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Definitions

AC: alternating current.
AFD: adjustable frequency drive.
amps: amperes.
Approval Required (AP): The BTR must approve the Contractor’s submittal; however, work associated with the submittal may proceed prior to BTR approval.
Approval Required Prior to Work (APW): The BTR must approve the Contractor’s submittal prior to the Contractor being authorized to proceed with any activity/work associated with the submittal.
BTR: Buyer’s Technical Representative.
Buyer: Contract Officer.
Construction Contractor: Separate contractor responsible for the construction of the facility housing the package system, installation of the package system, and installation of all supporting systems.
Contractor: The Offerer to whom a contract is written for a Task(s).
Contractor’s Project Manager: Contractor’s Project Manager responsible for a specific task(s).
ERDF: Environmental Restoration Disposal Facility.
FAT: Factory Acceptance Test.
FIO: for information only.
FLA: full load amperes.
Freeboard: The height above the resin bed available for bed expansion during backwashing.
gpm: gallons per minute.
hp: horsepower.
kVA: kilovolt amperes.
kW: kilowatts.
Manufacturer: The original equipment manufacturer regardless as to CHPRC’S Contract with a Contractor. The Manufacturer may be the Contractor, or a Subcontractor.
P&ID: Process and instrumentation diagram.
PLC: programmable logic controller.
PVC: polyvinyl chloride.
Resin Manufacturer: The company responsible for the manufacture of the ion exchange resin.
SCADA: Supervisory Data Acquisition and Control.
Sluicing: To transport resin in a stream of water.
SST: Stainless steel, Type 316 unless noted otherwise.
U: Uranium.
Volts: volts.
1 GENERAL

1.1 Scope

1.1.1 This Section covers the work necessary to design, detail, manufacture, deliver to the jobsite, and to startup and test, complete and ready for operation, an Ion Exchange System for removal of uranium (U) and technetium-99 (Tc-99) from contaminated groundwater as specified herein and as shown on the Drawings. The system shall be located in a building and shall consist of one unit, consisting of three ion exchange vessels (skid-mounted), configured to operate in series with piping and valving as shown on the Process and Instrumentation Diagram (P&ID) to allow the vessels to be interconnected in any possible order, including both series and parallel arrangements; face piping with manual valve nest; ion exchange resin; vessel internals; resin traps; instrumentation; spare parts; all system appurtenances required for a complete and functional system, and services as described below.

1.1.2 The system specified is a manually operated ion exchange system to remove U and Tc-99 from contaminated groundwater. The system will also likely adsorb carbon tetrachloride, which is present as a contaminant in the groundwater. For the purposes of disposal, the spent resin will be rinsed with hot water after removal from the vessel after it is saturated with U or Tc-99, to elute (remove) adsorbed carbon tetrachloride. Spent resin shall be sluiced from the vessel to a Buyer-supplied resin rinsing and dewatering system. Virgin resin shall be sluiced from the ion exchange resin vendor truck directly to the emptied ion exchange vessel, or a Buyer-supplied resin storage tank, using a Buyer-supplied sluicing recessed impeller-type pump, or similar device.

1.1.3 The intent of these Specifications is to indicate the level of performance and quality required for this equipment. System manufacturer can offer their standard design but shall indicate in writing where their equipment differs from this Specification, and where technical exceptions are taken.

1.2 References

1.2.1 The following Specification sections are referenced in this specification:

1.2.1.1 Section 01 43 33.LLE, Manufacturers’ Field Services.
1.2.1.2 SGW-54021 01 61 00, Common Product Requirements.
1.2.1.3 Section 01 78 23.LLE, Operation and Maintenance Data.
1.2.1.4 Section 01 88 15.LLE, Seismic Anchorage and Bracing. (excluding 1.03.G)
1.2.1.5 SGW-54023 05 50 00, Metal Fabrications.
1.2.1.6 SGW-54024 09 90 00, Painting and Coating.
1.2.1.7 SGW-54051 40 99 90, Package Control Systems.
1.2.1.8 SGW-54042 40 27 00.08, Stainless Steel Pipe and Fittings – General Service
1.2.1.9 SGW-54046 40 27 02, Process Valves and Operators
1.2.1.10 Section 40 91 00, Instrumentation and Control Components
1.2.2 The design, manufacture, and installation of this equipment shall meet or exceed the applicable provisions and recommendations of the following codes and standards authorities.

