GEO OUTLOOK

The Publication of the GeoExchange Industry

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Geothermal Technology Finds Common Ground

Also Inside:
The "Green" Olympics
Canadian Ice Rink Gets Assist from Geoexchange
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Directors' Forum

Notes from GHPC

By Wael El-Sharif
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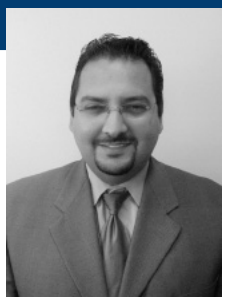

Technological advancements made in the last 20 years have ushered us into a global marketplace. Market studies have shown that success stories are contagious, and that theory has proven true as geoexchange continues to make steady progress around the world as the heating and cooling technology of choice.

One example of the incredible triumphs is Canada, a pioneering country that has been installing geoexchange since the 1970s. Driven by Natural Resources Canada (NRCan) with the GHPC's support, the creation of the Canadian Geoexchange Coalition (CGC) has made strides to promote the Renewable Energy Deployment Initiative (REDI) campaign. Along with Earth Energy Society of Canada, these organizations have begun to break down market barriers facing the Canadian industry. In fact, the government has become so supportive of geoexchange that, in the 2004 Sustainable Development Strategy report delivered to the Canadian Parliament, the Honourable R. John Efford, Minister of NRCan, committed the country to a goal of 25,000 new geoexchange systems in Canadian business and institutional facilities by 2008.

Recent years have shown rapid market penetration in Switzerland, with installation numbers climbing upwards at least 15% annually. Geoexchange systems have been part of the Swiss market since the 1970s, and data is showing that they are truly a prominent power in our worldwide industry. Switzerland currently estimates that there is at least one geothermal heat pump unit installed for every 1.2 miles.

The GHPC is proud to have been part of a joint effort with DOE, when we put geoexchange into four high-rise buildings in China, another country that is popularizing its use of geoexchange. Other countries that are enjoying increasing installation numbers are Germany, Sweden, Austria and the United Kingdom.

On the global level, the International Energy Association (IEA) Heat Pump Centre has helped to accelerate the implementation of geoexchange in various countries. In addition to offering a worldwide information service to support the global industry, the key players in the organization have grouped together into national teams, forging close relationships on a global level to achieve tailored successes in each group's local area.

Right now is a great time to be a member of our industry. People everywhere are using our technology, but the best is yet to come. As geoexchange becomes a more commonplace heating and cooling technology, everyone in the world will profit.

In our global marketplace, we need to remember the borderless benefits. The systems we install today pave the road for a better tomorrow, and even if there was no other benefit to using our technology, the environmental accomplishments won with each system are reason enough on their own. Increased use of geoexchange worldwide will bring about more technopolitical support, thereby maturing the international market, which will ultimately position the industry to offer our local consumers the best successes in their own backyards.

For all that each of you is doing to help your local industry, we at the GHPC would like to thank you for making the world a more efficient, cost-effective, and environmentally friendly place.

Directors' Forum

Notes from IGSHPA

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

IGSHPA members have a long and successful record of accomplishments in international activities. My first opportunity and introduction to international activity involving ground source heat pumps was presenting a paper at the Nordic Symposium on Earth Heat Pump Systems in Göteborg, Sweden, in October 1979. I mention this because of the technical innovation that had occurred at this time and the large number of presenters from various countries. Most of the technical work presented then has been refined, and formal design and development of standards has progressed significantly with contributions from around the world.

Since these early beginnings, the international market has flourished. The International Energy Agency has become an excellent source of science-based applications. International chapters of IGSHPA have been started with strong backing from their respective governments and industrial partners. Activities around the world are on the increase. Professor Liang Shi Ding's article in this issue of Geo Outlook describes her activities in promoting ground source heat pump technology in the upcoming 2008 Olympics to be held in Beijing, China. Japan has just formalized its Geo-Heat Promotion Association of Japan (GeoHPAJ). These are just two of the many leadership programs developing around the world.

Listen and Learn. This simple statement should be a reminder of the important role we need to assume in cooperating and the sharing of technology. This mind-set will firmly place ground source heat pumps as the renewable energy conserving technology of choice. We are fortunate to be able to communicate rapidly via the Internet and through more in-depth trade publications such as Geo Outlook. Greater advancements are on the horizon as a result of worldwide communications between individuals and groups.

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Bruce Ritchey

President/CEO
WFI Industries Ltd.
Fort Wayne, Indiana

Bruce Ritchey has been the President and Chief Executive Officer of WFI Industries since November of 1998. Mr. Ritchey came to WFI with over 25 years of experience in the heating and air conditioning industry.

During his 17 years with The Trane Company, he had held positions in human resources, training, marketing, sales, distribution and general management. Prior to his move to WFI, Ritchey was Vice President of Sales and National Account Operations for York International.

Mr. Ritchey and his wife Kitch live in Fort Wayne, but travel frequently to visit their grown children in Dallas and Denver.

Charles E. Elks, Jr.

President
Mechanical Equipment Sales, Inc.
Virginia Beach, Virginia

Charles E. Elks, Jr. Recreived his B.S in Civil Engineering From Virginia Polytechnic Institute and State University in 1961. He is a registered Professional Engineer in the state of Virginia and is the President and owner of Mechanical Equipment Sales, Inc. in Virginia Beach Virginia, a geothermal distributor for Florida Heat Pump since 1976. Mechanical Equipment Sales is FHP's largest distributor, stocking more that 200 water source heat pumps. He is a Certified Geothermal Designer and has assisted in the design and installation of more than 25,000 geothermal heat pumps in North Carolina and Virginia.

Geothermal Technology Finds Common Ground

By Karla Bradshaw

Cover Story

The world is definitely getting smaller these days. The Internet and advanced communication technologies facilitate a growing network of international partnerships in the HVAC industry. These partnerships foster opportunities for new business as the political and cultural barriers in developing markets fade. With new open doors, Asia, Europe, Central and South America, and even the Middle East offer ground floor participation in new construction and infrastructure renovation. China, for instance, is no longer just a manufacturing source, but a full-fledge market. Advancing into these emerging markets has allowed ClimateMaster Inc. to spread the "good news" of geothermal technology.

Passing on the good news may involve long hours, jet lag and eating exotic food, but the rewards can be substantial. Not only will our international clients reap the many benefits that geothermal technology offers, but we also learn a little bit more about each other and discover how the world can work together to protect the planet by using this environmentally friendly system.

China's in the Loop

In the East, Mike Kapps, ClimateMaster's Director of Development, facilitated the installation of a vertical closed-looped geothermal application at the Rose Garden Housing project located in Beijing, China. A master planned community, the typical home is a three-story structure featuring 3,200 square feet of residential space that includes basements. Although the first cost was more for the geothermal system, the developers were more than willing to invest in the latest technology upfront for greater savings and a higher quality product in the long run. They also wanted to demonstrate the energy and monetary savings of the geothermal application over other types of conventional systems in other homes.

"We wanted to offer this geothermal technology as a way to help 'green up' the housing market in China. The installation of the geothermal systems in the Rose Garden project was one of the first steps in showcasing geothermal technology to the Chinese developers," said Kapps. "By installing geothermal systems in Rose Garden homes, the developer created a sales differentiation benefit that set their homes above the average homes using standard technology. The sales and promotional benefits above the energy savings have made the project a great success for the developer, our local representative, Genesis International and ClimateMaster. A win, win in our book."

The installations involved drilling 10 vertical boreholes, 50 meters each, located in the back gardens behind the homes. High density polyethylene (HDPE) piping lead from the boreholes to the mechanical room located in the basement and connected to two ClimateMaster

The Rose Garden Housing project located in Beijing, features 3,200-square-foot homes heated and cooled by geothermal.

5-ton vertical water-to-air units. The systems consisted of two separate zones, which ensured the maximum comfort level for the residents.

