GEORGE MASON UNIVERSITY
DESIGN INFORMATION MANUAL

REVISION 30 September 2009

1. Add new Section 02655: Chilled Water (CHW) Distribution System ***(added 30 September 2009)***

2. Replace Section 03310 High Temperature Hot Water Tunnel with new Section 03310: High Temperature Hot Water (HTHW) Tunnel ***(Revised 30 September 2009)***

3. Add new Section 15200: High Temperature Hot Water (HTHW) Distribution System ***(added 30 September 2009)***

4. Replace Part V - Standard Details HTHW TUNNEL DETAIL, FAIRFAX CAMPUS with new sketch 03310 - 1 HTHW Tunnel Section.

5. Replace Part V - Standard Details HTHW TUNNEL TOP DETAILS with new sketch 03310 - 2 HTHW Tunnel Top Details.

6. Delete Part V - Standard Details HTHW MANHOLE DETAIL

7. Delete Part V - Standard Details HTHW MAIN, PREFERRED ANCHORAGE DETAILS

8. Add new sketch under Part V - Standard Details 03310 - 3 Tunnel Top Lifting Lug Detail

02655: Chilled Water (CHW) Distribution System ***(added 30 September 2009)***

See Part V - Standard Details:
03310 - 1 HTHW Tunnel Section

1. **General.** Chilled water distribution system to be designed for 42°F operating temperature with a14°F delta. All CHW distribution system piping to be preinsulated Schedule 40 steel pipe. All CHW distribution system components, including piping, valves, flanges and fittings must be manufactured in either Canada or the United States. The piping system must be designed to minimize system low points to the maximum extent possible. Any deviations from the George Mason University 2009 Utility Master Plan Update dated August 2009 (or later edition) in piping system sizes or design must be approved in writing by George Mason Facilities.

2. **Clearances & Pipe Bedding.** Wherever the chilled water lines are run alongside the HTHW Distribution System tunnel (see Section 03310), maintain a minimum clearance between the insulated CHW pipe and HTHW tunnel or manhole wall of two feet. Maintain a minimum depth of 30 inches. All CHW piping to be set in minimum 6 inch bed of washed natural sand or mason sand. Sand to extend to mid point of pipe section. Refer to Part V - Standard Details: 03310 - 1 HTHW Tunnel Section.

3. **Under Building Slab.** Whenever the CHW distribution system piping is run under a building slab, the piping must be run in a tunnel system which has a minimum clear height of seven feet and minimum three foot clear walkway. Such a tunnel system must be lighted, ventilated and accessible for maintenance. The same tunnel system can be used for HTHW lines.

4. **Valves.** At each branch line or building takeoff provide a three valve combination on both supply and return lines which allow back feed capability. Valves shall be OS&Y type gate valves with flanged connections. Triple duty valves are not acceptable. Provide two way flow control valves on the building main, located in the main mechanical room of the building(s) being served.

5. **Drains and Vents.** At CHW system low points, provide drains (on both supply and return lines) to discharge to the sanitary sewer. Drains to be 1" pipe size for 6" CHW lines; 2" pipe size for lines above 6". At CHW system high points, provide 3/4" vents. All drains and vents to be valved with gate or ball valve with valve box. Valve boxes located in other than paved areas shall be encased in a 20" x 20" x 6" thick concrete pad.

6. **Insulation.** Use manufacturer supplied pre-insulated pipe kit for piping joints and fittings. All raw ends shall be sealed.

7. **Inspection and Testing.** Weld inspection to include 100% visual inspection on gap alignment and root pass; and, ultrasonic inspection (UT) of at least 15% of the field welds by each certified welder on the job. Any failure in UT testing to result additional testing of 15% of that welder's work. There is to be 100% hydro testing at 200 psig to be witnessed by and coordinated with Mason Central Heating and Cooling Plant personnel and the Project Inspector.

02655: Chilled Water (CHW) Distribution System ***(added 30 September 2009)***

8. **Cleaning.**

8.1 **Flushing.** Perform initial piping system flush to remove core system debris prior to chemical treatment. Typically, this would involving filling the system with water, leaving no air voids, and then flushing the system out at fire hose volumes. In this process, all vents and drains need to be well rinsed until no visible debris or discoloration is visible. The initial rinse water shall be tested and compared to the raw water source to provide a base line for procedure performance. Flushing to be witnessed by and coordinated with Mason Central Heating and Cooling Plant personnel and the Project Inspector.

