JRA PROJECT NO. 2019111
KDE BG 20-136

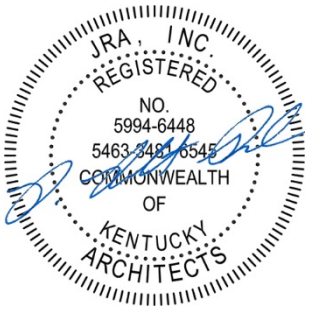
CENTRAL HARDIN HIGH SCHOOL

ELIZABETHTOWN, KENTUCKY

HARDIN COUNTY SCHOOLS
ELIZABETHTOWN, KENTUCKY

CONSTRUCTION DOCUMENTS

BID GROUP I



VOLUME II

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SECTION 23 21 13.33 – GROUND-LOOP HEAT-PUMP PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of ground-loop heat-pump piping work is indicated on the drawings and schedules and by requirements of this section. The ground-loop heat-pump piping consists basically of polyethylene fusion joined piping formed into vertical loops. The ground-loop heat-pump piping shall include all piping from wells, underground mains, into building mechanical room. Provide piping flanges 18” above mechanical room floor. See Drawings.

B. In the event the contractor wishes to utilize a piping arrangement different from the designed arrangement, it is the responsibility of the contractor to submit to the Engineer for approval of his proposed arrangement. The contractor shall furnish in writing that the different arrangement will provide the same heat rejection/addition capabilities as the designed arrangement.

C. A pre-installation meeting shall be held before any drilling can begin.

1.2 RELATED DOCUMENTS

A. The General and Special Conditions and all other Contract Documents (ESPECIALLY DIVISIONS 21, 22, 23 AND 26) are applicable to work under this section of the specifications. All the work under this section of the specifications shall be governed by any alternates and unit prices called for in the FORM OF PROPOSAL insofar as they affect this portion of the work.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of geothermal loop heat exchanger products and tools of the types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Installer must have completed a certified training program or be a certified geothermal service contractor and shall have at least two years of successful installation experience on projects with ground-loop heat-pump piping work like to that required for this project.

C. Fabricator's Qualifications: The only acceptable method for joining buried pipe systems is by a heat fusion process. Ground-loop heat-pump piping fabricators must have completed a heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of a Certified Heat Fusion Technician.

D. Codes and Standards: Comply with all local and state laws and ordinances.

E. Acceptable Bidders

1. All bidders for earth coupled/ground loop system must have Architect/Engineer approval prior to bidding the project.

2. Acceptable contractors shall be as follows.

a. Moses Drilling Company, Gray, KY

b. Eastern Well and Pump, Inc., Harlan, KY

c. Geothermal Earthworks, Inc., Bowling Green, KY

d. Geothermal Solutions, LLC, Loretto, TN.

e. Midsouth Geothermal, Memphis, TN

f. Mid-State Construction Geothermal, Livingston, TN

g. Withers Geothermal, Columbia, KY

h. T&B Drilling, Columbia, KY

i. E&E Drilling, Paris, KY

j. Jackson & Sons Drilling & Pump Co.,, Mansfield, OH

3. Any well drillers and/or earth coupled/ground loop system contractors not listed above must submit written qualifications to engineer seven (7) days (minimum) prior to bidding.

4. Submittal of qualifications shall include detailed information about the company including but not limited to, the number of years in business, number of drill rigs, number of employees and list of (5) current and (5) most recently completed projects of equivalent size and scope.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for ground-loop-heat-pump piping materials and products.

B. Installer and Fabricator's Qualifications: Submit names and certificates of successful completion of the required schools.

C. Record Drawings: Accurate dimensioned drawings of the geothermal loop heat exchanger shall be prepared and submitted at the time of testing and prior to backfilling.

D. Fusion Machine: Submit manufacturer's technical data on the fusion machine to be used in fabricating the ground-loop heat-pump.

PART 2 - PRODUCTS

2.1 PIPING

A. The piping shall be (high density polyethylene) with minimum cell classification 345434C per ASTM D 3350 "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials". Resistance to environmental stress cracking is critical to long life expectancy. Therefore, as a more stringent requirement, the piping shall experience zero failures after 5,000 hours under condition "C" (100% reagent at 100 deg. C) when tested in accordance with ASTM D 1693, "Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics".

B. All piping shall conform to the specifications and requirements of ASTM D3035-93.

C. Piping 2" or less shall have a minimum dimension ratio of 11. Piping 3" and larger shall have a minimum dimension ratio of 15.5.

D. All fittings which are molded shall conform to the requirements of ASTM D2683 (for socket fusion fittings), ASTM D3261 (for butt/saddle fusion fittings), or ASTM F1055 (for electrical fusion fittings).

