# GEO OUTLOOK

The Publication of the GeoExchange Industry

2004 Vol.1, No.1

## Bordertown Casino Hits the Geothermal Jackpot

Also Inside:
Hanging Judge Parker Museum
Drilling for Safety
Industry Leaders

Geo Outlook/OSU
499 Cordell South
Stillwater, OK 74078

Prsrt Std
U.S. POSTAGE PAID
Stillwater, OK
Permit No. 191

FHP MANUFACTURING

# The earth's ecosystem is in a delicate balance...

**FHP's ES Envirosaver Series is designed to help preserve this balance:**

Geothermal ready to utilize the energy of mother earth for heating and cooling.

Environmentally friendly refrigerant R-410A preserves the ozone layer and assures the availability of refrigerant for the life of your unit.

Two-stage operation for energy efficiency helps preserve our natural resources and saves you money.

A Two Stage UltraTech Scroll compressor together with an ECM blower motor result in a truly quiet unit and a greater level of comfort in your living area.

---

FHP's 30 years commitment to water source heat pumps make us your natural choice for Geothermal Systems.

Visit us at
**www.fhp-mfg.com**
for further information

## What's Good For Your Home Is Good For The Environment!

# Geo Outlook

Editor - IGSHPA
Lisa McArthur
mcarthl@okstate.edu

Editorial Director - IGSHPA
Jim Bose

Editorial Director - GHPC
Wael El-Sharif

Marketing Director - GHPC
Jack DiEnna

Art & Publication Director - IGSHPA
Jeanne Knobbe

Staff Writers - IGSHPA
Kathryn Jones
Trisha Harris

Subscriptions - IGSHPA
Sharon Trout
1-800-626-4747

Advertising - IGSHPA
Jeanne Knobbe or Kathryn Jones
1-800-626-4747

*Cover photo courtesy of Paddock Productions, Overland Park, KS.*

*Geo Outlook* is published quarterly by Oklahoma State University and the International Ground Source Heat Pump Association (IGSHPA), 499 Cordell South, Stillwater, OK 74078-8018. *Geo Outlook* is a joint venture of the Geothermal Heat Pump Consortium (GHPC) and IGSHPA. Send questions, story ideas, photos and comments to Editor, *Geo Outlook*, c/o IGSHPA, or call 800-626-4747. Visit our website at www.igshpa.okstate.edu.

Copyright 2004 by the Board of Regents for the Oklahoma State University Agricultural and Mechanical College, IGSHPA and GHPC all rights reserved.

Articles written by third parties reflect the opinions of the writer and are not necessarily the opinions or views held by GHPC, IGSHPA or Oklahoma State University (OSU). GHPC, IGSHPA and OSU make no claims to the accuracy of statements made in such articles.

# Contents

## Departments

Directors' Forum ..... 4
by Wael El-Sharif and Jim Bose

Industry Leaders ..... 7

Geothermal Incentives ..... 21

Geothermal Research ..... 24
by Trisha Swindle

Earth Insights ..... 26
by Phil Rawlings

## Features

Bordertown Bingo and Casino Hits Jackpot with Geothermal ..... 8
by Mike O'Neill

Keeping a Drilling Site Safe ..... 16
by Kathryn Jones

Fusion Class a Success at NGWA ..... 19
by Kathryn Jones

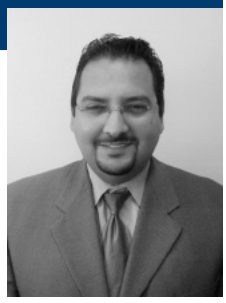
Overcoming Drilling Challenges with New Technology ..... 20
by Trisha Swindle

Museum Goes Geo ..... 22
by Trisha Swindle

# Directors' Forum

## Notes from GHPC

**By Wael El-Sharif**
**Executive Director,**
**Geothermal Heat Pump Consortium**



### Drillers, We Can't Live Without You

Where would the geothermal heat pump industry be without drillers? We certainly wouldn't have achieved the significant growth this industry has seen over the past decade without the expertise and involvement from this specialized trade group.

Be it open or closed loop systems, the drilling industry and its members who are active players in our industry are a vital part of the installation process. After all, they are our connection to the Earth - the energy source for geothermal heat pump systems.

Kevin McCray, executive director of the National Ground Water Association (NGWA), notes that more and more drillers are becoming interested in the geothermal industry. He attributes that to the increased availability of educational opportunities for drillers to learn more about how to become involved in our industry.

And getting involved can open up brand new business opportunities for drillers. Those actively working in the industry today are realizing the economic benefits. Expanding one's business line to more than just water well or oil drilling can bring more job opportunities. At larger installation sites, a driller can benefit from economies of scale by drilling multiple boreholes at the same location. Borehole drilling for geothermal systems can be less complex than water well drilling. Some drillers heavily involved in the geothermal industry see a significant increase in the amount of boreholes they produce each year, compared to water well drilling. And as geothermal sales continue to grow, more and more projects will come on line, opening up even more projects.

We at GHPC remain a strong advocate for the drilling industry. Over the course of our national and state programs, we've conducted a host of research projects aimed at advances in drilling techniques and improving borehole efficiencies. We've partnered with NGWA on creating guidelines on vertical boreholes in closed loop systems, a credible resource tool for regulatory officials as well as others involved with the construction of these types of systems. We've sponsored numerous events and hosted educational seminars, reaching out to keep the level of interest in geothermal systems high. With all of our programs, we work to promote those who maintain a high quality of work. We feel it is important to provide continued support to those drillers who have chosen to be a part of our industry.

Drillers, you are what keeps our industry growing. Thank you!

# Directors' Forum

## Notes from IGSHPA

**By Jim Bose**
**Executive Director,**
**International Ground Source Heat Pump Association**

### The Expanding Opportunities with GSHPs

I've often remarked that we probably don't know just how good the ground source heat pump technology is as an energy conserving and viable system for meeting our nations increasing energy demands. And then someone makes your day by pointing out how other technologies benefit by combining their technology with a ground source heat pump. I'm talking about a fuel cell working in combination with a ground source heat pump.

Conventional coal fired power plants deliver about 35 to 40 percent of the BTUs available in coal as electricity. The energy not converted to electricity goes up the stack or to the cooling pond/tower. Ground source heat pumps absorb more energy from the earth than is "wasted" at the power plant resulting in more heat delivered to the load than was available in the coal. Power plants with 40% efficiencies and water source heat pumps with COPs of 3.5 will yield a load to source ratio of (0.4 x 3.5) of 1.4.

Natural gas fuel cells are about 30 to 40 percent efficient. They also generate a lot of heat. Their efficiency can be significantly improved up to 75 percent (40% electricity and 35% heat) if you have some means of recovering or using the heat. The recovered heat can be used to supply heat to a water source heat pump for space heating, heating potable water or recharging the ground loop.

What the ground source heat pump technology brings to the table is the ability to use the waste heat for heating (water and/or air), to provide thermal storage in the ground heat exchanger and dissipation of excess thermal energy All of benefits make fuel cells more economically attractive. Our members benefit by having the additional business of installing fuel cells with GSHP's which represents an additional income stream.

In summary the combined systems 1) can reduce the demand on our overloaded electrical grid, 2) can result in very high overall fuel efficiencies, 3) will improve national security by having multiple distributed power sources, and 4) provide the necessary impetus on the further development of fuel cells by the Departments of Energy and Defense.

