Executive Summary

City Hospital campus of southeast Pennsylvania has a 30-year development master plan which included approximately one million square feet of research space, one million square feet of ambulatory care and clinical office space, and one million square feet of parking and support services. Laboratory and hospital environments such as the one developed by City Hospital in southeast Pennsylvania will have a much higher energy intensity than a typical building. City Hospital campus will have an estimated annual utility bill of $21.3 million upon completion, a direct result of the size of the building as well as the building type.

Due to the nature of activities performed in these spaces, stringent indoor air qualities are required to protect its occupants, and various methods engineered to control energy consumption on the air side are already in place, central plant is the focus of alternative building system design. The primary goal of the alternate building system modification is to further curtail energy usage and annual utility cost. It is also important to maintain occupant health and thermal comfort, system reliability in certain foreseeable events, the ability to expand as the campus grows.

Trace energy model indicated that heating, cooling, and electric load profile of City Hospital Phase 1 and Phase 2 is an excellent candidate for cogeneration where electricity and useful heat is produced simultaneously. Phase 1 and 2 can save $ 250,000 in energy cost by installing a cogeneration plant that produces enough electricity meet building's base demand without excess. Besides the fact that cogeneration can save annual energy cost, it's environmental benefits are significant. Carbon dioxide, nitrous oxide, and sulfur dioxide emission are reduced by 78% when compared to the existing building system.

The alternate system which included turbine driven electric generator is an additional source of noise on site, and the noise cause annoyance when transmitted to occupied spaces nearby. Acoustic properties of the building and generator are analyzed to engineer methods to reduce noise level and ensure occupant comfort. The study found that noise transmitted through existing room construction is acceptable, and acoustic remediation is unnecessary.

The Addition of cogeneration plant also has an impact of the electrical system. Additional electrical equipment such as paralleling-switchgear and feeders need to be sized and incorporated with the existing system.

Phase 1 and 2 is part of a 30-year development. Thus, the alternate system designed for the central plant must work well for Phase 1 and 2 and the completed campus. Two equipment staging and four life cycle cost scenarios are evaluated to find the most beneficial combination. It is concluded that cogeneration plant of larger capacity should be install at a later construction phase to increase annual savings and decrease payback period of the alternate system.