GEO OUTLOOK

The Publication of the GeoExchange Industry

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Keeping Patients Comfortable

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Directors' Forum

Notes from GHPC

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

Monthly energy bills are continuing to rise nationwide, imposing financial burdens in every market, particularly the commercial and public building sectors. The time to focus on energy efficiency and to invest in a permanent, sustainable solution is now. Since every state has different needs, state-level programs are smart and economical solutions for addressing local issues.

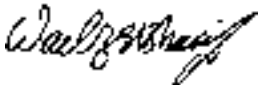
As you know, the GHPC is dedicated to promoting widespread adoption of geoexchange. We do this on national and state levels and have had positive results in both. We join our industry in actively providing states with the tailored assistance that is needed to fully promote geoexchange alongside other cost effective energy efficient options. We are proud to report that our programs have created long-lasting successes in numerous states.

Geoexchange can provide a whole host of benefits on its own. However, when coupled with other technologies, we can provide commercial and public buildings with even more sought-after environmental benefits, energy efficiency and economic savings. An example of the success that we are realizing with this approach is in the Illinois Department of Commerce and Economic Opportunity's Small Business $mart Energy Program.

As part of this program, we have helped develop a Smart Energy Design Assistance Center (www.sedac.org). This center is located at the University of Illinois at Urbana-Champaign and is dedicated to encouraging building owners in Illinois to incorporate meaningful, sustainable building goals early in the building design process. This is accomplished through detailed design assistance offered to area businesses, recommending specific energy conservation measures that will work well inside each participant's building. This assistance includes an analysis of all major building components, including the building envelope, lighting, and HVAC systems. Today in Illinois, geoexchange is included in every analysis, and when coupled with other measures, the savings for the system are even better.

If every state worked toward building a program like Illinois', the national benefits would be tremendous. Illinois' Governor has even released a sustainable energy plan that far exceeds the national energy efficiency and renewable portfolio standards. However, even small investments towards each state's renewable future are helpful. There are other wonderful examples of how state governments can make simple changes to accommodate great feats: the introduction of geothermal heat pump grant programs like Senator Teitelbaum's proposed senate bill in Maryland, Oklahoma's dedication to promoting the use of geothermal heat pumps, or New York's consistent efforts to help green building practices flourish.

We, as an industry, benefit from these sorts of forward-thinking movements. When we work in our backyard to make our local areas a better place, we help our nation move toward a more energy efficient tomorrow. Geoexchange is, and always should be, considered for every sustainable building package. If we can maintain our proactive momentum toward including ourselves in these whole building projects, we can continue to grow our market share, which will undoubtedly benefit not only our industry, but also our great nation for generations to come.



Directors' Forum

Notes from IGSHPA

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

Why does an industry grow? It grows because there is a need to be filled. Today, ground source heat pump systems (GSHPs) can fill many needs facing city, county and federal officials worldwide. Budget shortfalls, rising gas prices and clean-air policies are just a few of the considerations that public representatives need to contemplate in approaching the retrofit of an existing structure or the construction of a new facility in regard to HVAC installation. There is no other industry that can have the immediate impact in every one of these areas that GSHPs can.

As an industry, we must help public officials envision a longer range plan and become energy leaders in their communities instead of using the same assembly-line formula for their HVAC needs. Show them how they can save their citizens money, raise revenue for possible expansion and conserve resources for future generations. Help them visualize their communities as models of fiscal and environmental responsibility. Those who serve the public are keenly aware of how their use of public funds will be scrutinized. Since documentation to support GSHPs as a choice is readily available, it is easy to bolster the case for its use.

The Citizen Potawatomi Nation in Oklahoma is an excellent example of a forward thinking approach to energy. They have developed an energy plan with a goal towards energy sustainability for their long-term tribal needs. Their plan includes the use of GSHPs. The tribal leaders recognized the benefits of the technology and have embraced it wholeheartedly.

Municipalities that are in the business of power generation can become real players in the energy game. If our industry helps community leaders see the advantage of developing and implementing aggressive energy plans that employ GSHPs, everyone wins. We can help them recognize the benefits of reducing peak load demands from commercial and residential structures in their service area. At the same time, they will see how they can save enough energy to sell it to outside customers at a higher rate.

The potential for GSHPs in government and public facilities is unlimited. The second 2005 issue of the *Geo Outlook* presents just a few excellent examples of GSHP applications already installed in these types of buildings. In jobs like Nebraska's Haverhill Library with their rare book collection or Charleston, South Carolina's historic City Hall, built in 1801, GSHP technology has stepped up to the performance plate.

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Chris Smith

Vice President
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Chris Smith is Vice President of Sales & Marketing for FHP Manufacturing Co. (Florida Heat Pump). He has been involved in the water source and geo-thermal industry since 1967. Prior to helping start FHP in 1970, he was with Climate Master Products. He graduated with a B.S. degree in Business Administration from Florida Atlantic University in 1969. He was past Chairman of IGSHPA from 1995 -1997, Vice Chairman prior to that and is currently on the board for the Geothermal Heat Pump Consortium.

Mark Sullivan

National Sales Manager
WaterFurnace International

Mark Sullivan is the national sales manager for WaterFurnace International Distributor Operations. Sullivan is a graduate of Oklahoma State University. He has been selling geo systems since 1990, and he has conducted dozens of Geothermal Sales Training seminars for WaterFurnace territory managers, independent HVAC contractors and distributors. Sullivan has also hosted scores of 'Geothermal 101' type seminars for homeowners and building owners. He currently serves on the IGSHPA Advisory Council and has done so since 1999. Sullivan served on the HVAC Advisory Boards for both Canadian Valley Vo-Tech and Oklahoma State University-Oklahoma City.

Keeping Patients Comfortable

By Kathryn Jones

Hospital administrators not only wanted to keep their patients comfortable, but also wanted energy efficiency. Geothermal brought together both comfort and energy savings to the Great River Medical Center in West Burlington, Iowa. "Our goal when we opened the Great River Medical Center was to be the most energy-efficient hospital in the country," said Director of Facilities John Mercer. Their goal not only included reducing energy costs, but also a vision to minimize patient costs.

Photo courtesy of Great River Medical Center.

The Snake Valley Rehabilitation gym was a part of the second phase of the hospital construction.

Groundbreaking began in 1997, but the hospital wasn't open and functional until April 2000 – after a very fast track 18-month building schedule. The hospital chose to use only lake-loop technology, but when expansions were on the horizon, a new well field was needed. Now, with the new operational well field, the hospital spends only $0.81 per square foot on its utilities. Combining the well field with the pond loop, costs will continue to be low as the hospital's new $17 million construction project begins.

Lake Loop Technology

As one of the nation's largest, the hospital's lake coupled geothermal system flushes more than 5,000 gallons of water per minute through the 105 miles of geothermal loops in order to heat and cool 700,000 square feet. This square footage is used to heat and cool five separate buildings: the 378-bed main hospital, two medical office buildings, a cancer care center and a center for rehabilitation.

