SECTION 15500 - RO/DI EQUIPMENT

PART 1 - GENERAL

1.1 REFERENCE

A. Sections of Division I, GENERAL REQUIREMENTS, and requirements of Section 15010, BASIC MECHANICAL REQUIREMENTS, apply to work under this specification section.

1.2 EQUIPMENT REQUIREMENTS

A. General: Equipment shall be installed in accordance with applicable sections of this specification and shall be complete in every respect, including necessary accessories required to complete systems. Equipment shall meet all applicable codes and shall be UL listed when required by code or local authorities.

B. Prewired Control Panels (PWCP): Each piece of equipment required by these specifications to have a prewired control panel shall have panels that contain but are not limited to the following:

1. NEMA enclosure with hinged door or doors and gaskets, louvers, fans and durable finish to match the environment where it is located.

2. Control power transformer with primary and secondary fuses.

3. Pushbuttons, switches, liquid crystal display, and LED or pilot lights to indicate ON, OFF, speed or other appropriate information as specified for each piece of equipment.

4. Wiring diagram on the inside cover indicating terminals by number, wiring color to each control device both inside the panel and remote. Diagram shall be covered in plastic and affixed to the inside cover or box in a location easily readable after opening the front cover plate.

5. Panel shall contain motor starter as applicable for specific equipment to provide a complete and working system.

6. Individual equipment sections of this specification contain additional prewired control panel requirements. Read each section for requirements.

1.3 SCOPE OF WORK

A. This section of the specifications covers detailed requirements for the installation of a High Purity Deionized Water System for Washington University School of Medicine to provide 1 megohm water for laboratory use.

1.4 DESCRIPTION OF SYSTEM A

See Article 2.1 of this section.
1.5 SUBSTITUTIONS

A. No substitutions will be allowed except as specified under Article 1.5 of Section 15010, BASIC REQUIREMENTS.

1.6 SHOP DRAWINGS AND SUBMITTAL REQUIREMENTS

A. See Section 15010.

PART 2 - PRODUCTS

2.1 DEIONIZED WATER (RO/CDI) SYSTEM FOR WASHINGTON UNIVERSITY SCHOOL OF MEDICINE WATER EQUIPMENT ROOMS

A. The system shall consist of a cold water BFP, E-Z pressure booster pump system, duplex alternating water softener, duplex series carbon filters, RO unit, polyethylene RO storage tank with 0.2 micron vent filter, ultrasonic level sensor, continuous electrodeionization unit (CDI), RO duplex circulation pumps with VFD pump control panel, one (1) polyurethane DI storage tank with a ultrasonic level sensor (plus extra unit for maintenance stock), duplex DI circulation pumps with duplex VFD pump control panel, 1.0 micron prefilter canister (with spare filter cartridges), ultraviolet sterilizer (UV) with spare lamps, 0.2 micron final filter canister (with spare filter cartridges). System manufacturers: Siemens Water Technology (previously U.S. Filter Corp.), Hazelwood MO., (314)731-1462 or Schaefer Water Centers, Herculeaneum MO., (539)931-2268, unless otherwise stated.

1. Backflow Preventer: Backflow preventer shall be of reduced pressure type as manufactured by Wilkins with stainless steel/Noryl (modified polyethylene oxide) check modules. Similar approved devices manufactured by Watts, Cla-Val, Conbraco, or Febeco will be considered for approval. Unit shall consist of inlet and outlet bronze quarter turn ball valves bronze test cocks, bronze primary and secondary check valves with double-seated primary check flanges and vent port. Unit shall be complete with interconnections and sensing devices. Unit shall be Wilkins Series 975XL, factory assembled and suitable for installation directly into water piping. Provide air gap assembly with drain connection to floor drain Units 2 inch and smaller shall be constructed of all bronze.

2. Booster Pump: Grundfos E-Z Boost System with BMOE booster pump, diaphragm tank, controller, and pressure sensor. Pump shall be sized to boost process water pressure to maintain an inlet pressure of 40 psig at the RO unit. MC shall field assemble with required piping and fittings. Vendor: Industrial Process Equipment, (314)354-3100.

3. Water Softener:
   a. General:
      1) Contractor shall furnish and install where shown on plans, a new automatic duplex alternating water softening system.
      2) The water softener equipment shall consist of two (2) softener tanks, and a brine tank, internal distributors, upper distribution systems, exchange resin, and automatic electronic controller head. The control head shall control all backwash, brine and rinse functions and function based on volume initiation with timed cycles for backwashing during third shift. NOTE: Installing Contractor shall provide removable pipe sections at control head to allow for free spinning of head for
servicing tank while in its static upright position.

3) The system shall be capable of delivering unlimited gallons of soft water at a continuous flow rate to meet user requirements for RO feed service when properly backwashed and regenerated. (Based on water having a compensated hardness of 11 grains per U.S. gallon) capable of operating on a 24 hour basis.

b. Softener Tanks:

1) The softener tanks shall be molded fiberglass construction. Tanks shall be designed for 110 pound working pressure and tested at 1-1/2 times working pressure. Tank shall be supplied with reinforced openings for pipe connections and rigid supports. Mineral tanks shall be National Sanitation Foundation (NSF) approved. There shall be adequate side shell height to allow for 50 percent bed expansion during backwash. Tanks shall utilize premium grade gel-type synthetic high capacity cation exchange resin of polystyrene type.