8.2 **Chemical Cleaning.** Chemical cleaning must remove unwanted debris while installing an initial coating of corrosion inhibitor film. The objective is to reduce internal pipe corrosion by at least 95% during the first year of operation. The chemical treatment must remove oils, grease, mill debris, weld slag and other forms of new piping contaminants. The core ingredients of the chemicals used must be biodegradable. Chemicals used must form an initial film of corrosion inhibitor to yield high levels of internal pipe protection. Chemicals used must include an EPA approved micro biocide that provides a broad spectrum kill of unwanted microorganisms that result in corrosion.

8.3 **Recirculation.** Provide taps with isolation valves and cross connections as required to isolate and chemically clean each piping system section. Provide circulation pump(s) as required. Circulate the chemical solution for a minimum of 72 hours. During this process, monitor and maintain system pressure at appropriate levels. After 72 hours, flush the system until debris and products are no longer present. The rinse water shall be tested and be verified to be free of treatment products.

8.4 **Inhibitors**. After flushing the chemical cleaning solution, inject an initial charge of inhibitors to maintain the system until it is brought into service. If at any time prior to placing the piping system into service, the system is drained and refilled, then an additional charge of corrosion inhibitors must be injected into the piping system section. Once all treatment is completed, pipe must remain full of water.

8.5 **Report.** All chemical cleaning to be witnessed by and coordinated with Mason Central Heating and Cooling Plant personnel and the Project Inspector. Provide a written report of cleaning results. The term contractor used by the University for final cleaning is currently Water Chemistry, Inc., 3404 Aerial Way Drive, Roanoke, Virginia 24016 (phone 540-343-3618).

03310: High Temperature Hot Water (HTHW) Tunnel *(Revised 30 September 2009)*

See Part V - Standard Details:
- 03310 - 1 HTHW Tunnel Section
- 03310 - 2 HTHW Tunnel Top Details
- 03310 - 3 Tunnel Top Lifting Lug Detail

1. **General.** The pathway for the campus wide HTHW distribution system piping shall be a system of tunnels and manholes which are designed to facilitate operations and maintenance. The tunnel system shall be designed by a Virginia registered Professional Engineer. The tunnel and manhole system, including hatch covers, shall be designed for HS-20 loading capable of carrying a minimum of 200 passes per day.

2. **Tunnel System**. At least 90% of the tunnel system must have removable tops. At least 75% of the tunnel system must be designed so that the top is at grade. Tunnel height may vary with site contour but the inside (clear) tunnel height shall not be less than four feet and shall not exceed eight feet. The tunnel and manhole system should be designed to minimize the number of low points. All reinforcing steel used in construction of tunnel and manhole system shall be epoxy coated.

3. **Tunnel Section.** The minimum inside (clear) tunnel height when the tunnel is not at grade is four feet. Minimum clearances between insulated pipes must be 18 inches; minimum clearance between insulated pipes and sides of tunnel must be 12 inches; minimum clearance between insulated pipe and tunnel top must be 24 inches. For branch building service, where the tunnel is at grade with removable tops, the minimum height of the tunnel may be reduced with written approval of George Mason Facilities. Provide drain channel in floor of tunnel, with low points of tunnel and manhole system discharging to campus storm water drainage system. Refer to Part V Detail 03310 - 1 HTHW Tunnel Section.

4. **Tunnel Tops**. Removable tops shall not exceed 4500 pounds weight. Tops to be constructed with an alternating lip pattern to permit easy removal. Refer to Part V Detail 03310 - 2 Tunnel Top Details. Reinforcing steel to extend into the lip. Where the top of the tunnel is exposed at grade, provide broom finish. Provide neoprene gaskets between the horizontal surfaces at the lips and wherever the top makes contact with walls or an adjoining top section.

4.1 **Tunnel Top Lifting Devices.** Four epoxy coated reinforcing steel lifting loops will be installed in the sides of each tunnel top section (Refer to Part V Detail 03310 - 2 Tunnel Top Details) unless the top is located adjacent to a paved surface (such as plaza, road, sidewalk, or curb) or other situation that precludes side mounted loops. In which case, four stainless steel lifting lugs will be imbedded in the tunnel top, fitted with a screw in cap. (Refer to Part V Detail 03310 - 3 Tunnel Top Lifting Lug Detail) If lifting lugs are used, a total of ten lifting loops which screw into the lugs will be provided to the Owner; packaged and marked with the project identification.