According to Grant Schmidt, the lead mechanical engineer from KJWW Engineering in Rock Island, Ill., one of the major obstacles that the installation team had to overcome was the placement of the nearly 100 coil grids at the bottom of the lake. "Each grid contained more than 4,200 feet of pipe," he said. "The enormous weight made placement difficult. We had to take a different approach than is typical for a lake-coupled geothermal system." A fabrication shop was set up off-site to construct the grids, Schmidt said. Tractors were used to pull the grids into position, and the 14-foot lake was then filled to capacity. "This allowed us to position the grids correctly, preventing crossover of pipes," he said.

Gaining access to the grids at the bottom of the lake for maintenance was yet another obstacle. In a creative solution, the system was designed so each grid could be filled with air and floated to the surface for repair.

The hospital had a 120-acre plot of land with little development that it used for the man-made lake. The lake was not only used to house the loops, but also used for other reasons as well because most of the patient's rooms overlook the lake. "We really wanted to build a new facility that would incorporate a lot of healing elements into it," said Craig Borchard, director of public relations.

The pond has three fountains, but that isn't the only thing that gives the lake another dimension. There is also a walking track around it for the hospital staff and community members to use. West Burlington's American Cancer Society chapter has used the track in past years for the American Cancer Society's Relay for Life event – an all-night walking event for cancer survivors and their families. "It works out perfectly because there is a lot of space around the lake to put the memorial lanterns out," said John Mercer, director of facilities.

Many of the patients have been known to use the walking path. "Sometimes patients will request they be wheeled around in a wheelchair or they'll walk out near the lake and just stand there looking at it," Mercer said.

Mercer added there is also a manifold building that overlooks the pond and acts like a deck. The hospital also stocks the pond with bass, catfish and bluegill fish for the pond visitors to feed. "We put two feeders up there for people to put quarters in and get food for the fish," he said. The proceeds from the feeders go toward the hospital's hospice program.

The lake is also used as the hospital parking lot's storm-water run off area. "This way, when it rains, it goes into the lake," Mercer said. He added they also used the lake for the hospital's irrigation system, and in turn, don't waste money by paying for unneeded water.

Enhancing the Pond Loops and New Construction

In combination with the lake loop technology, the hospital uses 180 wells at a depth of 300 feet next to the lake. It uses three 150 horsepower heat pumps with a capacity of 1,400 tons. The well field was added a year after the hospital was opened in April 2000 to add to the energy efficiency of the hospital. "We did an efficiency study on the geothermal pond loops," said Borchard. "Even though it was operating far better than we had planned originally, we did determine with our engineers and contractors that we could gain additional efficiency if we added the wells." Added efficiency was

Photo courtesy of Great River Medical Center.

One hundred and five miles of loop is installed in the man-made lake. The lake is 14-feet deep.

a consideration, but so was expansion. "At the time we were putting the well field into place, there was a strong likelihood that we would be adding on to the hospital at some point in the future," Borchard said.

Steve Leavitt, Great River Medical Center's director of development, wanted to use geothermal because of its flexibility verses a conventional heating and air conditioning unit. "The medical center is always changing," he said. "The new building will change substantially over its lifetime. The nice thing about the system is the ability to tie into the loop and add additional capacity in locations where it's needed."

The hospital is now in the middle of a $17 million construction project, which will include expanded areas for their behavioral health center, in-patient rehabilitation unit, heart vascular center and surgical services. The hospital will also be adding an aero-medical services unit where a helicopter landing pad will be built. Geothermal housing is being constructed for the aero-medical team as well.

The well field has digital automatic activating valves. "While sitting in our computer room, we can tell what valves to open and what ones to shut," Mercer said. "We can actually program when certain temperatures are reached that this valve automatically opens." The automatic system is a Trane Tracer Summit system and can tell what each heat pump unit in each of the hospital rooms is doing at any given time. Mercer added that the control system is also able to be even more specific by highlighting a certain heat pump on a floor plan and telling how much discharge air is coming out of the heat pump, saving even more energy for the hospital.

The digital system also is able to tell what the thermostat is set on in every room. "That way, if a patient calls and tells us they're cold, then we can look at their thermostat on the computer and tell them, 'It's turned down to 60, and that's why you're cold," Mercer said.

Problems Solved

Choosing geothermal eliminated some challenges that would have come along with a conventional HVAC unit, Mercer said. He said since there are so many patients that have to be comfortable at the same time, the geothermal units could have given them some problems. Energy efficiency was such a major goal that the hospital staff just worked around this issue. "A heat pump is designed to operate at certain loop temperatures, like 55 degrees to 85 degrees," Mercer said. "When it gets up to those

upper temperatures in the loop, what is assumed is that you're going to be in a cooling mode. Everyone's going to want air-conditioning. But what happens in a hospital, you may have elderly or others who are cold. Then again, you may have people in the middle of summer who want heat in their rooms." This puts strain on the compressors and can cause failures. The hospital, however, was determined to stick with geothermal. "We put an electric heater on the unit itself so that the compressor doesn't operate over 80 degrees loop temperature," he said. "Then if the patients want their heat, this electric heater will kick in."

Another challenge was getting the pumping energy lowered in order to coincide with tests that were conducted prior to the installation. The differential pressures were not working properly, because of the system's initial installation method. "These pumps were running and running and trying to come to a differential pressure that it was asked to achieve," Mercer said. "They wouldn't do it. When we started looking at it, here with our staff at Great River, we figured it out." They corrected the pressure and were able to save even more money on their bills after it was fixed.

In addition, there are three heat pumps that are used to circulate the water through the geothermal loop system. At one time, Mercer said they had all three pumps running when the design only called for one to run 90 percent of the time and the other to run 10 percent of the time as a redundant back-up. "That kind of concerned us when we first got in there," he said. "We got everything adjusted properly and the differential pressures were satisfied, so right now, we just run one pump only. When we did that, you could tell a huge difference in our energy savings."

Award-Winning Technology

The hospital's energy savings efforts have been rewarded for the last three years as they were found to be the most energy efficient hospital in the prestigious Grumann/Butkus Associates study.

"We've won this award for three years in a row now," Director of Public Relations Craig Borchard said. "I think that speaks for how energy efficient this hospital really is." The study looks at 100 hospitals across the country and evaluates their energy efficiency in terms of annual energy consumption, total annual cost for electricity, and total annual cost for natural gas consumption, among other qualifications.

Photo courtesy of Great River Medical Center.

An aerial shot of the hospital shows the size of the campus.

The hospital puts so much emphasis into saving energy that they have a job position called an energy leader. "Their main focus is on energy issues throughout all of our buildings," said Mercer. "Their main function is to look for ways to save energy in each of our buildings. Whether this is by buying a new system or tweaking one we currently have or educating the staff as to how to turn equipment off when you're not using it."

The hospital has also been recognized for their dedication to providing superior customer service and is active in promoting it to the hospital industry members who stop by the hospital for a tour. But, that's not the only thing that the hospital touts to visitors. "We have a lot of people from other hospitals, and even those from outside the hospital industry, stop at our facility to tour it for a number of reasons," Borchard said. "It might be for one of our clinical offerings or to provide them with a presentation about our customer service program."

