Outside the Loop

A Newsletter for Geothermal Heat Pump Designers and Installers

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We Have Mud in Our Loops

By Ralph Cadwallader, President, Loop Tech International
(Over 16,000 vertical loops installed in 17 US states and Saudi Arabia)

The closed loop system for a geothermal or Geo-Exchange heat pump, is a very reliable piping system when PE3408 is installed properly. The mind immediately searches for a scapegoat when something does not go as expected. The first "goat" that is roped is what is not seen and still has a mystical air about it, the buried heat exchanger.

I have had several calls from owners and engineers stating "We have mud in our loops and a leak". The first question that I ask is "What color is this mud?" The response is "Dark red". The next question I ask is "How much water are you losing?" They usually have some figures that vary. They are flushing the lines and it is not actually a leak. I suppose the "leak" statement is to get an immediate response to their dilemma because it is still under warranty. The hydronic piping was constructed of steel pipe and there were no inhibitors added to the system. What happens is a very simple and inevitable chemical reaction with the oxygen in the water and the steel pipe: iron oxide. This iron oxide then accumulates in the heat pump strainers and the unit does down on high head. The strainer is cleaned out and the contents are like a muddy paste, therefore "clay". A simple way of proving that it is not clay and it is iron oxide is to mix a weak to medium solution of muratic acid in some water and put this "clay" in it. If it dissolves it is iron oxide if it does not it is clay. The way to prove that there is no leak is to put a water meter on the make-up water and monitor what is discharged.

I am sorry folks, this is not a warranty call back. It is poor design. If steel pipe is to be used and the inhibitors are not added then at least take the strainers out of the heat pumps. Flushing the system and then filling it with water insures that it will happen again because of a fresh supply of oxygen.

Southern Building Code allows PE to be used inside the building for hydronic piping. The plenum area needs to have copper because PE does make a black non-toxic smoke when it burns. The only drawback to using PE is the fact that more hangers are needed because it is not rigid. The advantages are: that the price is equal or less expensive than steel, it is easier and cheaper to install, it is light, there is no corrosion, will not burst if it freezes, can be pinched off to make repairs or additions, no mechanical joints and no leaks.

Try PE next time you have an opportunity. You might like it. One thing is for sure, you will have eliminated the possibility of getting "mud" in your closed loop system.

See related letter "Sludge in Our Stainers…", p. 6

Does Decentralization Make Sense?

Many engineers prefer to adapt practices for water loop heat pump (WLHP) and chilled water piping, which are primarily central systems. The building pipe loop is connected to a central ground loop. Interior piping is most often carbon steel. Pumps are arranged in primary-secondary loops and variable speed drives are occasionally used. However, a survey indicates the pump energy is a disproportionate percentage of the total (ASHRAE/Caneta, 1995).

Although the central loop approach typically will result in a smaller total ground loop size, it is not necessarily the lowest cost option. Large in-ground headers, vaults and interior piping can exceed added ground loops costs (OTL, 1998). Additionally, the required corrosion inhibitors for the carbon steel piping are not always acceptable for in-ground use and must be continually monitored. Finally, most of the system head loss typically occurs in the headers connecting the ground loop to the interior heat pumps. Vertical ground loop losses are usually less than 10 ft. (3 m) of water and heat pump losses are of a similar magnitude. Central system losses are typically in the 60 to 120 ft. (18 to 36 m) range, because of the large contribution of interior and exterior headers.

Continued on Page 2

Loop Contractors

- **Got any complaints about engineers and the crazy way we do things sometimes?**
- **Would you like to help us get better at designing ground loops?**

Then fill out the Ground Loop Cost Survey we sent you.

- **We need comprehensive ground loop cost data.**
- **Engineers need this information to design loops that are reliable yet economically acceptable.**
- **We need to avoid difficult-to-install designs.**

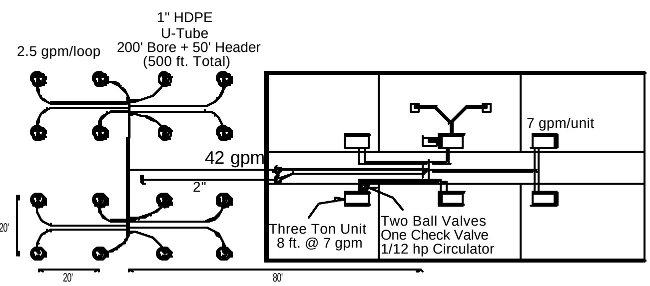
FAX 205-348-6419 or e-mail skavanaugh@coe.eng.ua.edu for a new form.