1.2.2.1 American National Standards Institute (ANSI), ANSI C80.1, Specification for Rigid Steel Conduit, Zinc Coated.

1.2.2.2 American Society of Mechanical Engineers (ASME).

1.2.2.2.1 B31.3, Process Piping.

1.2.2.2.2 BPVC SEC II, Parts C and D.

1.2.2.2.3 BPVC SEC V, Nondestructive Examination.

1.2.2.2.4 BPVC SEC VIII, Division 1.

1.2.2.2.5 BPVC SEC IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

1.2.2.3 National Electrical Code (NEC).

1.2.2.4 National Electrical Manufacturer's Association (NEMA).

1.2.2.5 National Fire Protection Association (NFPA).

1.2.2.6 Nationally Recognized Testing Laboratories (NRTL).

1.2.2.7 NSF International (NSF):

1.2.2.7.1 61, Drinking Water System Components – Health Effects.

1.2.2.7.2 62, Drinking Water Distillation Systems.

1.2.2.8 Occupational Safety and Health Act (OSHA).

1.2.2.9 Underwriter’s Laboratory (UL).

1.3 Factory Acceptance Tests

1.3.1 Factory Acceptance Tests (FATs) shall be conducted to ensure the structures, systems, and components and software meet certain requirements prior to shipment. FATs are conducted by the Contractor and may be witnessed as desired by the Buyer and Buyer’s Technical Representative (BTR). The Contractor shall provide a minimum 2 week notice to the Buyer/BTR prior to the FATs. Buyer/BTR may elect to visit manufacturing facility, at a mutually agreed-to time, prior to the FAT, to inspect the system.

1.4 Submittals

1.4.1 All submittal information shall be provided in English.

1.4.2 Required with Proposal. Provide the following items with Proposal. Submittals provided with Proposal shall be for the purpose of determining responsiveness and shall be used by
Buyer in selecting successful Contractor. Use key words below for tab labels in submittal:

1.4.2.1 Exceptions: Identify any exceptions to these Contract Documents.
1.4.2.2 Missing Items: Identify components that are not specified, but are necessary to provide a fully operational Ion Exchange System.
1.4.2.3 Drawings: Show plan layout, cross sections, and dimensions of equipment. Drawings shall be submitted as hard and electronic copy in AutoCAD Version 2013 or newer format (up to 2017).
1.4.2.4 Factory Acceptance Test Plan.
1.4.2.5 Weights: Net weight, operating weight, and shipping weight, and shipping dimensions of equipment. Also, equipment needed onsite (e.g., crane, forklift, etc. and weight rating) to off-load the equipment provided.
1.4.2.6 Flows: Design flow rates, recommended minimum and maximum flow rates, and recommended constraints for increasing or decreasing flow rates as groundwater extraction rates vary seasonally.
1.4.2.7 Operating pressure including maximum design pressure, and temperature ranges.
1.4.2.8 Detailed description of backwashing procedure and sluicing procedures (for removal of spent resin from vessel and addition of fresh resin to empty vessel), including required water flow rates, air addition requirements and pressures.
1.4.2.9 Instrumentation and controls. Describe field devices.
1.4.2.10 Necessary services, such as amount and pressure of utilities such as electricity, fresh water, air, etc.
1.4.2.11 Operations and Maintenance: A description of operations and maintenance requirements, including anticipated labor hours per day.
1.4.2.12 Special Tools: A list of any special tools to operate and maintain the equipment.
1.4.2.13 Spare Parts: A recommended list of spare parts and replacement media requirements for 1 year of operation, including pricing for all items.
1.4.2.14 Example of past project installation details.
1.4.2.15 Mechanical Components:
1.4.2.16 Catalog information for mechanical components of system including reactor vessels, pumps, valves, and piping.

1.4.3 Approval Required Prior to Work (APW) Submittals:

1.4.3.1 Provide the following items after Notice of Award for review and approval by BTR.
1.4.3.2 Shop Drawings:
1.4.3.2.1 Make, model, weight, and horsepower of each equipment assembly.
1.4.3.2.2 Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials of construction.
1.4.3.2.3 Detailed Structural, Mechanical, and Electrical Drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
1.4.3.2.4 External utility requirements such as air, water, power, drain, etc., for each component.
1.4.3.2.5 Shop and Field Painting Systems Proposed: Include Manufacturer’s descriptive technical catalog literature and specifications.
1.4.3.2.6 Where system proposed is different from that specified or where, in the manufacturer’s opinion, the coating system(s) exceed(s) requirements specified, submit complete technical literature of the proposed system(s) to Buyer’s Technical Representative (BTR) for review.
1.4.3.2.7 Electrical: Wiring diagrams for equipment and interconnection wiring diagrams.

1.4.3.3 Instrumentation and Control:
1.4.3.4 P&IDs, in electronic form, using latest version of AutoCAD.
1.4.3.5 Description of functions monitored, controlled, and alarmed.
1.4.3.6 Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Seismic Anchorage and Bracing.