5. **Manholes.** Manholes shall be provided at all valve and tempering tank locations. Inside height of manhole must be minimum of seven feet. Manholes must be provided with a floor drain, piped to the campus storm drainage system. If a gravity drain is not practical, provide a sump and sump pump for tunnel and manhole system drainage. Sump pump and associated discharge piping, where required, must be rated for minimum design operating temperature of 200 degrees F.

6. **Access Hatches & Hatch Covers.** Access hatches and hatch covers shall be provided at all manholes; and at all piping system expansion joints, ball joints, anchors, drain or vent valves, and sump pumps, when these components are not located in a manhole. Access hatches shall provide minimum four foot by three foot clear access and be fitted with a locking cover. A fixed ladder or rungs aligned with hatch opening must be provided at all locations where the depth of the tunnel or manhole is four feet or greater. Hatch lip drains must be piped, using copper or Sched 40 galvanized steel pipe, to within 6 inches of the floor.

7. **Foundation Drainage.** Foundation drainage must be provided around the perimeter of all tunnels and manholes. Drainage pipe must be at least four inches in diameter, perforated ABS pipe. It must be covered by filter fabric and sit a distance equal to its diameter from the tunnel bottom at level with the lower edge of the tunnel bottom. The drainage pipe must be covered in #57 stone to provide drainage to the pipe and the #57 stone must cover the pipe to a height six inches above the bottom slab of the tunnel, and extend to either side at the level in both directions lateral to the pipe a distance equal to the diameter of the pipe. If the tunnel has a bottom lip, the #57 stone has to meet the preceding qualifications and then continue laterally in towards the tunnel to meet the side tunnel water. The #57 stone must be wrapped in an approved filter fabric which must be brought up the side of the tunnel wall and pinned in place against the wall by protection board. See Detail 03310-1 for illustration.

8. **Waterproofing.** Exterior sides of tunnels and manholes must be waterproofed. Wherever the tunnel tops are below grade, the tunnel tops must be waterproofed. Where a tunnel section or manhole extends below the water table, use self adhered roll-type membrane waterproofing . Provide protection board as required for waterproofing system.

15200: High Temperature Hot Water (HTHW) Distribution System ***(added 30 September 2009)***

1. **General.** Piping system to be designed for an operating temperature of 400° F and operating pressure of 350 psig; with a 100°F delta. Use ANSI Class 300 Rating for valves, flanges and flanged fittings. All HTHW piping must be Schedule 80 or Extra Strong seamless steel. All HTHW distribution system components, including piping, valves, flanges and fittings must be manufactured in either Canada or the United States. Any change in piping direction must be made using standard welded fittings. Mitered fittings are not allowed in the piping system. The piping system should be designed with as little abrupt elevation and lateral direction change as possible to minimize requirements for additional anchorage points and expansion joints. The piping system must be designed to minimize system low points to the maximum extent possible. The pathway for the campus wide HTHW distribution system piping shall be a system of tunnels and manholes which are designed to facilitate operations and maintenance (refer to section 03310). Any deviations from the George Mason University 2009 Utility Master Plan Update dated August 2009 (or later edition) in piping system sizes or design must be approved in writing by George Mason Facilities.

2. **Clearances.** The minimum clearance between pipe and tunnel or manhole floor is 12 inches. The minimum clearance between pipe and tunnel wall is 16 inches. Refer to Part V - Standard Details: 03310 - 1 HTHW Tunnel Section.

3. **Under Building Slab.** Whenever the HTHW distribution system piping is run under a building slab, the piping must be run in a tunnel system which has a minimum clear height of seven feet and minimum three foot clear walkway. Such a tunnel system must be lighted, ventilated and accessible for maintenance. The same tunnel system can be used for chilled water lines.

4. **Valves.** At each branch line or building takeoff provide a three valve combination on both supply and return lines which allow back feed capability. Valves shall be OS&Y type gate valves with flanged connections. Triple duty valves are not acceptable.