"But the other thing they're always coming here to see is the geothermal system," Borchard continued. "We've had groups from Canada, Europe, Japan and Mexico stop here to see how we've implemented the geothermal system. In that regard, word is out there about the success we've had with our system. More and more hospitals are taking a look at it as an answer to their energy needs."

Geothermal Energy's Protective Nature

By Trisha Swindle

Preserving the contents of a library, as with any museum, requires certain precautions. Staff is hired and trained to protect and care for the books and other collections. The HVAC system chosen for a library is a hidden but integral part in maintaining any museum collection. The books and art collections within a library require constant levels of humidity and temperature consistency that can be found in geothermal technology.

The Haverhill Library in Haverhill, Mass., made the choice to use geothermal energy in the heating and air conditioning of their library. The library has been expanded twice and in both instances geothermal HVAC units were chosen. By choosing geothermal energy, the Haverhill Library ensures the protection of an excellent library collection which includes a section of rare books, as well as a beautiful local and rotating art collection.

Part of this collection contains the largest grouping of original Archie Comic books. Vic Bloom, author of the Archie Comic books, based the mythical town of Riverdale on Haverhill, Mass. Books are not the only items in this lovely building. On the second floor, the library provides local artists with a venue in which to showcase and sell a variety of art. The third floor houses a rotating art collection of library art and memorabilia. Mike Hutchinson, maintenance director of this facility, has enjoyed working with the geothermal system and has nothing but praise for its ability to keep the library at a stable and comfortable temperature.

The building is approximately 60,000 square feet on three floors utilizing two geothermal systems. The rare book collection is housed in the newer addition of the library. The first system was installed in January 1995. Due to its success, a second system was installed during the building of an addition to the library. The designer of both systems was Water Energy Distributors Inc. (WED) of New Hampshire. Uptack Inc. was the mechanical contractor of the first system and Walsh Mechanical Contractors worked on the second installation. The general contractor on both systems was Barr and Barr from Massachusetts. This installation was funded by the local electric utility–New England Electric Service, now part of the National Grid.

The first installation was a water-to-water system that uses six heat pumps weighing 10 tons each. Two standing column wells were drilled to 475 feet in depth. The pipes are PVC-80 in the building and high-density polyethylene in the earth. The system uses a combination of water/refrigerant to prevent freezing of the water. According to Carl Orio at WED, the first system was a straightforward installation with no problems or challenges.

However, the second installation was a challenge. As well as being three times larger, this addition to the library was to house the rare books section. This section needed greater humidity and climate control to protect the collection. To meet this need, a water-to-air unit was installed that used thirteen 10-ton heat pumps. ClimateMaster supplied the heat pumps on both installations.

Haverhill has a continental climate, which is prone

to temperature extremes that lead to frequent use of an HVAC system. The average temperature in January is 22 degrees Fahrenheit, and the average temperature in July is 90 degrees Fahrenheit. The library can use its geothermal system to keep its patrons comfortable while saving money that can be used elsewhere.

The annual building energy savings is approximately $11,000. In 1995-96, the library used 94,000 kWh/year with its new geothermal system in comparison to the previous year when 550,000 kWh/year were used. This is a savings of 456,000 kWh/year.

The Haverhill Public Library provides the citizens of Haverhill, Mass. an indelible service through their educational resources, community outreach and cultural activities. With such a strong presence in the community, the library is an example of how to use environmentally friendly and cost-effective technology to enhance the services it delivers to Haverhill. In other words, the Haverhill Library has set an example of caring for their community through their use of geothermal.

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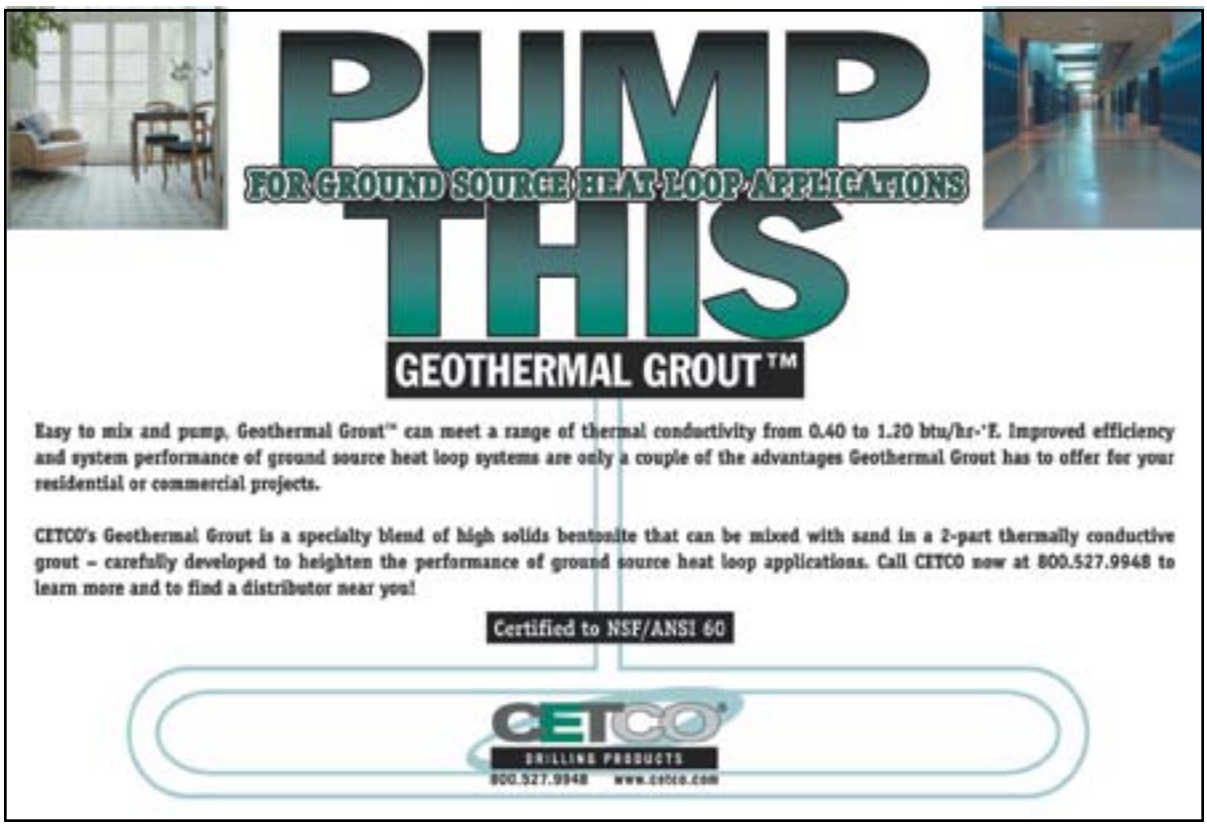


Preserving a Part of Charleston's History

By Dara McCoy

Built in 1801, the Charleston City Hall has stood in the public eye of its residents through centuries of history that shaped South Carolina and the United States. The storied building is a national historic landmark and the second oldest city hall still in operation, which makes it one of many historic tourist sites in Charleston.