2) Automatic electronic controller shall be capable of controlling, softening, backwash, brining, slow rinse, and fast rinse. Valve assembly shall be equipped to avoid hard water bypass.

c. Brine Tank:

1) Brine tank shall be constructed of polyethylene with removable plastic cover. Float operated fill valve shall ensure a constant supply of saturated brine for regeneration. Brine shall be made with soft water.

2) Salt shall be used for regeneration and the amount shall not exceed 15 pounds per 270,000 grains of compensated hardness removed.

d. Instructions and Startup:

1) A complete set of operating instructions covering the installation, maintenance and operation of the softener system shall be furnished bound in booklet form.

2) Contractor shall provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation, and acquaint the operators with the proper operation and maintenance of the equipment.

e. Guarantee: The manufacturer shall guarantee that under actual operating conditions, the effluent shall contain 0 grains per gallon (gpg) hardness as determined by soap test, that the loss of ion exchange resin through attrition during the first three years of operation shall not exceed 3 percent per year; that the resin shall not be washed out of the system during the service run or backwashing period; that the turbidity and color of the effluent, by reason of passing through the softener system, shall not be greater than the incoming water. The manufacturer shall also guarantee that any mechanical equipment proving defective in workmanship or materials within one year after installation shall be replaced F.O.B. factory.

4. Commercial Duplex Carbon Filters: The carbon filters shall consist of two (2) large automatic backwashable carbon filter fiberglass tanks piped in series. Sized for required flow rate as described below.
a. Carbon filter tanks shall be piped in series and set for timed backwash via the electromechanical timer and pretreatment lockout switch assembly to deactivate downstream equipment during backwash feed flow. Units shall provide adequate removal of chlorine before the reverse osmosis unit when piped in series for the required commercial service flow rate. Each filter shall provide the required flow rate for RO feed service. NOTE: Installing Contractor shall provide removable pipe sections at control head to allow for free spinning of head for servicing tank while in its static upright position.

5. Reverse Osmosis (RO): Units shall be a vertical style for product flow rates up to 10 gpm and horizontal styles for larger flows at 50 psig and 77 deg. F. A 20 inch sediment prefilter with cellulose 5 micron cartridge shall be on the inlet to the unit. The reverse osmosis unit shall have double TFC membrane units which can receive softened dechlorinated inlet water between 25 to 50 psi at 77 deg. F. The membrane housing shall be mounted vertically (or horizontally) and manufactured from 304L stainless steel. Configuration of membrane housing caps shall allow for quick and easy changeout of membrane filters without removal of other existing components. The membranes shall have a 92 to 98 percent contaminant rejection rate and have no surface applied decals. The unit shall have automatic low pressure shutoff to protect the 304 stainless steel quiet running submersible booster pump when inlet pressure is inadequate. The RO shall also have pressure indication for prefilter, postfilter, pump discharge, primary and final pressure gauges. Unit shall have autoflush system, thermal motor protection and remote on/off capability. Unit shall be mounted on non-corrosive stand with open style full skid mounted frame, complete with solid-state programmable controller housed in NEMA 4X enclosure with audible and visible alarm system. Controller shall have conductivity sensor for both feed and product, and a flow meter for product, reject and recycle flow rates. Controller shall be field-interlocked to shut down during timed regeneration cycling of carbon filters. Controller shall have liquid crystal display, mult-function keypad, visual and audible alarms, high/low pressure automatic reset, alarm silence, non-metallic NEMA 4X enclosure and are panel mounted. The controller for the new ultrasonic level sensor transducer head mounted on top of RO storage tank shall be powered by the new RO unit and field wired to start/stop new RO unit to maintain programmed operating level of RO water in storage tank. Mount level controller at tank.

6. RO Storage Tank: Single high density polyethylene (HDPE) vertical cylindrical RO storage tank with dished or conced bottom for total gravity drainage of product water. Tank shall have 12 inch long 0.2 micron vent filter mounted on top of tank. Tank support frame shall allow for gravity sloped piping to inlet manifold of circulation pumps.

7. Continuous Electrodeionization (CDI): New unit shall continuously produce an uninterrupted supply of high purity water by handling an inflow of RO feedwater and take to a higher level of purity (nominal 14 megohm-cm) without the need for regeneration chemicals. The packaged corrosion resistant skid mounted frame shall house a single or double 24 or 30 cell pairs CDI module to meet product water flow rate requirements. Unit shall have main control panel with power supplies, controllers, complete factory CPVC Schedule 80 piping, sample valves, cleaning connections, product flow monitoring and product resistivity meter both with LED readout on control panel. The product low quality divert valves will not be piped/used at this location. Unit shall be Siemens Model CDILX.

a. The system recovery rate shall be a minimum of 90 percent with range from 6.25 gpm minimum to 18.75 gpm maximum flow rate and respective pressure drop from 10 psi to 50 psi as an example for the 24 cell pair modules. Unit shall operate with feedwater ranging from 4 to 11 pH and hardness less than 1.0 PPM. The feed and product connections shall be 1 inch with reject at 1/2 inch size. Power required shall be 208 volts/single phase or 480 volt/3 phase as required.

b. Resistivity System: Function is to monitor final product quality from CDI unit and
recirculating water in DI storage tank for laboratory deionized water distribution system. System shall utilize the Thornton 200CR monitor supplied with the CDI unit.

