemical Storage Building.

.2 The storage tanks are made of materials which are compatible with the storing chemicals.

.3 For containment, all of the storage tanks is surrounded by a concrete structure to contain the volume of the largest tank in the event of rupture or spill. The containment area is designed to contain 110% of the contents of one chemical storage tank.

.4 Although the chemicals are stored in either two or four tanks, it is normally dosed from only one tank at a time. The tanks from which the chemicals are being pumped can be selected automatically, or by manually opening and closing the appropriate valves.

.5 Each tank shall be equipped with an access port, a high-level overflow, venting and flanged nozzles for equipment and piping mounting.

.6 Each tank is also equipped with an ultrasonic level sensor. At low-low level, the chemical flow to the dosing pump from the tank is switched off and automatically transferred to another tank ensuring continuous supply of chemicals to the dosing pump without interruption. At high level, an alarm is activated and chemical unloading stops. Under normal unloading conditions the unloading procedure is managed by the operators.

.7 A pressure level transmitter shall also be supplied and installed for each tank as a backup to the ultrasonic level sensor except for the aqua ammonia tanks where dual ultrasonic level sensor are to be supplied and installed.

.9 The tanks may be drained and washed down with water to flush out any sediment. Access to the tank may be required, depending on the amount of sediment and the ease with which it is flushed away. Inspections of the tank walls will be undertaken in accordance with the tank Manufacturer's recommended schedule and methods.

3.3 Chemical Dosing Description

.1 The chemical dosing description is as follows:

.1 All of the chemicals in the Bulk Chemical Building are fed to different injection points at various locations of the process train in the WTP.

.2 Either two or three skid mounted metering pumps as shown on the Drawings shall be Supplied and Installed for each chemical. One pump in each chemical skid acts as a standby pump. The pumps are magnetically driven gear pumps and peristaltic pumps with variable speed drives.

.3 Each duty pump transfers the chemical to either one or two injection points. However, inter-connections in the discharge lines allow flexibility in the choice of dosing locations for each pump. Chemical dosing is automatic with the ability to remotely or locally adjust dose rate.

.4 The operation of the chemical feed pumps is as follows:

.1 For ferric chloride and sulphuric acid the control of the chemical dosing flow is based on the flow proportional to the totalized raw water flow signals from each of the eight basin inlet flow meters. For sodium hydroxide, a compound control loop based on the totalized water flow from the chlorine contact channel and chlorine contact channel effluent pH are used to control the sodium hydroxide feed pumps to maintain a user-defined pH set point between 7.5 and 7.8. The aqua ammonia feed system delivers chemical to a single application point in the pipeline upstream

of the Clearwell (downstream of the sodium hydroxide application point). A compound control loop based on the totalized water flow from the chlorine contact channel and the chlorine residual level (at the Clearwell inlet) will be used to control the aqua ammonia feed pumps to maintain a user-defined chlorine to ammonia feed ratio.

.2 If the entire train is turned off at the Master PLC, the duty dosing pump is locked out.

.3 An alarm is sent to the plant control system if the pump VSD is lower than 10% or in excess of 95%.

.4 Remote start/stop capabilities from the plant main control system is available, as well as duty pump selection.

.5 A flow totalizer monitors chemical consumption. An ultrasonic level indicating transmitter within the bulk tank also calculates daily chemical consumption.

.6 If the level of any of the bulk storage tanks drop below low-low level, set at 5% of the maximum storage, the chemical flow to the dosing pump from the tank is switched off and the valves on the discharge line from another tank is automatically opened allowing the dosing pumps to run continuously without stopping.

.5 A pressure relief valve is provided in the discharge line for high pressure relief. Activation of the pressure relief valve diverts flow to the sump in the containment area.

.6 A flow meter is provided on each line, with output to the SCADA at the Master PLC.