Thanks to the five who returned a form.

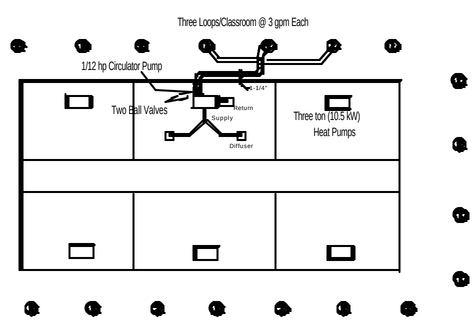
Design Issues and Tools

<u>Does Decentralization Make Sense? (Continued from p. 1)</u>

Two alternative options are shown in Figure 1. These options will require 5 to 20% more ground loop typically but overall costs can be substantially reduced, since large diameter ground loop and interior carbon steel piping are eliminated. If pumps with bronze, stainless steel, or epoxy-coated components are specified, the need for corrosion inhibitors is eliminated. The entire piping loop is high-density polyethylene (HDPE). Pumping head is substantially reduced as shown in Table 1. A six-zone sub-central loop is shown to indicate one loop of several in a educational application. Some diversity is available since zones are served by a common loop. The pumps can be low head circulators since the length of the headers is small. However, a check valve is required on every unit to prevent back-flow through units not in operation. The circulator is activated only when its unit is running.



Sub-Central Loop with Circulator Pumps



Individual Loops for Each Classroom

Figure 1. Sub-Central and Individual GHP Loop Options for Low Maintenance and Pumping Cost

The second option in Figure 1 is a system with individual units with individual loops. Total ground loop length will be greatest since no diversity is available. While this option may appear to be simplistic, it is favored by many clients because of it simplicity, ease of maintenance, and dependability.

Central system devotees are leery of using so many low efficiency circulator pumps. However, the two-way valves and the strainers required on central systems have proven to be far more problematic. The cost of multiple circulators is less than or equivalent to a system with a central pump (and back-up) when the added price of a two-way valve for every unit is included. While circulators are far less efficient than central pumps, system head is much lower. Try the math.

OTL Pop Quiz #1: *Compare the demand of two 1000-gpm systems. Central loop System A requires 100 ft. of head and has an 80% efficient, 1000-gpm pump with a 92% efficient motor. Multi-loop System B has 100 – 35% efficient, 10-gpm pumps with 70% efficient motors that require 25 ft. of head.*

Answer can be found at www.bama.ua.edu/~geocool

Table 1. Head Loss Summary for Sub-Central GHP Loop

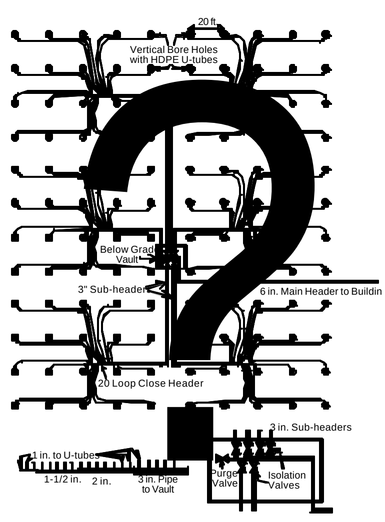
Water @ 60F, Density = 62.4 lb/ft3, Viscosity = 1.14 cp

No.	Component	gpm	Leq	ft/100	Δh (ft)
4	2" HDPE Butt Tee Branch	42	15.2	4.29	2.61
2	2" HDPE Butt Elbow	42	12.3	4.29	1.06
1	10-Ton Header End Take-Off	2.5	18	.48	0.09
1	10-Ton Header End Take-Off	2.5	18	.48	0.09
1	1" HDPE SDR 11 Pipe	2.5	500	.48	2.42
1	1" HDPE UniCoil	2.5	10.2	.48	0.05
1	1" HDPE SDR 11 Pipe	7	60	2.98	1.79
2	1" HDPE Butt Tee Branch	7	7.1	2.98	0.42
2	1" Zone Valve (Ball)	7	Cv=35		0.18
1	1" Swing Check Valve	7	Cv=21		0.26
1	Coil Head Loss	7			8
1	2" HDPE SDR 11 Pipe	42	160	4.29	6.87
	Total				23.8 ft.