Contractor shall connect new 50 ft. Long sensor patch cord (Part No. ZCOR1050-66) to the “spare” sensor “B” terminal on monitor with other end connected to the new sensor (Part No. ZCEL240-201) field installed upstream of DI circulation pumps intake manifold piping. Controller has two (2) analog outputs, two (2) SPDT mechanical relays and uses 120 VAC (24 VDC) power. Resistivity range from 1.0 ohm per cm to 50.0 Megohm per cm with performance accuracy of ±0.5 percent of reading and repeatability of ±0.1 percent of reading.

8. DI Storage Tank: Single high density polyethylene (HDPE) vertical cylindrical DI storage tank with dished or coned bottom for total gravity drainage of product water. Tank shall have 12 inch long 0.2 micron vent filter mounted on top of tank. Tank support frame shall allow for gravity sloped piping to inlet manifold of circulation pumps.

9. Ultrasonic Level Sensor/Controllers: The level sensor head (transducer Part No. DST-2421-CX50) shall be mounted on top of both the RO and DI storage tanks. The transducer head shall have a PVC housing, ceramic transducer (NEMA 6P rating), have internal temperature compensation, with accuracy being 0.25 percent of range and come with 50 ft. coax cable.

a. The controller (Part No. DCR1006) shall be mounted on and powered from the RO unit with polycarbonate NEMA 4X housing located next to RO main control panel. Contractor shall select voltage and signal outputs to minimize wiring on RO unit.

Controller shall have LED digital display, programmable response time, 1 inch resolution, and have sample rate range of 80 milliseconds to 10 seconds. NOTE: Controller shall field wire/interlock motor starters for RO and/or DI circulation pumps to shutdown when an ultrasonic level controller senses a “low level” condition in their related storage tanks.

b. Manufacturer to be Scientific Technologies Inc., 1-888-525-7300 ext. 1034, or approved equal.

c. NOTE: Contractor shall provide extra/spare ultrasonic level sensor/controller as described above and deliver to WUSM Maintenance Department Contact: Nick Dochwat at (314)747-2906.

10. Duplex Pumps and Control Panel: Pumps shall be 316 stainless steel Grundfos vertical multistage centrifugal “CR” pumps or Webro end suction pumps, base plate mounted with motor and flex drive coupling. Size as required. The control panel shall control the new duplex circulation pumps for either the RO or DI water loop systems. The duplex control panel shall have a single point power connection, one Toshiba frequency drive (VFD) for each pump which will automatically alternate running by means of an adjustable time clock, which shall be field changeable (initial running time shall be set at 24 hours). The pump speed shall be controlled by a pressure transducer (supplied with panel) field installed in the common discharge piping of the pumps to maintain a system pressure required by the project requirements. The panel enclosure shall be fiberglass, NEMA 3R, with nominal size of 24 inch wide by 30 inch tall by 10 inch deep. There shall be a thru the door disconnect handle, a pump selector switch, a pump running light (push to test style) for each pump, and a hand-off-auto switch for each pump. In the “auto” position the selected pump will be controlled by the pressure transducer. In the “hand” position the selected pump shall run at a “field tested” preset speed and shall not have a “by-pass” around the VFD to insure that the specific operating pressure of the loop piping is not exceeded. If the transducer fails, the selected pump will run in the hand position. The installing Contractor shall set high and low
alarm contact settings on VFD to alert building automation system (BAS) of an irregular output pressure. Vendor: Richards Electric Motor Company, 1-800-292-2535.

11. Ultraviolet Sterilizer (UV Light): The assembly shall generate the UV energy (254 nm) to act as the final polishing step by destroying bacteria in the product water from the CDI unit. In addition to the quartz sleeves, all wetted parts are fabricated from 316L stainless steel that is passivated and electropolished. The unit has a 304 stainless steel ballast enclosure and a non-resettable 99,999 hour timer. Inlet and outlet connections shall have 150 pound flanges with sanitary clamp connections sized for the required process flow rate requirements. Provide complete set of both new and spare 254 nm lamps in protective case. Contractor shall field wire/interlock power for UV light to energize only when related circulation pumps are operating.

12. Duplex Final Filters: The multi-cartridge filter housings shall be made of cast 316 stainless steel and include 316 stainless steel shell. MC shall install new filter cartridges and provide spare set for maintenance department. Quantities shall vary to minimize initial clean pressure drop to no more than 3 psig with 1.0 micron size prefilters (polypropylene depth media filter cartridges), and 0.2 micron size final filters (polysulfone membrane filter cartridges).

