CareFirst Cumberland

Cumberland, MD

Revised Thesis Proposal

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Mechanical Option

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Executive Summary

This proposal suggest of redesigned mechanical system for the CareFirst Cumberland, MD. In previous technical report, the overall evaluation for the existing building summarized. Within proposed alternative mechanical system, the existing of mechanical system redesigned into new mechanical system that considered of energy efficiency, construction cost, indoor air quality, and maintainability.

The mechanical redesign proposal will replace the multiple geothermal heat pump units to the single chiller/heater unit that can support both of heating and cooling loads. With changes of the mechanical system of the CareFirst Cumberland, the electrical and acoustical of the building are impact on it. These topics will be analyzed as breath part of the proposal with change of the depth of the mechanical system. From the ASHRAE Journal, few articles are used as proposal preliminary research. Not only in journal, ASHRAE Handbook of mechanical system and equipment, and other resource are also used.

A draft work plan for spring semester has been created to organize material and allocate design hours of the thesis project. This schedule maintain to work constantly thorough out the semester by each deadline. In the design phase of the thesis, the TRANE 700 modeled to calculate to energy consumption and simple payback period with comparison of the original design.

Project Background

CareFirst Cumberland is located in Cumberland, MD, which is operated by the CareFirst Blue Cross BlueShield that offers healthcare insurance to residents of Maryland. In March 2010, CareFirst announced plans to expand into Cumberland, MD to provide claims processing and customer service for accounts of 100 or more members. CareFirst suggested the idea for the sustainable energy solution to the VOA Architect. The project team proposed the core design of the geothermal cooling/heating system. The architectural feature of the building remained simplicity using limited color and material on the exterior façade of the wall. With the continuous brick wall and extensive double pane glass around the perimeter area, the building forms a rectangular shape and is directed to four directions. At the middle of the building, a strip of the clay brick wall forms a separation of the space; it is used as a main lobby, elevator core, and breakout room. CareFirst mostly serves as an open office area. A main lobby, conference room, computer room, cafeteria, and exercise room features are located on the first floor of the building. On the second floor, beside an elevator core in the center, all other spaces are served as an open office area. The north end of the building remained undersigned for future tenant expansion.

Mechanical Summary

The mechanical system of CareFirst Cumberland has features of the geothermal source system with the Dedicated Outdoor Air System (DOAS), which primarily supports the ventilation of the building. Directly below the site parking lot, fifty of the geothermal wells connect into the mechanical piping system for the heat rejection and heat recovery. Ten of the geothermal wells connect as a one branch loop. Three of the geothermal loops use for the existing building load, and rest of the two branches will operate for the future expansion.

An air handling unit located on the rooftop controls outside air intakes. The energy recovery wheel on this rooftop unit operates as a heat exchanger between outdoor air and exhaust air. The main branch of the supply air ductwork enters through the ceiling of the second floor restroom and supply to the heat pumps on the second floor. The ductwork also connects to the first floor through the shaft that is located at the core of the building and supplies ventilation to the heat pumps on the first floor. The supply ductworks connect with the heat pumps located each zones to serve both heating and cooling load in the building. The auxiliary boiler and cooling tower were designed with geothermal heat rejection and heat recovery in case of the set temperature of the geothermal supply water temperature does not meet.

The IT Computer laboratory, elevator machines room and a few of the mechanical and electrical spaces condition with the separated air-conditioned unit, because these rooms are designed as base and heat pumps as tenants. Unconditioned space at the north end side is treated with the electrical heaters to not affect to the interior spaces, which are located right next to the future space.

Overall Evaluation of system

Overall existing mechanical system of the CareFirst Cumberland has expensive initial construction cost and less operation cost. The geothermal heat pump system has an advantage by having both heat rejection and heat gain from the ground, entering water temperature between 35°F to 90 °F. Individual heat pump units are located in each zone to condition the zone. This existing system may attract building owners and engineers because it is a renewable energy, energy efficient and low operating cost. However, initial investment of the system may concern the building owner financially.