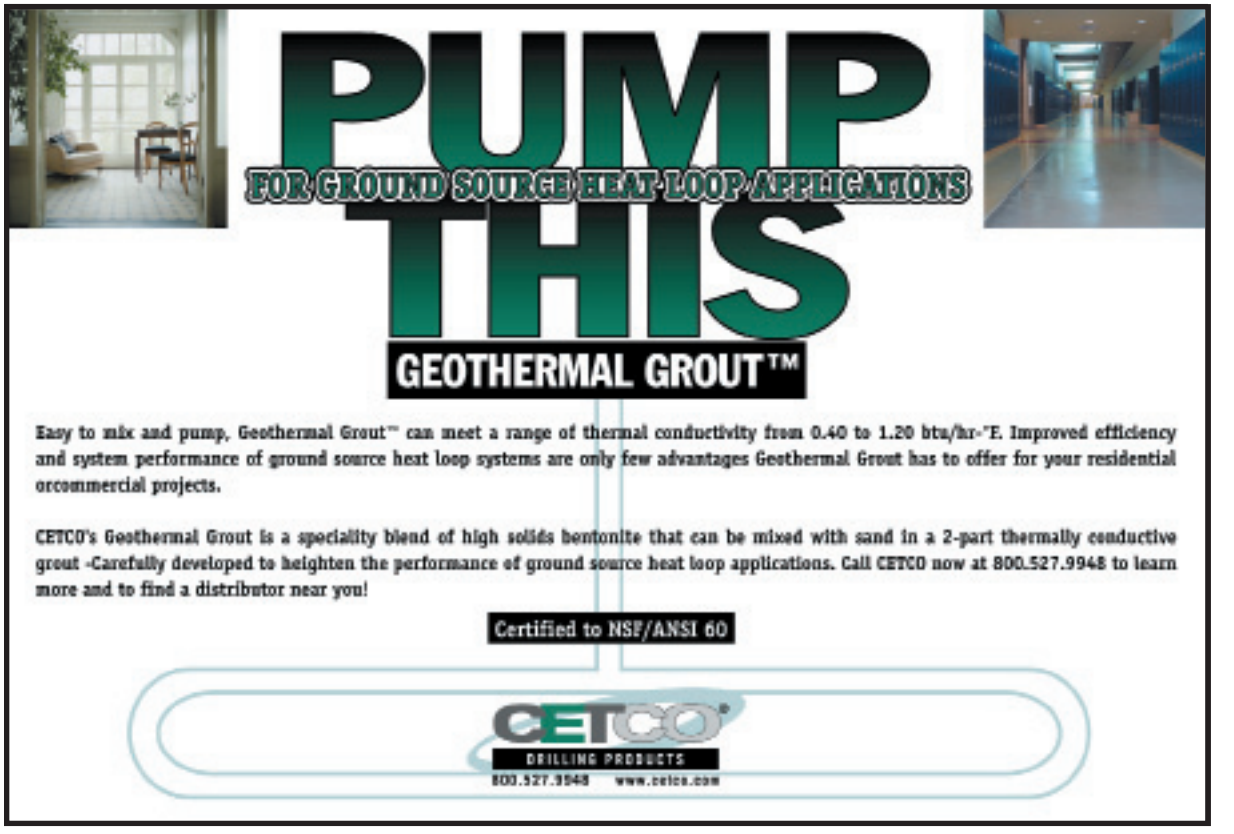
The residents of the Beijing Rose Garden Housing community gained a 35 percent savings in operating costs in comparison with the natural gas or hot water systems that were available. Also, the reduced maintenance and longevity of the geothermal system appealed to the developer as a selling point. When all the benefits of the geothermal system were added up, the relationships between developer, resident and manufacturer were strengthened.

Europe Goes for the Green

Halfway around the world, the green conscience of England welcomed the environmental benefits of geothermal technology with open arms. Europe continues to promote renewable energy with a mission of increasing green building applications. Interesting projects like British Petroleum's installation of green fueling stations in Spain and Portugal, which used a combination of horizontal and console units connected to a geothermal vertical loop system, exemplify the push for environmental safeguards. Another British venture, the Cotswold Water Park office complex in Cirencester, England, achieved the Queen's Award for its green design using a lake loop geothermal system.

In Chesterfield, England, the Dunston I Innovation Centre is a perfect example of government support to renewable energy sources. The Chesterfield Borough Council developed the 25,000-square-foot Dunston I Innovation Centre as a business opportunity for the older coal-mining town to generate new jobs and community growth. ClimateMaster's distributor, Clima-Gas, worked with the project designer to specify a geothermal heating and cooling system for the three-story new construction office building.

The geothermal application included the installation of 87 ClimateMaster console units that were wall mounted around the perimeter of the building. Six horizontal units were used for large open areas. These water-to-air heat pumps featured a reverse cycle and provided independent



Geothermal provides comfortable meeting facilities at Dunston.

heating or cooling to each office by a unit-mounted controller. The connected capacity of the heat pump units in the cooling mode is 242 kilowatts and the heating 130 kilowatts at ground operating conditions.

The internal loop piping was designed to facilitate energy recovery by transferring excess energy from one area to another in need of it. The heat pumps are capable of simultaneously heating and cooling space in different areas. Normally, two heat pump units operating on cooling mode will support one unit in the heating mode without additional energy being added to the loop circuit. This capability allowed for the individual temperature control of each office space, maximizing the comfort level.

The ground loop system consists of 32 vertical boreholes laid out in a 4 meter by 8 meter grid and were installed underneath a landscaped garden area at the rear of the building. Each vertical loop was constructed from high-density polyethylene tubing placed at a depth of around 60 meters. The boreholes were manifolded together and a set of supply and return mains terminated in a small equipment room with a set of pumps. The loop system was flushed and freeze-protected.

The success of the Dunston I project resulted in a second similar geothermal application for the Dunston II office building. This project featured approximately 40,000 square feet of office space, which required 122 horizontal water-to-air heat pump units. As with the first Dunston project, installing the individual controllers for conditioning each office space provided maximum comfort to the occupants.

According to Richard Skinner of Clima-Gas, when drilling the boreholes for the loop system on the Dunston II project, ancient Roman ruins were discovered at the site. A brief pause in construction resulted for an archeological evaluation of the discovery. After the study was completed, it was determined that no significant artifacts existed so the installation resumed as scheduled.

The Dunston I and II projects showcased the environmental benefits of the geothermal systems featuring no overall carbon dioxide emissions. According to the U.S EPA, if just 100,000 homes converted to geothermal heat pump systems, carbon dioxide emissions would be reduced by 125,000 tons per year (114,000,000 kilograms). Over 20 years, that is equivalent to converting 54,200 cars to zero emissions, or planting about 111,000 acres of trees.

We all have something to learn from each other. Europe's commitment to renewable energy sources has been reflected in the United States. Governments around the globe are being petitioned to consider new environmental standards in energy production and consumption.

The reasons the world is looking at geothermal technology are simple: energy efficiency, environmentally friendly and reduced maintenance and operating costs. When the big picture unfolds, it's a great return on investment not just for the developers, but also for communities, for families-for all of us. ◆

Karla Bradshaw is Public Relations Manager for ClimateMaster.

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The "Green" Olympics

Trisha Swindle

Only the elite of each sport earn their way into the Olympics. Such a showcase of skill and talent allows each country to put aside any challenges it is having and forget for a moment as its athletes shine. People from all over the world come to support their country and athletes, celebrate the host country's heritage, and bask in their hospitality.

The host country excels by presenting its community's best and allowing the world a chance to see the inner workings of the country through its handling of such hosting responsibilities. The Beijing 2008 Summer Olympics Committee appreciates this opportunity and has employed the brightest engineers and public officials to aid in the creation of not only exemplary games, but also an environmentally "green" Olympics.

One of these engineers is Professor Liangshi Ding from the Beijing Polytechnic University. She is using her expertise in geothermal to work with the Olympics Committee in the use and installation of geothermal heat pumps in some of the Olympic venues.

The Beijing Olympics Committee is utilizing many different kinds of environmentally friendly resources during the 2008 games, including geothermal, solar, wind and recycling. All are being used throughout the Olympics as a means of lowering the negative impact such a large increase of people can have on a community. This also provides the geothermal industry an opportunity to show the world that its technology is olympic in quality and ability.

The National Stadium

One of the largest geothermal installations is in the National Stadium, where the opening and closing ceremonies, track and field, and the final men's soccer game will be held. According to the Beijing 2008 Olympics official Web site, this facility will use a triple-pump system consisting of a geothermal heat pump, a cold water unit and a hot water unit. "This system will fully utilize the renewable energy of geothermal heat to generate simultaneous supply of cooling in summer, heating in winter for daily use," according to the Web site.