However, there are applications where central systems remain a viable alternative. These include buildings with significant load diversity, compact footprints, or in situations where the ground loops cannot be placed near the zone they serve.

A new approach is suggested that is reversed from thinking for conventional HVAC systems:

Engineers should first attempt to design sub-central or individual ground loops with 100% HDPE pipe, small circulator pumps, and simple control. If this is not possible, then try a central loop approach.



ONLY SUPPLY HEADERS SHOWN

Ground Source Heat Pump Design and Costs

An Open Mind on Open Loops

In our continuing effort to bring you the perspective of your peers in the engineering/construction profession, the following is an interview with Kirk Mescher, PE principal of CM Engineering of Columbia MO. Kirk's focus has been open loop systems and he currently has projects ongoing in Georgia, Illinois, Missouri and Nebraska.

OTL: How did you get started in GSHPs?

Mescher: I developed a client who was extremely interested in ground source technologies. When I began design on a new office facility for this client, it became apparent that they wanted a ground source system. The tonnage was such that I was concerned about drilling multiple boreholes for a closed loop ground heat exchanger and I was intuitively concerned about this primarily cooling dominated installation and the design of the ground heat exchanger. I saw one of your presentations on ground water installations and decided this would be a good choice for this project. Off I was into the exciting world of ground source heat pump systems.

OTL: You have been doing a lot of open loop systems in your area. What drives the choice of this system over closed loop?

Mescher: I review projects based on the availability of ground water, the potential size of the ground heat exchanger that might be required (for closed loop), the type and size of the building and the available maintenance staff. In our area we find that systems in excess of 30 tons are appropriate for ground water installations. The cost of the wells compared to the multiple closed loop boreholes is such that the ground water system has the economic advantage. An additional benefit for facilities with potential growth is the ability to increase the capacity of ground water systems by simply adding heat exchanger surface.

OTL: What system sizes and building types are you are doing?

Mescher: On the low end, I just finished a 6-ton residential closed loop system and at the other end of the spectrum a 400-ton open-loop system in a school. Our previous applications have also included nursing homes and office buildings.

OTL: Do you use a single well or multiple wells?

Mescher: The short answer is yes. In small installations we use a single production well and a single injection well. Both are equipped for production and injection and this allows us to "backflush" the formations. In systems that have been operating for as much as 7 years, we have had no problems once the original operating parameters are achieved. In larger systems we used as many as 3 production wells in cases where we were only able to get 50 to 60 gpm per well out of our limestone aquifer. This does offer some flexibility for staging of wells for part load operation.

Our largest installation has a single production well and a single injection well. Water is readily available on this site – so much that a closed loop system would have been difficult to install. At 275 ft. this aquifer will produce 15 million gallons per day. Our little 500 gpm well is not even a blip on the radar. The real answer as to number of wells is it's depends on the site (aquifer characteristics, etc.)

OTL: Are the wells part of your design or handled as a separate contract?

Mescher: Generally, the well design is part of our scope of work. Since we are not specialists in well design, we need a lot of help in making sure we get all our bases covered. Through our contacts at ASHRAE and other professional organizations we have been able to assemble a specification system which works pretty well with most installations.

OTL: Do you have any advice for dealing with well drillers?

Mescher: We are fortunate to have a number of experienced drillers in our area. Experience is a wonderful thing, however "set in their ways" is also part of their personality. Good drillers are capable of producing excellent results when it comes to drilling and completing wells. The design professional should insist on a flow test and also be involved in the selection of the well pump. Drawdown of the well at various flows (flow test results) is a key input to the system design and pump selection. Drillers are used to water systems that produce 60 to 70 psi at the well head and this is not necessary in heat pump systems.

OTL: What about disposal? Do you use surface or injection?

Mescher: Injection wells are our primary means of disposal. I don't like the term disposal. I would rather call it conservation. I like to "borrow" the water for energy purposes and replace it to be used again. Surface disposal can place undue stress on the aquifer and deplete a valuable resource.

OTL: What problems have you had with these systems?

Mescher: After completion, quite frankly, very few. Most of the problems we have had relate more to a lack of experience. Some of our early installations had problems with injection well overflow. This was before we required flow tests on the completed wells. When the pump test was performed, we were able to see that the well's performance was not as good as expected. The well was extended and the problem solved.

