SECTION 23 25 13 - CHEMICAL WATER TREATMENT

PART 1 - GENERAL

1.1 SYSTEM DESIGN REQUIREMENTS

A. General Information:
1. Coordinate with the university Facilities Operations for supplies and consulting. New projects should utilize the existing chemical treatment protocols.
2. Coordinate all start-ups with water treatment technician and vendor by notifying the University Project Manager.
3. Chemical treatment sites shall be over concrete dams with a retention volume equal to the volume of the chemical tank. Coordinate with the Architect to provide a curbed area for storage of on-site water treatment chemicals.
4. Separate freeze protection of systems exposed to outside air conditions into those requiring burst protection and those requiring freeze protection.
    a. Snow melt system shall be provided with 40% Dowfrost.
    b. Burst Protection: Systems that have some expansion capability and will remain dormant during the winter and will not require automatic start-up during cold weather shall be protected with concentrations of 35% Dowfrost.
    c. Freeze Protection: Systems that have no expansion capability or will require start-up during cold weather shall be protected with concentrations of 35% Dowfrost.
5. Treatment shall be as automated as possible with controllers and pumps installed in serviceable locations.

B. Hydronic Piping Systems:
1. Equip all closed water systems with a pressure pot feeder. Arrange for shot feeding or for continuous feed as appropriate.
2. Ethylene glycol is prohibited.
3. Provide ion exchange water softener for all boilers and clean steam generators capable of producing a consistent supply of make-up water containing less than 0.5 ppm total hardness. Provide a single softener vessel system for boilers that shut down at least 4 hours per day and a dual vessel system on boilers that run continuously.
4. Provide corrosion coupon racks on all chilled water, heating hot water, and condenser water systems.

C. Closed System: One bypass feeder on each system with isolating and drain valves installed around balancing valve downstream of circulating pumps.

D. Steam System:
1. Bypass feeder on feedwater line to each boiler.
2. Sequestering agent and base pumped from solution tank into boiler, condensate tank, or feedwater line near boiler. Agitator as required.
3. Oxygen scavenger pumped from solution tank into deaerator storage section, feedwater tank or feedwater line as far as possible from boiler. Pumps and agitator as required.
4. Carbon dioxide neutralizer or filming amine pumped from solution tank into steam header. Agitator as required.
5. Solution pumps shall be activated when feedwater pumps are running.
6. Conductivity controller shall sample boiler water on timed cycle and operate solenoid blowdown valve in line to blowdown tank.
7. Liquid level switch in each solution tank shall deactivate solution pump and agitator, and signal alarm.

E. Open System: Provide the system below for small open systems such as humidifiers, air washers, evaporative condensers, liquid coolers or small cooling towers.

1. Two glass-mesh feeder bags per unit, suspended in sump, filled with sequestering agent.
2. Drip feeder feeds sequestering agent into sump. Spray pump interlocked with solenoid valve on drip system.
3. Bleed-off with globe valve piped to drain located above flood line.
4. Conductivity controller samples sump water when activated by pump and operates bleed-off solenoid valve in line to drain.
5. Use automated controllers which start and start pumps to feed corrosion inhibitors, algaecide, microbicide and biocides.

F. Condenser Water Treatment: Provide the system below for medium to large systems such as cooling towers.
1. Automatic systems for inhibitor, blowdown and biocide, shall be activated by a water meter that is located on the system makeup and by a conductivity controller that has its probes located in condenser water line.
2. Sequestering agent and corrosion inhibitor pumped from solution tank into condenser water supply to tower. Agitator as required.
3. Meter feed biocide with blowdown locked out to ensure biocide retention time.
4. Conductivity controller samples water and operates solenoid bleed valve when condenser water pump is operating.
5. Biocide introduced to tower by continuous feed with solution pump or solenoid valve on tank.
6. Liquid level switch, in each solution tank, deactivates solution pump and agitator, and signals alarm.

G. Provide chemical safety data sheets for inclusion in Operation and Maintenance manuals.

1.2 QUALITY ASSURANCE

A. All services shall be performed by a qualified full-time representative. All products supplied shall meet with all regulations for safe handling and discharge into waste systems.