Along with the renewable energy of geothermal units, this building will employ several other "green" sources. To maintain the beautiful grounds outside of the National Stadium, "drip irrigation or micro irrigation heads in surrounding vegetations and sensors underneath the lawns of the stadium realize high efficiency of water consumption through intelligent automatic control," according to the Web site. Large windows will also be installed to make use of natural light during the day instead of artificial lighting to minimize energy consumption. These large windows will be equipped with external shades in order to maintain a comfortable and energy efficient temperature. Solar power is intended to be used to provide energy to the outdoor lighting in such places as the pedestrian square.

The Three Renewable Energy Sources

The National Stadium will not be the only building making use of natural light. Other buildings plan

to be equipped with windows and external shades too. Solar energy is to be used to provide energy for outdoor lighting and the public restrooms. The showers in the Olympic Village will be heated by solar power as well. Approximately 90 percent of the hot water used during the Olympics will be heated by solar energy.

According to the Beijing 2008 Summer Olympic Web site, "part of the power supply for the Olympic Green is expected to come from wind mills out of Beijing, and the potential of building local wind mills will be studied." Roughly 20 percent of the electrical demand at the Olympics is planned to be supplied through wind mills.

Reasons for Choosing Geothermal Energy

Professor Ding and the Beijing Olympic Committee chose to use geothermal energy in these instances because of its steady and reliable production of heating and cooling. It was also chosen because of the lower cost in comparison to natural gas, as well as its ability to decrease pollution. Besides using geothermal heat pumps, other geothermal technologies are to be employed through use of deep-well hot water systems, open loop shallow-well systems, and one standing well system.

Other Buildings Going Geo

Heat pumps are being installed in a variety of other buildings throughout the Olympic Village. These include the athletes' housing, spas, small office buildings, larger office buildings and classrooms. Approximately 600 units are to be installed, and total tonnage is estimated to be at least 2,000 to 3,000 pounds. In each instance, vertical single, double U-bend or horizontal slinky heat exchangers will be used. Borehole depth will vary between 80 to 150 meters. The heat pumps were purchased from a variety of manufacturers including: ClimateMaster, Mammoth Company, and CIAT Company.

The buildings will vary in size. The housing for the athletes will range from 3,000 to 6,000 square feet and will house between three to four people. They are being built from logs shipped from Finland. The office buildings will be from 130,000 to 500,000 square feet.

Athletes can visit another geothermal facility–the library at Beijing Polytechnic University.

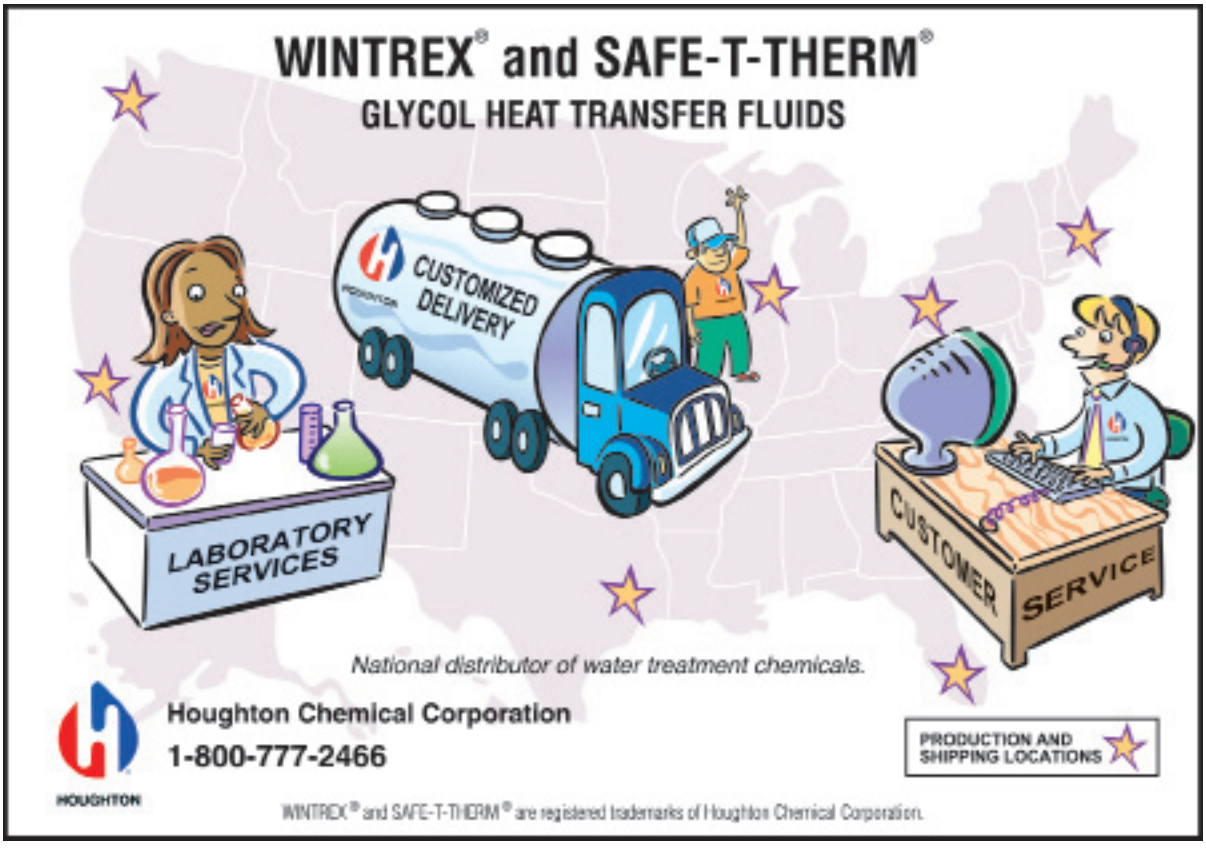
Approximately two million square feet of buildings are to be cooled and heated by geothermal units. According to the Beijing 2008 Summer Olympics Web site, the geothermal heating project in the Olympic Garden will serve 400,000 square meters in the stadiums and gymnasiums for space heating.

Other "Green" Choices

Transportation is a great concern with a large increase of people such as during the Olympics. Such a strain on a city's transportation systems or on the air quality is hazardous. To combat this issue, Beijing will build a railway system to connect the various Olympic venues and the city. To encourage spectators to use the public transportation systems, free bus passes will be provided to and from the venues. In the Olympic Village, only no emission or ultra-low emission vehicles will be used. Bicycle use will be encouraged through adding more bicycle lanes and offering free bicycles to be used in the Olympic Village.

In the spirit of conservation, the committee is also striving to conserve water throughout the Olympics. "Water and energy efficient building materials and equipment will be selected for the venues to protect the drinking water sources, water-pollution prevention and control technologies will be applied in building venues located close to water source conversation area," according to the Beijing 2008 Summer Olympic's Web site. Treated wastewater is proposed to be used to water the grass, trees, and flowers throughout the Olympic land. It will also be used for the cleaning of cars and the Olympic site.

The cultural heritage of China is of great importance to their people. The Beijing Olympic Committee is taking steps in order to preserve any cultural relics that



reside on the land set aside for the Olympics. They are striving to protect these relics so once the Olympics are complete, the people of China continue to benefit from and enjoy this place of renewed beauty.

The people of Beijing will be able to enjoy these preserved relics, but they will also be able to enjoy new buildings that the Olympics will leave behind. The stadium can be used by the people of Beijing as part of their daily exercise program, and the city of Beijing will be able to enjoy the benefits of all the "green" technology.

A beautiful Olympic forest park, approximately 40 square miles, is being built not only for the enjoyment of the people but as a form of conservation. Great care is being given to the selection of what plants shall be used in this project to ensure that only native plants are included.

The outdoors is not the only beneficiary of "green" technology use. Recycled paper is being used for all Olympic publications. E-mail is being used more frequently for inter-office communication and all computers are hooked up directly to copy machines to save paper and ink from printer use. All building construction is required to strictly adhere to specific guidelines set aside by the Olympic committee in order to reduce pollution.