Despite the importance of a building that existed through the baby steps of a country and all its growing pains, earthquakes, Hurricane Hugo and direct hits from cannon fire in the Civil War all made their marks. Last renovated in 1882, Evans and Schmidt Architects persuaded city officials that it was time for another complete renovation in 2004 to preserve a piece of history.

Long Overdue for Renovation

Photo courtesy of the City of Charleston.

When the City of Charleston first contacted Evans and Schmidt, it was for a $600,000 job to renovate the ground floor and fix moisture infiltration and mold problems. After the firm reviewed the site, it found mechanical problems, poor air circulation, roof leaks, leaky windows and other damages.

"We suggested that this was the time to do the 100-year fix, and they hired us to do some research into the building and figure out what needed to be done," said Joe Schmidt of Evans and Schmidt Architects.

Schmidt said the building was first constructed as a branch bank of the federal government in 1801 before the government exited the banking business. In 1818 it became the Charleston City Hall. In 1882, a complete renovation was done to repair direct cannon hits, but four years later an earthquake severely damaged the structure. He said no money was available to repair the damage in 1886, which was the primary reason the city hall was in bad shape when the renovation project started in 2004.

"As we exposed some of the exterior walls, we found some earthquake-damaged walls that we had to rebuild," said Tom Magee, general contractor and owner of NBM Construction. "The walls were 36 inches thick, and there were cracks where you could see through to the outside."

Magee's company had to stabilize ceilings, add concrete pilasters around the outside of the building and put steel reinforcements into stairs. With such extensive damage, the project quickly jumped to a $6 million project to completely gut and renovate the national landmark, restoring the enduring city hall to its 1882 look while keeping its functionality as an office, too.

"We've taken over 200 tons of wall, plaster, brick and tile out of the building already," said Magee. "This building will have all new HVAC, all new electrical, all new plumbing, all new fire protection and all new data cables. It's going to be top of the line even though it'll be a historic building."

A Public Centerpiece

"City hall is sitting on what they call the Four Corners of Law, it's the most prominent, famous corner in America, and there's a park behind it," said Joe Schmidt of Evans and Schmidt Architects. Every side of city hall is open to the public. The street corners and Washington Park, where residents often take their lunch, leave the city hall as open to the public eye as any building can be.

Photo courtesy of the City of Charleston.

NBM Construction begins the interior renovation of the historic city hall.

The renovation not only provided a chance for a much needed face-lift, but also a chance to repair public image. "We had been getting complaints about the city not setting a very good precedent," said Schmidt. "You're supposed to hide all your mechanical units on your homes and office buildings around town."

Yet, city hall had six residential air compressors on the roof and two chillers behind the building that were very visible from Washington Park. These should have never been installed, said Schmidt. "It's a very passive park, people enjoy it for that," he said. "They go out there and eat their lunch, and they don't want to hear those chillers running."

Another very public area of the city hall was an extremely large council chambers room with a 22-foot-high ceiling containing about $50 million of civic art that had been commissioned a century ago. "The city wanted a very tightly controlled mechanical system for that space, but at the same time it is a public museum, and it's open to the public at no charge," said Schmidt. "You can have tour groups of 15 people coming in there at a time, and it's very difficult to control the temperature in a room like that."

Photo courtesy of the City of Charleston.

Workers prepare to header the pipes at the Charleston City Hall.

A building meant for both the public and for a working office environment presents its own unique challenges. Added to these challenges are the need to preserve the structure and its contents, which are historic artifacts in themselves.

Geothermal Meets the Needs of Charleston City Hall

Schmidt's firm was facing the challenge of finding an HVAC system that was hidden from the public eye, silent to the public ear and environmentally air conditioned for office use. They also needed to address the demands of historic preservation and public visits, as well as satisfy the community demand for setting an aesthetic and environmentally responsible example.

"There was also some interest at the time to incorporate any LEEDs type, energy efficiency into the building, but that's really hard for a building like that," said Schmidt. To keep the historic integrity of the building, the renovation's goal was to keep as much of the old structure as possible. With a building that still had an Edison incandescent light bulb burning, more efficient materials like compact fluorescents, thermal glass or solar tinting weren't feasible, said Schmidt.

It was when Schmidt attended a local geothermal seminar sponsored by Florida Heat Pump that he decided a ground source heat pump might solve the multiple problems that needed to be addressed with the city hall site. Yet, there were several barriers to cross before Schmidt settled on geothermal.

The initial cost of the geothermal system was the first concern city officials had about installing a ground source heat pump, but Schmidt showed the payback model of the system and alleviated cost concerns. "The payback period, it really works here because we don't think you're going to be moving out," Schmidt said to the officials. "You've been here 187 years. We can probably get payback."

Then, Schmidt learned from the project engineer that the current units only provided about 70 percent of the needed air conditioning for the building. Both the payback and need for additional air conditioning helped Schmidt sell the geothermal system to the city officials.

Next, Schmidt learned that the 16,000-square-foot building would need 50 wells spaced 18 feet apart. Washington Park was the intended site for the well field, but was also an important archaeological site because it was once the city market from 1690 to 1790 and required a court order for permission to dig in the park.

"Once we plotted out wells, we realized this whole thing was just riddled with wells," said Schmidt. "Then they came back and said they really needed to be 30 feet apart, and it just looked like we just punched everything on this site."

Fortunately, Schmidt worked with the geothermal contractor Mike Hadley of Coastal Geothermal and came up with a space-saving design of the geothermal wells. "We came up with the idea, we'll drill at an angle so that the loop cluster of about 10 vertical loops, instead of being straight down, they'll be like an inverted ice cream cone, where the point's sticking up," said Hadley. The design enabled the geothermal well fields to fit in a 100-square-foot area, said Schmidt.

Hadley said he used the inverted cone design on five to 10 job sites as trials for his drilling rigs and the wells, and they all worked fine. "We added lifts, the whole rig comes up into the air and you adjust your lifts for what angle you want to drill at," he said. "It just looks kind of funny with you standing at an angle."

To minimize damage to the park, all equipment had to be on mats when inside the park and trenching was not allowed. Hadley had to horizontally bore the return and supply pipe underneath statues of George Washington and historic herringbone walkways to reach the building from each cluster. The city archaeologist was also on site in case historical artifacts were uncovered while Hadley drilled the boreholes.

Going Inside City Hall

While geothermal heat pump technology solved exterior problems by being out of sight and mind to the public eye of Charleston, indoor air conditioning needs also have to be met. The indoor environment is complicated due to the need to preserve the building and its artifacts, create a comfortable working environment for city workers and provide additional air conditioning for public group visits.