The entry of fuel cells will expand our member's opportunities for new business. The industry will need to develop design methods that take advantage of the integration of the two technologies. We will begin with awareness programs followed by training and marketing. I personally believe as others do that wind, solar, bio-mass will all be players, but ground source heat pumps in concert with these developing technologies will continue to be the energy conservation solution of choice.

Slim Jim®
THE GEO LAKE PLATE

*Introducing* the revolutionary Slim Jim® Geo Lake Plate – available nationwide, exclusively from *AWEB Supply*.

The Slim Jim® is the only simple, labor friendly alternative to polyethylene lake loops for fluid to fluid heat transfer in water cooled refrigeration and air conditioning equipment.

Simple, friendly...

## 'Pond Loop in a Package!'

- The Lake Loop that you have been waiting for!
- All stainless steel construction for years of trouble-free service
- Easy to install – saves on labor
- Easy to flush
- The Slim Jim® can handle any job size with multiple plates

The Slim Jim® family of lake plate heat exchangers...

Alan Watts

Applications include:

- Residential heating and cooling
- Commercial and Industrial heating and cooling
- Refrigeration units

Slim Jim®
THE GEO LAKE PLATE

AWEB SUPPLY

Visit the Slim Jim® online at:

www.TheSlimJim.com

Exclusively distributed by: AWEB Supply: 7350 Tom Drive, Baton Rouge, LA, 70806 Tel: (225) 928 2630

# Industry Leaders

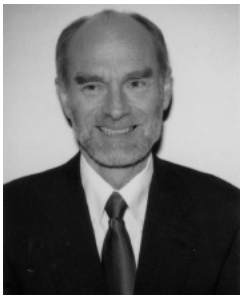
## Geothermal Heat Pump Consortium Board of Directors

John Kelly, Colorado Springs Utilities, Chairman/President
John Bailey, ClimateMaster Vice Chairman
Michael McGrath, Edison Electric Institute, Treasurer/Secretary
Lonnie Ball, Ball Drilling Company
Charlie Gloeckner, National Rural Electric Cooperative Association
James Bose, International Ground Source Heat Pump Association
Bob Hawkins, Alabama Power Company
George Head, EnLink GeoEnergy Services
Bruce Ritchey, WaterFurnace International Inc.
Phillip Schoen, Geo-Enterprises, Inc.
William Stephen Morrow, Tennessee Valley Authority
Ronald Robertson, Renaissance Energy Group
Nell Withers Thomas, Plumas-Sierra Rural Electric Cooperative

## International Ground Source Heat Pump Association Advisory Council

Phil Schoen, Geo-Enterprises, Inc. Chairman
Charles Elks, Mechanical Equipment Sales, Inc. Vice-Chairman
Larry Eitelman, Florida Heat Pump Secretary
Billy Abner, East Kentucky Power
Phil Albertson, Ditch Witch
Dan Ellis, ClimateMaster
Wael El-Sharif, GHPC
John Henrich, Bergerson-Caswell
Tim Hughes, Trane
Morris Lovett, OG&E
Pat McAllister, Performance Pipe
Chris Smith, Florida Heat Pump
Mark Sullivan, WaterFurnace International
John Turley, Middleton Group

## John Kelly



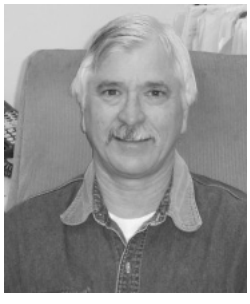
**Principal**
**The Kelly Group**
**Monument, Colorado**

John has over 20 years experience in the utility industry, including energy conservation, customer service and business development. He is currently a consultant for energy services and renewable energy. His other experience includes facilities engineering and federal government contract negotiation.

John has been on the Board of Directors of the Geothermal Heat Pump Consortium since 1997 and has been Chairman for the past two years. During that time, he has supported the development of the geothermal heat pump industry in Colorado and promoted IGSHPA training and certification in the region.

John has a degree in engineering from the U.S. Air Force Academy and a Masters in Public Administration from the University of Colorado. He is a registered professional engineer in Colorado and New Mexico.

## Phil Schoen



**President and CEO**
**Geo-Enterprises, Inc.**
**Catoosa, Oklahoma**

Phil Schoen is the president and CEO of Geo-Enterprises, Inc., a company he founded specializing in the design and application of geothermal heating and cooling systems. Mr. Schoen has worked in the GHP industry for over 26 years and has been involved in the installation of thousands of GHP systems in the United States, Bermuda, Korea and Japan. He has designed and installed many different types of ground heat exchanger piping systems, including ones used for convenience stores, US Department of Defense projects, US Embassy housing, Indian Health Services hospitals, Indian gaming casinos and many different types of school campus buildings. From the ultra luxurious lodging of Bio-Grande at the El Monte Lodge of Taos, New Mexico to the new hospital for the Pawnee Nation in Pawnee, Oklahoma and US Embassy housing in Seoul, South Korea, Geo-Enterprises, Inc. is known world wide as a premier company in the GHP industry.

# Bordertown Bingo & Casino Hits the Jackpot with Geothermal

**by Michael O'Neill**

In September 2003, as part of its 12th Annual Pow Wow, the Eastern Shawnee Tribe of Oklahoma held a grand opening for its sparkling new Bordertown Bingo & Casino. According to Chief Charles Enyart, the tribe has plenty to celebrate. "Since we opened our first bingo center in 1987, our business has continued to grow. In the '90s, we made three additions to our first building, and we were still running out of space. We brought the issue before the tribal council and the community, and they agreed that the best choice for the business and the tribe was to build a whole new facility." Situated on the Oklahoma-Missouri border near Seneca, Missouri, the new 57,000 square foot structure more than doubles the size of the original bingo hall and gaming room that it replaces.

"Our growth directly benefits the people," added Chief Enyart. "Proceeds go to support Eastern Shawnee social programs, which are among the best in Oklahoma. The money helps pay for education, healthcare, elder care, and other programs for tribal members living throughout the country. The new facility also gives us an opportunity to achieve longer-term goals, like building

*The Eastern Shawnee Tribe of Oklahoma chose geothermal for space conditioning their new 57,000 square foot casino and bingo hall. The modern facility is near the Oklahoma-Missouri border.*

# Stroke of Luck for the Drillers

All things considered, drilling and installation of the Bordertown Bingo & Casino loop field went well. The outcome could have been much different.

As any driller will tell you, it usually isn't easy to move a loop field's location after plans are set. Once drilling starts, moving the field impacts the entire project-and its costs. On their first day at Bordertown, the drilling team got lucky. At many other sites, the problem they encountered would have spelled disaster.

Because the Bordertown site was on ancestral lands settled by the Eastern Shawnee Tribe in the middle of the last century-and traversed by other Native Americans tribes for millennia before that-an archaeological survey of the site was required by law. It found a few signs of Indian presence between 7,000 and 8,000 years ago but uncovered no significant artifacts. With the survey concluded, the contractors got the go ahead to finalize plans. But in their site planning, they missed something much more obvious than long-buried artifacts.

When Doc Hawkins and his team pulled up to the site with their drilling rigs, a glance at the plan and the property revealed the problem. On the plan, the Eastern Shawnee Tribe's ceremonial Pow-Wow ring, a space dedicated exclusively to the tribe's annual gathering and celebration, was marked incorrectly. "Fortunately," said Hawkins, "there was adjacent land available, and we were able to start drilling without much delay. But if land were at a premium, well, we'd be telling a different story."