1.4.3.7 Testing Requirements: Quality Assurance Inspection Plan listing all recommended inspection and testing activities for factory, functional, and performance testing. Minimum testing procedures shall be as specified herein.

1.4.4 Additional Submittals:

1.4.4.1 Provide the following items after Notice of Award to Buyer and BTR.
1.4.4.1.1 Special shipping, storage and protection, and handling instructions, in accordance with SGW-54021 01 61 00, Common Product Requirements.
1.4.4.1.2 MSDS information for all chemicals required for Ion Exchange System.
1.4.4.1.3 Manufacturer’s written/printed installation instructions.

1.4.4.1.3.1 Draft installation instructions shall be provided within 60 days after Notice of Award.
1.4.4.1.3.2 Final installation instructions shall be provided a minimum of 60 days prior to shipment of equipment.

1.4.4.1.4 Manufacturer’s Certificate of Compliance for the Ion Exchange System, in accordance with Section 01 43 33.LLE, Manufacturers’ Field Services.

1.4.4.1.5 Manufacturer’s Data Report, as required by UG-120 of the ASME BPVC SEC VIII, Division 1.

1.4.4.1.6 Certification that factory-applied coating system(s) is identical to requirements specified.

1.4.4.1.7 Routine maintenance requirements prior to equipment startup.

1.4.4.1.8 Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33.LLE, Manufacturers’ Field Services.

1.4.4.1.9 Operation and Maintenance Data: As specified in Section 01 78 23.LLE, Operation and Maintenance Data.

1.4.4.1.10 Service records for maintenance performed during construction.

1.4.4.1.11 Factory, functional, and performance test results as specified herein.

1.5 Quality Assurance

1.5.1 A single manufacturer who shall have sole responsibility for the system shall provide all components including resin for the ion exchange system. The Manufacturer shall have at least 5 years of experience in the design, construction and operation of equipment of the type specified at a minimum of ten full-scale installations in the United States.

1.6 Extra Materials

1.6.1 Furnish, tag, and box for shipment and storage the following spare parts and special tools. Special tools are any tools required to operate and maintain the equipment other than standard tools that can be easily purchased at a hardware store.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve rebuilding kit</td>
<td>One set per each valve type</td>
</tr>
<tr>
<td>Special tools required to operate and maintain the system</td>
<td>One set</td>
</tr>
</tbody>
</table>
2 PRODUCTS

2.1 General

2.1.1 The use of a Manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered. Manufacturer’s field proven, standard designs are preferred.

2.1.2 All equipment supplied shall be skid mounted, preassembled, prepiped, prewired, and tested to the maximum extent possible.

2.1.3 All components of the ion exchange system shall be compatible with the conditions and chemicals to which they will be subjected during normal operation of the system. Uncoated carbon steel must not be used for any wetted part in order to avoid Tc-99 or U accumulation.

2.1.4 Equipment Identification Plates: Provide 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component identified on piping and instrumentation drawings in a readily visible location. Plate shall bear 1/4-inch high engraved block type black enamel filled equipment identification number and letters.

2.1.5 Functional Requirements: The following describes the minimum functional requirements of the intended system.

2.1.5.1 Backwash/Sluicing Process Description: The system shall use a single-use resin. When virgin resin is placed in the vessel, the resin will be backwashed using treated water from the centralized treatment facility. When the ion exchange resin reaches its loading limit, it will be removed from the vessel by sluicing it with treated water from the centralized system (finished water) into a carbon tetrachloride stripping tank (Strip Tank). The motive force shall be both compressed air applied to the vessel and a recessed impeller-type pump. The compressed air will be supplied from a plant air system, with air distribution piping and valves provided as part of this package system. The sluicing pump will be provided by others. Stripped resin will be disposed of from the strip tank by Buyer. Fresh resin will be loaded via either by the resin vendor truck, using a Buyer-supplied recessed impeller-type pump, or using an eductor sluicing system, to be provided by Buyer.

2.1.5.2 The backwash/sluicing process is manual and will require an operator to manually change valve positions and start pumps. The flow rates for the various process steps are to be field determined by the system Manufacturer.
2.2 **Recommended Manufacturers**