5. **Expansion Joints.** Expansion joints shall be the packed slip tube type which allows for additional packing to be injected while the expansion joint is under full line pressure. The ends of slip and body shall be furnished with raised face forged steel flanges. The stuffing box shall have integral internal and external guide surfaces. The guide surfaces shall have low friction, non-metallic inserts. The sliding surface of the slip is to be dual chrome plated with 0.001" of hard chrome applied over 0.001" of crack free hard chrome, permascope inspected in accordance with ASTM STD B-499. Each expansion joint to be provided with a two piece removable, reusable insulation blanket which cover the expansion joint body and slip, and incorporates access to the packing cylinders without removal of the body portion of the blanket. The basis for design is Advanced Thermal Systems, Inc. “TP2 Thermal Pak Expansion Joint”.

6. **Slides, Guides and Anchors.** All slides, guides and anchors to be hot dipped galvanized steel. Field modification of manufactured components cannot be made without prior approval of the Engineer of Record.

7. **Bolts.** All bolts and nuts at flanges to be ANSI Class 300 Rating. All bolts, studs or expansion anchors used to affix expansion joints, slides, guides or anchorage points to the concrete tunnel structure to be properly engineered and specified by the Engineer of Record. All bolts, studs, expansion anchors and nuts used to fix components to the concrete tunnel structure to be hot dipped galvanized.

8. **Drains and Vents.** At HTHW system low points, provide drains (on both supply and return lines) piped to a tempering tank to discharge to the sanitary sewer. Drains to be 1" pipe size for 6" HTHW lines and smaller; 2" pipe size for lines above 6". At HTHW system high points, provide 3/4" vent. All drains and vents to be welded Schedule 80 pipe with socket weld fittings. All drains and vents to be double valved, with ANSI Class 300 gate valves only.

9. **Tempering Tanks.** The water supply line to the tempering tank must be 2" copper and valved at both the source and at the tempering tank. Hanger spacing for copper water supply line to be to code.

10. **Insulation.** Insulation to be calcium silicate or cellular glass with aluminum jacket non-flammable moisture barrier. Staples are not to be used. All raw ends shall be sealed. Aluminum jacket to be secured using straps, not screws.

11. **Inspection and Testing.** Weld inspection to include 100% visual inspection on gap alignment and root pass; and, ultrasonic inspection (UT) of at least 15% of the field welds by each certified welder on the job. Any failure in UT testing to result additional testing of 15% of that welder's work. There is to be 100% hydrostatic testing at 600 psig to be witnessed by and coordinated with Mason Central Heating and Cooling Plant personnel and the Project Inspector.

12. **Cleaning.**

12.1 **Flushing.** Perform initial piping system flush to remove core system debris prior to chemical treatment. Typical, this would involving filling the system with water, leaving no air voids, and then flushing the system out at fire hose volumes. In this process, all vents and drains need to be well rinsed until no visible debris or discoloration is visible. The initial rinse water shall be tested and compared to the raw water source to provide a base line for procedure performance. Flushing to to be witnessed by and coordinated with Mason Central Heating and Cooling Plant personnel and the Project Inspector.

12.2 **Chemical Cleaning.** Chemical cleaning must remove unwanted debris while installing an initial coating of corrosion inhibitor film. The objective is to reduce internal pipe corrosion by at least 95% during the first year of operation. The chemical treatment must remove oils, grease, mill debris, weld slag and other forms of new piping contaminants. The core ingredients of the chemicals used must be biodegradable. Chemicals used must form an initial film of corrosion inhibitor to yield high levels of internal pipe protection. Chemicals used must include an EPA approved micro biocide that provides a broad spectrum kill of unwanted microorganisms that result in corrosion.

15200: High Temperature Hot Water (HTHW) Distribution System ***(added 30 September 2009)***

12.3 **Recirculation.** Provide taps with isolation valves and cross connections as required to isolate and chemically clean each piping system section. Provide circulation pump(s) as required. Circulate the chemical solution for a minimum of 72 hours. During this process, monitor and maintain system pressure at appropriate levels. After 72 hours, flush the system until debris and products are no longer present. The rinse water shall be tested and be verified to be free of treatment products.

12.4 **Inhibitors**. After flushing the chemical cleaning solution, inject an initial charge of inhibitors to maintain the system until it is brought into service. If at any time prior to placing the piping system into service, the system is drained and refilled, then an additional charge of corrosion inhibitors must be injected into the piping system section. Once all treatment is completed, pipe must remain full of water.

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