Painstaking detail was required for the indoor renovation because so much of the original woodwork was being taken out and refinished before going back to their exact location in the building. "Probably 90 percent of the original woodwork was in this building when we got here," said Magee. "We photograph it as is, take it down, de-nail it and mark it with a piece mark. We have files and files and files of these pieces."

Magee said finding and using skilled labor in historic, public building renovations like the city hall was a major difference as compared to new structures. "You can't just go in there and start knocking walls with a sledge hammer and breaking historic plaster," he said. "We go in first and wrap all of the door jambs with carpet, wrap the stairs with carpet. Everything that's going to stay is protected."

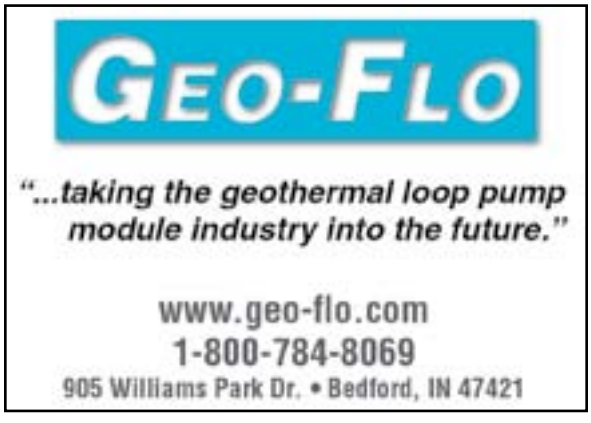
The desire to return the building to its 1882 design left little room to change the architecture or layout for an HVAC system. "We wanted a system that was versatile enough to break down into a number of smaller air handlers because there's not much space in the building for ductwork," said Schmidt. Schmidt was able to select the size and number of WaterFurnace heat pumps that best fit the city hall's needs.

One of the biggest challenges for the system was the demands on indoor air quality and environment. Temperature and clean air had to adjust for a large council chamber that could hold anywhere from a few office workers to a council meeting of 100 people. To maintain a more constant indoor temperature, Schmidt made a third unit available to kick in for the extra needs of the chamber based on a carbon dioxide sensor instead of having to wait on a temperature change.

Schmidt said new climate codes require a certain mix of outside air to be running through indoor spaces. However, with the quasi-museum council chamber and its $50 million in historic art, the less outside air to have to filter the better. The third unit is also the unit that picks up the outside air. "So, when it doesn't need to kick in, we won't be drawing in any outside air, which would just tax the conditioning capability of that space," said Schmidt.

Drawing Public Interest

During the Civil War, Charleston City Hall was struck at least three times by cannon balls from Ft. Sumter. City officials had to abandon the building



and move further up town because Federal troops were moving in. For a time, the ground floor of city hall was used as a makeshift prison for Confederate soldiers, but was not desecrated by Union troops during this conflict. Mathew Brady, a traveling photographer famous for chronicling the Civil War with his photographs, captured a scene where Federal troops leaned against the city hall guarding their prisoners inside.

This is only one story in a history of many that any building standing for over two centuries might collect. For this reason, Charleston residents had a vested interest in city hall not only when it was open to the public, but also during the renovation efforts. For a city so steeped in rich historic culture, buildings are far more than functional structures.

Photo courtesy of the City of Charleston.

The renovation process was highly visible to the Charleston community.

"We're in the public eye pretty much there," said Hadley. "That's a real high-profile job because the city hall was built in 1801, and everybody in Charleston is interested in this project." Hadley had to put up signs for safety reasons that asked passersby to not disturb workers or ask questions while they were drilling. "When you're working in a public place like this, there's a lot of public interest," he said.

"Charleston's a close-knit community," said Magee, who remembered working on another site in Charleston where people came back every year to see the progress. "When they'd come back towards the end of the job, I'd let them come in and see," he said.

Preserving a Part of History and Local Pride

With geothermal satisfying so many needs of the historic building and requests of the public, the renovation scheduled for completion in 2006 is headed towards being a big success for all involved. Magee finds the challenge of historical retrofits benefit enough to focus half of his company's time into these projects. "You get to think more," he said. "Every day is a challenge."

The companies involved in the renovation may own a sense of satisfaction that can only be found by working on projects so steeped in historical events and still important to the public pride in Charleston. "We're going to leave this building in very good shape for a very long time," said Schmidt. "We're very, very pleased that we're preserving something."

It truly is a one-of-kind opportunity to preserve something in history and in the public eye. "This is once in a lifetime," said Magee. "This building will never be renovated again in our lifetime." Charleston City Hall has seen numerous lifetimes, but for the first time, it will have an HVAC system that can last a lifetime with it.

The problem-solving technology of ground source heat pumps came to the rescue for Charleston City Hall. It proved a rare opportunity to meet both the needs of the building and the needs of a concerned public. In fact, one of geothermal technology's greatest benefits when installed into a public building is to not be seen by the public at all.

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Conserving the Beauty of Long Island through Geo

By Trisha Swindle

Establishing the National Parks of the United States was an idea that Theodore Roosevelt saw into fruition. During a speech before Congress he said, "The conservation of our natural resources and their proper use constitute the fundamental problem which underlies almost every other problem of our national life." He believed that as this country grew, numerous natural treasures would be lost if they were not protected. Jones Beach State Park is part of this system, and the State of New York has taken President Roosevelt's pledge of ecological protection one step further. They have installed a geothermal heating unit in their Theodore Roosevelt Nature Conservation Center at Jones Beach State Park.

Jones Beach State Park works not only to provide a beautiful recreation area for the community, but also to preserve the natural wildlife and educate the public about their part in this preservation. This conservation center will have external exhibits including a boardwalk, mystery whalebone, piping plover discovery coves for the children, a preserved shipwreck, a butterfly garden and a human sundial area. Inside the facility, exhibits will include information on the South Shore Estuary, Endangered Species, Dunes, the Atlantic Ocean, the salt marsh and the seashore. These exhibits are displayed through a variety of mediums such as: interpretive panels, interactive displays, classrooms and a laboratory with microscopes. With so much diversity in the museum, exhibits will benefit from the humidity and temperature control provided by a geothermal HVAC system. Local college and high school students will also benefit from this center through internships, teacher workshops, student environmental monitoring and classroom lectures.

Theodore Roosevelt Nature Conservation Center at Jones Beach State Park uses a geothermal system.

The 6,200-square-foot building uses a vertical closed loop system that was designed and installed by RJ Dooley Associates. Polyethylene 1.25-inch pipe was used for this installation. The total pipe depth is 5,775 feet and an antifreeze solution was used due to the large temperature fluctuations New England experiences. Twenty-one wells were drilled at 275 feet deep. The total weight of this system is 34 tons. Installation cost for this system was $140,000. The geothermal heat pumps were purchased from WaterFurnace. Taking advantage of geothermal heat pumps ability to be hidden, the heat pumps are in the attic of this building.