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL - MANUFACTURER’S FIELD SERVICE

A. Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of all Deionized Water (RO/CDI) Systems in 2.1 above, including piping and electrical connections, changing lamps and filter membranes and cartridges in all new equipment, and to report results in writing. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment as required.

3.2 DEMONSTRATION - STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services and to demonstrate and train Owner’s maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Schedule training with Owner with at least 7 days' advance notice.
SECTION 232223 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes steam condensate pumps.

1.2 DESIGN REQUIREMENTS

A. Steam condensate pumps shall be electric driven. Steam pressure driven pumps shall not be utilized.

B. Condensate receivers shall be vented to outside the building. Under no circumstance shall condensate receivers be vented to an interior space.

C. Building wide condensate return pumps shall be furnished with condensate receivers elevated above condensate pumps to provide for adequate net positive suction head. Condensate shall be configured to gravity drain to the condensate receiver. For the purposes of keeping building heat exchangers at a reasonable height, designers are encouraged to locate building condensate pumps in an open condensate pit or to locate heat exchangers overhead and provide an access platform.

D. Building wide condensate return pumps shall be provided with a primary and standby pump.

E. Building automation via direct digital control shall be provided for steam condensate pumps. Controls shall include high level alarm.

PART 2 - BIDDING AND CONTRACT DOCUMENT REQUIREMENTS

2.1 SINGLE-STAGE, CENTRIFUGAL PUMPS WITH FLOOR-MOUNTED RECEIVER

A. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pumps, controls, and accessories suitable for operation with steam condensate.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
B. Configuration: Duplex floor-mounted pump with receiver and float switches, rated to pump 200 deg F steam condensate.

C. Receiver:
   1. Floor mounted.
   2. Close-grained cast iron.
   3. Externally adjustable float switches.
   4. Flanges for pump mounting.
   5. Water-level gage and dial thermometer.
   6. Pressure gage at pump discharge.
   7. Bronze fitting isolation valve between pump and receiver.
   8. Lifting eyebolts.
   9. Inlet vent and an overflow.

D. Pumps:
   1. Centrifugal, close coupled, vertical design.
   2. Permanently aligned.
   3. Bronze fitted.
   4. Replaceable bronze case ring.
   5. Mechanical seals rated at 250 deg F.
   6. Mounted on receiver flange.

E. Motor:
   1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   2. Enclosure: Open, dripproof.
   4. Efficiency: Premium efficient.

F. Control Panel:
   1. Factory wired between pumps and float switches, for single external electrical connection.
   2. Provide fused, control-power transformer if voltage exceeds 230 V ac.
   3. NEMA 250, Type 3 enclosure with hinged door and grounding lug, mounted on pump.
   4. Motor controller for each pump.
   5. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
   6. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
   7. Momentary-contact "TEST" push button on cover for each pump.

2.2 SINGLE-STAGE, CENTRIFUGAL PUMPS WITH ELEVATED RECEIVER

A. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pumps, controls, and accessories suitable for operation with steam condensate.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. Configuration: Duplex floor-mounted pump with elevated receiver, float switches, and connecting piping; rated to pump 212 deg F steam condensate.

C. Receiver:
   1. Mounted on fabricated-steel supports.
   2. Close-grained cast iron or Welded steel.
   3. Externally adjustable float switches.
   4. Water-level gage and dial thermometer.
   5. Pressure gage at pump discharge.
   6. Bronze isolation valves between receiver and pumps.
   7. Lifting eyebolts.
   8. Inlet cascade baffle and convex heads.

D. Pumps:
   1. Centrifugal, close coupled.
   2. Permanently aligned.
   3. Bronze fitted with enclosed bronze impellers.
   4. Replaceable bronze case rings.
   5. Stainless-steel shafts.
   6. Mechanical seals rated at 250 deg F (120 deg C).
   7. Mounted on base below receiver.
   8. Rated to operate with a minimum of 2 feet (6 kPa) of NPSH.

E. Motor:
   1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   2. Enclosure: Open, dripproof.
3. **Motor Bearings**: Grease-lubricated ball bearings.
4. **Efficiency**: Premium efficient.

**F. Control Panel:**

1. Factory wired between pumps and float switches, for single external electrical connection.
2. Provide fused, control-power transformer if voltage exceeds 230 V ac.
3. NEMA 250, Type 3 enclosure with hinged door and grounding lug, mounted on pump.
4. Motor controller for each pump.
5. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
6. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
7. Momentary-contact "TEST" push button on cover for each pump.
SECTION 15110 – VALVES

PART 1 PROGRAMMING AND DESIGN GUIDELINES

1.1 GENERAL

A. When two or more valves of the same type are to be used in the same service, all valves of this type shall be of the same manufacturer.

B. All valves for use with insulated piping shall have stem or neck extensions.

C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

G. Butterfly valves larger than 6" shall have gear operators.

H. Butterfly valves and gate valves located above 12'-0" shall have chain wheel operators.

I. Triple duty valves shall not be used.

1.2 VALVE APPLICATIONS

A. Refer to piping Schedules for specific valve applications.

B. Chilled-Water/ Heating-Water/ Condenser Water/ Domestic Cold and Hot Water Piping: Use the following types of valves:

1. Ball Valves: ASTM B564 bronze 2 piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, full port 2" and smaller, standard port 2-1/2" and larger, reinforced TFE seats, all stainless steel trim, threaded or soldered ends.