2.2.1 Uranium Resin:

2.2.1.1 Dowex 21K, or

2.2.1.2 Similar uranium-selective ion exchange resin with demonstrated ability to remove U as approved by BTR.

2.2.2 Technetium Resin:

2.2.2.1 Purolite A532E, or

2.2.2.2 Similar uranium-selective ion exchange resin with demonstrated ability to remove U as approved by BTR.

2.3 **Exposure Conditions**

2.3.1 Groundwater Liquid Design Temperature:

2.3.1.1 Minimum Sustained Temperature: 50 degrees F.

2.3.1.2 Nominal Annual Temperature: 67 degrees F.

2.3.1.3 Peak, Transient Temperature: 90 degrees F.

2.3.2 Ambient Conditions:

2.3.2.1 Outside Building Temperature: Minus 23 degrees F to plus 115 degrees F.

2.3.2.2 Inside Building Temperature: 50 degrees F to 100 degrees F.

2.3.2.3 Air: Arid.

2.3.2.4 Elevation Above Sea Level: 727 feet.

2.3.3 Flow Rates (three vessels in series operation):

2.3.3.1 Nominal Design Flow Rate: 400 gpm.

2.3.3.2 Maximum Sustained Design Flow Rate: 450 gpm.

2.3.3.3 Minimum Operating Flow Rate: 150 gpm.

2.4 **Minimum Equipment Criteria**

2.4.1 Furnish an ion exchange system with three vessels in series to meet the following initial minimum criteria at the nominal design flow rate:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel Diameter (minimum)</td>
<td>8</td>
<td>feet</td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
<td>Units</td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>Vessel Height Seam-to-Seam (maximum)</td>
<td>8</td>
<td>feet</td>
</tr>
<tr>
<td>Resin Bed Depth (minimum):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Foot diameter vessel</td>
<td>6</td>
<td>feet</td>
</tr>
<tr>
<td>10 Foot diameter vessel</td>
<td>5</td>
<td>feet</td>
</tr>
<tr>
<td>Resin Volume (minimum)</td>
<td>360</td>
<td>cubic feet</td>
</tr>
<tr>
<td>Hydraulic Loading Rate (maximum)</td>
<td>8.9</td>
<td>gpm/sq ft</td>
</tr>
<tr>
<td>Resin Loading Rate (maximum)</td>
<td>1.25</td>
<td>gpm/cubic feet</td>
</tr>
<tr>
<td>Freeboard above resin bed (minimum)*</td>
<td>68</td>
<td>percent</td>
</tr>
<tr>
<td>Design Internal Pressure</td>
<td>150</td>
<td>psig</td>
</tr>
</tbody>
</table>

Note: *Depending on the vendor’s intended internal design, the height within the lower and upper vessel heads can be included in the bed height

2.4.1 Water Analysis: Furnish a IX system to meet the minimal criteria based on the following influent water analysis:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average Value (Before Bioprocess)**</th>
<th>Average Value (After Bioprocess)**</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Tetrachloride</td>
<td>370</td>
<td>25</td>
<td>µg/L</td>
</tr>
<tr>
<td>Nitrate as Nitrogen (average)</td>
<td>30</td>
<td>5</td>
<td>mg/L</td>
</tr>
<tr>
<td>Hexavalent Chromium</td>
<td>26</td>
<td>3.8</td>
<td>µg/L</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>2.8</td>
<td>0.4</td>
<td>µg/L</td>
</tr>
<tr>
<td>Iodine-129</td>
<td>0.4</td>
<td>0.4</td>
<td>pCi/L</td>
</tr>
<tr>
<td>Technetium-99</td>
<td>117</td>
<td>106</td>
<td>pCi/L</td>
</tr>
<tr>
<td>Tritium</td>
<td>3,000</td>
<td>3,000</td>
<td>pCi/L</td>
</tr>
<tr>
<td>Uranium</td>
<td>1.0</td>
<td>0.9</td>
<td>µg/L</td>
</tr>
<tr>
<td>Chromium (total)</td>
<td>26</td>
<td>3.8</td>
<td>µg/L</td>
</tr>
<tr>
<td>Alkalinity (as CaCO₃)</td>
<td>105</td>
<td>148</td>
<td>mg/L</td>
</tr>
<tr>
<td>Calcium as Ca</td>
<td>61</td>
<td>58</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>24</td>
<td>52</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chloroform</td>
<td>4.6</td>
<td>4.0</td>
<td>µg/L</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.35</td>
<td>0.35</td>
<td>mg/L</td>
</tr>
<tr>
<td>Parameter</td>
<td>Average Value (Before Bioprocess)**</td>
<td>Average Value (After Bioprocess)**</td>
<td>Units</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------</td>
<td>------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Iron (dissolved)***</td>
<td>0.25</td>
<td>nil</td>
<td>mg/L</td>
</tr>
<tr>
<td>Magnesium</td>
<td>21</td>
<td>21</td>
<td>mg/L</td>
</tr>
<tr>
<td>Manganese (dissolved)***</td>
<td>0.084</td>
<td>10</td>
<td>mg/L</td>
</tr>
<tr>
<td>Potassium</td>
<td>5</td>
<td>5</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sodium</td>
<td>21</td>
<td>21</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sulfate</td>
<td>60</td>
<td>70</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>1.6</td>
<td>1.6</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Suspended Solids***</td>
<td>1.9</td>
<td>nil</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>484</td>
<td>484</td>
<td>mg/L</td>
</tr>
</tbody>
</table>

** The analyses indicated are estimated analyses for two potential operating scenarios that affect specified process influent conditions, treatment before biological treatment and treatment after the biological treatment.