B. Supplier shall have 24 hour emergency spill response cleanup for any spills resulting from either the filling process or failure of the system. The individuals performing the cleanup must be OSHA certified and shall follow OSHA standards during the spill response process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Chemical Feeders:
   a. LMI
   b. Pulsafeeder
2. Chemical Treatment Water Meters:
   a. Carlon
   b. LMI
   c. Pulsafeeder
3. Conductivity Meters:
   a. LMI
   b. Pulsafeeder.
4. Pot Feeders:
   a. Neptune, Model FTF-5
5. Glycol Feeder Pressure Switch:
   a. Furnas Electric Company, Model 69WA
6. Deionized Water System:
   a. Culligan
   b. Siemens Water Technologies

c. Continental
7. Deionized Water:
   a. Carbon Filter
      1) Culligan HR-12
   b. Sediment Filter Housing:
      1) Gelman 961062
      2) or approved
   c. Storage Tank:
      1) Raven D9725
   d. Glycerine Filled Gauges:
      1) APAN LSF217
   e. Quality Monitor/Controller:
      1) Thornton 702
8. Glycol
   a. Dow Chemical Company, Dowfrost

2.2 MATERIALS, GENERAL

A. Chemical Feeders:
   1. Positive Displacement Pump: Diaphragm-type metering pump with adjustable flow rate, continuous-duty, fully enclosed electric motor and drive, and built-in relief valve. Construct pump parts in contact with chemical solution of PVC, Teflon, Viton, 316 stainless steel, polyethylene, or other corrosion resistant material.
   2. Chemical Solution Tanks: Chemical-resistant, double walled tanks sized from 60 to 110 gallons to accommodate four treatment products. Inner and outer tanks constructed of polyethylene. Provide tanks with 2 X 2-inch female threaded openings with bung and 1 X 8-inch man way fitting. Tanks shall have no fittings below liquid level. Supply tanks with transfer fittings and level indicator devices.
   3. Packaged Conductivity Controller: Micro-processor based with digital display, acceptance of 4 – 20 mA signal and capable of BACNET communications interface for building automation. Provide with the following control features:
      a. Conductivity control.
      b. ORP control.
      c. Inhibitor feed based on “bleed”, water meter input or percent time.
      d. Chemical time out.
      e. Dual biocide timer.
   4. Cold Water Meter: Positive displacement type with sealed, tamperproof magnetic drive; impulse contact register, single-pole, double-throw, dry-contact switch.
   5. Solenoid Valves: Forged-brass body, globe pattern, general purpose solenoid enclosure, and continuous-duty coil.

B. Pot Feeders:
   1. Bypass type chemical feeder of 5-gallon capacity, steel or cast iron construction, 125 psig working pressure. Provide a filter bag inside the feeder. Provide complete with fill funnel, 2 spare bags, shutoff valve, air release valve, and recirculation shutoff valves on inlet, outlet, and drain valve.

C. Glycol Feeder Assembly:
   1. Assembly shall consist of storage drum, feeder pump, pressure switch and low water cutoff.
   2. Glycol Tanks: Chemical-resistant 50-gallon reservoir fabricated from high density opaque polyethylene with graduated markings; molded fiberglass cover with mounting for liquid level switch, drain connection near bottom of tank.
   3. Pressure Switch: Corrosion resistant and rust proof construction, visible double break contacts which are silver-cadmium oxide, reinforced neoprene diaphragm, no-drift adjustable pressure setting, pilot duty NEMA-A600.

4. Low Water Cut-Off Switch: Switch to stop pump when water level reaches 3 inches (adjustable) above outlet supply fitting in storage drum. Switch shall also light a red warning light at the temperature control panel when activated. Label light "Glycol Storage Low Level".

D. Condenser Water Treatment Control Panel:
1. Control Panel: Solid-state integrated circuits and digital LED displays, in NEMA 250, Type 12 steel enclosure with gasket and lockable door.
2. Control dissolved solids on conductivity and include the following:
   a. LED digital readout display (micro-ohm/cm).
   b. Temperature-compensated sensor probe.
   c. HIGH, LOW, and NORMAL conductance indicator lights.
   d. HIGH or LOW conductance alarm light, trip points field adjustable, with SILENCE switch.
   e. HAND-OFF-AUTOMATIC switch for solenoid bleed valve.
   f. BLEED light to indicate valve operation.
   g. Adjustable internal hysteresis or dead band.
3. Control inhibitor feed on makeup volume and include the following:
   a. Solid-state reset counter (1 to 15, selectable).
   b. Solid-state timer (adjustable 15 seconds to 5 minutes).
   c. Test switch.
   d. HAND-OFF-AUTOMATIC switch for chemical pump.
   e. Illuminated legend shall indicate FEED when pump is activated.
   f. Solid-state lockout timer (adjustable 15 minutes to 3 hours) and indicator light. Lockout timer shall deactivate the pump and activate alarm circuits.
   g. Panel totalizer for amount of makeup.
4. Biocide programmer to include the following:
   a. 24-hour timer with 14-day skip feature
   b. Solid-state bleed lockout timer (0 to 9 hours) and biocide pump timer (0 to 2.5 hours), clock controlled.
   c. Solid state alternator to enable use of two different biocide formulations.
   d. Digital display of time of day (24 hours).
   e. Battery back-up on clock.
   f. HAND-OFF-AUTOMATIC switches for biocide pumps.
   g. BIOCIDE A and BIOCIDE B illuminated legends indicate pump running.