The Olympics is a showcase of not only the world's finest athletes but of the community hosting the Games. In conjunction with Professor Ding, the Beijing 2008 Summer Olympics has gone beyond the traditional athletic exhibition to include a very visible presence by the geothermal industry as well as other renewable energy sources. Olympic organizers say, "we will work for a considerable improvement in the ecological environment of the city." This opportunity has allowed the geothermal industry the chance to show the world that our technology can be used at Olympic proportions.

In the News

WaterFurnace Joins With Distributor in China

WaterFurnace Industries formed a Cooperative Production Agreement with its distributor in China, Ningbo Shenglong Group Co., Ltd., on June 1, 2004, and will operate under the WFI Shenglong brand in China.

"This is a historic day for our company," said Tony Cooper, WFI Industries Global Division president.

The new venture will occupy a 200,000-square-foot portion of Shenlong's existing manufacturing and headquarters complex, ISO 9002 and QS9000 certified, in Ningbo, China, which has installed a geothermal heat pump manufacturing line.

The new construction market in China is the largest in the world and is growing rapidly. Energy conservation and environmental protection are primary concerns, and the government has mandated that all new buildings adopt renewable energy technologies. Geothermal heating and cooling is one of the approved renewable technologies that has promises for wide-scale use.

The WFI Shenglong engineering, research and test facilities will utilize the same engineering and line software used by WaterFurnace. Shenglong has completed geothermal projects using WaterFurnace equipment over the past three years.

In 1996, the Ningbo Shenglong Group was established as a high-tech enterprise producing automobile components. The company is located in a new industrial complex in Ningbo City, in the Zhejiang Province. Shenglong employs 460 people in Ningbo, including more than 100 engineers and technical specialists.

Canadian Ice Rink Gets an Assist from Geoexchange

By Jessica Frick

Operating an ice rink is a demanding job in Canada, where hockey takes the place of the country's prized past time, much like baseball is to America. This love of the ice is why the Plum Coulee Hockey Arena and Hall wanted to keep its rink in top shape for as many months of the year as possible. When ice comes into the picture, that mission can easily become a daunting task since so many variables can work against the slick playing field. However, this rural Manitoba recreation center found in 2001 that installing a geoexchange system could solve all of its climate-controlling needs.

Geoexchange-also known as "geothermal heat pumps," "earth energy," or "green heat" in Canadian provinces-has been rapidly growing in popularity across the continent due to its high efficiency, extremely consistent heating and cooling abilities, environmental cleanliness, and the remarkably low operating costs it produces.

When faced with escalating energy costs and a small community depending on its operation, the Plum Coulee Arena managers decided they had to do something with the then 13-year-old building to make it more efficient. The entire town's population is 852 people, and the not-for-profit center provides the community with a place to get together.

"We chose to use a geothermal heat pump simply for the cost of operation," said Plum Coulee Vice President Wayne Reimer. "Our most popular activities on the ice are hockey and pleasure skating, which we offer for free. We couldn't do that unless we were saving the money we are on our heating and cooling system."

Plum Coulee's utility company, Manitoba Hydro, believed that the recreation center would make a positive statement to the community as to the practicality of a geoexchange system. After working through all the system details with Ed Lohrenz, Vice President of Marketing for Ice Kube Systems, the center was able to secure a financial incentive from Manitoba Hydro's Power Smart commercial assistance program.

"Recreation centers, ice rinks and community halls account for 19 percent of the commercial installations that have obtained the benefits offered through Manitoba Hydro's commercial program," said Martin Cloutier, Heat Pump Market Specialist at Manitoba Hydro. "Since these facilities are not for profit, they are ideal applications because these systems help to keep their costs very low."

Prior to going geo, the arena made its own natural ice inside the building once the ground froze, which typically lasted only three short months. Since the installation, three Ice Kube water-to-water heat pumps provide refrigeration for making ice six months out of the year in an 85 feet by 190 feet ice surface.

The other six months of the year, the rink area isn't used, but the community hall stays open for weddings and other rented events. Although the hall has its own steering committee, which chose to continue using conventional air conditioning units for its cooling needs, it still takes advantage of the geosystem's heating abilities throughout the year.

Geoexchange System Scores Added Goals

The Plum Coulee Hockey Arena utilizes geothermal to operate more efficiently and environmentally friendly.

Ice Kube water-to-water heat pumps provide the needed refrigeration for the ice rink.

When working on an installation that means so much to such a close-knit community, there is no room for error. Fortunately, Ed Lohrenz works on these sorts of projects all the time.

This particular system's refrigeration capacity for the heat pumps is approximately 10 to12 tons each. When they are operating at temperatures needed to make ice (approximately 14 degrees Fahrenheit entering fluid temperature), each heat pump produces approximately 150,000 BTUs per hour of heat (BTU/h). Hot water, kept at approximately 90 to 100 degrees Fahrenheit, is provided to fan coils in the ice area and to the radiant floor-heating system in the lobby, locker rooms, offices and second floor hall attached to the ice rink.

When heat is not needed in the building, it is stored in a vertical earth loop. In total, 96 boreholes drilled to approximately 85 feet each provide an alternate heat sink for the heat pumps (total of 8,000 feet of vertical bore). On the other hand, when the ice temperature is satisfied, the heat pumps use the earth loop as a heat source.

During the winter, the earth loop typically operates at temperatures between 55 and 75 degrees Fahrenheit, providing a very warm heat source for the heat pumps. When using the heat stored in the earth as a heat source, each heat pump has a heating capacity of approximately 315,000 BTU/h. A small fluid cooler is used to ensure the earth loop temperature can be maintained at temperatures less than 80 to 90 degrees Fahrenheit. The heat pumps use R404A refrigerant rather than R22. This is a hydro fluorocarbon (HFC) refrigerant.

The rink floor design incorporates the use of a thermal storage buffer. This allows the heat pumps to operate at off-peak times, typically at night, to store "cold" for the next day, while at the same time providing heat for the building. The thermal storage buffer allows the use of two 3-horsepower circulation pumps to circulate chilled

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fluid through the HDPE (high density polyethylene) pipe buried in the rink floor. A conventional system without the thermal storage buffer typically would use a 15 horsepower fluid circulation pump. This reduces the energy used by the pumps. It also reduces the refrigeration load to the refrigeration system by reducing the friction loads through the pipe in the floor.

Finally, this heat pump's technology reduces the operating and maintenance costs of the building because geoexchange systems are relatively simple to operate when compared to the industry standard, ammonia refrigerant-based refrigeration equipment.

Since its installation, the system has reduced the summer peak load by seven kilowatts and the winter peak load by 56.8 kilowatts, bringing the center's energy reduction total to 98,501 kilowatts per hour per year. The demand savings, combined with Manitoba Hydro's $11,958 incentive, gave this system less than four years until it recovered a full payback.

Geoexchange System Proves A Winning Choice

Wayne Reimer is extremely pleased with how the system is operating, stating that the entire facilities utility bills are between $1,600 to $1,800 per month, as compared to the $2,500 to $3,000 per month they would have paid with any other kind of system.

With an entire village reaping the benefits of the new system, the Plum Coulee Hockey Arena & Hall shows just how much Canadians benefit from the use of geoexchange and what a fun, environmentally friendly future they have to look forward to because of it.

"Our ice floor is as good or better than any other rink around," said Reimer. "This system is every bit as efficient as we anticipated! Any community looking to put in artificial ice should seriously consider this."

This article is dedicated to the memory of Roy Staveley, late Executive Directory for the Canadian Geoexchange Coalition. Although he passed on from this life in May 2004, his legacy will live on in the Canadian geoexchange industry, a market he was instrumental in the continuing transformation of, bringing this technology onto the front line.

Roy, you will be missed...

◆

Contributing Parties

- Ice Kube Systems - System Manufacturer
  www.icekubeheat.com
- Frontier Refrigeration - General Contractor
  www.frontier-refrigeration.ca
- DNS Geothermal - Loop Installer
- Manitoba Hydro - Utility Company
  www.hydro.mb.ca
- NextEnergy Solutions
  www.nextenergysolutions.com

Web Sites of Interest

- Natural Resources Canada
  www.nrcan-rncan.gc.ca
- Canadian Geoexchange Coalition
  www.geo-exchange.ca
- Earth Energy Society of Canada
  www.earthenergy.ca

Plum Coulee Hockey Arena and Hall provides the community with year-round entertainment.