2. Butterfly Valves: ASTM A395 ductile iron body, 1/4 turn, extended neck, geometric drive, EPDM molded-in seat liner, threaded lug type, aluminum bronze disc, 416 SS stem, lubersized bronze or Teflon bushings. Valves shall be rated for 200psi dead end service with out use of a downstream flange.

3. Balance Valves: Valves shall have position indication and calibrated flow curves. Valves shall provide positive shut-off for service and shall have adjustable memory stops to allow returning to original balanced position after servicing. Valves shall have integral pressure tap ports provided with "drip caps". 2" and smaller bronze body. 2-1/2" and larger iron body.

4. Swing Check Valves: 2" and smaller: Class 125 (125 psi at 400°F, 200 psi at
150°F), bronze, horizontal swing, vertical up-flow, Y pattern, teflon renewable seat and disc in conformance with MSS SP80.

5. Silent Check Valves: 2-1/2" - 10", Class 125 (125 psi at 400°F, 200 psi at 150°F), flanged, ASTM A-126 Class B, cast iron body, bronze trim, resilient seat.

6. Resilient Seat Gate Valves: 250 psig non-shock cold working pressure (maximum operating temperature 160°F), ASTM A536 ductile iron body, bolted bonnet, non-rising stem, EPDM coated ductile iron wedge, epoxy coated inside and outside per AWWA C550, mechanical joint ends.

C. Low Pressure Steam/ High Pressure Steam/ Steam Condensate Piping: Use the following types of valves:

1. Ball Valves: ASTM B584 bronze 2 piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, full port 2" and smaller, standard port 2-1/2" and larger, reinforced TFE seats, all stainless steel trim, threaded ends.

2. Gate Valves: 2-1/2" - 12": Class 125 (125 psi at 400°F, 200 psi at 150°F), ASTMA-125 Class B cast iron body, brass mounted, flanged, bolted bonnet, OS & Y, solid wedge, in conformance with MSS SP70.

3. Gate Valves: 14" and larger: Class 150 (150 psig at 500°F), ASTM A216 Grade WCB cast steel body, flanged bolted bonnet, OS & Y, flanged end is in accordance with ANSI B16.5 and B16.10, pressure temperature ratings in accordance with ASME/ANSI B16.34.

4. Globe Valves: 2" and smaller: Class 125 (125 psi at 400°F, 200 psi at 150°F), bronze, straightway pattern, screw-in bonnet, renewable seat and disc, in conformance with MSS SP80.

5. Globe Valves: 2-1/2" and larger: Class 125 (125 psi at 400°F, 200 psi at 150°F), iron body, brass mounted, flanged, straight way pattern, bolted bonnet, renewable seat and disc.

6. Check Valves: 2" and smaller: Class 125 (125 psi at 400°F, 200 psi at 150°F), bronze, horizontal swing, vertical up-flow, Y pattern, teflon renewable seat and disc in conformance with MSS SP80.

7. Check Valves: 2-1/2" and larger: Class 125 (125 psi at 400°F, 200 psi at 150°F), iron body, flanged, horizontal swing, vertical up-flow, bolted bonnet, renewable seat and disc in conformance with MSS SP71, type 1.

D. Natural Gas Piping: Use the following types of valves:

1. Ball Valves: ASTM B584 bronze 2 piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, UL listed, full port 1" and smaller, standard port 1- 1/4" thru 3", reinforced TFE seats, all stainless steel trim, threaded ends.
2. Welded Ball Valve, 4" and larger: welded carbon steel body, butt weld ends, full port, stainless steel ball and stem, teflon seat, 2" square operating nut with locking plate.

3. Underground Polyethylene: polyethylene ball valve, PE 2406, SDR-11, 80 psig rating, full port polyethylene ball, nitrile seat, 2" square nut operation.

E. Compressed Air Piping: Use the following types of valves:

1. Ball Valves: ASTM B584 bronze 2 piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, downstream vent, standard port 2" and smaller, reinforced TFE seats, all stainless steel trim, threaded or soldered ends.

F. Vacuum Piping: Use the following types of valves:

1. Ball Valves: ASTM B584 bronze 2 piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, full port 2" and smaller, standard port 2-1/2" and larger, reinforced TFE seats, all stainless steel trim, threaded or soldered ends.

PART 2 BIDDING AND CONTRACT DOCUMENT GUIDELINES

2.1 INSTALLATION

A. Specify that valves are to be installed with the stem above the horizontal.

B. Specify that welded or soldered valves are to have the seats protected from the heat during installation.
WASHINGTON UNIVERSITY SCHOOL OF MEDICINE
MEPFP DESIGN STANDARDS
BIOSAFETY LEVEL 3 (BSL-3) LAB SUITES

Part 1 – GENERAL

A. Actual laboratory usage and agents to be used will be determined by the University Environmental Health & Safety (EH&S) group.

