Executive Summary

The purpose of the Final Thesis Report is to evaluate and redesign the existing mechanical system of the National Rural Utilities Cooperative Finance Corporation (NRUCFC). The new headquarters building is 120,000 square foot office building that will house a fitness center, café, and executive lounge. The three-story above grade building is located on a 42-acre lot in Sterling, VA, about 10 miles north of the Dulles International Airport, at the intersection of Route 28 & 7. The headquarters is LEED® Gold certified.

The evaluation of the headquarters building begins with a brief mechanical system overview, a compliance evaluation with ASHRAE Standards 62.1 and 90.1-2007, design objectives and conditions, design ventilation rates and load estimates, and an annual energy use summary. The remainder of the report discusses the proposed redesign.

The first mechanical redesign depth proposes to change the four air handling units to a dedicated outdoor air system (DOAS) and replace the existing terminal units with chilled beams. The results of the redesign yielded an annual savings of $24,727.03 and a first cost of savings of $181,495.00. The simple payback of the system is 4 years.

The second redesign depth is to add 10 hybrid PV-thermal liquid solar collectors to the roof of the new headquarters building to produce both electricity and heat simutanously. The hybrid panel hasn't been widely adopted and few manufacturers make them so the first cost is high. The total first cost is $98,350.00 and yields a simple payback of 13 years. This redesign does not appear to be economically feasible.

Two breadth topics were also investigated: electrical and architectural. The addition of the PVT panels was found to not have a large impact on the façade of the building. The building façade is modern enough for the panels to not stick out and be an eye sore. The electrical breadth analyzed the load difference between the existing system and the chilled beam system. Several panelboards were condensed and the load was smaller with the chilled beam system. It also looked at the electrical output of the PVT panels, which yielded $4,632.56 of savings annually.