E. Condenser Water Filtration Assembly:
1. Filtration unit to remove suspended solids from condenser water.
2. Filter pump shall be all bronze with TEFC motor, strainer, and manual reset motor overload switch with pilot light.
3. Sand filter shall include glass-fiber-reinforced polyester tank, internal distribution piping, differential gage panel, manual and automatic pressure relief valves, backwash valve and sight tube, and graded silica sand.
4. Backwash control shall be automatic including time clocks and/or differential pressure switches, mounted in NEMA 250, Type 4 control panel. Backwash shall use city water versus system water.

F. Chemicals:
1. Chemicals compatible with piping materials, seals, and accessories.
2. Store all chemicals in a secured location on approved containment devices, with all required safety precautions. All chemicals are to be stored in a location that is warm enough to keep the chemical from freezing.
3. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
4. Biocide: Chlorine release agents or microbiocides.
5. Closed System Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.
6. Steam System Chemicals: Sequestering agent to reduce hardness and prevent feedline congestion, base to provide alkalinity, oxygen scavenger, carbon dioxide neutralizer, and filming amines.

7. Condenser Water (Cooling Tower) System Chemicals: Sequestering agent to inhibit scaling, acid to reduce alkalinity and pH, corrosion inhibitor, and biocide.
8. Open System Chemicals: Sequestering agent to inhibit scaling, acid to reduce alkalinity and pH, corrosion inhibitor, and biocide.
9. Provide quantity of extra chemicals equal to 50% of amount initially installed.
10. Provide “Material Safety Data Sheets” for all chemicals products that are onsite.

G. Glycol:
1. Dowfrost

H. Chemical Treatment Test Equipment:
1. Test Cabinet: White enamel with local fluorescent light, capable of accommodating 4 to 10 ml zeroing, titrating burettes and associated reagents.
2. Test kits shall be provided for determining water hardness and water characteristics. Test kits shall include carrying case and spare reagents. Provide as follows:
   a. Alkalinity titration.
   b. Chloride titration.
   c. Sulfite titration.
   d. Total hardness titration.
   e. Low phosphate.
   f. Conductivity bridge, range 0 to 10,000 micro-ohms.
   g. Creosol red pH slide, complete with reagent.
   h. Portable electronic conductivity meter.
   i. High nitrite.

I. Coupon Racks:
1. Constructed of 3/4 inch, schedule 80 PVC except schedule 80 mild steel pipe for hot water systems. Size coupon rack to accept four corrosion test specimens. Provide orifice valve in each rack to adjust water flow to 3 to 4 feet/second, throughout the rack.
2. Install coupon racks in condenser water systems with the warmest water supplying water to the rack.

J. Spare Parts: Refer to Section 01 78 46 – Extra Stock Materials.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Chemical Feeders:
1. Injection point for chemicals shall be higher than top of solution supply tank to prohibit gravity feeding. Interlock conductivity controller with recirculating pump on cooling tower. Install electric solenoid valve in bleed-off line with y-strainer ahead of valve. Chemicals shall be fed into pump discharge line on continuous metered basis.

B. C. Pot Feeders:
1. 1. Install shot feeders on closed system in upright position with top of funnel not more than 48-inches above floor. Pipe drain, with ball valve, to nearest equipment drain. Install piping adjacent to equipment to allow servicing and maintenance.

C. Glycol Feeders:
1. After cleaning and flushing piping, refill glycol piping system and glycol tank with mixture of propylene glycol and water solution.
2. Perform tests to determine the strength of glycol and water solution. Submit written test results to Contracting Officer and include in maintenance manuals. Provide test prior to end of first year of operation and replenish as required.