Long Island Power Authority (LIPA) donated the

geothermal system and photovoltaic roof system, which provides the heating and air conditioning as well as the power for the building. Each year these systems will eliminate 250 pounds of pollutants from entering the atmosphere. This investment cost LIPA $300,000 and will save the State Park $20,000 annually in energy costs. It includes not only the geothermal heat pump and roof, but also part of the building itself. Ford Motor Company donated $350,000 to this project. This community effort exemplifies those values that the geothermal community strives for and Theodore Roosevelt wanted.

Governor Pataki, along with LIPA, created the $355 million dollar Clean Energy Initiative. The goal of this initiative is to promote the use of green technologies in the attempt to preserve natural resources and lower pollution levels. They have designed a Residential/ Education Outreach Program to inform the public about the different rebate opportunities available for making their homes and businesses more energy efficient. These rebates apply to everyone, not just new construction. Upgrades and retrofits are also included in this program. Customers who purchase and install geothermal heat pumps are eligible for cash rebates based on an energy efficiency ratio and the size of the unit. Training sessions and certification workshops on geothermal technology are delivered to local tradesmen, including architects, engineers, builders and HVAC contractors. These workshops are provided through IGSHPA trainers.

President Roosevelt would have been one of the geothermal industry's greatest allies. He would have appreciated an energy source that harnessed the earth's heating and cooling potential in the name of lessening the use of nonrenewable energy. The State of New York, LIPA, Ford Motor Company and the Jones Beach State Park have developed a conservation center that is committed to protecting the natural wonders of the area. By using geothermal energy, they have taken steps to ensure that generations to come will continue to enjoy this facility and the land it protects.

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Total Geo University

By Dara McCoy

When the Broken Arrow, Okla., community decided they wanted a college and Northeastern State University needed a home after having to leave OSU-Tulsa, the scenarios fit like a glove. Broken Arrow raised $16 million through a city bond issue and donated the land that NSU Phase I sits on today. The total value of the campus after Phase 2 is completed will exceed $50 million.

Geothermal heat pumps were selected for the first phase not only because of their energy efficiency and payback, but also because of the higher than expected growth of NSU-Broken Arrow and the need for a quick construction process to house enrolled students. Through the innovative design process of the design team of Martin Engineering Design and Bates/LZW Architects, and the skilled labor of K&M Shillingford, geothermal was able to meet the demands of the project.

While geothermal technology may never be seen by the public at public institutions like schools and colleges, it is well documented how GSHPs have provided better functionality and comfort in many public buildings. The NSU project is yet another example of a geothermal success story.

Building for Today and Tomorrow

"We had an incredibly short schedule," said Glenn Martin of Martin Engineering and Design Inc. "We had a year to build the first building, three months to get the next one done." After NSU no longer had housing at OSU-Tulsa, they had to find a solution quickly for new office and classroom space. Broken Arrow's donation of land was a perfect fit, but bare ground didn't exactly provide the educational environment desired.

The first phase consisted of an 83,000-square-

foot administration building, a 76,400-square-foot classroom building, and a 47,200-square-foot computer science building. Martin said using geothermal was helpful on this project because individual GSHP systems could be installed for each building, which wouldn't affect later expansion.

"If we build a central plant, how big are we going to build it?" said Martin. "How do you economically expand and where do you put it? So, first of all we turned to the geothermal system as a problem solver."

Photo courtesy of IGSHPA

With the system hidden from view, geothermal compliments NSU-Broken Arrow's architecture and landscaping.

Job bonuses for finishing ahead of schedule, penalties for finishing late and good organization certainly helped motivate the crews, but geothermal helped speed up the construction in two ways. "They're over here putting half the mechanical system in without touching the building," said Martin.

K&M Shillingford crews not only drilled and trenched for the system without ever disturbing or slowing down the other builders, but were one of the fastest crews on site. "We got the highest bonus money of anybody on the project," said Jay Murphy of K&M Shillingford.

Yet, to keep a project running smoothly, especially under time pressure, working as a team is vital. "The coordination on that job was what made that job a success: the weekly job meetings, the fact that they kept minutes at those meetings, and they provided them to you the following week," said Walt Dean, site construction superintendent for K&M Shillingford.

Then, the design team came up with a design for a 12-foot-wide space in the attic area of the buildings to place all the heat pump units instead of inside mechanical rooms or closets. "So, in the middle of the air in this huge attic, Glen (Martin) designs this walkway that hangs in mid-air, and it's actually designed so all the pipes go on it, all the machines fit in it and it's a really cool idea to put the equipment there," said Murphy.

During the construction, this innovative design allowed crews to install the indoor pipes and units without getting in the way of the sheet rock installation or other building processes. Once the construction was completed, Martin's design allowed for easy maintenance access that would not disturb classrooms or offices. To make things even better, Martin used all 5-ton heat pump units to make maintenance easier on NSU Broken Arrow's staff.

"The simplicity of the geothermal system at NSUBA was instrumental to our project success," said Ed Bates, owner of Bates/LZW Architects. "We were able to not only finish the project ahead of time, but we were also able to come in under budget because construction

crews were not delayed by the system's installation."

With NSU-Broken Arrow's growth at two or three times their expectations since the first phase completion in 1999, it is fortunate the expansion-friendly geothermal technology was chosen for the campus. The second phase, which will include three more buildings, and double the campus capacity, was given authorization to proceed with construction on May 1, 2005.

Photo courtesy of IGSHPA

Pipes and heat pumps are hidden in an attic walkway that saves space and allows for easy maintenance.

Geothermal Sells Itself to NSU Officials

Before GSHPs became the system of choice for the Broken Arrow campus, the systems benefits had to be proven with a little help from Martin. At first, the architect on the job was set against using heat pumps until Martin's interstitial space design made the GSHP system virtually disappear entirely. There are no cooling towers, no ugly gas pipes, no space-taking mechanical rooms and no penetrations through the roof.

In fact, the attic walkway design is so unique it became a stop on the Broken Arrow campus-opening tour. "One of the crowning deals is Governor Keating was the governor when they opened this thing, and one of the first things they did, they took the governor in the mechanical room upstairs," said Martin.

Once the architect's mind was changed, Martin prepared a present-worth comparison of five different HVAC systems for the owner to choose from. "It's a very good way of comparing, particularly with the university because they're not necessarily always interested in first cost," said Martin. "We see what it's going to cost us in today's money for the next 30 years to buy the system, to maintain the system, to keep the system going, and the energy costs."

Because of the long life, durability and energy savings of the geothermal system, it can stack up to other systems a lot better in present-worth comparisons than just looking at initial costs. "I've done this about eight times now, the owner just looks at it (geothermal) and goes 'That's the one I want right there,' and he does it every time," said Martin.

Photo courtesy of IGSHPA

Geothermal technology meets NSU-Broken Arrow's current energy needs and allows for future expansion.

Designing the System

The first phase of the campus required 483 wells at 300 feet deep and 770 tons of heat pump units to provide three closed loop systems for the buildings. Martin said he believes that, "When we finish the second phase, it will definitely be the largest (geothermal job) in Oklahoma." Yet, the Broken Arrow system

won't only be big on size.

