Mechanical System Design Alternates

Laboratory and hospital environments such as the one developed by City Hospital in southeast Pennsylvania will have a much higher energy intensity than a standard commercial building. City Hospital campus has an estimated annual utility bill of $20.5 million upon completion. This is a direct result of the size of the building as well as the building type. Laboratory spaces have requirements that will directly increase the cost of operation. Air cannot be recalculated and therefore all of the air in the labs must be exhaust out of the building. Providing 100% OA to all laboratory spaces will increase fan energy and equipment energy because such large amount of the air must be conditioned and moved throughout the building.

As found in Technical reports One and Two, City Hospital P1 meets ventilation requirements outlined in ASHRAE 62.1, and complies with equipment power allowance and building envelope outlined in ASHRAE Standard 90.1. Due to the nature of activities performed in these spaces, stringent indoor air qualities are required to protect its occupants. In addition, the existing air side system already employed runaround glycol loop exhaust heat recovery and variable air volume fume hood exhausts to control energy consumption. Thus, the central plant is the focus of alternative building system design.

The primary goal of the alternate building system modification is to further reduce energy consumption and annual utility cost. As energy consumption is reduced, emissions will decrease as well. 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. Furthermore, the alternate design should have a reasonable payback period to justify its application.

Existing Load Calculation

The first step in the designing an alternate mechanical system for City Hospital Campus is to model the existing laboratory and office spaces with an energy analysis program as accurately as possible. Information for load calculation was obtained from the master drawings and specifications provided by construction manager Turner Construction Company, and MEP design engineer Bard, Rao, and Athanas Consulting Engineers, LLC.

Space	Ventilation Rate		Occupant Density	Lighting Density	Equipment Load
	ACH	CFM/occ.	ft^2/occ.	w/ ft^2	w/ ft^2
Lab	10.0	-	40	1.5	4.0
Office	-	20.0	200	1.5	0.5
Other	4.0	-	0	1.0	0.0
	Design Temp.		RH		
	DB °F	WB °F	%		
Winter	0	-	-		
Summer	95	78	-		
Indoor	72	-	40		