3. Run full size discharge line from relief valve to storage tank.

3.2 TESTING, CLEANING AND CERTIFICATION

A. General: Ensure system is operational, filled, started, and vented prior to cleaning. Place terminal control valves in open position during cleaning. Add cleaning chemicals as recommended by equipment manufacturer.

B. Heating Water Systems: Hot water heating systems, including converters, pumps, coils and piping shall be cleaned with a solution of trisodium phosphate. This cleaning also applies to glycol systems prior to filling. Apply heat while circulating, slowly raising system to design temperature; maintain for a minimum of 24 hours.

C. Chilled Water Systems:

D. Steam and Condensate Systems:
1. Steam System: Fill only steam boilers with cleaner and water. Apply heat and maintain for minimum of 12 hours. Cool and drain. Refill with clean water, drain, refill, and check for sludge. Repeat until system is free of sludge. Apply heat to produce steam for piping system and maintain for minimum of 8 hours.
2. Before placing steam and condensate piping system in service, the piping shall be thoroughly blown out with steam to remove dirt, rust, scale or other contaminants. Blow down to drain or into a container all system strainers once an hour for the first 4 hours and then twice a day until the entire steam and condensate system is interfaced with the university Steam and Condensate systems. Remove all screens and clean them. The university Facilities Operation Representative will witness the inspection and cleaning of an agreed upon number of strainer screens to verify their condition.
3. Bypass traps and waste condensate until approved by the university Facilities Operations Representative. Following approval by the university Facilities Operations Representative, return condensate to collection system and put traps back in line.
4. Open System: Flush with clean water for minimum of one hour. Drain completely and refill.

E. All Systems:
1. When the flushing, cleaning, and treating process is complete, remove all startup screens from the strainer element(s), if installed.

F. Chemical Treatment:
1. System Start-Up:
   a. The water treatment supplier shall put the treatment equipment into operation, and make adjustments necessary for proper operation.
   b. The water treatment supplier shall provide a written report to the mechanical contractor indicating that all equipment is operating properly.
2. General: Test hydronic water systems one week after each system start-up and perform a second test one week after the first test. Test for total dissolved solids, inhibitors, and hardness. Provide a certified report after each test indicating initial findings, treatment required and future recommendations. Chemical treatment shall contain no chromates and be bio-degradable. Provide water analysis to determine the type and level of chemicals required for prevention of scale and corrosion.
3. Provide chemicals and service program for period of three months from project closeout. Vendor must provide “drumless delivery” (transfer of material into customer’s receiver tanks) thereby eliminating any chemical handling on the part of in-house personnel. No drums will be stored on site. Service shall include monthly analysis of water systems. Adjust treatment as needed to maintain system quality as specified. Provide written report of each visit including initial and final water tests, chemicals and amounts used. Provide 24 hour spill response capabilities.
4. Test Equipment:

a. The water treatment chemical and service supplier shall furnish basic water test equipment, including carrying case and reagents for use with the supplier's products, include apparatus for determination of treatment residual. Where specialized or supplementary equipment is required, it shall be furnished as part of the offering.
b. Provide test equipment as needed to monitor cycles of concentration and the level of treatment chemicals with the respective systems.

5. Treat raw water available at the project site to sustain the following water characteristics:
   a. Closed System:
      1) Hardness: 0.5 times the make-up water hardness.
      2) Iron: 0.0.
      3) Total Dissolved Solid: 1500 to 2400 ppm (as CaCO3).
      4) Silica: 60 ppm or less.
      5) PH: 9.6 to 10.5
   b. Steam System:
      1) Hardness: 0.0
      2) Iron: 0.0.
      3) Total Alkalinity: 1026 ppm or less.
      4) Silica: 120 ppm or less.
      5) PH 10.5 or above.
   c. Open System:
      1) Hardness: 6 times the make-up water hardness.
      2) Iron: 0.0.
      3) Total Alkalinity: 1026 ppm or less.
      4) Silica: 120 ppm or less.
      5) PH: 7.5 or above.
      6) Total Algae: 0 growth.

3.3 COMMISSIONING (DEMONSTRATION)

A. Provide the operating personnel 8 hours of instruction so as to familiarize them with all treatment equipment and procedures. Demonstrate procedure for taking weekly water test on open-loop systems and demonstrate the application and safe handling of supplied chemicals.

B. Provide a written report to the mechanical contractor indicating that operator training has been completed.

END OF SECTION 23 25 13