Turning Point in Japanese Geothermal Heat Pump Industry Development

by Shinji Takasugi

During the last fiscal year, the Test Use Support Initiative of the Geothermal Heat Pump (GHP) System, which is one of the Test Use Support Initiatives under the Japanese Ministry of Environment's support venture system for Carbon Dioxide Emission Reduction, was established as an independent budget item. Unfortunately, this has not been used much in the past. However, in the 2004 fiscal year, many regional public bodies are preparing to make use of this grant support. It is expected that the initiative support will be widely used in the future.

Low noise boring equipment was developed for use in high density urban areas, such as Tokyo.

There are many people currently researching GHP technology using many different methods. The aim is to expand its use as soon as possible. Consequently, the Geo-Heat Promotion Association of Japan (GeoHPAJ) is working hard to demonstrate the economic benefits of GHPs. Here are some new results from trials taking place all over the country.

Resort Location's Use of GHP and EIMY

At the Hoshino Resort Company located at Karuizawa, Nagano, the territory is operating with the vision of creating an ecological community. They were aware that emissions arising from the resort operation were affecting the environment. Using the concept of Energy In My Yard (EIMY), developed by Professor Niistuma from Tohoku University, they introduced an integrated natural energy system aiming to satisfy the needs of the resort operation and the environment.

The resort is investigating an integrated GHP use plan using small scale hydroelectric power generation and coupling it with the use of waste heat from hot springs. Areas where there are underground flows of hot spring water are suitable for a method of heat removal using advection, which is different from methods previously used.

Areas of underground hot spring water flows are very common in Japan. Since 2002, they have been con-

ducting a heat recovery test using a 400 meter deep well. Using the annular space, the open well hole between the casing and the strata of the well, the fluid convection in the ground is directly promoted. With a concentric pipe, a heat recovery of 500 watts per minute (200,000 watts per well) has been measured and is the highest ever recorded in Japan. It has also been shown that the measured value agrees well with the theoretical value.

Energy Conservation Reform at Detached House

The use of GHP for improving the energy efficiency of residential reform has been difficult in the past. However, efforts have been made to overcome this by solving various technical problems. For example, in detached housing in Hachioji City, Tokyo, low-noise boring equipment developed by Japanese company, YBM Co., Ltd. , was used to drill three 80 meter wells in a garden of the residential units. Also, a commercial inverter air conditioner was modified to become a water source heat pump. A 600 liter thermoelectric hot water heater was not used, because hot water was supplied by a GHP and hot water resulting from electricity used at night was stored using a GHP in a 600 liter tank. All this work was done while the house was inhabited by its residents and was completed without any major problems. The heating and cooling could be used in the exact same way as the previous inverter air conditioner, and the hot water supply could be used in the same way as the previous water heater. Therefore, there was no discomfort for the users. Economically, this saved energy by reducing the electricity charge and acted as an environmental measure that can be applied to energy savings. It has been evaluated very highly.

Use of ECO-LOCK Pile as a Heat Exchange Well

There are big expectations for the construction of eco-housing using GHP, both from the consumer's side and the supplier's side. The big problem with realizing this potential is the installation cost of a heat exchanging well for GHP.

Even in housing there are many buildings that are supported on piles in Japan. Many types of piles have been used, but if they are used as a heat exchanger, then the installation cost can be reduced. For instance, two or three U-tubes can be inserted depending upon the diameter in the highly versatile tubular steel piles. By using U-tubes, the leakage of circulation water from the pile can be prevented.

The ECO-LOCK piling system was used as heat exchanging wells after approval from the Ministry of Land Infrastructure and Transport.

If tubular steel piles are used for supporting buildings, it is necessary to obtain the approval of the Ministry of Land Infrastructure and Transport (MLIT). In a test, the ECO-LOCK piling system, with MLIT approval, was used as heat exchanging wells.

Steel tubular piles are normally inserted until the N-value reaches 30. Depending upon the location, if it is shallow, then it can cause trouble connecting the pipes at the surface. However, around nine steel tubular piles of 20 meter length can virtually provide the heat requirements for one house. This is a practical, low-cost method.

Steel tubular piles are inserted.

Thermal Response Test System

When using GHP, it is essential to know the performance of the heat exchanger and the thermal conductivity of the soil strata to design the optimum length of well for geothermal heat exchange and heat exchanger for the load. For this reason, it is normal to carry out a test in which a heat exchanging medium is heated and sent underground. The Kelvin line source theory was used to analyze the thermal response, calculate the thermal conductivity of the soil strata and evaluate the heat transmission characteristics of the heat exchanger.

Many companies have developed their own test equipment, but the equipment introduced here was developed by Geo-System Co., Ltd. and is of a size and weight that it can be operated by one person. Remote operation is possible, but for safety reasons a device is provided to prevent overheating. It is powered by a conventional electrical grid power source.

In recent years, it has become clear in Japan that groundwater flows have a big impact on the heat exchange performance. Therefore, in the future, it will be necessary to adopt an evaluation method that takes groundwater flows into account.

Conclusion

GHP systems use stable heat sources effectively, energy efficiently, and then help to reduce carbon dioxide emissions. In addition, heat is not discharged into the air, so they can help reduce the heat island effect at a big city such as Tokyo. The knowledge to enable GHP systems to be widely adopted is being developed throughout Japan, and just one of many examples has been introduced here. The GeoHPAJ faced a new challenge by the completion of its application to become a non-profit organization (NPO). Early in April 2004, the association began its activities as an NPO. NPO GeoHPAJ looks forward to receiving cooperation and support. On behalf of the association, the author wishes to thank all of the people who contributed information for this article.

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Shinji Takasugi is director of the Geo-Heat Promotion Association of Japan (GeoHPAJ)

Pushing, Pushing, Pushing Geothermal

By Kathryn Jones

He walks down the International Ground Source Heat Pump hallway, wearing his favorite tan baseball hat, brown leather belt and bronze belt buckle, and carefully picks a chair in an empty meeting room. He chooses a comfortable orange chair and rests here for a few moments while those with him gather to reminisce about his earlier years. Letting everyone else speak and patiently waiting to respond, he listens to the conversations that go on around him in the room. "Of all the blessings that God has given me, my Phil is number one," his wife touts of him. He finally gives a wide smile and humbly interjects some comments about his enormous impact on the heat pump industry.

No one would be able to guess it from this modest demeanor and quiet disposition, but Phil Albertson has made countless contributions to the geothermal industry - many so significant that Popular Science magazine has called him a "pioneer" in developing geothermal technology, and Fortune magazine gave him the title of "geothermal evangelist." But geothermal is merely one area that Albertson has dabbled in during his lifetime.

Like other family members before him - his father, a professor of economics at the University of Oklahoma, and his uncle, the founder of the Idaho-based Albertson's supermarkets - Phil worked his way through school, doing everything from manually setting up bowling pins at the local bowling alley to delivering newspapers. He first experienced installing buried pipe and trenching machines during one of these odds-and-ends summer jobs. "We spent most of the time laying pipe and shoveling the dirt back into

Mona and Phil Albertson.

the trench by hand, since we didn't have a tractor with a blade," he told the IGSHPA newsletter, *The Source*.

Albertson then entered the U.S. Air Force Jet Fighter Pilot Training program during the Korean War where he was assigned to a group that was trained to deliver a retaliatory MK-7 bomb to a military target in the former Union of Soviet Socialist Republics (USSR). He had to, along with the rest of his flying group, memorize low level checkpoints to escape radar detection with the F84F jet fighter planes - aircrafts that came in at 500 miles per hour at an altitude of anywhere from 50 to 200 feet. During this time, Albertson designed a ground performance pocket computer for F84F takeoff and stopping performance, which saved the pilots' time that might otherwise have been spent checking several other reference books. The ground performance pocket computer worked like a circular slide ruler with windows and scales. It was picked up by the Republic Aviation Company and the U.S. Air Force for both organizations to use. Albertson completed his military obligation in 1955.