*Eastern Shawnee Tribe ceremonial dancer.*

Even the simplest change of plans will delay drilling, which in turn will impact installation of geothermal and other mechanical systems. If a more radical change is required and plans have to be redrawn, every phase of construction will be pushed back. The lesson learned: to ensure that jobs move forward smoothly, careful site planning is critical. A contingency plan "sketch" is a good bet too-if nothing else, it will make you double check your original. The one thing you don't want to count on too often is luck.

*The loop field had to be moved at the last moment due to an incorrectly marked site. The original drilling site was located on a ceremonial pow-wow ring.*

new businesses to help members become increasingly self-sufficient."

Visitors to the new Bordertown Bingo & Casino drive up under a dramatic canopy and enter into a large vestibule with gift shop, vending and sitting areas, and restrooms. They proceed down a corridor to the central atrium, 85 feet across, 40 feet high, and dominated by a waterfall cascading over natural-looking stone. Prominent in the scene are a black panther and white swan, symbolic of the Eastern Shawnee tribe's courage and dignity. From the atrium, visitors can enter the three main gaming venues-off-track betting, electronic gaming casino, and bingo hall-or the new Country Kitchen restaurant.

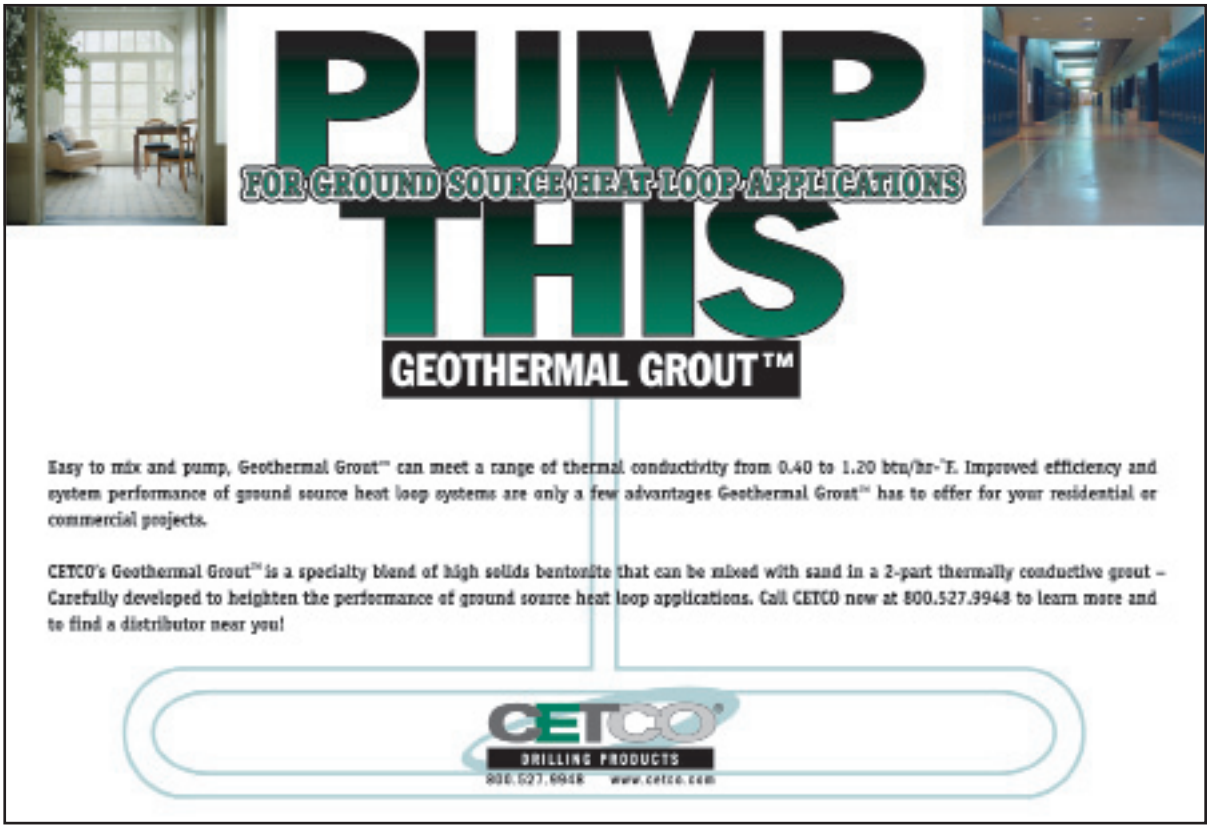
But before construction of new complex could begin, Chief Enyart, Bordertown General Manager Dan Captain, and the entire community had to address a range of challenges. Among the toughest was a high demand for clean air without the correspondingly high energy requirements. To meet this challenge, Bordertown Bingo & Casino turned to geothermal heating and cooling.

## Going Geothermal

The tribe had visionary goals when they initiated the Bordertown Bingo & Casino project. They wanted to provide visitors with a comfortable entertainment complex-the kind of place that would invite people to return again and again. They wanted a landmark building that tribal members would be proud to call their own. They wanted the facility to be environmentally and economically friendly. And most of all, they wanted to build fast to ease the overcrowding in their existing bingo and gaming hall.

At the outset, the tribe started down the traditional design-bid-build path, opening discussions with several area architects. But it quickly became apparent that the traditional route would add costs and lengthen the project by months. Looking to control time and money, Chief Enyart and the tribe turned to a general contractor they knew and trusted, Dale and Chris Marion of Branco Enterprises, Neosho, Missouri, who had constructed the gaming-room addition to the old bingo hall. Branco proposed a time-saving, money-saving alternative.

Vice president of business development Chris Mar-



*Chief Charles Enyart and Dale Marion of Branco Enterprises discuss the success of the decision to use geothermal in the new casino and bingo facility.*

ion remembered how his company got the job. "Tribal leaders set some high goals, but they also wanted to move forward as quickly as possible and keep a close eye on construction costs. After all, their ultimate aim was to provide income and employment for tribal members. Branco presented an accelerated design-build model as an alternative to design-bid-build. We were able to do this because of our trusted professional network, including architects who were prepared to continue designing after construction began, suppliers like Butler Building Systems who were ready to provide a pre-designed, partly pre-fabricated structure, and sub-contractors like Advance Climate Control who had experience handling mechanical and electrical on the accelerated design-build basis. The leaders liked what they saw, we brought the proposal before the tribal council, and we got the contract."

During planning, two related issues came to the forefront-figuring out how to bring fresh air into the indoor environment and how to keep energy costs under control. Dan Captain described the situation facing Bordertown: "As many as 1,700 people pass through our doors in a single day. About two-thirds of them are smokers. Clearing the air was the biggest challenge we put before our contractors."

Anyone who has ever visited a casino or bingo hall lacking adequate air filtration has actually seen the problem. During peak usage, a cloud of smoke hovers several feet below the ceiling. In the tribe's existing bingo room, the haze was so thick even the smokers complained. For the new facility, the tribe wanted to make sure that smokers and non-smokers alike could enjoy their gaming and breathe easy. "Our objective was to have our bingo hall occupied by 700 smokers and not see any smoke," said Captain. This requirement for fresh air at affordable rates turned the tide in favor of geothermal environmental control.