*** Indicated contaminants may deviate up to twice the indicated value. Manufacturer to indicate the maximum concentration stripper can tolerate, when using vendor recommended antiscalent at vendor recommended dosage for the each indicated contaminant.

### 2.5 Performance Requirements

#### 2.5.1
The system shall be sized and designed to allow for continuous, 24 hours per day, 365 days per year operation, unattended for up to 5 days.

#### 2.5.2
The system shall produce a maximum nominal design discharge contaminant concentration of 30 μg/L of U from the second vessel under all specified process influent conditions and the maximum sustained design flow rate, including simultaneous maximum sustained influent U and minimum or maximum sustained inlet fluid temperature during the normal service period of the resin bed in the lead bed (after rotation from the second bed position). Maximum nominal design discharge contaminant concentration is defined as the maximum concentration under steady state conditions,
excluding only brief, transient conditions constituting no more than one percent of the total operating time of any 24-hour period.

2.5.3 The normal service period of the lead resin bed time required to produce less than 30 μg/L of U (effluent from the second bed), shall be a minimum of 45 days at peak flow.

2.6 Equipment Requirements

2.6.1 General:

2.6.1.1 All equipment supplied shall be skid mounted, preassembled, prepiped, prewired, and tested to the maximum extent possible.

2.6.1.2 Uncoated carbon steel shall not be used for any wetted part in order to avoid Tc-99 or U accumulation.

2.6.1.3 All fasteners for flanged connections on the tank, both internal and external, shall be 304 or 316 SST.

2.6.1.4 Refer to Article Painting herein and to SGW-54024, 09 90 00 Painting and Coating, for painting and coating requirements of system components.

2.6.1.5 Equipment shall fully comply with OSHA standards.

2.6.1.6 Electrical material and equipment shall have UL listing wherever standards have been established by that agency. Complete electrical assembly shall meet requirements of National Electrical Code (NEC), National Electrical Manufactures Association (NEMA), and National Fire Protection Association (NFPA).

2.6.1.7 All circuit breakers shall be provided with a permanently attached lock-out provision.

2.6.2 Vessels:

2.6.2.1 Contractor shall design and fabricate vessels per ASME BPVC SEC VIII, Division 1. At Contractor's option, the vessels may be fabricated from stainless steel clad plate per ASME BPVC SEC II, Part D, Table 1A as follows:

2.6.2.1.1 Clad Plate: SA-264, with Type 304L cladding per SA-240. Minimum cladding thickness shall be 10 percent of the total plate thickness.

2.6.2.2 The vessel shall be designed to resist seismic forces. The seismic forces are to be based on the vessels and all appurtenances full of water. See Section 01 88 15, Seismic Anchorage and Bracing, for specific requirements.

2.6.2.3 All vessel components and attachments shall be 1/4-inch minimum base material thickness. Actual finished thickness may vary but must meet or exceed ASME Section VIII code requirements. Design of pressure vessel cylinder and heads shall include 1/8-inch corrosion allowance, when epoxy coated carbon steel is used.
2.6.2.4 Vessels shall be stamped according to the 2013 (or newer) ASME Boiler and Pressure Vessel Code. Welding procedure specifications and welders and welding operators shall be qualified per ASME BPVC SEC IX.

2.6.2.5 All vessel internals shall be Type 316L stainless steel, regardless of the selected shell material. The upper internals (inlet distributor and backwash collector internals) shall consist of at least six individual collection points evenly distributed throughout the upper vessel head or Manufacturer’s standard design, subject to BTR’s approval, or Buyer-approved equal. The lower internals (treated water collector and backwash distributor) shall be externally mounted septa wedge wire screen elements and shall consist of at least six individual collection points evenly distributed throughout the lower vessel head or Manufacturer’s standard design, subject to BTR’s approval, or Buyer-approved equal.

2.6.2.5.1 Each vessel shall incorporate sample taps located at the inlet and outlets.

2.6.2.5.2 Nozzles for water inlet and outlets (six externally mounted septa screens), resin removal (center of bottom vessel head), sampling taps between vessels (to monitor for saturation breakthrough), air supply (for resin sluicing) and any other nozzles required for a complete and functional system.