In 1959, Phil completed his industrial engineering degree from Oklahoma State University and began working for Charles Machine Works, manufacturer of the popular Ditch Witch, in Perry, Oklahoma, as an industrial and manufacturing engineer. His many duties at the company - all of which were done concurrently - included: new product design; sales forecasting; materials scheduling and purchasing; manufacturing machinery specification and purchasing; tooling design and component purchasing; productivity improvement project management; facilities expansion and manufacturing flow layout; and new product research and development. Albertson was acknowledged as an exceptionally hard worker at the company, and those that he worked with came to regard him as having "the tenacity of a bulldog."

A Charles Machine Works employee demonstrates a vertical drilling machine that Albertson helped design.

Albertson's direct involvement with the geothermal industry started when he attended one of Oklahoma State University's first GHP workshops in 1978. It was there that he got to know Dr. James Bose, now the executive director of IGSHPA. "Phil came on over to the class from Charles Machine Works to just see what all we were up to and he was appalled that we were using backhoes instead of trenchers," Bose said. "This class was really the start of a strong working relationship." Albertson talked about the class in *The Source* and said,

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"After finding out that the greatest problem (among those in the class) was installing pipe, I took the group to the Ditch Witch proving grounds and demonstrated how much faster and easier it can be done with a Ditch Witch trencher."

Shortly thereafter, Albertson, Bose and several other individuals decided there needed to be an association for the geothermal industry, but the group would need a constitution and some bylaws. Bose recalls how he and Albertson were staying at a hotel where an association of cake bakers was having a convention. "We just wrote our constitution and bylaws based on theirs," he said with a chuckle. "We thought, 'Hey, why not?" Shortly following this incident, Charles Machine Works became the first member of IGSHPA.

While at Charles Machine Works, Albertson designed two vertical drilling machines. The first could trench and backfill; the other was more compact, with a unique mud pump design that minimized wear. In addition to these machines, he developed a four-pipe attachment for a trencher that would allow an installer to trench, place four polyethylene pipes at independent depths, and back fill the trench with a mud slurry. He also helped adapt equipment and developed procedures to drill horizontal bores for installation of ground heat exchangers. This process decreased installation time of horizontal ground loops by as much as 50 percent.

It was not surprising then that in 1981, Albertson designed and installed a geothermal system in his own home. The system is currently saving him 60 percent in operating costs alone - about $1,000 each year - compared to his former propane heating and air-conditioning systems. In his home, Albertson also installed the first solar hybrid geothermal system and kept tabs on the unit by installing the copper pipes through the bookcase in his family room so that he could monitor all the systems' activities. He even installed the system's gage just to the left of his easy chair so he could monitor it without getting up. Albertson's work with heat pumps in the home has benefited his family in more ways than one - two of Albertson's four children currently work in the geothermal industry.

Albertson was also responsible for developing and designing the slinky pipe configuration - the flattened, overlapping plastic coil - which has become a staple in the industry. It minimizes stored energy losses and increases the efficiency of the energy recovery by concentrating the pipe-to-earth heat transfer into a small storage volume. When Albertson first came up with the idea for the slinky, Bose said he and Albertson were working together on a contract project to design an ice storage system. They needed to put 500 feet of pipe into a 5,000 gallon tank, but they needed to be sure that the pipes were spaced throughout the tank to avoid gathering ice. Albertson had played with his children's Slinky-brand toys that they had gotten for Christmas, and he wondered if he could use this same design concept. After playing with the toy, he discovered that when it was laid out flat that this design would work perfectly

In his Air Force uniform, Albertson poses for a picture atop a fighter plane during the Korean War.

for the tank. The pipe configuration is currently a very popular choice for GHP installations. Albertson told The Source, "I designed the slinky configuration initially for off-peak earth energy storage. Test results were promising, but showed a need for a test using relatively simple changes in the storage pipe configuration."

He is also responsible for aiding in the design process of Oklahoma State University's Smart Bridge

Another of the many Ditch Witch machines that Albertson helped design. Although retired, he continues to do consulting for the Ditch Witch manufacturer, Charles Machine Works.

project. The project is a bridge deck heating system used to eliminate icy bridges and overpasses during the winter and would be an alternative to chemical and salt de-icing. Albertson developed the details of the bridge's design, layout and installations procedures for incorporating geothermal heat pump systems into the bridge's deck. The bridge has been up and running since 1999, but Albertson actually began working on designing the project as early as 1986. Albertson pitched his idea to members of the Oklahoma Department of Transportation, including then Gov. Henry Bellmon, and even the federal government. For the bridge calculations, Albertson used a pocket computer that he designed to be used for geothermal calculations and sizing geothermal equipment. It served as a comprehensive analysis system for designing and analyzing the economic benefits of heat pumps and other energy conservation systems.

As an advocate for the geothermal technology, Albertson continues to actively promote the industry. He is a great supporter of IGSHPA activities and has been a member of the Advisory Council since the organization's inception. He has served in several of the association's committees, including Training, Marketing, Research, Bylaws, and is chairman of the Standards committee - and has been since the committee's establishment.

Albertson is currently retired, but that does not mean he is not working hard to benefit the industry. He is a geothermal consultant for Oklahoma State University, as well as his former employer, Charles Machine Works. Bose recalls how Albertson was the ultimate consultant even before he was retired. "Every time there was a problem with trenching or backfilling, he would go anywhere in the world and solve it," Bose said. "And he wouldn't stop working until he was completely finished. That's just like him - pushing, pushing, pushing."

And it is this pushing that has impacted the geothermal world so greatly and benefited so many - reaching beyond the United States into international territory. Albertson will continue this commitment to the geothermal industry by enthusiastically devoting his great knowledge and experience of ground source heat pumps. ◆

Palmer Bit

Geothermal Incentives

Getting to Canadian Dollars and Sense

By Jessica Frick

Geoexchange systems' payback periods vary per system, as do the initial installation costs. However, the option to use geoexchange becomes a very attractive one when the life-cycle costs are applied to the system. Studies have estimated that commercial installations in cold, Canadian climates usually show a payback in the four to eight-year range. For this reason, utilities and associations began taking matters into their own hands to promote the use of geoexchange by offering programs that ease the financial investment required for a typical installation.

Residential Programs

Homeowners in Manitoba have been taking advantage of Manitoba Hydro's Residential Earth Power Loan, a 6.5 percent fixed rate loan with a maximum term of 15 years, since it began in 1996. The maximum amount of the loan is $15,000, which can be conveniently paid on the customer's energy bill.

Lowering the Residential Earth Power Loan rate from 8.5 percent to 6.5 percent has had a dramatic effect on program participation - applications received have increased from 34 in 2002 to 83 in 2003-a 144 percent increase. Although not all homeowners influenced by the program have requested financing through the Residential Earth Power Loan, the amount of homeowners influenced by the program have accounted for an estimated total energy savings of 1.7 gigawatt- hours, demand savings of 0.6 megawatts, natural gas savings of 156,802 square meters, and a reduction of 1,618 tons of carbon dioxide.

Commercial Programs

To assist commercial and institutional customers with the installation of geothermal heat pump systems, financial incentives are offered through individual utility companies for both pre-project feasibility studies and system installations. Since its inception, 101 commercial heat pump projects have been completed utilizing Manitoba Hydro's Power Smart assistance. These installations have accounted for energy savings of 7.4 gigawatt- hours demand savings of 8.2 megawatts and carbon dioxide savings of approximately 1,550 tons. Interest in the program has increased in the past year, and more than 37 heat pump projects are currently in the feasibility study and/or construction phase.

In addition to utility-supported programs, Canada has begun offering energy efficiency programs that provide financial incentives based on overall efficiency. For example, NRCan's Commercial Buildings Incentive Program (CBIP) provides a financial incentive of up to $60,000 for building owners whose designs meet CBIP requirements. The CBIP incentive for a building that meets the program criteria is calculated as a one-time financial incentive equal to twice the difference between the estimated annual energy costs if the building were constructed to the Model National Energy Code for Buildings standard, to a maximum of $60,000 or the total design costs, whichever is less. New or extensively renovated industrial, commercial or institutional buildings that are heated and/or cooled, intended for occupancy, and constructed to the program criteria will be eligible.