Another problem occurred at a site where the water was very corrosive to steel. All of our projects now use polyethylene pipe from the well to the heat exchanger. We now require a chemical analysis of the water to aid us in material selection.

In one job we found that the water flow from the well was not up to specification. The submersible pump was set too shallow in the well so it was cavitating. The pump was lowered and the system worked fine. The bottom line is testing at the construction stage for water flow and water chemistry.

Ground Source Heat Pump Design and Costs

OTL: We understand that you have used an open loop solution to address some "hot loop" problems in closed loop systems.

Mescher: A small university in the area had installed a closed loop system comprised of over 500 boreholes in four distinct bore fields. We like to say that they perforated ½of Boone County. The wells were placed too close together for the cooling dominated load of the facility and loop temperatures were approaching the 120°F range. There was no further room for boreholes and the college didn't like the idea of a fluid cooler so it came down to ground water as the only available option. A plate and frame heat exchanger was "boot strapped" onto two of the systems in conjunction with a production and injection well. Last summer the college kept their loops below 85°F for the first time. It did take a lot of time and water to cool the over stressed borefields. There were other problems with these systems, many of the basic engineering variety. Anyone who does engineering on these types of systems should keep his basic fluid dynamics, heat transfer and common sense in mind.

OTL: How do you handle outside air in these systems?

Mescher: I have a deep and profound preference for air-to-air energy exchangers of the total energy variety. With the increased ventilation requirements I have found many applications where the mix air conditions to the heat pump are such that I cannot meet the dehumidifcation load. With the addition of the air to air exchanger, the mixed air conditions are in line with the heat pump's capacity and this increases the number of jobs where GSHP systems can be considered.

Substantial improvements have been made in the reliability and performance of this equipment recently. Properly applied, outside air loads can be reduced by as much as 80%. In many buildings, this can reduce heating and cooling loads sufficiently to pay for the installation of the recovery equipment. My first concern is to assure proper air quality, dehumidification and comfort. Heat exchangers allow this to happen with the additional benefit of reduced energy use.

OTL: Do you have some well and total job cost information?

Mescher: I just completed a project where my well costs were $34,000 for two wells, pumps, wiring and piping to the building. The total installation cost was $252,000 or about $8.36 per ft². (See the breakdown in right column.)

	$/ton	**$/ft²**	**%**
water wells [1]	680	1.13	13.6
heat pumps	660	1.10	13.2
sheet metal	1160	1.93	23.1
piping (int)	1820	3.03	36.1
controls	200	0.33	4.0
Misc	500	0.76	10.0
Totals	5020	**8.28**	100.0

[1]Well costs are high ($/ton) due to the low flow rate used

OTL: What about controls? Do you use DDC?

Mescher: DDC is great to have with an educated owner who understands the complexity of the system. For the inexperienced it is daunting. We select a control system for the owner which best fits with their method of operation, the level of maintenance expertise and the human interface required. Often simple thermostats with remote night setback are appropriate. The most important goal is to keep the systems simple, otherwise I couldn't understand them.

Lonnie Ball's Choice: Banking or Drilling

Continued from Page 5

When asked why he prefers geothermal work, Lonnie replies, "When you're doing water well work, you're married to it. Call-backs seem to occur on Christmas day. If you are making a conscientious effort with geothermal installations, when you're through with it, you're through with it." When prompted for words of wisdom for engineers Lonnie doesn't hesitate. **"Keep it simple. Don't put a lot of bells and whistles on the system that give it more places to leak."**

By the time you read this Ball Drilling will have completed 5000 loops. We know there are a lot of people in the Austin area that are happy that Lonnie choose drilling. After all, it's a lot easier to find a banker than it is to find a contractor that can put five or six 290 ft. loops in the ground in a day.

Whoppers – Ground Source Heat Pump Cost

A mild-mannered commercial rep for an electric utility has been working real hard to put together ground source heat pump projects. He felt good about finally getting a qualified driller on board that would give a reasonable bid. He felt confident about the project for an addition to a school. He couldn't believe it when the bids came back.

36,000 ft² School

Ground Loop Cost = $123,000 ($3.41/ft²)

Mechanical Cost = $156,000 ($4.33/ft²)

Control Costs = $197,000 ($5.47/ft²)

The job came in at $20/ft². The engineer is able to control 14 points on each heat pump. The utility rep is trying to figure out how he could come up with that many. We are wondering why the engineer would ask the school system (which is likely strapped for cash) to pay for many control points on a single-speed, constant-volume unitary heat pump with internal refrigerant control.