Advance Climate Control Inc. (ACCI), Neosho, Missouri, Branco's sub-contractor responsible for mechanical and electrical work, took on the challenge. Like Branco, ACCI was able to move fast by bringing together experienced partners and by making a strong case for choosing geo-

*Pipe from some of the 176 boeholes wait to be headered up.*

thermal heat exchange.

"We knew what the casino needed-heating, air conditioning, and a huge fresh air requirement," explained Chad Marion, president of ACCI-and brother to Chris. "We also knew what they expected to spend up front for conventional HVAC. But there were some critical numbers that hadn't figured into their calculations-operating costs and long-term ROI. Those numbers make the difference between conventional and geothermal."

To demonstrate the economy of geothermal before the tribal leaders, Chad worked with Philip "Doc" Hawkins, CEO and president of Ground Source Systems, Buffalo, Missouri, to develop and present two concepts-conventional and geothermal-including detailed energy audits. Assuming normal Missouri-Oklahoma weather conditions and corresponding operational costs for a standard commercial facility of 57,000 square feet, ACCI calculated that the tribe could anticipate achieving ROI on its geothermal system in just 4 years. At that time, the total cumulative cost of Bordertown's geothermal system-initial outlay for the system plus monthly energy expenses-will equal the cumulative cost for a conventional system. Thereafter, the money saved on geothermal's lower energy consumption will go directly to improving Bordertown's bottom line. With a life expectancy of 20-25 years, the geothermal system should provide this profitability boost for many years to come.

"We presented first to Chief Enyart, Danny Captain, and members of the Council and then to the community as a whole," said Marion. "When they realized how fast they would see payback on their geothermal system and reduce environmental impact at the same time, the decision was easy."

*Extensive ductwork layout was installed to get adequate air quality.*

## Installation and Operation

On the job, ACCI took responsibility for everything mechanical and electrical, including the geothermal system. Said general contractor Chris Marion, "There aren't a whole lot of companies that are knowledgeable about geothermal. And no one has ACCI's ability to manage every phase of the project and deliver a quality product at a competitive price."

Headed up by ACCI's Chad Marion, the geothermal team included Doc Hawkins, drilling and installation contractor who also assisted with system design; Russ Martin, president of Energy Engineering Inc. for mechanical, electrical, and plumbing engineering; and Phil Schoen, president and CEO of Geo-Enterprises Inc., who consulted with Energy Engineering and furnished the heat pump system. "The Bordertown job was a total team effort and took a tremendous amount of coordination," said Marion. "But we've worked together on many geothermal projects at schools, churches, offices, and residential sites."

Like all geothermal systems, Bordertown Bingo & Casino's begins under ground, in the loop field. Drilling and loop field installation went almost without a hitch, said Doc Hawkins. "We drilled 176 total bore holes-

eight rows of 22-spaced 20 feet on center, to a depth of 280 feet. Altogether we installed over 20 miles of pipe. Even when we relocated the loop field away from the tribe's ceremonial ring (see the side story, "Stroke of Luck for the Drillers"on page 9), we were still less than 150 feet from the mechanical room inside the casino."

The installation as a whole follows standard design. From the end of the loop field, the header lines feed into a central manifold. Each line has a separate valve to isolate it from the others, allowing maintenance on any single loop without impacting the others. A 25 horsepower, 1000 gallon per minute pump, housed in the mechanical room inside the casino, circulates water from the loop field throughout the building and returns it to the loop field.

Inside the building, 35 Florida Heat Pump systems suspended between roof and ceilings deliver heat and air conditioning when and where they're needed. Because demand varies among the 5 main public spaces as well as the offices that occupy smaller areas on the first and second floors, the Bordertown system also makes use of geothermal's loop diversification. Instead of having to purchase additional electricity to heat one part of the building when another is being cooled, loop diversification enables a simple trade of BTUs from one zone to another. The system has been online since July 1 and is meeting expectations. Said Dan Captain, "Our utility bills are right in line with the computer model Chad and Doc provided."

## Clearing the Air

Not every building is the same, of course, and not every user of geothermal can expect to break even in just four years. It was Bordertown's "smoker-friendly" indoor environment and the need to refresh the interior environment-shared by casinos and bingo centers everywhere-that accelerated return on the geothermal investment. The system at Bordertown does more than just cool and heat the building; it's a critical component in a cost-effective, high-performance air quality system.

Cleaning the air is no small feat. The total volume of air in the entire complex-nearly a million cubic feet-is filtered 12 to 15 times per hour, or about 300 times per day. ACCI employed three technologies in concert

In the Eastern Shawnee Tribe Logo, the panther, swan, and spear symbolize the tribe's courage, dignity, and commitment to defend the country at all costs. The panther and swan also have a prominent place on the Bordertown Bingo & Casino atrium waterfall scene.

to overcome the number one challenge at Bordertown-a state-of-the-art air filtration system to do the heavy cleaning, plus an energy recovery ventilator and the geothermal system to make air exchange economically feasible. Throughout the rooms where smoking is permitted-off-track betting, gaming casino, and bingo center-Cosatron RV4000 filtration units effectively knock the smoke out of the air by giving incoming air a 20,000 volt electrical jolt. Once electrically charged, microscopic particles in the air attract other particles to form larger particles, making filtration easier and more efficient. The units remove over 95 percent of smoke and other particles. With the Cosatron system, the facility achieves its goal: even when smoking areas are packed full, there is no visible smoke, and the air is virtually odor-free.

While filtration minimizes the need for outside air, there is a continued requirement to bring in fresh air from outside. In winter, the air needs to be warmed; in summer, it needs to be cooled. It is this introduction of exterior air that increases energy demand and multiplies the operational costs of conventional systems. At Bordertown, ACCI installed Loren Cook energy recovery ventilators (ERVs) and the Florida Heat Pump systems to minimize energy loss. An ERV, with a dessicant recovery wheel, is designed to transfer heat, or BTUs, from warmer to cooler air. If outgoing room air is warm relative to the outside air, the ERV transfers its stored energy to heat the incoming air. If the outgoing air is cooler, the ERV transfers energy from the warmer incoming air, effectively reducing its temperature. The geothermal system provides final temperature adjustments to all fresh air introduced into the complex at a far lower cost than conventional systems.

"All three systems are critical to keeping Bordertown's air clean and comfortable," concluded Marion. "Working together, they provide the best possible air quality at the lowest possible cost." Dan Captain couldn't agree more: "We're moving air, evacuating the smoke from the building, and saving money in the process."

*Keeping the air filtered and smoke-free was a key point in using geothermal.*

Plus, there's a real possibility that Bordertown Bingo & Casino can achieve ROI even faster than the four years anticipated in Chad and Doc's model, assuming business continues to boom. As the facility gets busier, not only will Bordertown see higher revenues, they will save even more on energy output.

For Chad Marion, it was rewarding to work with Chief Enyart, Dan Captain, and the tribe in making the move to geothermal: "Not everyone has their vision. On projects like this with high energy demands, my trade is the only one that can put you out of business with operating costs-or save you money. For Bordertown, geothermal makes a big difference." Chief Enyart concurred, "With the help of Chris, Chad, and geothermal, we're finding better ways to reach our ultimate goal and provide for the well-being of the tribe."

