Ground Source Heat Pump Drilling Regulations Discussion

November 12, 2020

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Marriott Albany
April 14 & 15, 2021
NY-GEO 2020— Electrify with Heat Pumps!

Presented by:
www.ny-geo.org
Ground Source Heat Pump (GSHP) is most commonly an electrically-driven water-source heat pump HVAC system which uses the earth (ground) as a source and sink for thermal energy for buildings.

Ground Heat Exchanger (GHX) Vertical or Horizontal – A ground loop that acts as the means for a heat pump to extract/reject heat from/to a building.

Well is an artificial excavation, hole or structure for the purpose of withdrawing an underground resource, usually water but can also be Gas/Oil. Remains open from bottom to surface for continued extraction of the resource it was designed for.

GSHP Bore or Borehole – A bore for the sole purpose of installing a GHX, most commonly HDPE pipe in a closed loop configuration. A GSHP bore or borehole is grouted from the bottom of the bore to the top using a tremie line and a non permeable mixture of water/bentonite grout and graphite. This grout both aids in sealing / decommissioning the well to avoid communication of different levels of an aquifer and to guarantee heat transfer between a circulating heat transfer fluid, the HDPE pipes and the surrounding medium with temperatures that range between 25 °F and 75 °F.

Geothermal is a general term that may refer to 1) accessing depths sufficient to produce steam used to further produce utility scale electricity generation or 2) accessing elevated temperature subsurface ground temperatures for direct exchange used to heat a building or process or lastly 3) to refer to GSHP low temp thermal extraction/rejection for heating/cooling buildings/hot water etc.
Technical Details of a GSHP Borehole

• Drilling process is essentially the same as used for water wells
• Bores are drilled using mobile drilling rigs
• Most drilling rigs are rotary based
  • Methods include Air Rotary, Drill/Drive, Mud, Reverse Circulation, Dual Casing Advancement, & Sonic
• Drilling consists of 3 major goals
  1. Casing (permanent or temporary) into the top of rock
  2. Drilling of bedrock to TD
  3. Insertion of HDPE to TD and sealing bore with grout
Ground Source Heat Pump Boreholes Discussion

- HDPE U-bend & tremie line are inserted to bottom of the bore
- Non-permeable grout is pumped from the bottom of the bore
- Water/Antifreeze solution is circulated in the “Closed Loop” while the grout helps move energy to and from the bedrock
- Horizontal runs are below grade and excavation and backfilling, and site restoration occur as a part of the installation project
Status and Assumptions

• Setting casing adds significant time and expense to a drilling project
  • On the order of 40% more expensive for each foot of casing
  • Casing does not improve GSHP system performance

• Drilling deeper than 500’ is relatively common for water wells
  • Approx. 15% of ~4,500 wells exceed 500’ based on DEC Website just in Albany County
  • Drillers have ability and tooling to drill deeper than 500’

• Qualified GSHP borehole drillers are in short supply
  • NYS projections commonly target 1/3 of all building electrification from GSHP systems
Deeper GSHP Boreholes = Fewer GSHP Boreholes

- **Reduces** casing risk
  - Difficult to predict accurately on small projects
- **Reduces** casing expense
- **Reduces** time on site for skilled labor and expensive equipment
- **Reduces** site restoration due to smaller footprint
- **Reduces** containment area for cuttings/water
- **Reduces** number of fusion joints for horizontal runs
500’+ Triggers a Large Shift in Regulations & Fees

Applicable Forms & Submittals to the NYSDEC

- Organizational Report, Form 85-15-12
- Application for permit to drill a well, Form 85-12-5
- Environmental Assessment, Form 85-16-5
- Financial Security Worksheet, Form 85-11-2
- Well Drilling and Completion Report, Form 85-15-7
- Certified site plan
- Casing and cementing plan
- Various other submissions during and following construction
Impact of Deeper GSHP Boreholes

Small Buildings / Residential
• Single Bore vs multiple bores have many advantages
• ~50% to 60% of existing homes can be served by a < 500’ GSHP borehole
• ~90 to 95% could be served by a single borehole < 750’ GSHP borehole
• So some 3.2 MM (40%) homes in NYS would benefit

Larger Buildings / Commercial
• 100% of larger buildings could benefit from >500’ GSHP boreholes
Greater depths allow us to serve more homes with 1 borehole

Dandelion Energy’s Experience

• With current 500’ restriction, ~20% of homes require only 1 borehole (~80% require 2 boreholes or more).
• If the cap is raised to 600’, twice as many homes (~40%) only require 1 borehole.
• If the cap is raised to 700’, about 60% of homes require only 1 borehole.

This is important because many homes don’t have room for multiple boreholes.

Ground Source Heat Pump Boreholes Discussion
Deeper boreholes result in $1000s in savings

Aztech Geothermal’s Examples

• Example 1: Drilling to 700’ would have saved an Elka Park, NY homeowner $4,200 in their transition to renewable heating.

• Example 2: Drilling to 600’ in Saratoga, NY would have saved that homeowner $3,500 in added cost in their transition to renewable heating.

These added costs are high enough to discourage the transition to renewables.

The Saratoga project required an additional 200’ GSHP borehole, two additional foundation penetrations, balancing valves and additional piping.
Standardizing on One Borehole / Home

- Partnership of 5 Installers, 3 Drilling companies and 2 distribution/manufacturing firms
- Standardized design approach – single bore for single family homes
  - Includes 100% of heating, cooling and domestic hot water
- Over 700 residential and 8 Large installs last 18 Months alone
Going beyond 500’ is critical in urban areas.

**Geothermal borefield restricted to 130 Boreholes**

Drilled depth to meet geothermal requirements on this NYC site was 925’

**Key Issues**
1. Driller very confident of drilling required depths to install closed loop boreholes
2. Cost of drilling below 500’ due to current NY State regulations made solution financially untenable
3. NY State regulations impacting ground sourced heating and cooling industry

*Ground Source Heat Pump Boreholes Discussion*
Brightcore Energy Experience:

- **Darien Library, CT**: Ten closed loop boreholes were installed to 900 feet depth in CT. Going deeper enabled fewer drill rig set ups, less lateral piping, less site area disruption, less traffic/parking disruption (Library remained open during work), and avoidance of existing site utilities (storm sewer, electric, telecon).

- **Ashland Public Safety Bldg, MA**: renovation includes installation of 18 600 ft boreholes. Site constraints resulted in the optimal geothermal design including deep boreholes. Underground infrastructure (site stormwater, electrical, water, etc.) constrained borehole placement.

- **Multifamily/Com New Construction, NY**: new construction of 250,000 square foot multifamily/commercial development in gas constrained area. Maximizing the available site area requires geothermal boreholes to be installed to 600’ depth to provide capacity for the full heating load.

Pre-existing constraints make deep bores essential for retrofit
Next Steps