B. Decontamination agent used is typically Vaporized Hydrogen Peroxide (VHP) but should be verified with the EH&S group on a project-specific basis.

C. Any and all penetrations (ductwork, electrical conduits, sprinkler piping, gas piping, etc.) into the BSL-3 laboratory space or suite containment boundaries shall be fully sealed and pressure tested with a (or a combination) of material(s) designed to withstand the chemicals and concentrations associated with decontamination of the space.

D. All equipment shall be tied to the building automation system (BAS) and also to the main campus BAS computers for constant monitoring.

E. An autoclave shall be placed in the lab suite.

Part 2 – Heating, Ventilation, and Air Conditioning (HVAC)

General:

A. All air supplied to the suite shall be 100% outside air.

B. All air from the suite shall be 100% exhausted. No recirculation of air is permitted.

C. Energy recovery units can be utilized, but all energy recovery devices in the exhaust airstream must be kept downstream of the HEPA filter. Energy recovery devices that have any potential for cross-contamination (i.e. energy recovery wheels) are not permitted.

D. Air delivery system to the suite shall utilize pressure-independent control valves on supply and exhaust ducts feeding individual rooms of each suite.

E. Exhaust air from suite shall be HEPA filtered. Ductwork upstream of the HEPA filter shall be of welded, stainless steel construction. Ductwork downstream of...
the HEPA filter may be galvanized, but any ductwork exposed to the outside shall maintain the stainless construction.

F. Access panels in the suite should be avoided, but if required shall be gasketed for an airtight seal and their number minimized.

Airflow Requirements:

A. Supply airflow required shall be the greater of the following:

1. Calculated airflow required to meet room load calculation results with end user’s temperature/humidity requirements.

2. 15 air changes per hour.

B. Air transferred from room to room in the suite shall be from the “cleanest” area to the area deemed “dirtiest”.

C. Suite shall be maintained negative to the corridor at all times.

D. Air devices shall be located as to minimize interference with function of laboratory biological safety cabinets (BSCs) or fume hoods.

Suite Specific Equipment:

A. Room-to-room pressure monitors. Relative pressure monitors shall be placed at these minimum locations for a visual inspection before entering the associated door:

1. Entry airlock into BSL-3 suite on corridor (clean) side.

2. Entry door into each BSL-3 laboratory on the corridor (clean) side.

Pressure monitors provide a clear indication of airflow direction and pressurization. Baulin-tube pressure indicators (“ping pong” ball type) are not permitted. If manuahelic gauges are to be used, line sized HEPA filters must be placed on the sensing and reference airlines.

B. Door security. Based on information from the University, magnetic interlocked doors or lights may be requested. Locking/unlocking of doors shall be based on an engineered matrix of pathogen escape pathways and shall be determined on a project-by-project basis.

C. Fan failure alarms. Audio/visual alarms shall be placed in the lab suite to alert the users that the exhaust fans have failed.
Ductwork:

A. All ductwork shall be constructed to withstand the maximum pressure capable in the system.

B. Supply ductwork may be galvanized construction from air handler to the bioseal damper. From the bioseal damper to the air device, supply ductwork shall be welded stainless steel construction.

C. Exhaust ductwork upstream of the HEPA filter shall be of welded, stainless steel construction.

D. Ductwork downstream of the HEPA filter may be galvanized, but any ductwork exposed to the outside shall maintain the stainless construction.

E. All exhaust ductwork in rooms with select agents being used shall have a dedicated exhaust duct from BSL-3 suite to HEPA filters. This may be requested, regardless of National Institute of Health (NIH), Center for Disease Control (CDC) and Biological Safety in Microbiological and Biomedical Labs (BMBL) standards, due to the future potential of using select agents in the lab.

F. Supply air ductwork to the individual rooms shall consist of the following parts in this specific order of airflow:

1. Pressure-independent air control valve. This valve shall automatically close upon loss of exhaust fans to eliminate positive pressurization of the lab suite.

2. Reheat coil (if required) conforming to the University’s current hydronic/electric reheat coil requirements.

3. Bioseal damper for positive closure during any room/suite decontamination procedures. Damper shall be gear operated, capable of bubble-tight shutoff at a minimum of 10" water column, and have a edge seal material matched to the decontamination material to be used (silicone for VHP). Bioseal damper should be located adjacent to biocontainment boundary of the suite.

4. Decontamination port (may be eliminated if use of a portable room-type decontamination device is to be used exclusively).

5. Laminar flow diffusers with minimum stainless face/aluminum backpan. Air devices shall be placed in a gypsum to lay-in ceiling bracket that is secured and sealed to the gypsum ceiling. The air device shall be gasketed to the bracket surface to maintain the ceiling’s airtight integrity.
G. Exhaust air ductwork from the individual room shall consist of the following components in this specific order of airflow:

1. Stainless steel or aluminum exhaust air device (depending on application). Air devices shall be placed in a gypsum to lay-in ceiling bracket that is secured and sealed to the gypsum ceiling. The air device shall be gasketed to the bracket surface to maintain the ceiling’s airtight integrity.

