SECTION 23 21 00

UNDERGROUND CHILLED WATER SYSTEMS (Issued AD-6)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Cement-lined ductile iron pipe, pipe fittings and accessories for chilled water supply and return distribution piping.

B. Valves.

1.2 REFERENCES

A. ANSI/AWWA C111 – Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.

B. ANSI/AWWA C151 – Ductile-Iron Pipe Centrifugally Cast in Metal Models or Sand-Line Molds, for Water or Other Liquids.

C. ANSI/AWWA C110/A21.10-82 Ductile Iron and Gray Iron Fittings, 3 inch through 48 inch, for water and other liquids.

D. ANSI/AWWA C205 – Cement Mortar Protective Lining and Coating for Steel Water Pipe – Shop Applied.

E. ANSI/AWWA C504 – AWWA Standard for Rubber-Seated Butterfly Valves.

F. AWWA C601 – Standard Methods for the examination of Water and Waste Water.

G. ASME B31.3 - Process Piping.

1.3 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.4 SUBMITTALS

A. Submit product data under provisions of Supplementary Conditions.

B. Include data on pipe materials, pipe fittings, valves, operators, and accessories.

C. Detailed pressure and leakage testing procedure.

D. Certification of specification compliance by Contractor that chilled water systems were built in conformance with ASME B31.3 standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Supplementary Conditions.

B. Store and protect products under provisions of Supplementary Conditions.

C. Deliver and store valves in shipping containers with labeling in place.

D. Delivery and Storage: Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Store materials on site in enclosures or under protective coverings. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

E. Handling: Pipe, fittings, and other accessories shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Special care shall be taken not to injure pipe coatings or linings. If coatings or linings of pipe or fittings are damaged, satisfactory repairs shall be made at no extra cost to BNL. Pipe shall be carried to the trench not dragged. Rubber gaskets that are not installed immediately shall be stored undercover out of direct sunlight.

PART 2 - PRODUCTS

2.1 PIPING

A. Pipe & Fittings 4 inch diameter and over (CHWS & CHWR):
   1. Ductile iron pressure class 350 for pipe sizes 4 inch to 12 inch and pressure class 250 for pipe sizes 14 inch and over in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.
   2. Double thickness cement mortar lined and bituminous seal coated inside and outside in accordance with ANSI/AWWA C104/A21.4.
   3. Joints:
      a. Restrained joints shall be U.S. Pipe TR Flex to match existing service.
      b. Push-on joints used in conjunction with restrained joints shall be in accordance with ANSI/AWWA C111/A21.11.
      c. Flanged Joints: Pipe shall be shop fabricated in accordance with ANSI/AWWA C115/A21.15. Pipe barrels and flanges shall have tapered pipe threads in accordance with ANSI B2.1. Bolt circle and bolt holes shall match those of ANSI B16.1 Class 125 flanges and ANSI B16.5 Class 150 flanges:
         1) Gaskets shall be rubber (EPDM) full-faced 1/8 inch thick.
         2) Bolts, studs, and nuts shall be low carbon steel per ASTM A307 Grade B.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

B. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION – PIPING

A. Pipe Laying and Jointing: Pipe, fittings, and accessories will be carefully inspected by BNL before and after installation and those found defective will be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall be cut accurately to measurement established at the site and shall be worked into place without springing or forcing. Any pipe or fitting that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. The pipe shall be graded by straight lines, taking care to avoid the formation of any dips or low points. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recesses excavated to accommodate bells, joints, and couplings. Anchors and supports shall be provided where necessary and where indicated for fastening work into place. Proper provision shall be made for the expansion and contraction of pipe lines. Trenches shall be kept free of water until joints have been properly made. Open ends of pipe at the end of each day's work shall be closed temporarily with plastic sheeting and wood blocks or bulkheads. Pipe shall not be laid when

conditions of trench or weather are unsuitable.

B. Route piping in orderly manner and maintain line and gradient.

C. Anchorage: Use restrained joints for 3-full pipe length on either side of all changes of direction of piping. Provide in accordance with Manufacturer's recommendations. Anchorage shall be designed to withstand all loads associated with hydrostatic testing of piping system.

D. Excavate and backfill in accordance with Section 02317 for work of this Section.

E. Prior to starting system verify system is complete, flushed and clean. Provide full flow capacity pipe flushing, under direction of BNL.

3.3 TESTING

A. After installation, but before backfill, every joint will be examined and inspected for proper installation by Contractor and PE. Repair all unacceptable joints. After approval by BNL backfill piping to elevation of compressed air piping system. Contractor shall provide blanks for testing and shall remove blanks after system is accepted.

B. After Backfilling pressure test and leakage test pipe.

C. Pressure Test – Each valved section of pipe shall be filled with water slowly at the specified test pressure, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner approved by BNL. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure:
   1. Hydrostatic: Test at a pressure of 165 psi. Repair all leaks found and retest.
   2. Test pressures shall be continuously maintained for a minimum time of two (2) hours. Test pressure shall not vary by more than $\pm$5 psi for the duration of the pressure test.
   3. Before applying the specified test pressure, air shall be expelled completely from the pipe and valves. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied.

D. Leakage Test – The leakage test shall be conducted concurrently with the pressure test:
   1. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
   2. No pipe installation will be accepted if the leakage is greater than that determined by the following formula

$$L = \frac{SD\,(P)^{0.5}}{133.200}$$

In which L is the allowable leakage, in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

This formula is based on an allowable leakage of 11.65 gpd, per mile, per inch nominal diameter at a pressure of 165 psi.

E. Provide all pumps, compressors, test connections, leak rate apparatus, and gages necessary. All equipment, instruments, and other appurtenances which may be damaged during testing shall be either blocked off, gagged or disconnected. In no case shall piping or any component be subjected to pressures exceeding their ratings.

F. Pressure and leakage testing shall be witnessed by BNL and documented. 24 hours notice shall be given to permit sending representative to witness the tests.

G. Test fluids and water shall be clean and free from debris and contaminants. Water shall be clean and potable.

H. Acceptance of installation shall be determined on the basis of test pressure and allowable leakage. If any test of pipe laid does not continuously maintain pressure as specified or disclosed leakage greater than that specified, the contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance.

I. All visible leaks are to be repaired regardless of the amount of leakage.

J. Upon successful completion and acceptance of tests, piping shall be relieved of pressure, and completely drained. In addition to vents and drains, all new line valves shall be open during the draining period.

END OF SECTION