Installation Equipment and Loop Contractors

Commercial Building GCHP Loop Contractors

A&E Drilling Services, Greenville, SC 864-288-1986
Alabama Geothermal, Trussville, AL 205-661-9143
Ash Drilling, Lebanon, TN, 615-444-0276
Ball Drilling, Austin TX, 512-345-5870
Michael Barlow Drilling, Joppa, MD 410-838-6910
Bergerson-Caswell, Maple Plain, MN 612-479-3121
Bertram Drilling, Billings, MT (and PA), 406-259-2532
Harvey Cain Drilling, Atlanta, TX 903-796-6339
C&W Drilling, Columbiana, AL 205-669-0228
Can-America Drilling, Simla, CO 80835, 719-541-2967
Closed Loop Systems, Tallahassee, FL, 850-942-7668
Craig Test Boring, Mays Landing, NJ, 609-625-4862
Douglas Exploration, Douglas, WY, 307-358-3125
Donamarc Geothermal, Union Town, OH, 330-896-4949
Earth Energy Engineering, Big Stone Gap, VA 540-523-2283
Energy Systems, Pensacola, FL, 850-456-5612
Enviro-Tec, Cresco, IA, 800-728-6187
Ewbank & Associates, Enid, OK, 405-272-0798
Falk Brothers, Hankinson, ND 701-242-7252
Gedney-Moore, King of Prussia, PA, 610-354-9843
Geo-Energy, Vermillion, SD, 605-624-6745
Geo-Therm Heating-Cooling, Alexandria, KY, 606-635-7442
Geo-Systems Inc., Wallingford, KY, 606-876-4621
GeoMasters, Newton, TX 409-379-8537
Georgia Geothermal, Columbus, GA, 800-213-9508
Geothermal Drilling, Huntsville, TX, 409-293-8787
Geothermal Drilling, Louisville, KY 502-499-1500
Geothermal Loop Services, Bel Air, MD, 410-515-6191
Geothermal Services, Mays Landing, NJ 877-394-4689
Geothermal Energy Management, Savannah, GA,912-964-7486
Ground Source Systems, Buffalo, MO, 417-345-6751
Frame Drilling, Elkins, WV, 304-636-6025
Hammett & Hammett, Andalusia, AL, 334-222-3562
Henry Drilling, Franklin, TN, 615-794-1784
Jedi Drilling, Cibilo, TX, 210-658-7063
Jensen Well Company, Blair, NE, 402-426-2585
Johnson Drilling Co., Dallas, TX 972-924-2560
K & M Shillingford, Tulsa, OK, 918-834-7000
Layne-Atlantic, Suffolk, VA 757-934-8971
Loop Master, Indianapolis , IN, 317-872-3766
Loop Tech International, Huntsville, TX, 800-356-6703
Mid-America Drilling, Oakland, IA 712-482-6911
Mid-State Drilling, Livingston, TN, 931-823-7345
Middleton Geothermal, Akron, OH 330-620-0639
Mineral Services Plus, LLC, Cologne, MN 612-446-5503
Morrison Inc., Duncannon, PA 717-834-5667
Moses Drilling Co., Gray, KY, 606-523-1215
Murray Drilling Corp., Princeton, KY, 502-365-3522
Neese Jones Heating-Cooling, Alpharetta, GA, 770-751-1850
Larry Pinkston, Virginia Beach, VA, 804-426-2018
Pruitt Drilling, Moab, UT, 435-259-6290
Reith Brothers Well-Drilling, Emmaus, PA 610-965-5692
Richard Simmons Drilling, Buchanan, VA 540-254-2289
Rock Drillers, Inc., Bardstown, KY, 502-348-6436
Saathoff Enterprises, Bruce, SD, 605-627-5440
Somerset Well Drilling, Westover, MD, 410-651-3721
Thermal Loop, Joppa, MD 410-879-3588
Venture Drilling, Inc. Tahlequah, OK 918-456-8119
Van and Company, Duncan, OK, 580-252-2205
Virginia Energy Services, Richmond, VA, 804-358-2000
Virginia Service Co., Virginia Beach, VA , 757-468-1038
Winslow Pump & Well, Hollywood, MD, 301-373-3700
Yates & Yates, Columbia, KY 502-384-3656
Jesse Yoakum Well Drilling, Cleveland, MO, 816-899-2561

Lonnie Ball's Choice – Banking or Drilling

When Lonnie Ball received his Banking & Finance degree from Texas Tech he faced the difficult choice of making $400/month in banking or $1000/month on the seismographic rig he had worked during his summers. He chose on the rig but was drafted after nine months and was sent to serve in Viet Nam. When he returned he was home only one day when his old boss called. He had suffered a heart attack and needed someone to move his rigs "up north".