Mechanical Proposed Redesign

The existing geothermal heat pump system has high energy efficiency and low operating cost. However, the geothermal heat pump system is not always energy saving way to supply conditioned ventilation to the space. The temperature of supply geothermal water has a range of 35 °F to 90 °F. In the existing system, before geothermal water supplies to the individual heat pumps those serving zones, it is conditioned one more time by the auxiliary boiler and cooling tower. The temperature range is dropped down to 45 °F to 85 °F, and an average of 65 °F -70 °F. With the critical condition, the heat pump system may use more electricity over a period of time to provide the same amount of the heat gain and rejection.

The redesign of the mechanical system will focus on reducing capital cost and providing comfort conditioned space. The proposed redesign is replacing the geothermal system into a single unit, double effect absorption chiller, known as chiller/heater. The chiller/heater unit can provide heating and cooling simultaneously. It has three different operation modes: heating only, cooling only, and simultaneous mode. The operation mode of the chiller/heater holds the building energy consumption. The operation mode of the unit will analyze and compared to the energy consumption of the exiting design. In addition to proposed central plant, the radiant ceiling panel system will be replaced the individual heat pumps in the zones to improve thermal comfort. With the application of the dedicated outdoor air system, the radiant cooling panel and radiant heating panel applied to the ceiling to maintain the designed room temperature and humidity. The minimum required ventilation outdoor air supplies through the DOAS.

Electrical Breath

With operating equipment for ground source heat pump system and general building energy usage, electrical energy cost in CareFirst Cumberland can reduced by integrating the Photovoltaic system. The installed location and incident angle of the panel must carefully select, because with location and incident, not much of solar radiation emitted into the PV-system. The PV-panel selection has wide range of form, size, and type. For this breath, sun direction and geography in Cumberland, MD, sizing, location of installation, and its total energy generation will be analysis and calculated.

Acoustic Breath

The proposed mechanical system of the geothermal central system replace the multiple distributed geothermal heat pump on top of the ceiling of the office space to the central mechanical space. However, the ventilation distribution and mechanical room acoustically cause problem to the offices nearby. High levels of the background noise effects on personal comfort and work productivity. With modification of the acoustical proof device and analysis, the environment will be modified with complied NC level.

Preliminary Research

Air Quality Filtration

Inghram, David, P.E. "Underfloor for High-Tech Campus." *ASHRAE* Journal (May 2004): 48-50. Print.

Boiler Efficiency

Durkin, Thomas H., P.E. "Boiler System Efficiency." *ASHRAE* Journal (July 2006): 51-57. Print.

Free Air Cooling

"Free Cooling-Outside Air Economizer." *Colorado Springs Utilites*. N.p., 11 Mar. 2005. Web. 16 Dec. 2012.

Geothermal Central System

Durkin, Thomas H., P.E. "Geothermal Central System." *ASHRAE* Journal (August 2007): 42-48. Print.

Geothermal Well Construction Guide

Underground Injection Control Program. "Guidelines For Ground Source Heat Pump Wells." *Massachusetts Department of Enviormental Protection* (January 2012): 1-22. *Http://www.mass.gov/dep/water/laws/gshpguid.pdf*. Web. 16 Dec. 2012.

Trane Centralized Geothermal and Decentralized Geothermal Comparison

Cline, Lee. "Central Geothermal Systems and Control." *Engineers Newsletter Live*. TRANE, Apr. 2010. Web. 16 Dec. 2012.

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ANSI/AHSRAE. (2007). Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Building. Atlanta, GA: American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

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"What Is MERV Rating and Is Higher Better." *What Is MERV Rating and Is Higher Better*. Filters4Life, 2007. Web. 12 Nov. 2012. <http://www.filters4life.com/What-is-MERV-rating-s/4961.htm>.

"Geothermal Heat Pump Grant Program _Maryland." *Database of State Incentives for Renewable & Efficiency in USA*. U.S. Department of Energy, 2011-2012. Web. 12 Nov. 2012. <http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=MD21F>.

Project Team

- Owner: CFBC Properties, LLC.
- General Contractor: Carl Belt, Inc., http://www.thebeltgroup.com/
- Architects: VOA Associates, Inc.,http://www.voa.com/
- Civil Engineer: SPECS, Consulting Engineers & Surveyors, http://www.specllc.com/
- MEP Engineer: R.G. Vanderweil Engineers, LLP,http://www.vanderweil.com/
- Structural Engineer: Tadjer Coher Edelson Associates, Inc.,http://www.tadjerco.com/