2. Decontamination port (may be eliminated if use of a portable room-type decontamination device is to be used exclusively).

3. Bioseal damper for positive closure during any room/suite decontamination procedures. Damper shall be gear operated, capable of bubble-tight shutoff at a minimum of 10" water column, and have a edge seal material matched to the decontamination material to be used (silicone for VHP). Bioseal damper should be located adjacent to biocontainment boundary of the suite

HEPA Filter:

A. HEPA filter module shall be of stainless steel construction. Sloped-roof style shall be used if HEPA filter module is be housed outdoors.

B. HEPA filter shall contain the following components (in order of airflow):

1. Bioseal damper (as described above).

2. Decontamination port (may not be eliminated) for decontamination of HEPA unit.

3. Inlet transition from round bioseal damper to rectangular HEPA module.

4. Bag-in, bag-out 30% pre-filter.

5. Bag-in, bag-out, knife-edge, gel-seal HEPA filter.

6. HEPA filter test section for verification of integrity of installed HEPA filter.

7. Outlet transition from rectangular HEPA module to round bioseal damper.

8. Decontamination port (may not be eliminated as room level port).

9. Bioseal damper (as described above).

Exhaust Fans:

A. Exhaust fans shall be designed to be fully redundant. The redundant fan shall be automatically signaled to start upon failure of the primary fan.
B. Although not required in every situation, induced-draft, high-plume exhaust fans are preferred due to outdoor location and available shared plenum.

C. Static pressure shall be increased beyond minimum pressure requirements to allow the HEPA filter assembly to be changed at less frequent intervals than non-BSL-3 suite HEPA filters.

Part 3 – Plumbing:

General:

A. Emergency showers that are located within the suite shall not have an associated floor drain nearby (unless all waste is to be contained in a holding tank for later decontamination).

B. All sinks in the suite shall be hands-free with the timer adjustment set to the maximum duration of flow after activation.

C. All vacuum outlets in the suite shall have hydrophobic (water-resistant) system dedicated filters or local filters provided by the end user on the suction side of the pump. All vacuum exhaust shall be outside the building. If a system filter is used, a way for decontamination of the house vacuum lines shall be incorporated.

D. An eyewash station shall be readily available in the lab.

Part 4 – Fire Protection:

General:

A. Gasketed sprinkler heads shall be used to maintain the airtight construction of the ceiling system. Gasket material shall be compatible with the decontamination agent to be used.

Part 5 – Electrical:

Lighting:

A. All recessed lighting shall be gasketed at the ceiling penetration. Gasket material shall be compatible with the decontamination agent to be used.

B. Light fixtures shall be of a one-piece backpan to maintain an airtight fixture.

C. Light fixture material shall be stainless or aluminum as required to withstand the decontamination chemicals.
D. Light switches shall be weatherproof, corrosion resistant, stainless steel cover with a transparent silicone rubber gasket.

Power:

A. Emergency power shall be utilized on the following equipment as a minimum:
   1. One light fixture per lab space.
   2. All Biological Safety Cabinets (BSCs).
   3. Exhaust fans serving the BSL-3 suite.
   4. All monitoring equipment, both for any lab equipment and HVAC equipment.
   5. All fume hood exhaust fans.
   6. Specimen refrigerators, freezers, cold rooms, warm rooms, etc.
   7. Incubators.
   8. Specialized equipment designated by the end user.

B. All backboxes shall be water-tight, gasketed, and have a threaded hub. All conduit penetrations shall be sealed.

C. All conduits shall be sealed airtight internally at the containment boundary.

D. Receptacles shall be corrosion and moisture resistant with neoprene gasket and stainless steel cover as a minimum.

Fire Alarm:

A. Fire alarm horn/strobes shall be present in actual lab rooms.
Phoenix Air Valve Information

There are four (4) versions of the Phoenix Air Valve product. Out of the 4 versions there are currently 3 versions of the product being used in buildings that Facilities Engineering is responsible for maintaining.

Celerius 1 air valve is pneumatic and receives a 0-10 vdc signal from the Building Automation System (BMS). The buildings that have Celerius 1 are Southwest Tower and SIF East.

Celerius 2 air valve has a high speed pneumatic valve with electronic controls for fume hoods and labs. This system requires a Phoenix Gateway to communicate information from the Phoenix Air Valve to the BMS. The buildings that have Celerius 2 are McDonnell Pediatrics, CIR – 2nd Floor, McMillan – 7th Floor and South Building – 1st Floor.

Celerius 3 air valve has an electric actuator (Honeywell), electronic controls and uses LON (Echelon) communication protocol as a means to communicate information from the Phoenix Air Valve to the BMS. BJCIH is the only building with this model.

Celerius 4 air valves have an electric actuator (Honeywell), electronic controls and uses BACnet as a communication protocol as a means to communicate information from the Phoenix Air Valve via a MSTP (Master Slave Token Passing) bus of a BMS. It is recommend that in all future applications that the Celerius 4 Air Valve product be installed.