E. Joining shall be by the socket fusion, or butt fusion method in accordance with manufacturer's Heat Fusion Qualification Guide. The operator shall be properly trained and shall have executed quality fusion joints.

F. Pipe, tubing or fittings fail within 25 years from the date of purchase, piping manufacturer shall supply the following:

1. Replace, free of charge and freight prepaid, a quantity of new pipe, tubing or fusion fittings equal to that proved to be defective.

2. For the first five (5) years after the date of purchase pay all direct labor charges up to $1.00 per linear foot incurred on the job site in removing the defective pipe, tubing or fusion fittings and replace the same with new pipe, tubing or fusion

fittings. For claims during the sixth (6th) through twenty-fifth (25th) years, the payment made by piping manufacturer for direct labor charges shall be reduced at a rate of five percent (5%) per year.

2.2 FUSION MACHINE

A. The fusion machine used to make the joints shall encompass the following features:

1. Guide rods shall be in a plane that passes through the centerline of the pipe thus canceling the bending forces in the machine caused by the fusion forces.

2. The combination butt/saddle machine must have a mechanical advantage of at least 5.5 to 1 in the butt fashion mode, and 2.5 to 1 in the saddle fashion mode.

3. A butt fashion only machine must have a mechanical advantage of at least 10 to 1 and a saddle fusion only machine must be capable of applying at least 600 lbs. of thrust.

4. The pipe clamps shall have the strength to "round-up" the pipe close to the fusion joint. They must be adjustable for removal of high/low mismatch of pipe walls and clamp each piece on continuing straight centerline.

5. The pipe facing device shall be capable of rapid facing of the pipe ends to a perfectly flat surface, so when the ends are brought together, there is 100% plastic contact.

6. The facer shall be hand-powered for pipe sizes up to 2", and electrically powered for pipe sizes up to 8".

7. The facer shall have precisely machined stops to lock the facer squarely between the clamping jaws at the end of face off.

8. The heater plate shall be electrically heated and thermostatically controlled. The surface shall be smooth with a high quality non-stick coating. The heater shall be capable of quick heat-up and maintaining a constant surface temperature in the desired temperature range even in inclement conditions. The heater plate shall be equipped with a thermometer to indicate drastic temperature change. A surface pyrometer should be used periodically to assure proper temperature.

2.3 GEOTHERMAL WELL CASING (if specified or required)

A. The contractor shall assume that each bore hole will have 90 feet of permanent casing. Provide a unit price per foot to add or delete the casing, depending on the earth conditions. Unit prices shall include both permanent steel casing and removable casing. Minimum cost per linear foot shall be $9/SF for permanent casing, and $4/SF for temporary casing. Refer to Unit Prices, attachment to Form of Proposal, Division 0.

B. PVC pipe that is used as permanent casing shall be new pipe that is manufactured in compliance with the standards of ASTM specification F 480-90.

C. PVC pipe that is used as permanent casing shall be SDR 21 or heavier.

D. PVC pipe that is used as permanent casing shall be new pipe that is in compliance with ASTM specification F 480-90.

E. Each length of PVC pipe that is used as permanent well casing shall be legibly marked, by the manufacturer, with all the following information:

1. The nominal pipe sizes.

2. The standard dimension ratio (SDR).

3. The type of plastic (PVC 1120 or PVC 1220).

4. The wording “well casing.”

5. The impact classification (IC).
6. A designation that the pipe is in compliance with the provisions of ASTM specification F 480-90.
7. The manufacturer's name or trademark.
8. The manufacturer's code for resin manufacture.
9. The lot number and date of manufacture.
10. A certification mark that verifies that the pipe is in compliance with the provisions of ANSI/NSF standard 14.

F. Casing pipe that is manufactured from thermoplastic materials other than PVC shall be in compliance with the provisions of ASTM specification F 480-90 and shall be used only with the written prior approval of the engineer.

G. PVC well casing joints shall be deep socket bell ends or couplings that are manufactured in accordance with ASTM specification F 480-90.

H. PVC casing fittings shall be legibly marked with all the following information:

1. The nominal well casing pipe coupling size.
2. The type of plastic.
3. A designation that the fittings are in compliance with the provisions of ASTM specification F 480-90.
4. The manufacturer's name or trademark.
5. A certification mark that verifies that the fittings are in compliance with the provisions of ANSI/NSF standard 14.