Because of Martin's viewpoint of the earth as an engine for heating and cooling and subsequent design, the campus' GSHP is big on efficiency. "I've got a well piping system and a building system, and it's decoupled," said Martin. With this system, Martin uses the energy of the building itself and exhaust air to meet heating and cooling needs.

"In designing the system, it's not only the geothermal system," said Martin. "You're looking at the entire system, everything, pump sizes, lighting. We're trying to make a very energy efficient building."

Martin only uses the geothermal field when it's needed instead of constantly circulating water that can lead to overheating the well field. Martin said his design has never produced an overheated well field in any of his projects. "He's the only guy that's ever looked at the well field like that," said Murphy, whose company has imitated the design in subsequent projects.

NSU Broken Arrow's total utility costs per year for over 200,000 square feet of space are $162,000 with the geothermal system, which is more than a 50 percent cost savings over Building Owners and Managers Association standards, according to an NSU news release.

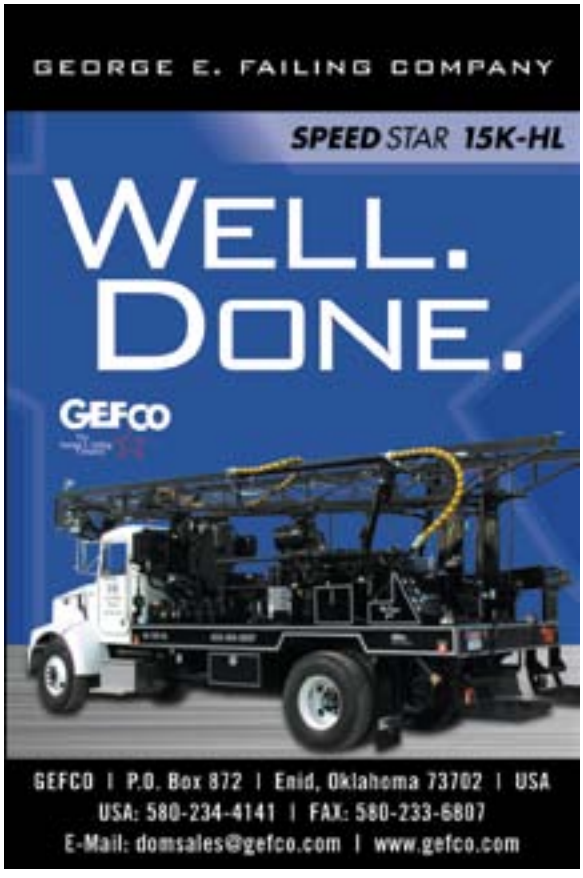
"This system is a very simplistic solution to high efficiency," said Martin. "The geothermal heat pump system is simple, concealed and most importantly, it is energy efficient. It says we're doing our job."

Making Happy Customers

Anything that saves a building owner over $180,000 in utility costs per year is sure to make them happy, but geothermal heat pumps did much more for NSU Broken Arrow. The underground system takes nothing away from the landscaped grounds of the campus, and with Martin's catwalk mechanical room, takes little away from the interior design and architecture of the buildings.

"The architect and engineer did a fantastic job, working together to design these buildings to be not only beautiful and functional, but energy efficient as well," said NSU President Larry Williams, in a statement after Phase I's completion. "Building this campus was a tremendous opportunity for Northeastern to set new standards in educational facilities."

Geothermal systems have long been known for their practical benefits of saving energy and money in large buildings, but as the indoor comfort, air quality and overall environment become more and more important in public buildings like educational institutions, geothermal is an even better "problem solver" for designers and owners. ◆



DOE Supports Geo Efforts in China

By Kathryn Jones

Thanks to support from the International Utility Efficiency Partnership, Inc. (IUEP), a program of the U.S. Department of Energy, Beijing, China, now has a new technology building.

The 308,000-square-foot Huaxia Technology Building is located in the Zhongguancun National High-Tech Park in Beijing. The building was completed in December 2004, with the total cost of the building being $10 million. Originally, a conventional heating and cooling system was budgeted to be installed for $760,000, but Shawn Xu from Sustaine Technologies received $100,300 in funding from the U.S. Department of Energy's International Utility Efficiency Partnership to use geothermal in the building instead. In order to establish a clean energy demonstration project for the city, support in the amount of $181,000 was also provided by the Beijing municipal government.

Photo courtesy of Shawn Xu

The Huaxia Technology Building received funding from the International Utility Efficiency Partnership, Inc. to use geothermal technology.

Don McKinnon, project manager for the IUEP, said this organization features an annual competitive request for proposal (RFP) process. In this process, grants are awarded to assist in development of greenhouse gas reduction projects, including renewable energy technology and energy efficiency projects. He added that Sustaine Technology's project was an appealing candidate for the IUEP for several reasons. "The market in China was so appealing because it's a huge growth market," he said. "Led by an American-owned company, this project represents a beachhead for use of American technology in China. Before installation of this technology, developers in China were unfamiliar with the technology and skeptical about using geothermal. Now, as a result of a successful installation and

an aggressive public awareness program, other developers are already making inquiries about additional geothermal installations in China," he said.

The IUEP was established in 1994 as an affiliate of the Edison Electric Institute. They have been giving the RFP grant for eight years. McKinnon said this grant was unique because the IUEP doesn't typically fund a lot of heat pump projects. "But with this project, it was a question of timing," he said. "The building was either going to use diesel or electricity for its heating and cooling needs or be geothermal. This DOE grant will result in a 515,000 ton reduction in greenhouse gasses, while creating future business opportunities for U.S. technology companies."

Photo courtesy of Shawn Xu.

PeopleSoft, a software company, currently leases the Huaxia Technology Building.

The building was an ideal candidate for geothermal, Xu said. "The geographical and meteorological conditions of Beijing are perfect for the demonstration of building energy systems because there is a significant demand during the year for both heating and cooling," he said. "Also, as the capital of the second largest energy-consuming country the city of Beijing has a great influence on China's national energy policies, technologies and regulations. This project has already attracted the attention of the top Chinese leaders who are regulating and controlling China's national energy policy."

A special meeting to promote renewable energy technologies in the city had been called on the project site by the Beijing Energy Saving and Environmental Protection Center. The attending administrators from the Beijing Department of Construction's Committee of Development and Reforming highly evaluated the project.

The building has currently been leased to PeopleSoft Inc., a division of Oracle Corporation to use as their research and business offices in China. Oracle is the world's largest enterprise software company.

The basement primarily serves as a parking garage with equipment facility rooms. The basement is full of the heating and cooling equipment, which includes the heat pumps, air handler units, circulation pumps, power supply system, water processing tanks and wastewater treatment facility.

There are also five apartment units on each of the three floors of the building, for a total of 15 apartment units. The units are available for the technical staff and managers of the company and utilize geothermal. Sustaine provided the apartments with 15 small water-to-water geothermal units.

Approximately 150 miles of polyethylene pipe was used in this closed-loop design. Nearly 649 vertical boreholes were drilled and 1,236 loops were installed. "The engineering team worked 24 hours per day, three shifts per day, seven days per week to

complete this drilling job," Xu said.