4. OPERATING DESCRIPTION

4.1 Chemical Unloading Operation

.1 The chemical unloading operation will be done either by trucks or rail cars. In the following narrative, chemical unloading operation is explained. The unloading procedure is similar for all the chemicals in the bulk chemical building.

.2 Railcar unloading:

.1 The chemical unloading system is basically a manual operation assisted by some automatic control elements for quick response and easy controlling.

.2 Before starting the unloading process, the operator must first check that the railcar is properly spotted, following the standard spot procedures outlined by GWWD Rail. The operator must also follow any and all procedures outlined by the chemical supplier.

.3 Check the railcar ID numbers and placards for accuracy.

.4 Inspect the railcar and make sure the brakes are set and wheels are chocked.

.5 Inspect the vents in the chemical storage building for blockages. Remove any blockages.

.6 The chemical unloading control system monitors liquid levels in the storage tanks, valve status, unloading air pressure, and unloading flow rate. The tank levels is also displayed on the local unloading control panels.

.7 The system allows for filling of one selected storage tank; when one tank is full, its inlet valve closes and another will open to continue filling another tank.

.8 The control system turns on the "READY TO UNLOAD" indicator when the total available spare capacity in all the storage tanks is greater than a preset volume (enough to accommodate a full railcar volume plus a safety margin).

.9 The operator manually verifies the tank liquid level readings on the unloading control panel.

.10 The operator takes a sample of the chemical.

.11 The operator removes the blind caps from the air inlet port and the chemical discharge port on the railcar.

.12 A swivel joint will also be used for unloading the chemicals from the top. The sleeve joint will have a slide sleeve type arm and assembly that moves in and out to adjust for variations in the distance from the loading rack to the rail car.

.13 The operator manually connects the air padding hose to the railcar.

.14 The operator opens the liquid line isolation valves ensuring that there is no pressure in the railcar:

.15 A high air pressure in the railcar is not desired. The railcar will be unloaded in 4 to 6 hours with a chemical flow rate of 10 to 15 m^3/hr.

.16 The operator initiates the unloading procedure by pressing the START button on the control panel.

.17 When unloading starts the operator must monitor the tank liquid level readings on the unloading control panel.

.18 The control system starts by opening the tank inlet valve for the filling of tank.

.19 For each chemical, when the isolation valves and tank inlet valves are confirmed open, the control system operates the respective three-way air inlet valve so that compressed air is directed to the railcar. The operator then opens the air flow control valve slowly and begins to pressurize the railcar. A bypass air control valve can be used in case the three-way valve is out of order.

.20 When the chemical begins to flow, the operator checks the whole piping line for leakage.

.21 The system allows for filling one storage tank at a time. When one tank becomes full, its inlet valve closes and filling continues into another tank.

.22 The operator must stay in attendance with the railcar at all times when the unloading connections are attached.

.23 Unloading continues until the railcar is empty. Railcars are not allowed to stand with unloading connections attached after unloading is completed.

.24 When the railcar is empty, the air pressure blows out the transfer lines resulting in a drop in unloading air pressure. The pressure reading indicates to the control system that the railcar is empty. After a time delay, the control system then stops air flow by turning the three-way valve to the vent position and vent the railcar pressure to atmosphere. The time delay is required to purge the railcar atmosphere of corrosive gases. The tank inlet valves are closed after operation of the three-way valve.

.25 Unloading can be manually stopped in progress or when complete by pressing the ESD at the railcar unloading panel, truck unloading panel, railcar platform, or in the chemical storage building. This action immediately stops the air flow by venting the compressed air to atmosphere. In addition, the storage tank valves close, and an alarm initiated.

.26 The control system, on detecting high unloading air pressure assumes failure, pipe blockage, or incorrect setting of the pressure regulating valve and initiate alarm and shutdown.

.27 The control system, on detecting high level in any of the storage tanks initiate alarm and shutdown flow from that particular tank.

.28 The control system, on detecting failure or non-responsiveness of a control valve initiates alarm and shutdown.