I. PVC well casing joints shall be formed utilizing a 2-step solvent cementing process that is consistent with the provisions of ASTM specification F 480-90. The pipe ends shall be free of burrs, dust, or moisture that might interfere with the solvent weld. A primer or welding solvent shall be used before cementing. The primer, welding solvent, and solvent cement shall be compatible with the pipe being coupled and the ambient temperature at the time of use.

J. Screws or similar mechanical fasteners shall not be used for joining PVC well casing.

K. PVC well casing joints which are not of a bell end configuration or are not made utilizing a 2-step cementing process shall be approved, in writing, by the engineer before use.

2.4 BASIC IDENTIFICATION

A. General: Provide identification complying with Section 230553 - IDENTIFICATION OF MECHANICAL PIPING AND EQUIPMENT in accordance with the following listing:

1. Underground Piping: Underground-type plastic pipe markers.

2.5 GEOTHERMAL WELL VAULT

A. General

1. This specification designates the requirements for the geothermal vaults (2) (valve pit) including internal pipe, fittings, and valves. The packaged system shall be similar to custom made Atlantis heavy duty polyethylene vault. At contractor's option, a concrete vault may be submitted. Install vault in strict accordance with manufacturer's requirements.

B. External Shell

1. The external shell shall be constructed of high density polyethylene flat stock having a cell classification of 345444 with a UV stabilizer of C. All materials used shall have a minimum thickness of 1". Internal and external seams are heat welded using high density polyethylene welding rods having a cell classification of 345444C. All seams are nitrogen tested. Walls to be 72" high, with a 30" manhole with ladder. The manhole lid is connected with 8-3/8" stainless steel counter sunk bolts. Lid to have 5000-pound load bearing capacity. Provide vault with sump pit and sump pump. See plumbing drawings and specification for sump pump (SP-3) requirements. Provide 1" conduit from vault to where geothermal piping mains are terminated in building. See Drawings. Coordinate all work with Plumbing Contractor and Electrical Contractor.

C. Internal Bracing

1. Bracing shall be spaced at a maximum of 30" and constructed of a minimum of 1" thick high-density polyethylene flat stock heat welded to the external shell with high density polyethylene welding rods.

D. Internal Piping

1. Piping shall be constructed of CPChem Performance Driscoplex 5300 Climate Guard TM High Density Polyethylene DR 15.5 pipe having a cell classification of 345444 with a UV stabilizer of C. This internal pipe is constructed in an offset, over and under, model for supply and return lines. All joints to be heat fused. The entire piping system to be tested using 150 psi nitrogen. The main supply and return pipe to be shipped with cap butt welded to pipe. All pipe penetrating the vault walls shall be DR 11 and heat welded to the external shell.

E. Fittings

1. P/T Plugs shall be constructed of solid brass and have a dual seal core of Nordel, Good up to 350 degrees F for water. Plugs shall be rated zero leakage from vacuum 1000 psig and can receive a pressure or temperature probe.

2. Butterfly Valve shall be constructed of a cast iron body, 416 stainless steel stem with a lever shut off system.

3. 90 Degree Elbows shall be molded out of high density polyethylene resins in accordance with the requirements of ASTM 3261.

4. Branch and Service Saddles shall be molded out of high density polyethylene resins in accordance with the requirements of ASTM 3261.

5. Provide integral circuit setters near the header on the return line for each loop.

6. Provide test/flushing ports on circuit in vault.

F. Installation

1. The vault shall be lowered into a pit 105" deep with a 6" bed of #57 gravel. Once the vault is in place, concrete is poured 36" deep and 12" thick around the vault to balance buoyancy pressure and allow for anchoring. Install sump pump, float controls and 1 ¼" polyethylene discharge piping. See details on Drawings. The Contractor shall confirm all vault sizes and piping layouts.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which ground-loop heat-pump piping systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 EARTHWORK

A. Excavating, trenching, warning tape, and backfilling are specified in Section 221000 – PLUMBING PIPING AND VALVES.

3.3 HORIZONTAL PIPING INSTALLATION

A. Install HDPE piping in trenches according to ASTM D 2774 or ASTM D 2657 and in accordance with manufacturer's written instructions.

B. The horizontal ditches for the ground-loop heat-pump header piping may be dug with trenching machine. The header piping shall be buried a minimum of 48" deep. Dig the trench approximately 6" deeper than required and install a base of 6" of compacted sand or #9 limestone gravel. Clean out all rocks from trench before placing piping. After the piping is installed, tested, flushed, purged, inspected and approved, backfill with 6" of sand or #9 limestone gravel first then finish with rock free backfill material. Note: Backfill under paved areas shall be compacted dense grade from the 6” of manufactured sand to the underside of paving.