◆

*Michael O'Neill is principal of O'Neill Marketing Communications in Stillwater, Oklahoma.*

*Photographs courtesy of the Eastern Shawnee Tribe, Paddock Productions and Advanced Climate Control.*

## Contributing Parties

- Branco Enterprises - General Contractor
  www.branco.com
- Advance Climate Control Inc. - Mechanical, electrical contractor
  www.acc-inc.net
- Ground Source Systems - Drilling contractor
- GeoEnterprises - Heat pump supplier/ contractor
  www.geo-enterprises.com
- Energy Engineering Inc. - Engineering

### Web Sites of Interest

- Florida Heat Pump Systems
  www.fhp-mfg.com
- Cosatron air filtration
  www.cosatron.com
- Loren Cook energy recovery ventilators
  www.lorencook.com
- Butler Building Systems
  www.butlermfg.com

# Keeping a Drilling Site Safe

**By Kathryn Jones**

It was time to collect soil samples from the drilling site. The three men doing geothermal engineering core sampling used a rig with a 22-foot high tower. As they removed the sampling rod, it struck a 4,160-volt electrical power line directly above the work area. One employee was lucky - he was only severely shocked while handling the sampling rod. The other two men were not as fortunate. The employee handling the sampling rod and the employee handling a guy wire attached to the sampling rod were both electrocuted.

The Occupational Safety and Health Administration (OSHA) inspected this accident and found that if their construction safety standards had been followed regarding working to close to power lines, this accident may have been prevented. However, drilling projects where overhead power lines are involved can be one of the most difficult projects to do safely, according to Jack Henrich of Bergerson - Caswell, Inc., and Wesley Weed of the George E. Failing Company.

While following OSHA guidelines for keeping a drilling site safe are a very important part of any geothermal project, many factors affect the safety of a drilling site and being proactive in preventing accidents is necessary. Sometimes this is achieved by providing employees with proper training classes. In a letter from Gerald F. Scannell of OSHA to former U.S. Representative Joseph E. Brennan (D.-Maine), Scannell said that in addition to requiring appropriate machine guarding, OSHA also requires employers to train employees to recognize and avoid hazards. The letter goes on to say that due to the wide variety of drilling equipment available, it would be difficult to develop specific safety standards for every responsibility to protect employees from hazards. Therefore, it is recommended that drillers take refresher courses periodically and review the operation manual for their equipment as needed.

One way Charles Machine Works, Inc. / Ditch Witch is preventing accidents on the drilling site is by using a directional boring simulator in their training classes, said Ditch Witch's Phil Albertson. He said that using this computer program instead of going into the field and setting up a demonstration bore is safer on equipment and on the driller. "I learned to fly an airplane in the Air Force after going through a project that taught pilots how to fly in a simulator," Albertson said. "This is the same kind of thing."

After drillers have been properly trained to work on a drilling site, it is their responsibility to remember to be safe on the job. Steve White of Standard Pipe said there are many times when drillers stop paying attention to the job at hand. He added that drillers sometimes forget that they are working around life-threatening equipment. "You get comfortable around a site and become immune to what's going on around you," White said. "You start forgetting, and you can get a little careless."

Phil Albertson added that Ditch Witch has produced several videos about how to stay safe on a drilling site. A common hazard of electrical circuits above or below ground is addressed in Ditch Witch's video, "Trenchers: Stay Alert - Stay Alive." It says that once the local one-call service has determined where buried power lines are located, the entire crew should be informed about what was found. This way no one is confused or ill-informed

*Courtesy of Denyse Burkhart, Burkhart Photography*

when drilling begins.

Ditch Witch's directional boring safety video says that even if the crew is told that there are no buried power lines in the area, wearing electrical strike protection equipment is always recommended. The video adds that if a strike should occur, the crew should stay where they are and warn others to stay clear also. The video recommends calling the power company for additional assistance.

Electrical lines aren't the only things affecting the safety of a drilling site. Naturally occurring conditions, as well as the personal lives of the drillers, can impact the safety of a site. Bill VanAlstine of Van & Co. said that it is very possible for drillers to hit natural gas pockets also, which in turn cause explosions. Companies may also frequently use random drug testing as a preventative measure to ensure the safety of their employees and work sites. Drilling in certain kinds of soil can also be hazardous, Henrich said. Drillers need to keep the rig from settling in the soil and tipping over. Also, especially in soft soil, the trench can cave in and carry on-lookers into the digging chain.

Courtesy of IGSHPA

*Roping off the drilling site prior to drilling is essential in maintaining safety among the drilling crew.*

Individual companies involved in the drilling aspect of the industry work to comply with OSHA safety regulations to maintain employee safety. White said, "Standard Pipe is a company that emphasizes safety above all else. If a company makes money on a project but they lose an employee on the job site, they have to stop and ask themselves, 'Was it worth it?'."


IGSHPA
Accredited Installer
Workshops
Stillwater, OK

April 24-27, 2004
August 25-27, 2004
October 6-8, 2004

For more information call
1-800-6626-4747
or visit our web site
www.igshpa.okstate.edu

GEO-FLO

www.geo-flo.com
905 Williams Park Dr.
Bedford, IN 47421
1-800-784-8069

# Fusion Class a Success at NGWA

**by Kathryn Jones**

The National Ground Water Association's 2003 Ground Water Expo held December 10, 2003, through December 12, 2003, was attended by nearly 3,700 people, which included contractors, suppliers, manufacturers and engineers, according to Kathy Butcher, director of professional development for NGWA. This expo was an opportunity for ground water professionals to showcase their new equipment on the exhibit floor, hear lectures and addresses from experts in the industry, and advance their careers with a full schedule of educational opportunities.

One educational opportunity that NGWA and The International Ground Source Heat Pump Association offered on December 11 was a fusion training and demonstration class titled "Good Fusion Techniques Made Simple." Tracey Temcoff, ISCO Industries; Steve White, Standard Pipe; David McCool, Geothermal Supply Co. Inc.; and Gary Brazaille, Performance Pipe, demonstrated that good pipe fusion accreditation increases the kinds of pipe that the installer can work with, the types of projects that they can do, and what makes them more qualified than other installers. Taught by Gary Brazaille of Performance Pipe, the classroom-setup included a video, a team discussion session, and a hands-on instruction session. After completing a successful pipe fusion and accreditation test, the participants were give pipe fusion accreditation from pipe manufacturers and representatives, which included Performance Pipe, Geothermal Supply Co. Inc., Standard Pipe and ISCO Industries.

Courtesy of IGSHPA

*During the NGWA conference, Tracey Temcoff of ISCO Industries demonstrates the use of fusion equipment.*

Courtesy of IGSHPA

*Steve White of Standard Pipe shows students some of the equipment used in fusion.*

Pipe fusion accreditation counted as continuing education units for both NGWA and IGSHPA. Participants were also given a 10 percent discount on the April 24 - 27, 2004, Accredited Installer class that will be held in conjunction with the 2004 IGSHPA Technical Conference and Expo.

For more information on the NGWA conference, visit www.ngwa.org.

