Geothermal Loops

These hoses are the ends of 4 – 100 ft. loops of oxygen-barrier Pex-B burried about 34” under our back yard. This system was installed for 2 uses – to dump excess heat from the solar collectors in the summer, and to provide “passive” air conditioning using the Fan Coil.

Excess Heat Dump

In the summer, it is possible for the solar collectors to collect excessive heat. Since the system cannot be shut off (or the Glycol will boil in the solar collector's header), the excess heat must be discarded. There are several ways of doing this; dumping hot water down the drain, letting the tank boil and letting the relief valve dump the steam (*not* recommended!), or expelling the excess heat outdoors through a buried loop.

We have not need to hook this up yet, because we boiled the system (a few times...) and melted our closed-cell foam insulation. This limits the maximum return temperature through the increased radiant loss through the 50' of 3/4” copper pipe running up to the headers and back to the tank.

Now that we've replaced the insulation, we'll probably have to hook this up this year. In the mean time, if the tank gets too hot, we can just dump some heat into the basement slab hydronic zones.

Passive Air Conditioning

Glycol pumped through the ground loops should return the water at around 50 F. This can then be passed throught the Fan Coil, and should knock a few degrees off the air circulating through the fan coil.

Care must be taken when sing a “heating” fan coil to do any kind of cooling, to ensure that the water temperature never drops below the “dew point” – the temperature at which humidity begins to condense out of the air. The dew point can be calculated if one has a humidity sensor and a temperature sensor in the return air duct of the Fan Coil.

Once the current “dew point” is calculated, a computer-controlled 3-way mixing valve is used, to mix only the amount of the ground-cooled water required to achieve a temperature just above the dew point. Another 3 temperature sensors (measuring the cold and warm mixing valve water supply, and mixed output temperatures), and a variable voltage controller (2-10 volt output for controlling the mixing valve) are required. At least additional pumps (1 to circulate the glycol thru the ground loops, and 1 to

circulate the glycol throught the 3-way mixing valve and the Fan Coil) will be required.

Ground-Source Heat Pump

These loops could also be used with a heat pump, to augment the solar system (in the winter, on overcast days, etc.) We decided not to implement a heat pump system for the following reasons (which may or may not be correct!).

My understanding is that heat pumps are about 300% efficient – this means that for every unit of energy put in (electricity to run the heat pump), 3 units of heat energy come out (heat extracted from the ground, plus heat from running the pump itself).

Therefore, in order to be cost effective, the energy used to run the heat pump cannot be more than 3 times a costly as gas – otherwise, you might as well just run the boiler!

If energy is $0.07 per kWh, and 1 kWh = 3.6 mJ (megajoules), electricity costs per gigajoule (277.7 kWh) is 277*$0.07 = $19.39/gJ.

If we use a 90% AUFE boiler, then gas would have to rise to at least $19.39*90% = $17.45/gJ before it would make sense to use a heat pump.

If these calculations are incorrect, let me know!

Why are heat pumps so popular, then?

A ground source water loop to cool the condensor (instead of an air cooled condensor) makes air conditioner run much more efficiently. For example (from http://www.mcquay.com; EER means Energy Efficiency Rating):

> In a Boiler/Tower system, with a loop temperature of 60 to 70°F, the heat pumps have an EER around 22. Geothermal heat pumps, with a loop temperature of 25°F to 30°F, can have an EER as high as 36.

So, for climates where air conditioning is required, it makes sense to put in a geothermal system for air conditioning. Since the same unit can often be used for heating and cooling, it might make sense to design your structure to use the heat pump for heating too; the total cost of putting in a seperate heating system and heating oil or natural gas supply might be greater than the cost of electricity to run the heat pump in heating mode, expecially if your heating needs are limited.

Perhaps since most companies have head officies in the USA or eastern Canada, I suspect that many companies just “assume” that western Canada has similar heating/cooling needs…