Sustaine and Jiangsu Yixin Company were contracted to prepare the mechanical rooms in the basement and install two large-scale reversible geothermal chiller heat pumps, which were 400 tons each. Sustaine Technologies completed the installation of the manifold collection and distribution pipes for the underground loops and provided circulation pipes, valves and measurement instruments.

A monitoring system was also installed and measures: influent and effluent water temperatures for the underground loop circulation water; hot water temperature from the condenser to the room and its running temperature; indoor room temperature in different locations; and the air temperature out of the fan-coil units. The City Department of Construction provided a grant of about $40,000 to support this monitoring work. "We believe that the data acquisition system will be a great help for our understanding to the operation of the system," said Yanfen Tang, Director of the Energy Efficiency Evaluation Center (EEEC) of Beijing. "The data we are going to get will be a great assistance to the engineering design, and market penetration of the industry." The EEEC will provide first hand information as a reference for business decision makers and government regulators.

Shaojun Xin, Director of the Beijing Energy Saving and Environmental Protection, said he is glad that his office can be a part of this project and assist financially with it. "We strongly believe that this is the technology that will dramatically improve the city environment, reduce the energy consumption and provide better comfort," Xin said.

The construction of the other buildings in the technology park is scheduled to begin soon. Xu was invited to give a presentation to the managers of the second phase of the software park. "There is a high possibility that building developers will choose to use this technology in the second phase," he said. "This will amplify the results of the IUEP in reducing greenhouse emission gases in the community." The second phase of the park will be 3 million square feet, which is 10 times the size of the Huaxia project.

To read more about how to apply for the IUEP grant, visit http://www.iuep.org/project.html.

In the News

DOE Backs Geothermal

According to Susan Norwood, the former GeoPowering the West national coordinator, the state of the geothermal industry is poised to take off again. But currently, most of the research and development dollars that the DOE receives go toward geothermal power. "Heat pumps are considered commercially viable, and therefore are not part of our research and development program," Norwood said. "There are opportunities, however, for the DOE to promote their use."

GeoPowering the West is active in 14 states, but most efforts are in geothermal powering, not heating and air conditioning. However, since GeoPowering the West program manager Roy Mink joined operations, he has diversified the program to include heat pumps. "When GeoPowering the West was established, it specifically was for direct use and electric power only, not heat pumps," Norwood said. "Now we've shifted away from that side of that. There's an opportunity to include geothermal heat pumps in our outreach efforts, but not in our research efforts."

The DOE is promoting the heat pump technology with the help of their marketing materials and outreach efforts. The GeoPowering program is also working diligently with a little help from other organizations.

"We are incorporating heat pumps into GeoPowering the West by promoting them through our state geothermal working groups and the DOE's Energy Efficiency and Renewable Energy (EERE) department information center," Norwood added. "That's really the focus of our program: to identify those barriers and look for ways to remove them."

For more information on the DOE's GeoPowering the West program, visit http://www.eere.energy.gov/geothermal/deployment_gpw.html.

Norwood, who had been with the program for five years, has recently resigned from her position with the GeoPowering the West program. She is currently working for the National Nuclear Safety Administration.

Maryland Enacts Legislation

Geoexchange has become a hot topic in the state of Maryland this year with the introduction of a new grant program. Senate Bill 361, which was introduced by Senator Teitelbaum et. al. in February 2005, provides grants to individuals for a portion of the cost of installing a geothermal heat pump.

During hearings for this bill, Wael El-Sharif, executive director for GPHC, gave testimony to the Maryland State Senate. Jack DiEnna, key accounts director for GHPC, testified before the Maryland House of Delegates. Both El-Sharif and DiEnna spoke in support of Sen. Teitelbaum's bill by offering information on geoexchange technology and the ways the grant program would help the state address energy, environmental and economic issues.

In April 2005, Maryland SB-361 became law. This bill provides a $1000 rebate to individuals installing geoexchange systems and will take effect in July 2005.

Montana Enacts Energy Bill

Montana Gov. Brian Schweitzer recently signed into law a bill that establishes renewable energy requirements for the state. According to the new law, public utilities must purchase at least 5 percent of their electricity from renewable energy sources in 2008. Hydropower, bio-mass, wind, solar and geothermal energy are all eligible renewable energy sources. The bill also requires public utilities to buy renewable energy from customer-sited facilities with capacities of 5 megawatts or less. These facilities must provide 75 megawatts of renewable energy capacity to each of the state's public utilities by 2015.

To read the complete story, visit http://data.opi.state.mt.us/bills/2005/billhtml/SB0415.htm.

Earth Insights

By Phil Rawlings, CGD

If you have a question about geothermal installation, design or troubleshooting, send it to Phil Rawlings in care of *Geo Outlook*, Oklahoma State University, 374 Cordell South, Stillwater, OK 74078 or via e-mail to insight@igshpa.okstate.edu.

1. Has the federal government initiated any energy efficiency mandates or related programs to help conserve energy?

The past several administrations and their corresponding congresses have provided guidance for energy conservation, use of renewable technologies, etc. in an effort to control and reduce energy consumption in federal facilities.

2. What has been done to promote energy efficiency in federal facilities?

Energy mandates, such as Executive Order 13123, mandated energy usage reductions to targeted levels, with time frame milestones put in place to monitor progress. Programs were also established to facilitate energy conservation measure applications and the use of renewable technologies.

3. How do these programs work?

These programs were discussed in the previous issue of Geo Outlook and have generally been successful. However, there have been some problems:

• When the military base family housing privatization programs began, many of the bases stopped improvements or renovation of their housing stock.

• The Energy Savings Performance Contracting program expired but has now been reinstated. One key fault with the ESPC program is utility costs. Because of negotiated utility rates in some areas, there is limited payback potential created by energy conservation measures.

4. Has privatization had an impact other than delaying projects?

Yes. Based on everything I have seen, the privatization contractors are building homes with high quality envelopes. However, most do not consider geothermal heat pump systems as the first choice for the HVAC system. To quote Jack DiEnna of GHPC: "In spite of significant increases in utility costs over the past few years, we have not experienced the growth in geoexchange heat pump applications on government facilities that was expected. Much of this is related to military base privatization contractors using minimum efficiency HVAC equipment to control first costs, believing that the government energy efficiency mandates do not apply to them." However, DiEnna's inquiries to several members of Congress indicate that this is definitely not the case. He added: "The bases are putting pressure on privatization contractors to build as many housing units as possible. They ignore the impact higher utility costs will have on the resident military families. Also, the privatization contractors are looking at first cost instead of life cycle cost. This will change if Congress provides guidance to the military and privatization contractors indicating that they are obligated to follow the energy conservation and renewable technologies guidelines."

5. So, no privatization contractors are considering or using geothermal heat pump systems?

No. There are many that consider geothermal heat pump applications. Some, but not all, are considering geothermal heat pump applications as an alternative, while others are indicating they will use geothermal.

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.

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