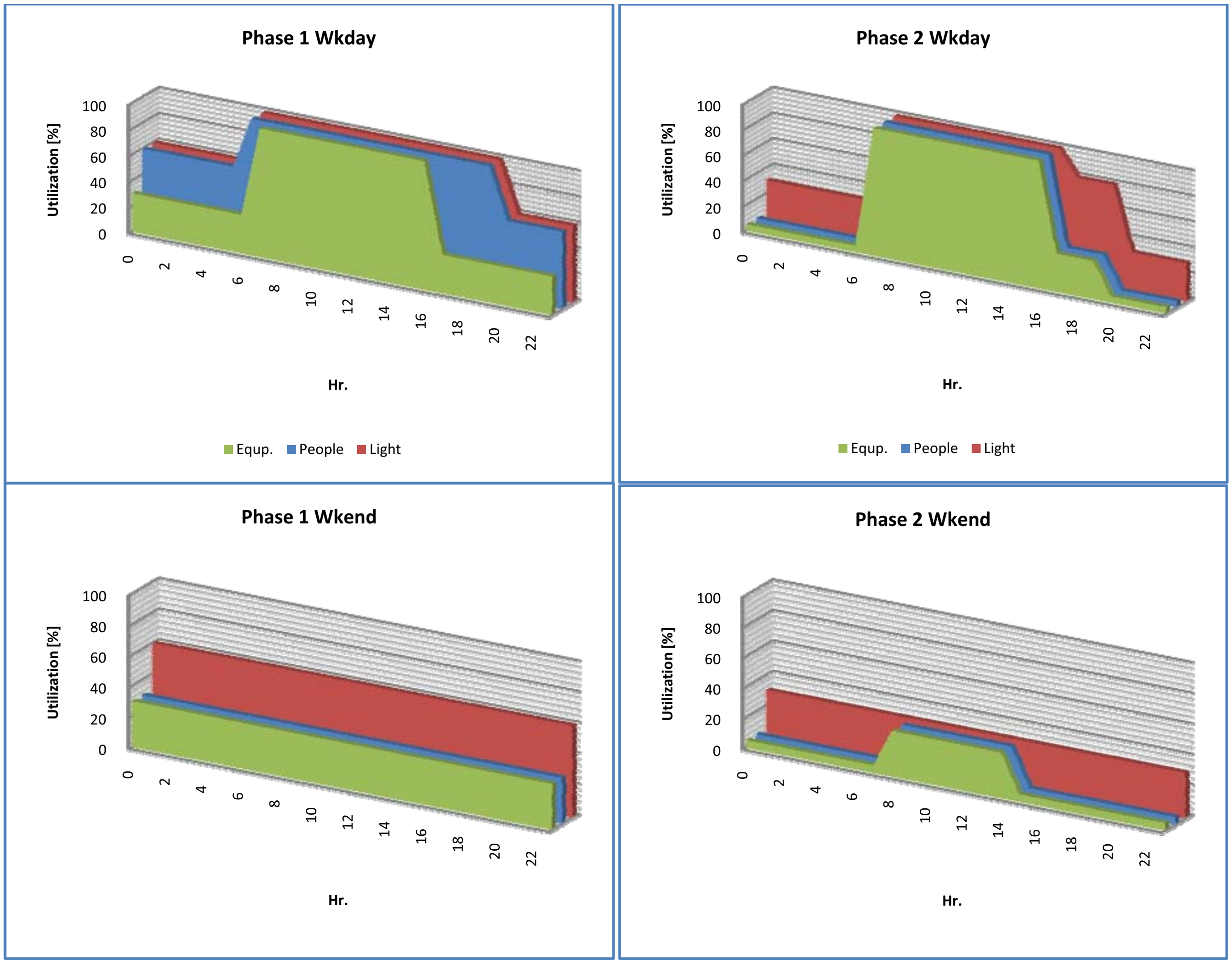

Figure 8: Assumed Occupant, Lighting, and Lab Equipment Schedule

Trane Trace was used to stimulate load calculation based on design criteria, assumed schedules, and construction documents such as:

- Room dimensions and orientations
- Wall, ceiling, and floor assemblies
- Window and roof characteristics
- Air system type and equipments specifications
- Plant characteristics and configurations

Results from the Trace model provided electric and thermal demand of the existing system, and serve as a benchmark which alternate designs are compared and analyzed.

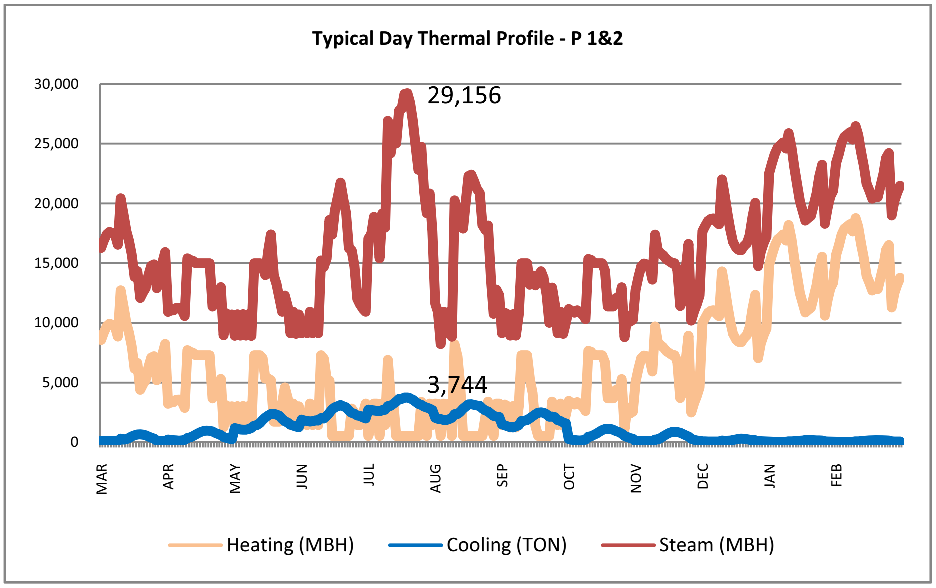

Figure 9: P 1&2 Thermal Profile

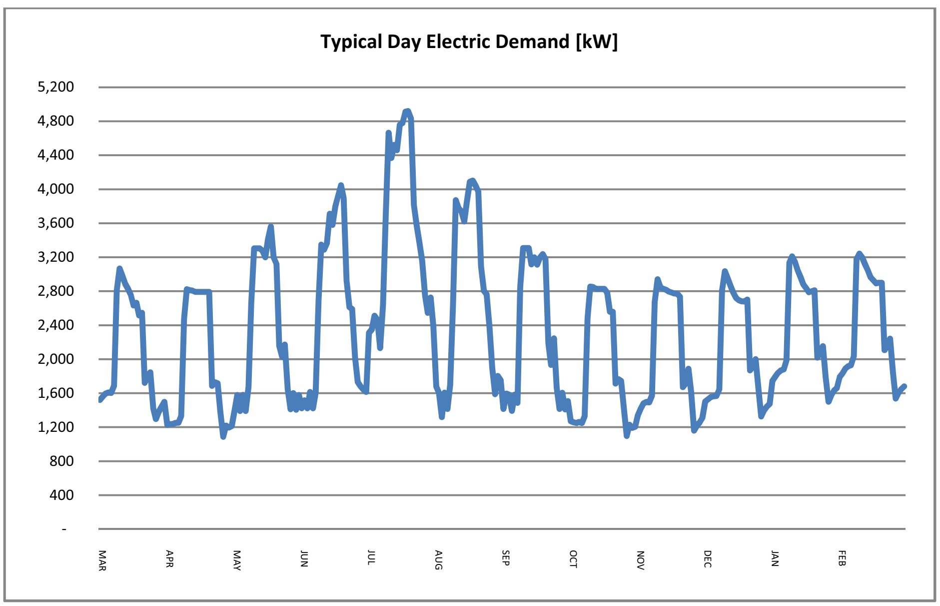

Figure 10: P 1&2 Electric Demand Profile