Ground Source Heat Pump Systems
Assisting Energy Savings
While Protecting Groundwater

2009 REVISIONS TO GUIDELINES FOR THE CONSTRUCTION OF VERTICAL BOREHOLES FOR CLOSED LOOP HEAT PUMP SYSTEMS

Kevin McCray, Executive Director
Units Shipped: 1999-2007

Source: Current Industrial Reports, U.S. Census
Value of Units Shipped: 1999-2007

$266,213,000

Source: Current Industrial Reports, U.S. Census
Ground Source Heat Pump
Boreholes: 1999-2005
Loop Field Design

- Borehole Spacing
- Site Limitations
- Topography & Site Access
- Property lines
Loop Field Design

- Underground utilities
- Aboveground utilities
- Septic fields
- Other contaminant sources
- Sanitary protection
- Drilling
- Potable supply wells
- Surface water or wetlands
- Buildings/structures
- Right-of-way
- Isolation
Loop Field Design

• Borehole spacing dependent upon:
  – balance of the annual thermal loading;
  • Risk of thermal pollution
  – land surface restrictions.
Loop Field Design

- Borehole diameter impacts heat transfer rate.
- Borehole diameter must be large enough to allow use of tremie for placing grout from bottom to top.
Loop Field Design

• Site conditions that dictate modifications to borehole construction must be brought to designer’s attention.

• Drilling contractor must inspect site to ensure rig & support equipment’s safety.

• System designer must consider space limitations for drill rig.
WARNING!

- Special care must be taken when working around overhead power lines.
- Know location of underground structures.
Loop Field Design

- Must protect against surface contamination of the aquifer.
- Must protect against cross-contamination of hydraulically separated aquifers.
Hydraulic Connectivity
Borehole Construction

• Drilling contractor must use potable water adjusted to the correct pH at all times.
• Drilling fluids must comply with state and/or local requirements -- some states require ANSI/NSF compliance.
• Drilling fluids must be used as prescribed by the manufacturer.
Borehole Alignment

• The borehole shall be in alignment to such an extent that the closed-loop piping can be placed to the entire borehole depth, grouted with a tremie pipe from bottom to top, and such that the borehole does not intersect another nearby borehole.
Borehole Grouting

Grout materials to be used

• Use of Portland cement
• Use of sand cement grout
• Use of neat cement grout
• Use of bentonite grouts
• Use of enhanced thermal conductivity grout
Grout to...

- Protect the aquifer
- Increase the borehole heat transfer rate
Borehole Grouting

• Must consider existing surface conditions and subsurface conditions when grouting.
• The entire length of each borehole shall be grouted from bottom to top.
• Formations yielding water must be sealed off to prevent cross-contamination of the formations.
Borehole Grouting

• Loop placement and grouting should begin as soon as possible after drilling.
• Loop placement and grouting should be completed same day as the borehole is constructed.
Borehole Grouting

• Grout must be placed by tremie pipe from the bottom of the hole to the surface.
Temporary Loop Capping

- Any vertical closed loop that is to be temporarily removed from service, or which is completed for a period prior to being placed in service, or is left uncompleted due to a recess or delay in construction shall be equipped with a water-tight cap.
Loop Field Identification

- Site plan.
- Tracer tape or marker.
- GPS position of boreholes
Loop Field Trenches

• Be aware of open trench hazards.
Permanent Loop Piping Decommissioning

- Loop pipe flushing.
- Grout materials.
- Grout placement.
- Special conditions.
- Vertical loop piping and header decommissioning records.
Permanent Loop Piping Decommissioning

• If a loop is abandoned (decommissioned) must fill the loop to prevent worst case scenario of loop piping failure acting as conduit to the subsurface.
Revision Soon to be Available

• Will be disseminated at no charge to state regulatory oversight agencies for their consideration

• Will be available to ground source heat pump system designers and other professionals
Thank You

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