EXECUTIVE SUMMARY

CareFirst Cumberland currently has the geothermal heat pump system. The primary goal of the existing system was high energy efficiency and lower operating cost. Individual heat pumps serve each zone of the building to condition the space. A ventilation unit consisting of an energy recovery wheel, heating coils, and cooling coils, is located on top of the roof. Conditioned supply air is distributed by the rooftop unit with the minimum ventilation rate and reduces loads on the heat pumps. However, the existing geothermal heat pump system has high initial investment and possibility of operation failure when an underground temperature is too low or too high.

A direct-fired chiller/heater simultaneously operating with radiant panels is designed for an alternative mechanical system to reduce the initial investment and provide thermal comfort to occupants. The direct-fired chiller/heater replaces the existing geothermal system and serves as a central unit to produce hot water and chilled water. Hot water and chilled water produced by the direct-fired chiller/heater are supplied to both the cooling/heating coils in the rooftop unit and the radiant cooling/heating panels.

A main concern of this alternative mechanical system is properly controlling water temperature that enters to and leaves from the radiant cooling panel; temperatures of water lower than the designed dew point cause water vapor to form on the surface of the radiant panel. Temperatures and flow rates of hot water and chilled water are controlled to consistently maintain the comforts of zones. Another concern of this alternative mechanical system is higher operating cost, even if the system has lower initial investment than the existing mechanical system.

In this report, two ways to alleviate those concerns stated above are studied and analyzed: water temperature control for the radiant panels and operating mode controls. Chilled water pumps, hot water pumps, and condensate water pumps that are required for the Chiller/Heater will be installed in the existing mechanical room. The existing geothermal piping system and pumps will be demolished. Economics of the alternative mechanical system was analyzed and compared with that of the existing system.

In addition, a photovoltaic system is designed for on-site generation in order to reduce the operating cost. Even if the PV system is expensive to install, the system will reduce the payback period by making the operating cost even less. The PV system is designed to produce 10% of the total utility cost. Also, the noise exhausted form the equipment requires sound attenuation devices. The noise reduction through the existing partitions is not enough to meet the acoustical requirements of adjusting occupied spaces. Walls with high sound transmission level were selected based on the requirements and applied to the building.