C. The pipe and pipe fittings must be joined using the socket or butt heat fusion process. No other method is acceptable. The vertical loop take-off tee fittings may be made using the saddle fusion process on header piping 1 1/4" and above. Exercise extreme caution to completely remove the cutout material. On header piping 1" and smaller use regular tee fittings. Bell reducer fittings shall be used at all pipe reductions to eliminate trapped air.

D. Coordinate the laying of the header piping with existing utilities, new mechanical and electrical utilities. Prepare dimensioned drawing of the complete ground-loop heat-pump piping system showing the exact location and depth of all exterior geothermal loop piping and the exact location of each geothermal well before backfilling.

E. Install continuous detectable warning tape for underground piping. Locate tape a minimum of 24 inches below finished grade, directly over piping. Underground warning tapes are specified in Section 230553 – IDENTIFICATION OF HVAC PIPING AND EQUIPMENT.

3.4 VERTICAL PIPING INSTALLATION

A. Install HDPE piping in boreholes according to ASTM D 2774 or ASTM F 645.

B. Minimum bore hole diameter shall be 6 inches or sufficient diameter to facilitate the installation of the U-tube assembly.

C. Minimum bore depth shall be as shown on the drawings.

D. The assembled bore hole piping shall be pressure tested at 100 psi prior to installing in the bore hole. After pipe is placed in bore hole, hydrostatic test to 100 psi for 3 hours and then backfilled immediately.

E. The bores shall be backfilled by hand with a 50%/50% mixture crushed limestone (#9 gravel) and manufactured sand and the top 25 feet of the bore holes shall be capped with Bentonite. Backfilling shall be done in a manner to insure pipe contact, and shall not contain large, sharp, or jagged rocks or debris. Extreme care must be taken to insure NO bridging of the backfill within the bore holes and that backfilling does not crush, cut, or kink the pipe.

F. Backfill all well bores after U-tubes are installed. Wells shall not be left open overnight or any extended length of time.

G. Contractor shall provide to the Engineer a drilling log for all borings indicating makeup of soil including voids, water seams, etc.

H. Contractor shall notify Engineer 48 hours before boring is to take place.

3.5 TESTING AND CLEANING

A. Cleanliness: During installation, trash, soil and small animals shall be kept out of the pipe. Ends of the high-density polyethylene pipe shall be taped or capped until the pipe is joined to the circuit.

B. Flushing the Earth-Coupling: Before connection of the plastic earth-coupling lines to the distribution manifolds, each loop shall be flushed thoroughly and left filled with clean water.

C. Each polyethylene U-fitting assembly (loop) shall be water filled and pressure tested to 100 psi prior to installation into well bore. The complete system shall be water filled and pressure tested to 100 psi prior to backfilling to the trenches. The pressure test must be observed and approved by the Engineer before the system can be backfilled.

3.6 FLUSHING AND PURGING THE SYSTEM

A. General: Before backfilling the trenches, all systems shall be flushed and purged of air and flow tested to ensure all portions of the heat exchanger are properly flowing. A portable temporary purging unit shall be utilized and shall consist of the following: purge pump - high volume and high head; open reservoir; filter assembly with by-pass; flow meter; pressure gage; connecting piping; and connection hoses.

B. Using the purging unit described above flush and purge each geothermal loop heat exchanger system until free of air, dirt and debris. A minimum velocity of 2 ft/sec. is required in all pipe sections to remove the air. This flushing and purging operation should be conducted with the water source heat pump piping isolated with shut off valves. After the geothermal loop heat exchanger is completely flushed of air and debris, open the isolation valves and permit circulation through the heat pump portion of the system until the entire system is flushed and purged.

C. Utilizing the purging unit conduct a pressure and flow test on the geothermal loop heat exchanger to confirm the system is free of blockage. If the flow test indicates blockage, locate the blockage systematically clamping off loops with a pinch-off tool, remove the blockage, then re-purge and conduct the pressure and flow test again until all portions of the system are flowing. The flow test must be observed and approved by the Engineer before the system can be backfilled.

END OF SECTION 23 21 13.33

SUBMITTALS

In accordance with the requirements of the General Conditions and Supplementary General Conditions, the following information is required to be submitted for this Section. The Contractor shall submit the required information to Architect for approval within 30 days after notice to proceed.

ITEM DESCRIPTION	SHOP DRAWINGS	CATALOG DATA	PARTS LISTS	OPERATING MANUAL	WIRING DIAGRAM	CERTIFICATION	SAMPLES	OTHER
Pipe	X	X						
Fusion Equipment	X	X		X				
Vault	X	X						
Certifications	X					X		
Drilling Log	X	X						
Record Drawings	X							