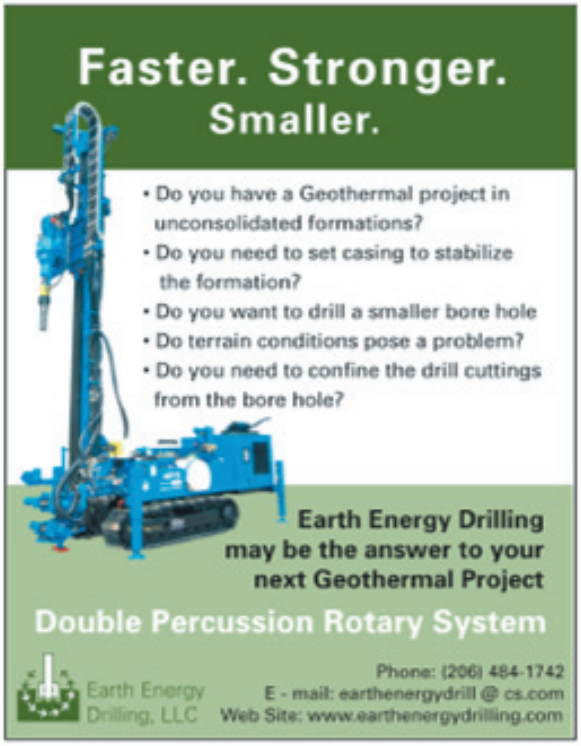
# Overcoming Drilling Challenges with New Technology

**by Trisha Swindle**

The geology of a site can make or break a geothermal project. If unknown geological conditions are encountered during the drilling of a project, they can cause difficulties that may lead to the project having to be abandoned. One of our own has found one answer to this problem. Alan Zdunich of Earth Energy Drilling (EED) has developed a double percussion rotary drill that is reported to overcome the challenges of unknown geological conditions.

After attempting to get a U. S. manufacturer to help design and build Mr. Zdunich's idea for this drill, he turned to a European engineering company. Together they developed the HBR 205 GT—double percussion rotary drill. The drill allows for simultaneous drilling and casing in overburdened situations. Under reamers, ring bits and drilling fluids are not necessary because rotary percussion, an energy application used for advancing casing, is applied to the casing while both the drill string and the casing are rotating.

Mr. Zdunich's company Earth Energy Drilling has had great success with using this drill in several projects. Last summer they completed a project for Linn Marr High School in Cedar Rapids, Iowa. The hole was 205 feet deep, 4 1/8 inches in diameter while the loop size was 3/4 inch. Some of the challenging geological formations encountered were sand, clay, void zones (2 feet to 27 feet), fractured limestone and water bearing zones. Casings were set between 60 feet and 110 feet. Their current project, the Chillicothe Library in Chillicothe, Illinois, will be completed before February 2004. The hole depth is 205 feet, diameter 4 1/8 inches and the loop size 1 inch. More challenging geological formations were encountered at this site including clay, sand, gravel, water gravel zones and shale. Casings were set to 130 feet. According to Mr. Zdunich had they not used the HBR 205 GT this site could not have been drilled due to the ground conditions. Had a regular drill been used the hole may have refilled itself. By using his company's drill, Mr. Zdunich was able to place casings



# Geothermal Incentives

*Geo Outlook* will be including in each issue a segment explaining a few states incentive programs and where to gain access to them.

## Arkansas/Missouri Incentive Programs

The Mainstay Energy Rewards Program-Green Tag Purchase is the incentive program for both states. This company purchases the environmental certificates a.k.a. Green Tags from individual and commercial installations. Most small and medium installations do not produce enough green tags to be traded on markets. By selling your green tags to Mainstay, small and medium installations can be grouped together and sold as a whole to municipalities and corporations. Mainstay then pays you a regular, recurring payment that can be used to offset the expense of installation of your system.

To find out more information about this program and its requirements please visit their website at www.mainstayenergy.com ◆

while drilling thus maintaining the integrity of the hole without fear of refilling. According to Mr. Zdunich, customers such as the Library would have been forced to rely on traditional heating and cooling methods had this drill not been available.

For the driller, bidding on a project without knowing the geology can make or break the job. There is always the chance of encountering gravel, sand, boulders or lost circulation. With the new rig, the driller could look at the number and depth of holes of the project and feel comfortable with their production. He could minimize the risks associated with turnkey projects and assume any risks associated with the job, including unknown geology. According to Mr. Zdunich, holes can be drilled on location to the depth required using this drill.

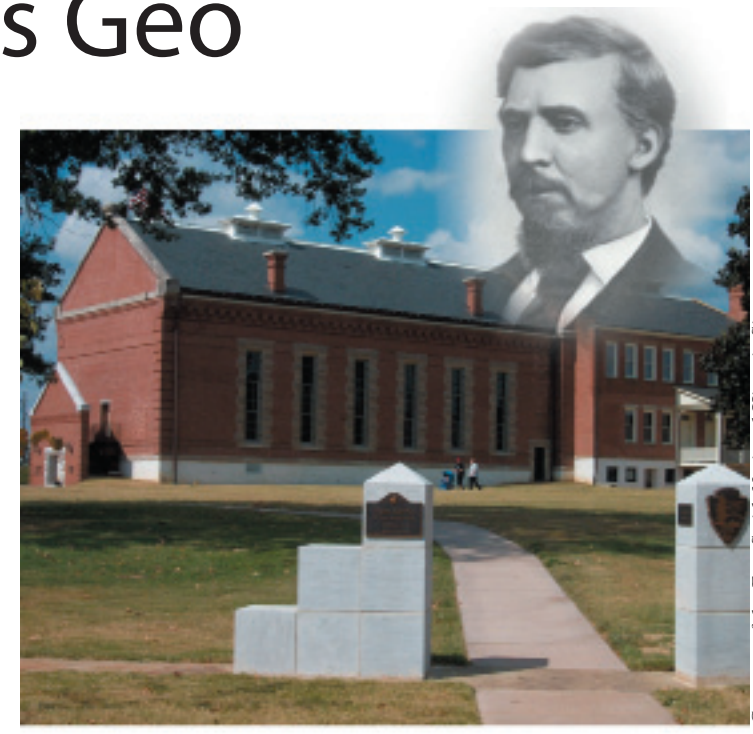
The new drill is reported to save the customer money in time and clean up. The HBR 205 GT eliminates geology as the deciding factor in projects, according to Mr. Zdunich. EED maintains the drill can drill holes to depth, produce daily production levels and drill a smaller hole. Less grout is used with this machine and there is less clean up of drill cuttings. All of these factors could contribute to finishing a project on time. Along with benefits to the customer, site clean up methods are reported to help the environment. Drill cuttings travel up the annulus of the casing to a discharge head and into a cyclone, a round tub. The cyclone can be placed over a dumpster or other container, the cuttings collected, then easily removed from the project location.

Along with using this new technology on difficult projects, Earth Energy Drilling has been demonstrating its abilities to interested parties. In March, 2003 they traveled to Alcoa and Gatlinburg, Tennessee to demonstrate double percussion rotary drilling. The Alcoa test project was a 300 feet, 4 inch diameter hold, installing a 1 inch loop. Casing was set at 50 feet to stabilize the formation, which consisted of clays, voids and water zones. Approximately 80 people consisting of drillers, engineers and Tennessee Valley Authority (TVA) managers, gathered for the catered barbeque. The TVA sponsored this event for the drilling and grouting of the test holes. The second test hole was for the United States Forestry Service at Gatlinburg, Tennessee. EED drilled to 300 feet, with a 1 inch loop. Casing was set to 120 feet to stabilize the formation, which consisted of rock slide, boulders to a diameter of 5 feet—130 to 300 feet of this was limestone. Both test sites were a success and Earth Energy Drilling plans to have further demonstrations in the future.

