Consumers Energy PROJECT OF THE YEAR

PROJECT DESCRIPTION DOCUMENT
SEPTEMBER 16, 2014

UM Flint Boiler Replacement Project

The existing central plant generated 115 PSI steam for distribution through a tunnel piping system to the campus buildings. The existing steam line leaving the plant through the tunnel is a 12" pipe. This 12" pipe is adequately sized for present and future campus steam demand. The steam was generated by four boilers. Three of the boilers were sized at 350 HP, and one boiler was sized at 300 HP. These boilers were beyond their useful life and in need of replacement. These existing boilers were operating with a stack temperature of over 700 degrees, and with excess O2 levels of up to 15%, with boiler efficiencies between 60% and 70%.

In early 2009 the existing steam plant operation was analyzed. Steam flow of the plant was derived from natural gas consumption which CSI obtained from the gas company. Converting this gas consumption to steam production indicated approximately 25,700 lbs/hr was the average peak load. Using 34.5 lbs/hr/BHP and a factor of evaporation of 1.02 - this equals roughly 760 BHP. This corresponds to the actual boiler usage during peak periods, where two 350 HP boilers are operating on high fire and a third boiler is operating on low fire. Observations by UM of boiler operation on lightly loaded days indicated that one 350 BHP boiler is typically operating continuously at greater than 20%. These boilers provide heating for the pool, for domestic hot water generation for the entire campus, and for heating hot water for reheat coils across campus. Low fire, or 20% operation of one 350 BHP boiler equates to 70 BHP.

The average steam flow by month and equivalent boiler HP was as follows:

Month	Average Flow – lbs/hr	Equivalent Boiler HP
January	25,668	744
February	24,900	722
March	18,610	539
April	7,560	219
May	3,910	113
June	3,910	113
July	3,740	108
August	3,820	111
September	6,452	187
October	17,850	517
November	23,322	676
December	25,289	733

It is noted from this profile that the steam load is 400 HP or less for approximately 60% of the time, and 125 HP or less for approximately 40% of the time. Based on this, the efficiency of various sized boiler sizes was studied as indicated in the Table 2.

Boiler Number, Size, % Load	Efficiency Gas	Efficiency Oil	Comments
1-800 HP @ 100%	82.9	86.1	
1-800 HP @ 50%	82.5	85.9	Note 1
1-400 HP @ 100%	81.9	84.9	
1-800 HP @ 25%	81.9	85.4	Note 2
1-200 HP @ 100%	81.4	84.5	

Note 1) the 800 HP boiler operating at 50% is more efficient than the 400 HP boiler operating at 100%, and Note 2) the 800 HP Boiler operating at 25% is more efficient than the 200 HP boiler operating at 100%. This indicated that an 800 HP boiler was the most efficient selection throughout its operating range. Packaged fire tube steam

boilers complete with a 10:1 turndown along with linkage-less burner technology and Seimens combustion controls were selected to allow for steady operation of the boiler without short cycling and to significantly improve boiler efficiency.

Utilizing the load profile indicated above in Table 1, a flue gas economizer analysis was performed to determine the economic feasibility of utilizing excess flue gas heat to pre-heat boiler feedwater. Simulating annual operation based upon actual percent boiler loading, and looking at installed cost of the economizers, the following was found:

Annual Energy Savings:	$ 28,070
Installed Cost of 2 Economizers:	$108,000
Simple Payback on Investment:	**3.9 years**

Based upon this rapid payback flue gas economizers were installed.

Condensate surge tank and transfer pumps, deaerator, variable speed boiler feed pumps, combustion air system, boiler stacks, and chemical treatment complete with de-ionized water make-up were provided to provide a complete, properly sized system with reduced maintenance requirements.

A Johnson Controls Inc. (JCI) Metasys building automation system (BAS) currently existed on campus including service to systems located in the Central Heating Plant. It was expanded to monitor and control the new boiler equipment. New JCI-ADX server system software was purchased and installed for monitoring and control enhancements. The campus goal was to upgrade the existing JCI Network Control Module (NCM) platform and migrate to the Network Application Engine (NAE) platform. The NAE platform allowed additional operator access to the JCI Metasys BAS using the campus IT network in a secured manner – password protected, restricted to operators with specific levels of access. The new system was set-up to operate and cycle the boilers automatically, but has an override function whereby the operators may operate the system manually.

Pressure control for the operation of the boilers was packaged by the boiler manufacturer and included a sequencing panel to allow Lead Boiler selection and Auto Standby operation of the second boiler when selected. A remote status panel was included and installed within the existing control room. Boiler control system included an open protocol communication interface (Modbus) for 3rd party monitoring from the JCI Metasys BAS. Per code, new local emergency shutdown switches were provided at each exit from the building.

PROJECT PHASING

This project needed careful consideration that steam must always be available for campus domestic hot water generation, reheat, and pool water heating. The phasing of construction was roughly as follows: Feed the existing boilers directly from the condensate surge tank, install the new water softener and RO system, remove and replace the existing feed water pumps with variable frequency drives, install new boiler B-1 in the location of the original (removed) B-1, energize the new boiler system. The second ‘phase’ of construction was roughly as follows: remove 4 existing boilers, infill existing hole in boiler room floor, install new boiler B-2 in location of the removed boilers, install new condensate surge tank and energize, and remove existing condensate surge tank.

The project progressed very smoothly, without unplanned shut-downs, and is operating very satisfactorily today. Based on calculations that included heating degree day calculations the new boilers have shown a 30% gas reduction.