Executive Summary:

Buildings A and B are both being constructed on the existing National Naval Medical Center Campus located in Bethesda, Maryland. Building A will be housing areas for services such as the Cancer Treatment Center, Children's Health Area, Medical Staff Offices, and Examination Rooms. Building B is the smaller of the two buildings and is the location for the Ambulatory Receiving Center, Operating Rooms, and houses all of the Patient Bedrooms. The new buildings are striving towards a LEED Silver Rating from the United States Green Building Council.

The mechanical system that is currently designed uses a constant volume supply of 100% outdoor air. The air is supplied to remote CAV boxes located throughout both buildings which helps provide greater occupant comfort. Total energy wheels and heat recovery chillers have been implemented on this project in order to offset some of the costs associated with a 100% outdoor air system. The chilled water plant utilizes electricity to run and the heating demands for both buildings are met by a campus steam plant.

Alternatives were chosen in this report to meet the goals of either reducing the peak energy consumption or reducing the dependence on the campus steam plant. The alternative design options that were selected to be analyzed were decentralizing the supply air fans, adding a backpressure steam turbine, and two configurations for a combined heat and power plant. Decentralized supply fans can potentially reduce the total fan energy required in the building by being able to run at higher fan efficiencies. A backpressure steam turbine was analyzed in parallel with the existing pressure reducing station in order to expand the high pressure campus steam over the blades of the turbine which will reduce the steam to the distribution pressure required while also powering an electric generator. Combined heat and power (CHP) was analyzed with and without the use of a backpressure steam turbine. Utilizing CHP was hypothesized to be able to significantly reduce the quantity of steam required from the campus steam plant as well as utilizing the waste heat to generate electricity which can offset most of the electricity peaks throughout the year.

The CHP plant analyzed utilizes a natural gas fired internal combustion engine which can be very loud when running at full load. An acoustical analysis was performed in order to ensure that the proper noise criteria would still be met in the surrounding spaces through the use of sound absorbing material. Solar shading and day lighting were also analyzed in order to reduce some of the solar load on the building as well as provide a more aesthetically pleasing atmosphere in the exterior occupied spaces.

After the analysis was performed, combined heat and power without the use of the backpressure steam turbine had the lowest twenty year lifecycle cost. However, CHP is a significant investment and if the owner is unable to spend that much capital in the beginning of the project then it is recommended that a backpressure steam turbine be installed in parallel with the pressure reducing station. Both of these options will be able to last well beyond the twenty year life cycle cost assumed as long as proper maintenance is performed regularly. The longer that the owner is able to keep this equipment in good operating condition the more these systems are going to be able to pay off throughout the building life.