The geothermal industry continues to benefit from new technology, including the HBR 205 GT double percussion rotary drill. According to Mr. Zdunich, drilling jobs that in the past have had to be abandoned or expensive methods employed in order to be finished can now be completed. Mr. Zdunich has a fitting drilling motto: "Sometimes the only way out of a job, is to drill your way out." ◆

# Museum Goes Geo

**by Trisha Swindle**



Courtesy of the Fort Smith National Historic Site

*The Fort Smith National Historic Site in Fort Smith, Arkansas houses the Judge Isaac Parker Museum.*

What do "Hanging Judge Parker" and the IGSPHA 2004 Technical Conference "Geothermal Round-up" have in common? Geothermal energy of course! In July of 1999 the Fort Smith National Historic Site in Fort Smith, Arkansas, found it was time to make some changes in regards to the heating and cooling of the historic building that houses the museum. According to Bill Black, the museum curator, "the Visitor Center is made up of the former barracks/courthouse and jail. The barracks part of the building dates from the 1840's and the newer jail wing were built during the 1890's." As with any historic building, great care has to be taken when deciding what sort of heating and cooling system will be installed, so geothermal was a natural choice.

This museum is managed through the National Parks Service. As with some of the nation's armed forces base housing, NPS museums are encouraged to seek alternative energy sources. In this case a geothermal system was chosen, "to preserve the historical look of the buildings and grounds by not having any external HVAC systems, and the long term cost efficiency of the units." The historical buildings that museums are frequently housed in, as well as the delicate contents they contain, benefit by the use of geothermal systems due to the ease in which they can maintain the temperature and humidity levels. Mr. Black felt that this type of system was well suited to historical buildings because, "we no longer have window air conditioners or open flame gas furnaces in a historical building, it is now all electric with no visual intrusions on the historic scene. ...we are able to heat and cool the building very economically with this system saving the park's annual budget for other priorities."

The building's vertical geothermal system was designed and installed by a group of dedicated workers. The general contractor on this site was Crawford Construction, the mechanical contractor was Chamberlain Mechanical and the mechanical/electrical consulting engineer was Thomas Electric-Johnson Control, Harrison Trance. The 74.5 ton system has 32 boreholes at 400 feet deep. The twelve units were purchased from Trane. The complete cost for this system was $450,000. This 18,000 sq ft building maintains a staff of eight while seeing up to 50,000 visitors annually. Annually this building uses 344,640 kilowatts on energy to maintain the building including exterior lights. The annual energy costs are $17,131 and a $2,875 maintenance contract is paid annually. The museum is excited about saving money on energy costs as they can use them for other needs.

Some difficulties did arise with this system but they were quickly rectified. Two leaky welds in the lateral trench lines were discovered soon after the installation.

They were immediately fixed under warranty by the contractor. Occasionally during the year the museum has difficulty maintaining a comfortable temperature. The climate in the Midwest is subject to extreme and unpredictable temperature fluctuations especially during the spring and fall. This can make maintaining a comfortable indoor temperature challenging due to the time it takes to cool or heat a building regardless of the system used. Overall the building's staff has been happy with their geothermal system.

Courtesy of the Fort Smith National Historic Site

*The Museum's geothermal unit was supplied by Trane.*

Judge Isaac C. Parker was on the bench of the U.S. Court for the Western District of Arkansas during the late 1800's. He sentenced 160 people to be hanged during his 21 years of service earning the nickname of "Hanging Judge Parker". Much like some of the common misperceptions of geothermal units, Judge Isaac Parker is sometimes misrepresented—remembered more for his notoriety as a "Hanging Judge" than the justice he strived to achieve in his court. The Fort Smith National Historic Site strives to educate the public as to the great strides this man took in the name of the United States Justice System just as the geothermal industry uses such forums as the IGSPHA Technical Conference to further educate and inform. Case studies as the Fort Smith National Historic Site will be discussed at the 2004 IGSPHA Technical Conference "Geo Round-up." ◆

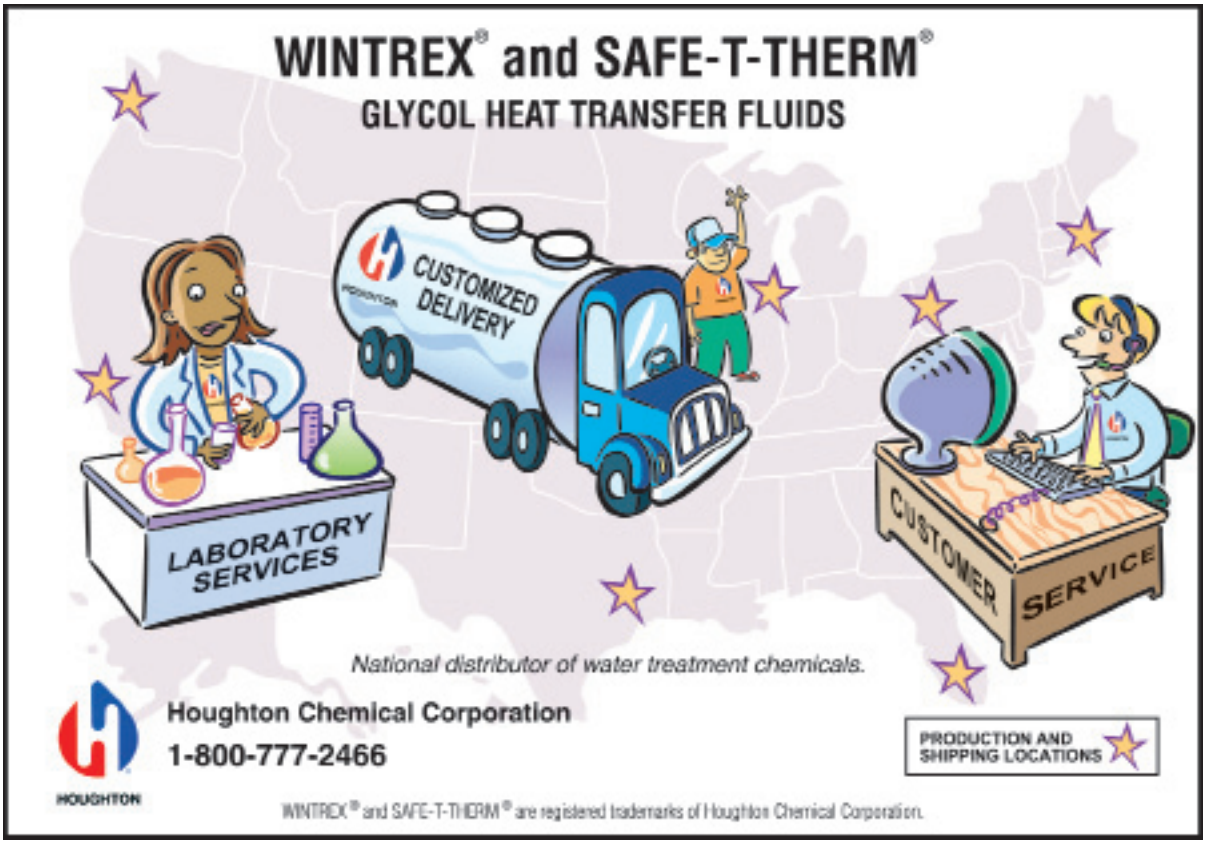
# Lab Will Be First One in Nation

**By Trisha Swindle**

In December of 2002 construction began on Oklahoma State University's Hybrid Ground Source Heat Pump Lab-the only one in the nation. According to their website at www.hvac.okstate.edu, "This facility, will be used to develop hybrid ground source control strategies and validate hybrid ground source heat pump (HGSHP) models for simulation programs." The hybrid heat pump system is being built to simulate normal operating conditions in order to validate a more efficient and environmentally friendly way to heat and cool small and medium-sized buildings. This system is beneficial for buildings where the cooling loads are larger than the heating loads. A benefit is the possible decrease in the initial costs compared to conventional ground source heat pump systems. This project will aid contractors and engineers in educating the public of the benefits of using geothermal energy in their homes and businesses.