The program requirements are based on two documents: MNECB and CBIP Technical Guide. An eligible building design must demonstrate a reduction in energy use by at least 25 percent when compared to the requirements of the MNECB. The duration of this program will be from April 1, 1998, to March 31, 2007.

Although incentive programs like this one do not directly promote geoexchange, a geoexchange system, when installed, can help a building get to the needed goal in order to win the award.

Tech Park in Energy Hungry China Conserves with GHP

by Kathryn Jones

As the People's Republic of China continues to face challenges regarding energy efficiency, it is becoming crucial to utilize new technologies in order to meet the country's energy needs. However, the Zhongguancun Science Park, located in Beijing, is prepared to help lessen the city's energy woes.

As one of the fastest growing high-tech parks in China, the park has adopted a policy of using energy-efficient and environmentally-friendly technologies in the construction of their buildings - which includes solar, groundwater and geothermal technologies. Such a policy became necessary to implement so that Chinese entrepreneurs, who have been educated abroad and have worked in high-tech industries in the United States, Europe and other countries, could be recruited into the park to start their own businesses.

Dr. Xu outside the building site of the Zhongguancun Science Park.

Sustaine Technologies - a technology firm from Columbia, Missouri, with offices in China - has partnered with the Shougang Group Company, the largest state-owned company in Beijing, to design and install the closed-loop geothermal heat pump system for the first phase of the park development. Within the park, a demonstration project for geothermal technology is currently under construction for a 280,000 square foot, three-story office complex, plus 15 apartments occupying a wing of the building. Heat pump units of 800 United States refrigerant tons (USRT) in total will be used in conjunction with 720 vertical boreholes with depths of 200 feet. This project is the first phase of their program to apply ground source technology to other sectors, including industry, restaurant water heating, and aquaculture.

The complex will serve as housing for technology researchers. Dr. Shawn Xu, senior research and development engineer for Sustaine and Research Associate Professor at the University of Missouri-Columbia, is coordinating the project with the project's design institute heating ventilation and air conditioning engineers. He said, "This office-apartment complex project is the perfect opportunity to show the advantages of ground source heat pump technology in providing a comfortable environment for both office and residential spaces." He added that two separate systems will service the two sections. This project is the first phase of their program, which will be applying ground source technology to other sectors, including industry, restaurant water heating, and aquaculture. The heat pumps are being supplied by Addison Products and being installed by Sustaine Technologies.

Townhouses in Shanghai are amoung Sustaine Technologies other projects.

This project also received a grant of 1.5 million Chinese yuan - or approximately $200,000 U.S. dollars - from the Beijing Municipal Government through its Energy Savings Office. An office representative said the agency is enthusiastic about the potential of closed-loop geothermal systems to improve air quality and save Beijing's valuable ground water resources.

In the technology park, coal- and oil-burning boilers are not permitted because of environmental concern, but there was also another need for the park to implement such an environmentally-friendly policy: China is the second largest energy consuming country in the world.

"China is experiencing significant challenges in energy supply," said Shaojun Xin, director of the City of Beijing's Center for Energy Conservation and Environmental Protection. "The use of renewable energy and improvement of energy efficiency in both residential and commercial buildings are top priorities of the Beijing city government."

Xin added that he is impressed with the park's decision to use systems that do not involve pumping groundwater. "We especially encourage the use of closed-loop systems that use the underground energy without pumping groundwater, since underground water is a very limited resource for most cities in China," he said.

The park is located in the Haidian district of Beijing and leads the nation in the development and commercialization of new technology with its research and development resources. The district is also home to 39 key universities - including Tsignhua University and Peking University with a total of 300,000 students - and the Chinese Academy of Sciences that employs 20,000 scientists.

Many companies have set up offices or research centers in the area, including Microsoft, Hewlett-Packard, Bayer, Philips, and Motorola - who just last year set up a $100 million U.S. dollars research center in the park. Companies that have registered their subsidiaries in the park include Siemens and Oracle.

Xin said he hopes that the park's decision to use geothermal technology will persuade other businesses in Beijing to use it as well. "We are glad to sponsor the ground source heat pump technology project for the Shougang and Sustaine joint project and encourage the use of this technology in our new development zone," he said. "We have great expectations for this project and hope that it can show the great advantages of ground source heat pump systems." He added that his staff will continue to monitor the operation of the system and use the data as a reference for future projects.

Xu said that the research for the demonstration project will be of "great benefit, not just for Sustaine Technologies and the Beijing Center for Energy Conservation and Environmental Protection, but for the entire industry for technical development and marketing in China."

Building Demand from the Ground Up

By Jessica Frick

Building the market from the ground up has brought together various associations, utilities, government agencies and industry-related businesses under a unified vision: to increase the use of geoexchange and the numbers of people working with the industry.

"Given the Canadian climate, with its wide range of temperatures and the country's predominately higher heating load, a geoexchange system is a rational technology choice for Canadians, since none of the system's components are exposed to the outdoor air temperatures," said Phyllis Hoshino, Chief Interagency Energy Efficiency Cooperation at Natural Resources Canada (NRCan), who was also an instrumental proponent in winning geoexchange the attention it's currently enjoying in Canada.

"However," Hoshino continued, "despite its market-readiness, geoexchange systems have had negligible penetration in the Canadian HVAC market because of institutionalized barriers in the marketplace."

One of Canada's champion utility companies, Manitoba Hydro, has already found that those barriers are workable. Although the province represents less than 4 percent of the national population, Manitoba accounted for approximately 19 percent of geoexchange installations in Canada in 2003. Sales in Manitoba grew from 400 units in 2002 to 513 units in 2003, a 28 percent increase, and by the end of 2003, total heat pump saturation in the province was 3,413 units compared to 34,750 in the entire country.

Martin Cloutier, heat pump market specialist at Manitoba Hydro, believes the lack of awareness, the industry's current infrastructure and the potentially high cost associated with the initial installation to be the obstacles he most often encounters.

"We have found the obstacles to the widespread use of geoexchange systems to be challenges, but we believe that they are issues we can work with," said Cloutier. "Manitoba Hydro's 'Earth Power' program mitigates market barriers by separating the needs of the residential and commercial markets and addressing their demands individually. It's been successful."

A pioneering example of a successful utility supporting and promoting the use of geoexchange, Manitoba Hydro is reaching out to all customers in their service area to help overcome the lack of industry infrastructure and public awareness.

Creating Canadian Industry Infrastructure

Consumer confidence is a tough issue for those just entering the Canadian geoexchange market. Sometimes their lack of exposure to the technology leaves uninformed customers without professional confidence, as well as untrained contractors who feel as though they would like to get into the market but aren't sure how.

"It's hard to find people that are qualified in a new technology to sell your product," said David Hatherton, geoexchange pioneer and president of one of Canada's biggest geothermal companies, NextEnergy. "Trade people, if they're not trained properly and don't have

a real familiarity with your product, discourage the company they work for from selling it. Offering training opens you up to a more professional marketplace."

In response to this barrier, the Ontario-based NextEnergy, which turns 5 years old this year and was recognized by Profit Magazine as one of "Canada's 50 Hottest Startup Companies" in 2002, constructed a training center occupying 3,000 square feet of their 11,000-square-foot facility where the company offers a free, three-day, hands-on program that covers the basics of its renewable energy technology. As a result, the firm's service call rate has dropped by at least 50 percent, says Hatherton.

Utilities are taking this barrier to heart, as well. To counter this hurdle, Manitoba Hydro organizes and sponsors International Ground Source Heat Pump Association (IGSHPA) Installer Training Courses. In 2002, approximately 50 percent of the accredited installers in Canada took advantage of the two courses offered. There will be three courses offered this year, which will increase the amount of installers more than 100 percent, from about 50 in 2003 to 132 by the spring of 2004. This increase exceeds the original goal that they had hoped to have 100 installers ready to meet the demands of 2005. The utility promotes them by including a list of accredited contractors on their Web site and by inserting the list into the information kits sent to its customers.

In addition to the IGSHPA courses, Manitoba Hydro is also marketing and sponsoring the Heating, Refrigerating and Air Conditioning Association's (HRAI) "Residential Heat Loss and Heat Gain Calculations" course. The course, which will focus specifically on the detailed heat loss and gain calculations required for heat pump applications and loop sizing, is already full.

