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GEOTHERMAL HEAT PUMPS: Technology Transfer Training

James E. Bose, Marvin D. Smith, and Jeff D. Spitler
Oklahoma State University

KEY WORDS

engineering training, geothermal heat pumps, ground source heat pumps, HVAC, heating, cooling

PROJECT BACKGROUND AND STATUS

Ground source heat pumps are one of the nation's fastest growing businesses in terms of increased sales of equipment as reported by geothermal heat pump manufactures. One reason for the fast growth of geothermal heat pumps (GHPs) used in the residential and commercial heating cooling and water heating market are demonstrations that this technology can save significant amounts of energy and save customers money. Engineers and architects are needed to be trained in the ground source technology to provide the desired growth in the industry. This project was focused upon assisting and training those in the federal sector to increase implementing this technology. Technical support was provided for several federal projects, primarily DoD's SERDP (Strategic Environmental Research and Development Program) funded by DOE. A training manual for architects and engineers was developed, material was prepared for presentation, and a training seminar was presented in the Washington DC area in September 1995.

Over the course of the SERDP Program eight DoD bases received SERDP funds after considering 20 bases. The eight bases involved installations of about 4,500 GHPs with an investment of about $20 million. Much of the effort was coordinated with Sandia National Laboratory and Oak Ridge National Laboratory who were involved with design assistance, GHP acquisition and installation, and monitoring.

PROJECT OBJECTIVES

Project objectives are to provide technical assistance for selected federal geothermal heat pump design projects to increase the installation of GHP systems and to develop and deliver an architects and engineers training program to enhance the implementation of GHP systems in the federal sector.

Technical Objectives

Technical Assistance

- Provide the federal sector access to experts in the geothermal heat pump field

Technical Objectives (continued)

Technical Training

Present "the state of the art" overview of:

- Geothermal technology,
- Space heating and cooling and water heating technology,
- The design of residential, commercial and industrial applications,
- Geothermal equipment (heat pumps, circulators, underground piping, etc.),
- Design procedures and methods, software, design tools,
- Installation methods and procedures, the associated equipment, types of heat exchangers, completion (grouting/backfill) choices, and
- Inspections, commissioning, performance monitoring, contracting, & fed. customers.

Expected Outcomes

- Increased number of federal projects involving GHP technology through the leadership of class participants and recipients of technical assistance on projects.

APPROACH

With respect to technical assistance, the approach was to be available to assist in the design of any federal GHP project upon request by the project officer. The approach for the training portion of the project was to develop material pertaining to design and specifications of GHP systems and assimilate pertinent material already developed for inclusion into a design manual. A team of experienced persons was organized to develop material for the manual and for presentation during the training seminar. Individuals in the federal sector having or potentially having responsibility for GHP projects were contacted and invited to attend the seminar.

Technical Assistance

Examples of projects which were given assistance and a brief synopses of each follows: Army bases in Texas and Michigan receive assistance through coordination with Bill Sullivan, Sandia National Laboratory, providing basic information to do a review of building loads and heat exchanger lengths for GHP projects on the respective bases. Vance AFB, Enid OK, was also visited by a team to evaluate and select potential projects. The selection was a day care center

on base to do a design study in incorporating GHP for heating and cooling the building. A design was accomplished for this facility. Another example is the evaluation of the potential for using GHP's on a large maintenance building on Tinker AFB.

Technical Training

Speakers in the program included: Phil Albertson of Ditch Witch, James Bose, Fred Jones of OSU (Oklahoma State University), Steven Parker of Pacific Northwest Laboratories, Randolf Perry of OSU, Gary Phetteplace of US Army (CRREL), Philip Schoen of Earth Energy Technology and Supply, David Shizak of US Navy (Pax. River), A. Glenn Simpson of PEPCO Services, Inc., Marvin Smith, Jeffrey Spitler of OSU and Louis Torbett of Torbett Engineering.

Some salient features of the training activity and a brief synopses of each follows:

Design Methods and Software

Jeff Spitler prepared material for the manual and presented it, including load calculations and the programs available to predict the loads. Material presented covered examples to apply software packages to do building loads, heat pump selection, ground loop heat exchanger design, and determination of ground thermal properties including in-situ test procedures. A discussion of using rule of thumb methods and comparison with design calculation were made. Techniques of designing Slinky heat exchangers developed by Marvin Smith were included in the manual.