2.6.2.5.3 Accessible low point drains shall be provided to allow dewatering of vessels and all piping for maintenance.

2.6.2.5.4 All connections to the vessel shall be flanged type.

2.6.2.5.5 For a coated carbon steel vessel construction, all penetrations of the vessel wall by stainless steel components shall be configured to provide dielectric isolation of the stainless steel from the carbon steel vessel wall. For the upper internals, the SST header shall connect to the internal tank nozzle through a short FRP or Schedule 80 PVC flanged spool piece to ensure dielectric isolation of the connection. The FRP spool piece shall be designed to support the upper internals under all operating conditions, transportation loads, including seismic as specified herein. The support at the opposite end of the header from the tank wall shall be similarly positively isolated using an FRP spacer. The lower internals shall be configured to provide complete dielectric separation of the wedge wire screen elements from the tank nozzle and flange. Fasteners shall be stainless steel and coated with the tank coating after installation.

2.6.2.5.6 Penetrations through a stainless steel clad tank wall shall be welded in conformance with ASME BPVC Sec. VIII, Division 1.

2.6.2.6 Vessels and piping shall be hydrostatically tested at 1.5 times design pressure prior to shipment per ASME BPVC Sec VIII, Div. 1, UG-99. Each vessel shall be provided with a pressure relief valve sized to limit the pressure in the vessel in accordance with ASME BPVC, which requires that the relief device shall
prevent the pressure from rising more than 10% or 3 psi, whichever is greater above the maximum allowable working pressure (UG-125). Relief valve shall be of stainless steel construction.

2.6.2.7 Each vessel shall be equipped with elliptical, ASME style manways, of the standard 14-inch by 18-inch size. A manway shall be located in the top of the vessel to provide access to the diffuser and on the side near the bottom of the vessel. Each vessel shall have structural legs fitted with base plates and anchor bolt pattern for leveling. Anchor bolts shall be provided with the package system and shall be 3/4-inch stainless steel.

2.6.3 Supporting Skid:

2.6.3.1 The ion exchange vessels and all appurtenances shall be supported on a single skid unless transport restrictions require multiple skids due to equipment sizing. Skid shall be shop-fabricated of mild steel in accordance with ASTM A36. Skid shall be factory finished as specified in SGW-54024, 09 90 00 Painting and Coating. A system where the ion exchange vessels are individually supported on legs and a pipe rack is provided separately, upon which the vessels are mounted, is not acceptable.

2.6.3.2 The skid shall be designed to resist seismic forces. The seismic forces are to be based on the vessels and all appurtenances full of water. See Section 01 88 15, Seismic Anchorage and Bracing, for specific requirements.

2.6.4 Resin (Provided by Buyer):

2.6.4.1 The ion exchange resin for uranium shall be Purolite PGW6002E, or equivalent resin that has been demonstrated to remove U, as approved by the BTR.

2.6.4.2 Dowex 21K is a macroporous strong base anion resin (supplied in chloride form) crosslinked with divinylbenzene. Dowex 21K has the following physical and chemical characteristics:

<table>
<thead>
<tr>
<th>Total Capacity (minimum)</th>
<th>1.2 eq/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Size Typical</td>
<td>0.80—1.1 mm</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.08 g/mL</td>
</tr>
<tr>
<td>Temperature Limit (maximum)</td>
<td>212 degrees F</td>
</tr>
<tr>
<td>pH Limit (stability)</td>
<td>0—14</td>
</tr>
</tbody>
</table>

2.6.4.3 The ion exchange resin for technetium-99 shall be Purolite A532E, or equivalent resin that has been demonstrated to remove U, as approved by the BTR.
Purolite A532E is a polystyrenic gel strong base anion resin (supplied in chloride form) crosslinked with divinylbenzene. Purolite A532E has the following physical and chemical characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capacity (minimum)</td>
<td>0.85 eq/L</td>
</tr>
<tr>
<td>Mean Size Typical</td>
<td>0.60—0.70 mm</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.04 g/mL</td>
</tr>
<tr>
<td>Temperature Limit (maximum)</td>
<td>212 degrees F</td>
</tr>
<tr>
<td>pH Limit (stability)</td>
<td>0—14</td>
</tr>
</tbody>
</table>

2.6.5 Piping:

2.6.5.1 The ion exchange system functional piping shall be included on the skid as part of the package system. Piping system shall be designed, installed, examined, and tested in accordance with ASME B31.3. Piping shall be arranged to carry out all the routine operations of service, backwash, and resin removal sluicing.