"It is the first one," said Shawn Hern, mechanical engineering graduate student. "We are going to do an entire system simulation model because that's never been done before. Previous research has only validated certain models but not the entire system combination." Hern, who is helping build the facility, also mentioned that the research is pushing for low energy costs and low energy buildings. It will save energy and money at the same time. The facility, which is located about half a mile northwest of OSU, will be finished by the end of March. The entire project is being funded by a $750,000 grant from the Department of Energy.

When compared to the conventional chiller/



Courtesy of the O'Collegian

*Copper pipes line a building in OSU's new Hybrid Ground Source Heat Pump Lab.*

boiler systems found in most buildings, new systems may save 30 to 50 percent annually on electricity costs. Lower energy consumptions mean less carbon emissions and less pollution in general. "In the big picture, the hybrid systems will save energy," said Dr. Jeffery Spitler, professor of mechanical and aerospace engineering. "It's an innovative way for doing it, and it's very environmentally friendly."

The system consists of a ground-loop exchanger (GLHE) featuring a load and a plant side. The plant side includes a building with two ground source heat pumps-one hot and one cold, a GLHE, a pond coil and a cooling tower/plate heat exchanger. These have all been installed but the instrumentation awaits calibration. These components have been installed to allow for testing various combinations between the GLHE, pond coil and cooling tower. The load side consists of a building used in a previous research project. Three different space conditioning schemes, a radiant floor, radiant ceiling panels, and a forced convection system are being installed in this building. In a radiant system, water is circulated through each component and energy is radiated only around occupants and surfaces. These components help the building save energy by not allowing the unused space to be conditioned. The radiant floor and radiant ceiling panels have been installed but need to be calibrated.

Dr. Dan Fisher, assistant professor of mechanical and aerospace engineering is collaborating with seven other institutions in developing the Building Energy Analysis software that will design hybrid systems and do performance evaluations of systems. According to Dr. Fisher this software will perform two main tasks in regards to geothermal. First, it will help design the hybrid systems. Secondly, it can be used by the industry to help convince commercial and residential owners to use geothermal energy. The software can be used to create the design of the building and then show the owner the energy output of the building using a geothermal system vs. a traditional heating and cooling system. Then the consumer can be shown the money savings they will have using the geothermal system.

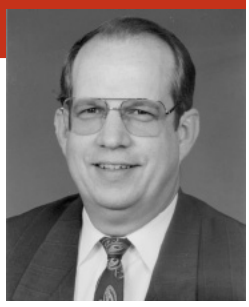
The system works best if it is balanced and rejects equal amounts of what it extracts, Dr. Spitler said. "The hybrid system allows balance by transferring excess heat in the winter to balance it over the year," he said. "Then you can transfer heat when it's coldest and most efficient to do so." With the help of better software, buildings can be optimally designed in the beginning to be more efficient. Another benefit of the hybrid over the conventional system is that it is easier to fix if something goes wrong. He said local talent could fix these systems because they don't require a sophisticated technician.

The idea of the hybrid system came about when OSU professors in the department Mechanical and Aerospace Engineering and the Division of Engineering Technology found many commercial systems rejected a lot more heat than they extracted from the ground. "We're hoping more people will implement these systems," Spitler said. "We're hoping to further our design tools and to spread knowledge." The staff at IGSPHA is very excited that this lab is here at Oklahoma State University and will be completed in time for this year's Technical Conference in April 2004. Dr. Fisher will be speaking at the conference and tours of the lab will be available during the conference as well.

◆

*O'Collegian Article Referenced written by Jessica Pilkington*

# Earth Insights



By Phil Rawlings

If you have a question about geothermal installation, design or troubleshooting, send it to Phil Rawlings in care of *Geo Outlook*, Oklahoma State University, 499 Cordell South, Stillwater, OK 74078 or via e-mail to insight@igshpa.okstate.edu.

**Can standing column wells be used in all parts of the country?**

Standing column wells are basically constructed in the same manner as a water well. However, this technology can only be used in areas where natural conditions fill the majority of the well with standing water. For example, if a well is 500 feet deep and has 450 feet of standing water, it would be suitable for a standing column well. If it had 100 feet of standing water, it would not be suitable.

**Are there rule-of-thumb guidelines for standing column wells?**

Standing column wells are open to the aquifer but still use a design criteria that is clearly defined. The results of using "rule-of-thumb" with a standing column well are going to be the same as using them for vertical closed loop system design - you are increasing the possibility for error. That said, some basic guidelines are:

- Required depth without bleed is typically 80-120 feet per nominal ton.
- Bleed (discharging some portion of the water elsewhere) rates are typically 10-30% and may reduce depth per nominal ton significantly but in a non-linear fashion.
- The well should require no more than 200 feet of casing prior to reaching rock formations - otherwise casing related costs will make the application not be cost effective.
- Well production must be sufficient to fill the well column to a stable, shallow static water level.
- If the static water level is 150 feet or deeper, use as a standing column well is not recommended.
- If bleed is used, well production must be equal to or greater than the amount of bleed discharge.
- A standing column well may be used as a water source for the building if production is equal to or greater than the building and bleed requirements. Use as a supply well actually enhances the performance of the standing column well system by moderating supply water temperatures.

**Do supply and return header pipes need to be separated on ground heat exchangers?**

Typically, all supply piping is run together, and all return piping is run together. The supply and return piping is usually separated in the trench or in two trenches. On smaller residential trenches, the single supply and return lines are on opposite sides of a wide trench separated by 2 feet in a narrow (chain trencher) trench – piping from the heat pump to the loop field is shallow, pipe returning to the heat pump is deep.

*Mr. Rawlings has over twenty-five years experience in the geothermal industry. He is a Certified Geoexchange Designer (CGD) and an IGSHPA Accredited Installer and Trainer.*

# IGSHPA Technical Conference and Expo

## April 26-28, 2004 • Stillwater, Oklahoma

Pre-Conference Workshops - April 24-27

- Certified GeoExchange Designer
- Accredited Installer Training

Conference Features:

- Drillers' Rodeo
- Marketing Seminar
- Software Demonstrations
- Drillers' Roundtable
- Innovative Products
- School Superintendents Symposium

For more information or to register visit our web site at:
www.igshpa.okstate.edu
or call
1-800-626-4747

Sponsored by:

ClimateMaster • Geo-Flo • Trane

WaterFurnace • Geo-Enterprises • Florida Heat Pump
OG&E • Earth Energy Technology & Supply • Palmer Bit Co.

...because this home has a state-of-the-art **WaterFurnace geothermal** system. There's **no flame** from burning fossil fuels and **no danger** of carbon monoxide. **No annoying blast of cold air** as with ordinary furnaces. And **no high energy bills,** because a **WaterFurnace** system can save up to 60 percent in annual heating and cooling costs. WaterFurnace geothermal heating and cooling: **A lot more** than meets the eye.

**Visit waterfurnace.com or call 800-GEO-SAVE for more information.**

WaterFurnace®