TEI-CADD AutoCAD Templates

Lou Torbett of Torbett Engineering developed material for the manual and gave a demonstration of the HVAC software module which is a supplement to the basic AutoCAD program. This module simplifies the interface between the operator/designer and the "machine", so that the simple repetitive CADD operations are automated to allow the operator/designer to concentrate on the design task. Various templates include electrical, heat pump equipment, plumbing and geothermal wellbore designs. Combined engineering and designer project time through the use of this system has been reduced from 50% to 75% once the users become familiar with it.

Ground Field Design & System Commissioning, and Specifications

Phil Schoen of Earth Energy Technology & Supply along with Lou Torbett developed and presented many combinations of wellbore template designs with header configurations. Phil also presented features of commissioning a system which would reduce potential problems and help expedite the process. A set of general specifications was assimilated by James Bose and Phil and they were integrated and included in the manual. Phil Schoen discussed special features of the specifications.

System Performance Monitoring

Gary Phetteplace of US Army Cold Region Research and Engineering Laboratory and Bill Sullivan of Sandia National Laboratories developed material for the manual on requirements and case studies regarding measuring and monitoring GHP systems in the federal sector. Gary presented the material at the training session.

Interfacing with the Federal Customer

Dave Shizak of the US Navy Public Works Engineering Department developed presentation material pertaining to experiences in promoting, obtaining approval and completing a GHP project for the Navy. He brought out some key features in working within the federal system.

Other material was included in the manual and presented at the training seminar, some which was developed previously and some specifically for this seminar. Demonstrations with pipe fusion equipment, pipe testing equipment, heat pump start-up, and purging were conducted by Jim Bose, Randy Perry, and Fred Jones. An ASHRAE manual was also provided to participants. All the IGSHPA manuals provided to train-the-trainers were also a part of the training packet.

A survey was made among several in DOE and DoD to determine the salient features that should be covered in the training sessions. The significant thrust is considerations in contracting GHP's from selling the concept to specifications and standards and from site selection to maintenance of the installed system.

RESEARCH RESULTS

Representatives from the Army, Navy, Marines, Air Force, Department of Defense, Department of Energy and others were participants in the training. One from Anderson AFB in Guam came and had direct application of the material presented. Over 25 people attended the training and manuals have been provided to several who could not attend and to those who have heard about the training and requested the material or attended the sessions and wanted the material for key people in their organizations.

FUTURE PLANS

Increase to six Pentium 90MM CPU computers and training engineers and designers on TEI-CADD systems in conjunction with other software design tools in cooperation with ASHRAE and GHPC. Increase the coverage in some of the design areas to include specific case studies for integrated systems, schools and commercial buildings. Design examples and design methods would be presented which would take these projects from conception to operation while utilizing design tree decisions and multiple software packages.

INDUSTRY INTEREST AND TECHNOLOGY TRANSFER

Industry interest is on the increase. More applications are being explored that will utilize resources not extensively tapped in the past. Examples such as convenience stores like the Phillips 66 stations where integration of the energy sources and sinks are made to reduce operating costs, and obtaining energy from abandoned mine waters to heat and cool with GHP's are being put into practice. These same concepts can be applied to the federal sector. Some of the participants in the training have projects which they are in the process of implementing, thus an indication of the interest. Training programs such as this project are an effective method of technology transfer.

REFERENCES

Copies of the architect and engineers training manual developed for this project are available from the International Ground Source Heat Pump Association at cost. It is referred to as the DOE/DoD 94 training manual.

CONTACTS

DOE Program Manager:

Lew Pratsch
U. S. Department of Energy
Geothermal Division, EE-122
1000 Independence Ave., SW
Washington, D. C. 20585
Tel: (202) 586-1512
Fax: (202) 586-8185

Principal Investigators:

International Ground Source Heat Pump Association
482 Cordell South
Stillwater, OK 74078 - 8018
Tel: (405) 744-5175
Fax: (405) 744-5283