1.0 Executive Summary

The following thesis reports the findings of three studies performed to investigate the possibility of improving building system efficiency in the Peirce Hall dining facility of Kenyon College in Gambier, Ohio. Peirce Hall underwent a major renovation, expansion, and addition project beginning in 2006 and ending in 2008. The intention of the project was to accommodate the increased demand on the facility and replace the outdated building systems with more efficient, economical, reliable, flexible, and maintainable systems. This goal was achieved in many aspects such as the new chiller plant and air distribution system. However, the previously existing campus steam supply is still used to supply heat and power is still purchased from a local provider. These areas showed the greatest potential for significant improvements.

Modifications and additions to the facility's mechanical, lighting, and power systems have been explored to address areas of incompliance and to attempt exceeding requirements of The American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 Section G with intent to approach LEED Certified status. Doing so will provide evidence of the facility's performance, and is one way to assure Kenyon College eligibility to apply for various federal funding opportunities.

A depth study was performed to assess the feasibility and effectiveness of using a combined heat and power (CHP) system to supply Peirce Hall with steam and power. Successfully designing an effective CHP plant for the facility would reduce the dependence on campus steam and purchased power. The proposed system uses three Capstone 800kW high-pressure natural gas microturbine packages. The system was observed operating under electrical load and thermal load following scenarios and compared to a modeled interpretation of the existing separate heat and power system, all modeled in Microsoft Excel. Due to a decreased annual utility cost of 9% and a significant reduction in harmful gas emissions, this study determined that Peirce Hall can benefit from a CHP system operated to follow the facility's electric load profile.

To ensure that the microturbine packages specified as the prime mover for the Peirce Hall CHP plant did not create a noise disturbance to the occupants of the facility or surrounding campus, an acoustic breadth study was performed. A variety of scenarios involving different construction material types for the prime mover housing were considered. The goal of this study was to reduce emitted sound levels below 50 A-weighted decibels, the approximate noise level of typical office activities (Egan 13). This was investigated and achieved by using a variety of lightweight concrete masonry unit wall constructions.

The lighting power density values in the Great Hall dining area of Peirce Hall were far above the ASHRAE Standard 90.1 recommended values, as found while performing research for Technical Report I. This again, is a factor that prevents Peirce Hall from LEED certification. To remedy this, 9W Toshiba Dimmable LED PAR20 lamps were specified to replace the existing 40W incandescent candelabra lamps. The LED lamps use much less power and improve illuminance in the dining area to a level closer to the Illuminating Engineering Society of North America recommended level, all while providing a similar warm color temperature. A model was created to calculate and compare illuminance levels of the space under both lighting scenarios in AGi32.