After spending six months in New York and a few more in Michigan, Lonnie told his boss he liked this kind of business. To his surprise the boss "floated a note" and Lonnie was the proud owner of the company. He returned to Michigan for three years where he met his wife, Andrea From there they moved to Kingsville, Texas and to then Bryan. In 1983, he bought a water well rig to complement his three shot hole rigs. Andrea liked politics and Lonnie liked being near an airport and Drilling Supply & Manufacturing (DSM). So in 1987 they moved to Austin, Texas. For three years Ball Drilling did cathodic protection holes, water wells, and seismograph work.

In 1990 the famous Bob Lawson, was looking for drillers to do ground loop work (and a lot of it) for the Austin Independent School District. He got Lonnie's name from DSM. Since then Lonnie has done 95% GHP work. The other 5% is either cathodic protection or a water well for a close friend. Ball Drilling consists of Lonnie, three permanent employees, two or three temporary workers, and two rigs.

People wonder why the loops in Austin are so long (~290 ft/ton). One reason is that is real hot. But another reason is that Lonnie (a maybe one or two competitors) can do about five 290 ft. holes per rig per day in the Austin chalk (medium limestone) and shale. Drilling is normally air rotary with 4-3/4 inch Chevron bits. Lonnie and his crew recently reported doing a 300 ft. hole in 48 minutes in shale in Waco. However, difficulty is greater in southwest Austin, where caverns and hard limestone are abundant. In these formations a roller cone-button bit or air hammer is required.

Continued on Page 4

Letters, Comments, Questions, & Suggestions

Is Standing Column for Me?

We are considering the installation of a Standing Column system for an office building of approximately 20,000 ft2. The attractiveness for us of this type of system is the elimination of the disposal problem associated with a standard open loop system and the reduced capital cost compared to a closed loops system. Are there any issues that require special attention for these systems?

Your application sounds as if it would fit within the range for a standing column system based on the building size. In the past these systems have been applied to small to medium size buildings, in areas where the aquifer will not produce sufficient water to use a conventional open loop system, where a competent formation (rock) permits "open hole" type well completion and where water quality is excellent.

There are a number of issues with which you should concern yourself in the process of the design. Most importantly, there are not established design criteria for these systems at this point. ASHRAE has a current research project to evaluate this but the results will not be available for some time. It may be useful to involve a designer with experience in these systems.

Use of the standing column approach does not eliminate the issue of water disposal. These systems "bleed" 10 to 15% of the circulating flow rate to maintain acceptable water temperature in the well. Some means of disposal must be identified for this flow.

Water chemistry is a key issue with these systems, particularly with respect to scaling. Most standing column systems have been installed in New England. This region has the least scaling (typically low pH, low hardness) of the entire country. As standing column systems are considered for other areas, particularly those with limestone geology and/or high hardness, the need for regular maintenance should be considered. Since standing column systems typically do not use an isolation heat exchanger, the ground water is directly used in the heat pumps. For applications characterized by high hardness (>100 ppm) and high pH (>8.0) and high cooling operating hours, it is likely that scaling of the heat pumps will occur.

Standing column systems operate at temperatures between those of open loop systems and closed loop systems. In colder climates, with low ground water temperatures, it may not be possible to incorporate a heat exchanger into these systems to isolate the groundwater from the heat pumps.

Since a small submersible well pump is used as the system circulating pump, pumping design is an important issue in SC systems. Wire-to-water efficiency of these pumps is low relative to conventional circulating pumps. As a result, system flow rate and head loss should receive careful scrutiny in the design process, particularly where the well pump supplies both the domestic needs and the heat pumps.

GSHP Chillers?