The government is taking consumer confidence seriously. Canada's Energy Efficiency Act regulates standards for equipment in the country, eliminating inefficient, energy-using systems from entering the market. Testing standards are mandated through Canada's Energy Efficiency Regulations for HVAC equipment. All of the standards for GSHP equipment, design, and installation practices are upheld to reinforce industry performance standards and to increase confidence in the technology.

Developing Awareness About Geoexchange

In order for geoexchange to penetrate the market, consumers needed to learn about and understand what the technology is and what it will do for them. Early assessments throughout Canada showed that few people knew what it was and even fewer had one installed, even though the country itself was a pioneer in the use of geoexchange. During the beginning phases of Natural Resources Canada's Renewable Energy Deployment Initiative (REDI) program, geoexchange represented less than 1 percent of the total non-residential HVAC market. Projected sales were optimistic, and rightly so, but the numbers were cautioned with statements advocating a strong awareness campaign to ensure successful market growth.

According to Cloutier, awareness has increased to about 41 percent in Manitoba since April of 2002, when surveys showed that only about 20 percent of Manitoba Hydro's target market customers (single detached homes) had heard of geoexchange.

It is fair to say that the knowledge was almost entirely created as a result of the utility's awareness campaign. The campaign included advertising in magazines and newspapers, informational pieces on utility Web sites, mailed information kits with case studies, presentations, articles in the company newsletter, and media coverage resulting from the company's promotional campaign. The utility also provides information on its toll-free phone line. Ultimately, Manitoba Hydro plans to continue working on its promotional efforts to reach its goal of an overall awareness percentage of 60 percent by the end of 2006.

Tenants Go Green to Keep Clean

by Kathryn Jones

When they took over many homes in Cornwall, England, which were in need of renovation, the Penwith Housing Association of England had an energy policy aimed at providing affordable warmth for all of its tenants. The policy did not include burning fossil fuels.

Coal-fired heating was in the 14 single-story houses - called "bungalows" in the United Kingdom (UK) - that the association was ready to renovate. "Some residents are frail or elderly and find it hard carrying bags of coal around," said Denys Stephens, the association's senior architectural assistant. "It's fairly expensive, and there is dust and mess, too."

The homes had an open coal fire grate in the living-rooms and a back boiler behind the grate. The coal fire attempted to heat the homes' livingrooms - and the back boiler heated water for a couple of other radiators and the domestic hot water.

The association had many options. Conventional electrical heating, or storage heating, does not provide affordable warmth. And - as it is called in England, "mains electricity," or electricity from a main line - is responsible for producing high levels of carbon dioxide. Oil-fired heating can provide affordable warmth; however, recent legislation that called for bonded fuel tanks was bringing installation costs to new levels. Robin Curtis of GeoScience, the lead consultant on the project, said there were really only two heating and cooling options from which the tenants could choose.

The small gardens near the homes were virtually untouched by the drilling.

"Down here in Cornwall, we have limited mains gas supplies, and the options for upgrading the heating systems in these bungalows was oil fired central heating or GSHPs," he said. "In consultation with the tenants, they opted for geothermal - very bravely."

And brave indeed. After choosing geothermal, there were challenges that the association had to face.

Overcoming the Odds

First, there was the obvious up-front cost of geothermal, but Curtis

said this really was not much of a problem. "The capital cost is obviously higher," he said. "But this was met by a capital grant - both from the government's Clear-Skies program, the PowerGen utility company and support from the local Penwith District Council," he said.

Second, there was the problem with retrofitting the systems. "Some people said we wouldn't be able to install it in existing buildings," Stephens said. "But lots of our homes need heating, and we need to face up to it."

Curtis added they also had a hard time dealing with the homes' radiator systems internally. Stephens said that they had to stagger the installation because they did not remove the existing radiators until the ground works were completed.

"(The homes) had gravity-fed radiators, but they were not appropriate for the system," Stephens said. "In new units, geothermal is often used with under-floor heating, but we can't do that in existing homes. We had to ask what would work in existing houses with new equipment. Radiators were usually the best solutions, and then we had to ask which radiators would be best with the system. A conventional boiler wants to deliver heat quickly and then turn off, and the latest components are designed for that approach - like radiators with low water content that heat quickly to provide a quick hit."

Another barrier included drilling boreholes in the small gardens surrounding the homes. The rig that was used was about 2.5 meters high, and it drills two 200 millimeter holes in each garden. "It worked very well," Stephens said. "We came away from the gardens, and the daffodils were popping up untouched."

There was also an abundance of groundwater in the area. Stephens said his contractors from Carnon Enterprises really had to rise to the challenge. "It used waterproof material to cover the garden, and it used a drilling rig made by Holman that runs on tracks small enough to go down a garden path," Stephens said. "There was lots of groundwater, but there was a tanker on standby, and the water was pumped out straight away."

Geothermal Market Barriers in UK

Curtis said that this was "a breakthrough project for GSHPs in England. It's the first time that we have retrofitted borehole-based closed loop ground source heat pumps in the social housing sector." Stevens said the project proved some useful lessons. Even though these tenants chose geothermal, there are still serious market barriers in the UK when it comes to installing this type of renewable energy.

"There is not really an existing industry ready for these projects, and it is something that is affecting all renewable energies," Stevens said. "I have never run a contract before that put plumbing and heating contractors together with drilling contractors, and we don't have a workforce that's clued up for these technologies."

Despite this, he said, "Technically, I am very pleased with the way things have gone." And so are the residents.

Pleased with Their Pumps

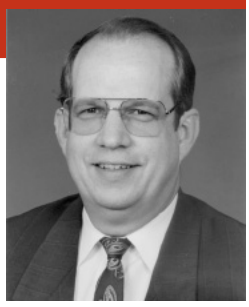
Curtis said a major benefit for the tenants is the obvious cleanliness compared to their coal burning systems from before. "They will no longer have to fetch the coal from the outside bunker, and they should have lower fuel running costs than any other heating system that they could currently be offered," he said.

At a meeting in the village hall, all the residents were enthusiastic to try the new geothermal technology, Stephens said. "We couldn't have done it without their support."

He added that the only problem the residents have had is getting the heating controls to work properly. "Whatever system is used, heating controls are always difficult," he said. "One problem has to be user awareness that a heat pump is not the same as a fossil fuel boiler." The association's response is to employ a part-time energy advisor who visits residents to help them get the most out of their system.

But these tenants are very pleased with their systems, and one thing is certain - they don't need advise on how to shovel coal and still stay clean in the process. With their new heat pumps, the residents and homes are staying clean - and so is their environment.

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.

In foreign markets, is there one key point to be cautious about when sizing geothermal heat pumps?

Yes - equipment capacities. Here in the U.S. we are used to a number of different power supply voltages that are 60 cycle and either single or three phase. In many other countries, the power is 50 cycle. This significantly impacts equipment capacity. Review equipment capacity carefully at the operating temperature parameters, flow rates and electrical characteristics you will be using. The capacities that you are used to working with in the USA are greater than the same equipment, under the same conditions but on a 50 cycle power source. While it is recommended that you use manufacturer's data, as a reference, typical correction rules of thumb are 60 cycle data times 0.833 for CFM, 0.92 for capacity and 0.95 for watts.

This is my first international project. What do I need to prepare for?

Virtually everything, but be sure to:

- Verify travel and work documents and the time frames they allow are adequate if you encounter delays
- Verify that you can source "IT" at the project location or near by. If not, take what you need (plus spares) with you.
- Remember the time frames it may take for equipment and materials to clear customs
- Verify the power source at the exact site, not the general area
- Remember that your American electric tools will probably not work
- Remember metric versus inch/pound measurements
- Investigate local work cultures and be prepared to work with them

Any differences in loop design criteria?

None, other than the equipment capacity issues discussed in the first question. Also, be sure to verify that the equipment capacities used in your loop design programs include or can include 50 cycle power and international voltages.

What about travel documents and shipping paperwork?

- Investigate the country's entry and work paperwork requirements. In most cases you must write the country's Embassy for a work visa. Typical travel related documents are not usually acceptable as work documents.
- Be sure to keep original U.S. export documents at the project office. These are used to receive all equipment and material and will be used during demobilization as proof of what equipment was sent out of the U.S. and is now being returned.

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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