2.6.5.2 The face piping (except sluicing lines), pipe supports, and valves shall be supplied and installed to the limits as shown on the Drawings. The face piping shall be constructed of new material. Piping sizes shall limit the maximum liquid velocity at peak design flows to no more than 8 feet per second. All piping shall be stainless steel as defined in SGW-54042. All piping shall be as specified in SGW-54021, 01 61 00, Common Product Requirements.

2.6.5.3 Air piping for sluicing and/or backwashing shall be 1-inch stainless steel piping, as specified in SGW-54021, 01 61 00, Common Product Requirements, connected to the top of each vessel using a flanged connection.

2.6.5.4 The skid mounted system shall be piped complete to the following single points of connection to the plant facilities beyond the skid limits. All necessary piping connections to the vessels and interconnecting piping among the vessels to allow for the specified alternate modes of operation and as shown on the Drawings shall be supplied with the skid-mounted system. If the vessels must be provided on separate skids due to shipping requirements and constraints, piping interconnections between the skids shall be provided with the equipment for field installation by the Construction Contractor.
2.6.5.4.1 Groundwater influent.
2.6.5.4.2 Backwash supply.
2.6.5.4.3 Backwash waste.
2.6.5.4.4 Treated water.
2.6.5.4.5 Sluiced resin in.
2.6.5.4.6 Sluiced spent resin out.
2.6.5.4.7 Common skid drain.

2.6.6 Valves:

2.6.6.1 Functional valves shall be manual butterfly valves as indicated on the Drawings. Valves shall be line size of stainless steel or coated carbon steel construction, as specified in SGW-54046 40 27 02, Process Valves and Operators.

2.6.6.2 Sluicing line valves (inlet and outlet) and all other isolation valves not shown to be butterfly valves shall be full port stainless steel ball valves, as specified in SGW-54046 40 27 02, Process Valves and Operators.

2.6.6.3 Miscellaneous Valves:

2.6.6.3.1 2-inch air release valves shall be provided for all vessels and all looped piping as required. Valves to be stainless steel for all wetted parts, as specified in SGW-54046 40 27 02, Process Valves and Operators.

2.6.6.3.2 2-inch manual valves on the compressed air lines shall be Instrument Air Shutoff Valves as specified in SGW-54046 40 27 02, Process Valves and Operators.

2.6.6.4 Elevated valves (higher than 6 feet 6 inches), 3 inch and larger require geared operators/chain wheels easily accessible (less than 18” deep in skid) in lieu of platforms.

2.6.7 Resin Traps:

2.6.7.1 Each vessel effluent shall include a resin trap using a Type 316 stainless steel wedge wire strainer.

2.6.7.2 Provide a differential pressure indicating transmitting to monitor pressure drop through the resin trap.

2.6.8 Sample Ports and Sight Glasses:

2.6.8.1 Each vessel shall include four 1/2-inch Type 316 stainless steel sample cocks. The Type 316 stainless steel sample cocks shall be located by the ion exchange system manufacturer to assist the Buyer in operation of the system. The sample cocks shall be screened as necessary to prevent plugging and loss of resin. Provide each sample cock with a reducer and ¼-inch elbow oriented downward to facilitate sample collection.

2.6.8.2 A single clear nonbreakable sight glass shall be provided on the side of each vessel to indicate visual loss of the resin bed. Sight glass shall be 1 foot long
and shall evenly straddle the nominal height of the top of the resin bed and not be obstructed from view. Sight glass shall be rated for the tank test pressure.

### 2.7 Electrical Components and Accessories

2.7.1 General: Provide field panels, electrical components, and wiring for a complete, functional system. Provide all items whether specified or not, required for proper system operation.

2.7.2 Conductors:

   2.7.2.1 Conductor shall be copper.
   2.7.2.2 Use minimum conductor size of No. 12 AWG for power circuits.
   2.7.2.3 Install conductors in conduit suitable for location installed.
   2.7.2.4 Size conductor and conduit per NEC.

### 2.8 Instrumentation And Controls

2.8.1 General:

1. Provide instruments and panels in accordance with general control requirements specified in SGW-54051, 40 99 90, Package Control Systems.
2. The minimum functional requirements of the control system are specified herein. Provide additional instrumentation and controls as to provide a safe and operable system.
3. A single ion exchange monitoring location shall be provided to monitor all included vessels for each train.

2.8.2 Instrumentation: All instrumentation provided shall meet the requirements of SGW-54051 40 99 90, Package Control Systems, and 40 91 00, Instrumentation and Control Components, with regard to preferred manufacturers (where noted) and quality and performance standards.

2.8.2.1 As a minimum, each train shall include the following instrumentation as shown:

   2.8.2.1.1 Magnetic Flow Meters (FE): One for each vessel in each supplied train, mounted in the influent piping for each individual vessel as shown on the Drawings, to allow for measurement of the flow to each vessel regardless of the operating configuration of the vessels in the train.

