

November 17, 2006

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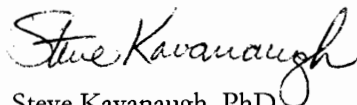
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Gentlemen,

I have been requested to render an opinion with regard to the renewable nature of the ground loop portion of geothermal heat pumps. My comments use the vertical ground loop design as a base but they apply to a variety of loop types including horizontal and lake loops. A letter in the correspondence I received summarized well the issues of loop overheating (or overcooling) as potential problems. This has happened in cases when proper design and installation practices are not followed. Ground loops can easily be designed to be "self-renewing" by engineers who are well informed in both ground loop and building heat transfer.

I will attempt to keep this brief but please consider the following points;

1. For a heat pump with of Coefficient of Performance [COP = 4 (EER=13.6)] in cooling, 5 units of heat are rejected to the ground for every 4 units of heat removed from the building. (Input electrical energy is converted to heat and must be removed through the ground.)
2. For a heat pump with of Coefficient of Performance [COP = 4 (EER=13.6)] in heating, 3 units of heat are removed from the ground for every 4 units of heat supplied to building. (Input electrical energy is converted to useful heat and is delivered to the building.)
3. Thus, a building that requires approximately 80% more hours of heating than cooling will be in balance and will be self renewing.
4. Adequate separation of ground heat exchangers can be used to minimize the ground heat change to minimal values for a wide range heating-to-cooling hours variation. Separation increases the volume of ground and provides adequate thermal capacity so the ground will remain near its natural temperature until the end of the heating or cooling season. At the end of the season the heat pump cycle is reversed and the temperature "renewal" process begins again.
5. In applications that have much greater cooling hours, a "hybrid" GHP can be used to minimize the heat build-up with a fluid cooler or cooling tower. This device is used in parallel with the ground loop and insures the heat build-up does not exceed the heat pump's capacity to renew the ground temperature when the cycle is reversed in the winter. Water-to-water heat pump water heaters can also be used to divert a large portion of the excess to hot water generation.
6. In applications that have much greater heating hours, it is suggested that air-side heat recovery units be explored to minimize the heating requirement. In most commercial applications the ventilation air requirement is the primary load and HRUs will bring the heating hours to much closer balance to cooling hours. Additionally, auxiliary heat is suggested in some very cold climate applications.



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