Phoenix Air Valve Applications:

- High-Speed – Air Valves are used on fume hoods because of their quick response time to pressurization changes when the fume hood sash is opened from a closed position.
- Low-Speed – Tracking Pairs are typically used in laboratory situations for room pressurization without fume hoods. These Air Valves have a response time of 10-30 seconds.
15300 Fire Protection Guidelines

15334 TESTING

Preliminary testing witnessed by the Architect / Engineer and the Owner's Representative shall be conducted to assure proper operation before the final test is scheduled.

15323 WATER FLOW SWITCH

Water flow switch shall be Potter Electric model VSR-F no others.

15324 SUPERVISORY SWITCH

Supervisory switch shall be Potter Electric model OSYSU-2 no others.

15325 VALVES

All Zone Valves to be butter-fly style valves with built in tamper switches.

OS&Y valves to be used only at pump & back-flow device.

Check valves after each zone valve with test & drain with gauges.

15326 GAUGES

Gauges at fire pump and jockey pump shall be liquid filled type.

15327 SPARE HEAD CABINET

Provide a minimum of six (6) heads of each type of sprinkler head. Provide only two (2) of any dry pendant / sidewall types.

15328 PIPING MATERIAL AND FITTING SCHEDULE

All pipe, fittings, valves, etc... to be made in the United States of America.

Schedule 40 steel pipe only. Black or galvanized as needed in dry systems.

No roustabout fittings.

Express drain for system to sump pit.

15329 FLEXIBLE HOSES

No flexible hoses permitted.

15330 WET PIPE SPRINKLER SYSTEM
15331 SPRINKLER HEADS

Prefer semi-recessed chrome sprinkler heads.

Limit use of concealed heads.

Sidewall sprinklers where utilized in Unobstructed Construction shall be horizontal recessed type with a white factory finish. Heads shall be equivalent to Viking Microfast model M or Reliable HSW-1.

15340 PRE-ACTION SPRINKLER SYSTEM

15341 GENERAL

All pipe to be galvanized schedule 40.

Pre-action valves shall be Viking Corporation only.

15342 SYSTEM DEVICES

The deluge valve shall be Viking Model E-1 or F-1 only.

The Alarm Pressure Switch shall be Viking, part number 09470 or 09471 or Potter Electric.

15343 AIR COMPRESSOR

The air compressor shall be floor mounted.

15350 DRY PIPE SPRINKLER SYSTEM

15351 SPRINKLER HEADS

Prefer semi-recessed chrome sprinkler heads.

Limit use of concealed heads.

Sidewall sprinklers where utilized in Unobstructed Construction shall be horizontal recessed type with a white factory finish. Heads shall be Viking Model M or Reliable model G3.

15352 DRY PIPE VALVE

Dry pipe valve shall be Viking.

15380 FIRE PUMPS-ELECTRIC

15381 FIRE PUMP
Pump shall be made by Aurora

15382 FIRE PUMP CONTROLLER AND POWER TRANSFER SWITCH

Starting method: The controller shall be of the combined manual and automatic type designed for full voltage.

The Pump Controller shall indicate an alternate power source as well as pump run, power fail, and phase reverse.

Fire Pump Controller shall be by Firetrol, Metron, or Joslyn Clark.

15383 JOCKEY PUMP

Jockey Pump shall be Aurora only.

Furnish an in-line jockey pump configured for 480 volt, 3 phase, with a horsepower rating of 3hp.
LABORATORY AIR VALVES

Phoenix Valves only.

PLUMBING FIXTURES

Toto only. (Please refer to BJCIH Specifications)

DUCTWORK AND PIPING INSULATION

No internal lined ductwork.

No “stuffed” plastic fittings on piping. Hard insulation with PVC jacket, 10 feet and below.

Custom made jackets for steam appurtenances that require servicing.

AIR INLETS AND OUTLETS

Krueger or Titus TDC

VIBRATION ISOLATION

Items on ground level do not need isolation but anything above does. We expect the building not to shake.

FUEL STORAGE

Any flammable storage, needs to be approved by our insurance carrier, FM Global.

TERMINAL HEAT TRANSFER UNITS/RADIANT HEAT

No radiant heat.

PIPING

Natural gas piping is to be type “L” with hard soldered joints. Do not use black-iron pipe and fittings for any piping two (2) inch and below.

CONTROLS

Invensys Bac-Net IA or Johnson Metasys Bac-Net only.

SUMP PUMPS

Engineer should design out of the project. Prefer not to have any sumps.

Duplex with motors above the flood level of the pit.
WATER HEATERS

AERCO high efficiency only.

AIR COMPRESSORS

Beacon Madeus, Ohio Medical, All-type. High Efficiency type.

STROBIC FANS

Greenheck and Cook are acceptable alternates.

FIRE PROTECTION

See Attached.

DESIGN TEMPERATURES

Design all building loads to a 14 degree F, Delta "T".

Chilled water that is connected to the campus loop shall be designed for a 12 degree F, Delta "T".

Building Heating Water should be designed with 140 degree F temperature or less.
Has the plumbing drawings been checked to see that reference is made that the use of sanitary crosses are prohibited?