   2.8.2.1.2 Pressure Indicators (PI): Two for each vessel, one on the inlet piping and one on the effluent piping. Gauges shall be mounted locally at point of connection.

   2.8.2.1.2.1 Range: 0 to 150 psig.

2.8.2.2 Pressure Elements: One for each PIT/PI combined connection, and one for each PDIT connection.
2.8.2.3 Monitoring location for the supplied train, mounted on the skid, including the following instruments, mounted to facilitate access to the instruments for calibration, troubleshooting, setup, monitoring, etc.:

2.8.2.3.1 Flow Indicating/Transmitter (FIT): One for each vessel on the train (three total), connected to the flow meters described above.

2.8.2.3.2 Pressure Indicating Transmitter (PIT): Two for each vessel (six total), one for upstream pressure and one for downstream pressure. Instruments shall be connected to the piping using tubing or piping as recommended by the instrument manufacturer.

2.8.2.3.3 Pressure Differential Indicating/Transmitter: One for each vessel and one for each resin trap (six total). Instruments shall be connected to the piping using tubing or piping as recommended by the instrument manufacturer.

2.8.2.3.4 Wiring and conduit from each panel mounted device to the plant SCADA system will be provided and installed by the Construction Contractor.

2.8.2.3.5 If instruments are not available in a panel mount configuration, they shall be mounted together on an appropriate support system as recommended by the instrument manufacturer.

2.8.2.3.6 In addition, Type 316 stainless steel sample cocks shall be mounted on the panel to provide water samples for influent raw water and underdrain treated water from each vessel. All sample cocks shall be provided with appropriate name plates. Provide 1/4-inch diameter stainless steel piping from each sample cock to an appropriate location on the system piping to obtain the influent and effluent water samples from each vessel. Panel shall include a minimum 9-inch deep by 9-inch high by required width (to accommodate all of the sample cocks) stainless steel sample collection sink to facilitate sample line flushing and sample collection. Collection sink shall include a 1-1/2-inch drain connection for drain piping connection by Construction Contractor.

2.8.3 All instruments shall be identified with nameplates identifying instrument number (as per the P&IDs), vessel number, and location measured (e.g., influent, effluent).

2.9 Source Quality Control

2.9.1 The ion exchange vessels shall be hydrotested at the place of manufacture, and may be witnessed by a representative of the BTR.

2.9.2 A separate inspection record shall be made for each vessel. Inspection records shall be sent to the BTR for approval at least 2 weeks prior to shipment.
3 EXECUTION

3.1 Site and Utilities

3.1.1 Site preparation, utility service and installation are not the responsibility of the Manufacturer and shall be the responsibility of the Construction Contractor.

3.2 Installation

3.2.1 The equipment specified herein will be installed by the Construction Contractor in conformance with the Manufacturer's written instructions, as accepted by the BTR. A factory representative shall inspect the installation after completion of installation and shall make all necessary adjustments to the equipment for satisfactory operation.

3.2.2 The Manufacturer shall submit to the Buyer complete installation instructions including initial startup instructions at least 60 days prior to shipping.

3.2.3 Finished surfaces of all exposed equipment openings shall be protected. Finished iron or steel surfaces not painted or coated shall be properly protected to prevent rust and corrosion.

3.2.4 Proper care shall be taken to protect mechanical and electrical components from the entrance of water during shipment, storage and handling.

3.2.5 Construction Contractor will be responsible for providing 24-volt power supply to instrumentation. All other wiring needed to interconnect the skid-mounted components and the monitoring panel shall be provided with the system and installed by the Contractor. All piping, appurtenances, and instruments that are specified herein as part of the skid-mounted system shall be installed by the Contractor. System shall be provided with specific piping connection points at the limits of the skid for connection of facility piping by the Contractor as specified herein.

3.3 Field Quality Control

3.3.1 Functional Test: Performed in accordance with Manufacturer’s approved Quality Assurance Inspection Plan by Construction Contractor with oversight provided by Contractor.

3.4 Manufacturer’s Services

3.4.1 In accordance with Section 01 43 33.LLE, Manufacturers’ Field Services.

3.4.2 Manufacturer’s Representative: Present at site or classroom designated by Buyer for minimum person-days listed below. All training shall not commence until an accepted lesson plan for each session has been reviewed by the Buyer.

3.4.2.1 8 person-days for installation assistance and inspection.
3.4.2.2 5 person-days for facility startup.
3.4.2.3 5 person-days for functional and performance testing.

3.4.2.3.1 1 person-day for pre-start classroom and field training.

3.4.2.3.2 1 person-day for post-startup training of Buyer’s personnel.