.29 To stop unloading a railcar for any reason, all connections must be disconnected. All valves must be tightly closed, and all other openings securely closed.

.30 Once unloading is complete the operator isolates and disconnects the liquid and air lines, ensuring that the system is fully vented prior to disconnecting by checking the local pressure gauge. The operator removes the flexible air piping and hangs it on the rack on the platform.

.31 As soon as the railcar is completely unloaded, all valves must be tightened with a wrench or other suitable tool. The unloading connections must be removed and all other closures made tight.

.32 The by-pass air control valve is opened slowly for a few minutes so that compressed air can blow out residual chemical from the transfer line. Opening the by-pass air control

valve will be followed by opening of the chemical storage tank inlet valves in the OPEN position.

.33 The operator removes all other equipment from the railcar.

.34 The operator raises the access walkway and secures it in place with a chain.

.35 The operator performs an outbound inspection on the railcar by following the established procedures provided by the chemical supplier and railway authorities.

.3 Truck unloading:

.1 Truck unloading is essentially the same process as railcar unloading.

.2 The control system turns on the "READY TO UNLOAD" indicator when the total available spare capacity in both storage tanks is greater than a preset volume (enough to accommodate full truck/trailer volume plus safety margin).

.3 The operator manually verifies the tank liquid level readings on the unloading control panel.

.4 The driver manually vents any built-up pressure or vacuum from the truck using the chemical supplier’s procedure.

.5 The driver manually connects the liquid discharge hose to the truck.

.6 The driver manually opens the isolation valve for the chemical line. The operator initiates unloading by pressing the START button. The control system opens the tank inlet valves for the tank(s) to be filled.

.7 The driver uses the onsite compressed air system for unloading the chemicals.

.8 Unloading normally continues until the truck is empty. The driver then manually stops the compressed air system.

.9 When the truck is empty, air pressure blows out the transfer lines resulting in a drop in unloading air pressure (monitored on the truck). At this time, the control system detects the empty truck and closes the tank inlet valve(s).

.10 Unloading can be manually stopped in progress, or when complete, by pressing the ESD button at either of the local panels, at the platform, or in the railcar building. This action immediately closes the storage tank inlet valve(s) and initiates an alarm.

.11 The control system, upon detecting high level in any of the storage tanks, initiates alarm and shutdown of that particular tank.

.12 The control system detecting failure or non-responsiveness of a control valve initiates alarm and shutdown.

.13 The driver isolates and disconnects the liquid and air lines at this time, ensuring that the system is fully vented prior to disconnecting.

.14 The driver closes the isolation valve and disconnects the chemical line.

4.2 Chemical Dosing Operation

.1 At initial start-up the pumps require priming. If the duty tank is full, priming occurs naturally due to the head. If the duty tank level is low, and the standby tank is full, the standby tank outlet valve is opened to provide priming head to the pumps. If the piping to the pump skid contains fluid, priming of the pumps is not necessary, irrespective of the tank levels.

.2 In normal operation the COH switch is in the COMPUTER position, and the pump speed is controlled from the SCADA at the Master PLC.

.3 Local speed control can be undertaken with the COH switch in the HAND position.

.4 The pumps transfer the chemicals to the injection points, as appropriate. It is likely that, under most conditions, only one or two pumps operate.

.5 Pressure relief valves on the pump discharge prevent over-pressure of the discharge piping. When activated, the valves direct excess flow to the containment through the vent line.

.6 Back pressure valves are used to adjust the discharge pressure.

.7 The ultrasonic level sensors monitor the chemical level in the tanks.

.8 Pump status is output to the SCADA at the Master PLC.

.9 A calibration column is used for calibration of the pumps. The column is normally filled by gravity when the chemical level in the storage tanks is high enough. If the chemical level in both tanks is low, the calibration column can be filled by the pump.

.10 The pump discharges are interconnected; flow can be directed as desired by opening the respective valves on the discharge side.

END OF SECTION