Our firm has been hired to design a system for a 60,000 ft^2 office building in New York. The owners and our firm are not comfortable with a system that has a large number of heat pumps scattered throughout the building. We would like to design a system that uses a chiller, a boiler, and a ground loop to replace the cooling tower. Can you tell us how to adapt the ground loop sizing program *GchpCalc* to accomplish this task?

A central chilled water system (CWS) is very expensive and a ground loop is also costly. The auxiliary energy consumption of a chilled water system is also very high compared to a water-to-air heat pump system. When you marry a CWS to ground source, you have a system that is more expensive and less efficient than either system in its normal configuration.

In almost all GSHP commercial applications, the heating mode operating cost is much lower than with a boiler and associated water distribution system. You have invested in the ground loop but you're only using it part-time. It would be like paying John Elway to play on your football team and then only using him to as a nose tackle when you're making a goal line stand on defense. (International units ≡ using Pele as a goal keeper when your team is down 0-3 with 10 minutes left).

Finally, the size of the ground loop is influenced by the balance of the amount of heat added to and extracted from the ground. If a boiler is used, the ground loops must be larger to compensate since none of the large amount of heat that was added to the ground in cooling is being extracted in heating.

Sludge in Our Stainers is Straining Heat Pumps

Thank you for taking the time to talk to me about the problems we are starting to experience with one of our GSHP applications here at Fort Eustis, VA. The system we have installed is a central loop system with HDPE piping exterior and Schedule 40, carbon steel and copper interior. We do have variable speed drives installed on the pumping system. The problem that we are faced with is the corrosion of the carbon steel pipe. The sludge generated from this corrosion process migrates and settles in the strainers on the individual heat pump units causing them to shut down on high head. Our mechanics have to flush out the strainers and reset the units. I do want to thank you for the information on decentralized loops and the use of HDPE piping inside buildings verses the carbon steel. It is very informative. I guess all I can do is apply this to the lessons learned column for future GSHP systems to be installed at Fort Eustis. Thanks again for your assistance.

Angela V. Peyton
Engineering & Services Division, Fort Eustis, VA

Anyone out there with any suggested solutions?

Contractors, Meetings, Publications, and Information Sources

Meetings & Seminars – 2000

May 14-17, GeoExchange Technical Conference, IGSHPA, Stillwater, OK, 800-626-4747 or ***www.igshpa.okstate.edu***

June 18-20 – BOMA Annual Convention, San Diego, 202-326-6331 or ***lbest@boma.org***

June 24-28 -- ASHRAE Annual Meeting, Minneapolis, MN, 404-636-8400. ***www.ashrae.org***

Aug. 21-23, Energy 2000, Pittsburg, 800-396-8574 or ***www.energy2000.ee.doe.gov***

Sept. 20 – One-Day Design Workshop for Engineers, Arkansas Energy Office, Little Rock, 800-558-2633

Oct. 25-27, Geothermal Heat Pump Consortium Annual 2000 Meeting, (in conjunction with the World Energy Engineering Conference), Atlanta, GA 888-255-4436 or 202-508-5500

Publications

ASHRAE (404-636-8400) web site: www.ashrae.org

"Operating Experiences with Commercial Ground-Source Heat Pumps", (Case Studies), 1998

Ground-Source Heat Pumps: Design of Geothermal Heat Pump Systems for Commercial/Institutional Buildings, 1997

Commercial/Institutional Ground-Source Heat Pump Engineering Manual, 1995

Ground Source Heat Pump Bore Field Issues & Regulations
(Symposium MN-00-02 Papers from 2000 Annual Meeting)

- Geology & the Ground Heat Exchanger
- Measurement/Validation of Conductivity Fill Materials
- Bore Field Performance of Standard & Enhanced Grout
- Regulations on Grouting for Closed Loop GCHPs in the US

GSHP Systems: The Inside –the-Building Story
(Symposium MN-00-05 Papers from 2000 Annual Meeting)

- Measure Performance of VS Pumping in GHPs and WLHPs
- Energy Use of Ventilation Air Options for GSHPs
- Life Cycle Costs of GHPs & Conventional HVAC-Nebraska
- Operational Problems of Commercial GSHP and GWHPs

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The **USGS** Ground Water Atlas of the US series. **(OL)** with text and figures. http://sr6capp.er.usgs.gov/gwa/gwa.html

(OL) = Available On-Line @ listed web site.

Outside the Loop

A Newsletter for Geothermal Heat Pump Designers and Installers

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