Final Scientific/Technical Report

Award Number: DE-EE0000321
Recipient: Cleary University
Project Title: Cleary University Geothermal Energy Retrofit, CDP NO. 54.09
Project Director: Gary Bachman, Facilities Director, Cleary University
Consortium/teaming members: none

Distribution Limitations: NONE

Executive Summary

Cleary University owns a 30,000+ square foot pre-fabricated steel, industrial building including 3,400 square feet of office space. The office space was heated and cooled by conventional, gas forced air roof top HVAC units. The former manufacturing space includes a mezzanine space with a 9'ceiling and 21,120 square feet of open space with a ceiling height ranging from 18' to 21'. Adjacent to this building are 3.75 acres of open land owned by the university and available for the geothermal ground heat exchanger.

The Cleary University Geothermal Energy Retrofit project involved:
1. A thermal conductivity test;
2. Assessment of alternative horizontal and vertical ground heat exchanger options;
3. System design;
4. Asphalt was stripped from adjacent parking areas and a vertical geothermal ground heat exchanger system installed;
5. the ground heat exchanger was connected to building;
6. a system including 18 heat pumps, control systems, a manifold and pumps, piping for fluid transfer and ductwork for conditioned air were installed throughout the building.

In November, 2012, the natural gas to the building was disconnected and the building is being 100% heated and cooled with the geothermal system. The building is designated for future use as a community wellness and recreation center. New restrooms, locker rooms and a demonstration kitchen will be installed. The system was designed with capacity to provide domestic hot water to the entire building following build out of the wellness and recreation space.

Comparison of Actual with Original Expectations

The original goals of the project were to eliminate natural gas consumption, reduce electric consumption, improve temperature control and improve occupant satisfaction. Natural gas has been disconnected from the building and there has been a small decrease in electric consumption. Electricity and gas were operating two roof top HVAC units and one split unit supplying the office space. It is now operating 8 heat pumps, all air circulation fans and all fluid circulation pumps supplying the office area and 10 heat pumps, all air circulation fans and all fluid circulation pumps supplying for former industrial space. Total building electricity consumption has been reduced. Temperature control in the office space is managed by programmable system that provides 8 zones of control compared to the original 3 zones and occupants of the office space report improved satisfaction with the temperature in their individual work spaces. Actual has met or exceeded all original goals.

Lessons Learned

All phases of this project took longer than expected. System design was prolonged primarily due to no prior grant recipient experience with geothermal systems. Understanding and evaluating options took more time than expected. System construction was delayed by equipment delivery lead times and scheduling of construction in a building that remained open and in operation during construction. Both system design and system construction were made more complicated because they had to accommodate a future build out of space.

On future projects it is recommended that the geothermal system design coincide with new building design or renovation design and that system construction coincide with new building construction or renovation build out.

Submitted by:

Gary Bachman
Project Manager
Facilities Director
Cleary University
Genoa Township, Michigan

The Cleary University Geothermal Energy Retrofit project, CDP NO. 54.09, is an initiative by Cleary University, Livingston County, Michigan campus, to install a geothermal alternative energy solution to research the effectiveness of this energy source for campus and community consideration. The University will measure energy savings, and make the research methods and results available to the public and make the geothermal installation available for study to others contemplating retrofitting existing commercial buildings incorporating alternative energy options. The project should also significantly reduce campus energy consumption.

Scope – The building to be converted to geothermal is a 30,000+ sq. ft. pre-fabricated steel, industrial building including 3,400 sq. ft. of office space. The office space is currently heated and cooled by roof top HVAC units and domestic hot water is supplied by an electric hot water heater. Adjacent to this building is 1.5 acres of open land.

Approach – The project will research alternative geothermal approaches, select the most appropriate, design and install a system, convert conventional HVAC systems in one campus building to a geothermal based HVAC system, measure energy savings over a five year period, research cost-effectiveness of energy production against land values, make the installation available to public inspection as a demonstration of effective retrofitting of an existing building heated, cooled and supplied with domestic hot water via an appropriate geothermal system, and assess opportunities for the conversion of other campus buildings to alternative energy systems.

Project stage: This project will focus on research to evaluate the cost-effectiveness, energy savings, maintenance savings realized from the conversion of one building to a geothermal system for HVAC and domestic hot water. The goal is to assess and recommend additional alternative energy solutions on campus. In addition, the project will serve as a demonstration project, available to other building owners and operators, for evaluation and evidence of the benefits of conversion to geothermal as an energy saving alternative.

Expected Outcomes: The University expects research findings will confirm the cost-effectiveness of geo-thermal as an alternative Michigan energy source, reduce energy consumption, and reduce maintenance and equipment down time.

The total cooling capacity of the ground heat exchanger is approximately 80 tons. The ground heat exchanger will consist of approximately 48 vertical closed loops at 20 foot spacing. The vertical loops will be headered into six circuits. Each circuit will contain eight vertical loops. The six circuits will enter the building and connect to a manifold. The manifold will connect to a building hydronic loop inside the building. Multiple water to air ground source heat pumps will be connected to the building loop. The heat pumps will provide space heating and cooling. Each heat pump will serve one zone of temperature control. A dedicated energy recovery system will be provided for outside ventilation air. Tempered ventilation air will be ducted to the return size of each heat pump.

The design and installation will follow IGSHPA and NGWA recommendations. The system will be designed by an IGSHPA certified designer. Installation will be performed by IGSHPA certified installers.