

CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

1. Category - Check one and indicate New, Existing, or Existing Building Commissioning (EBCx)

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|--|------------------------------|--------------------------------------|-------------------------------|
| <input type="checkbox"/> Commercial Buildings | <input type="checkbox"/> New | <input type="checkbox"/> Existing or | <input type="checkbox"/> EBCx |
| Institutional Buildings: | | | |
| <input type="checkbox"/> Educational Facilities | <input type="checkbox"/> New | <input type="checkbox"/> Existing or | <input type="checkbox"/> EBCx |
| <input type="checkbox"/> Other Institutional | <input type="checkbox"/> New | <input type="checkbox"/> Existing or | <input type="checkbox"/> EBCx |
| <input type="checkbox"/> Health Care Facilities | <input type="checkbox"/> New | <input type="checkbox"/> Existing or | <input type="checkbox"/> EBCx |
| <input type="checkbox"/> Industrial Facilities or Processes | <input type="checkbox"/> New | <input type="checkbox"/> Existing or | <input type="checkbox"/> EBCx |
| <input type="checkbox"/> Public Assembly | <input type="checkbox"/> New | <input type="checkbox"/> Existing or | <input type="checkbox"/> EBCx |
| <input type="checkbox"/> Residential (Single and Multi-Family) | | | |

2. Name of building or project: Elmhurst University -
New Central Chilled Water Plant & Boiler Decentralization
City/State: Elmhurst, IL

3. Project Description: New central chilled water plant and boiler decentralization
Project Study/Design Period: 01/2021 to 09/2022
Begin date (mm/yyyy) End date (mm/yyyy)
Percent Occupancy at time of submission: Existing campus, normal occupancy


4. Entrant (ASHRAE member with significant role in project):

a. Name: Skelton Benjamin A
Last First Middle
Membership Number: 05219191
Chapter: Illinois (049)
Region: VI

b. Address (including country): 815 S. Wabash Avenue
Chicago IL 60605 USA
City State Zip Country

c. Telephone: (O) (312) 520-0025 d. Email: bskelton@cyclone.energy

e. Member's Role in Project: Commissioning / Measurement & Verification

f. Member's Signature: 

5. Engineer of Record: Tom Kelleher, AMS Mechancial Systems

By affixing my signature above, I certify that the information contained in this application is accurate to the best of my knowledge. In addition, I certify that I have discussed this entry with the owner and have received permission from the owner to submit this project to the ASHRAE Technology Awards Competition.

This award is being submitted by three engineers and ASHRAE members that worked collaboratively on the project: Benjamin Skelton, Francis Kohout and Thomas Kelleher

Project Overview

Elmhurst University set out to modernize their aged campus central plant systems. The campus had a central steam plant with four natural-gas steam boilers that distributed steam to 17 buildings (706,518 SF in total) through a tunnel system. At all but two buildings, there were steam-to-hot water converters that distributed heating hot water to HVAC systems and domestic hot water. The other two buildings used steam directly. The existing steam boilers were 50 years old and no longer had parts available. The steam lines were well known for heating the sidewalks above the tunnel because of leaks and steam traps failed frequently.

On the other side of campus, four screw chillers in the basement of a dormitory building (that ironically isn't served by chilled water) and a constant volume, single speed (wooden construction!) cooling tower were WELL beyond their useful life and frequently experiencing leaks, failures and had obsolete parts. The location of the chillers in the basement was not ideal for replacement and didn't allow for expanded capacity. Additionally the cooling towers sat on property that was prime territory for a potential future building.

The project eliminated the steam boilers in the physical plant and located individual boiler plants in each of the buildings. This opened up the physical plant, allowing for three new 600 ton chillers, expanding capacity for future buildings on campus. Additionally, the entire campus controls systems was upgraded including building controllers, front end and sequences of operation. The entire project was accomplished without disrupting University operations.

Energy Efficiency

For the heating project, eliminating nearly a mile of aged steam piping, steam traps and aged steam boilers had a significant natural gas energy reduction. Multi-burner, 5:1 turndown, 95% thermal efficient condensing boilers were installed in 15 buildings eliminated the converters. The remained two buildings installed high efficiency steam boilers. A normalized analysis of natural gas consumption over the first nine months of operation have demonstrated 52.2% energy savings.

The chilled water plant previously had four 300 ton screw chillers with constant volume chilled water, condenser water and secondary distribution. The new plant has three 600 ton variable speed drive centrifugal chillers. New variable speed pumps were installed for the chilled water, condenser water and secondary pumps. Cooling towers were located on the roof of the physical plant with the ability to stage and with variable speed fan control. Pre-installation calculations predict a 35% annual savings. Actual savings are being calculated at the conclusion of cooling season.

The chilled water plant received entirely new controls and each building on campus had their 15 year old controllers replaced and upgraded. New sequences of operation for the campus included chilled water temperature reset, condenser water reset, cooling tower staging, variable speed cooling tower fan operation, chiller head pressure control, variable speed secondary pumping, heating hot water reset and in several upgraded buildings, optimized start, supply air temperature reset and static pressure reset.

Indoor Air Quality

There were several aspects of the project that maintained the safety of indoor air quality and enhanced performance. With the decentralization of the boiler plant, having boilers in 17 buildings not designed to have flue gas venting, required careful engineering to locate vents in locations safely away from occupied areas, operable windows and existing vents. Each building installation was done with additional separation beyond code requirements.

The previous cooling tower was located immediately next to a dormitory building which has operable windows. While the cooling tower water was monitored and well maintained, there was potential for drift carrying harmful bacteria through open windows. The new tower is located safely away from any occupied building. The new tower also has new chemical treatment system with monitors and safeties to prevent the formation of bacteria.

Innovation

Relocating a chilled water plant to the vacated physical plant allowed for the campus to increase the size of the chilled water system by a third, giving future capacity for planned buildings. No buildings were built or torn down as a result of decentralization of boiler plants.

Cost Effectiveness

A campus rearrangement and infrastructure project isn't expected to pay for itself with energy savings. The previous equipment had to be replaced so the design and operational characteristics of the new systems were done as if designing a new campus to optimize efficiency. Utility savings, including electricity, natural gas and water were estimated and are currently tracking \$160,000 per year. Additionally the annual maintenance budget from the steam system to low mass boilers was reduced by \$70,000 and chemical treatment by \$10,000. The \$10 million project also received nearly \$750,000 in utility incentives.

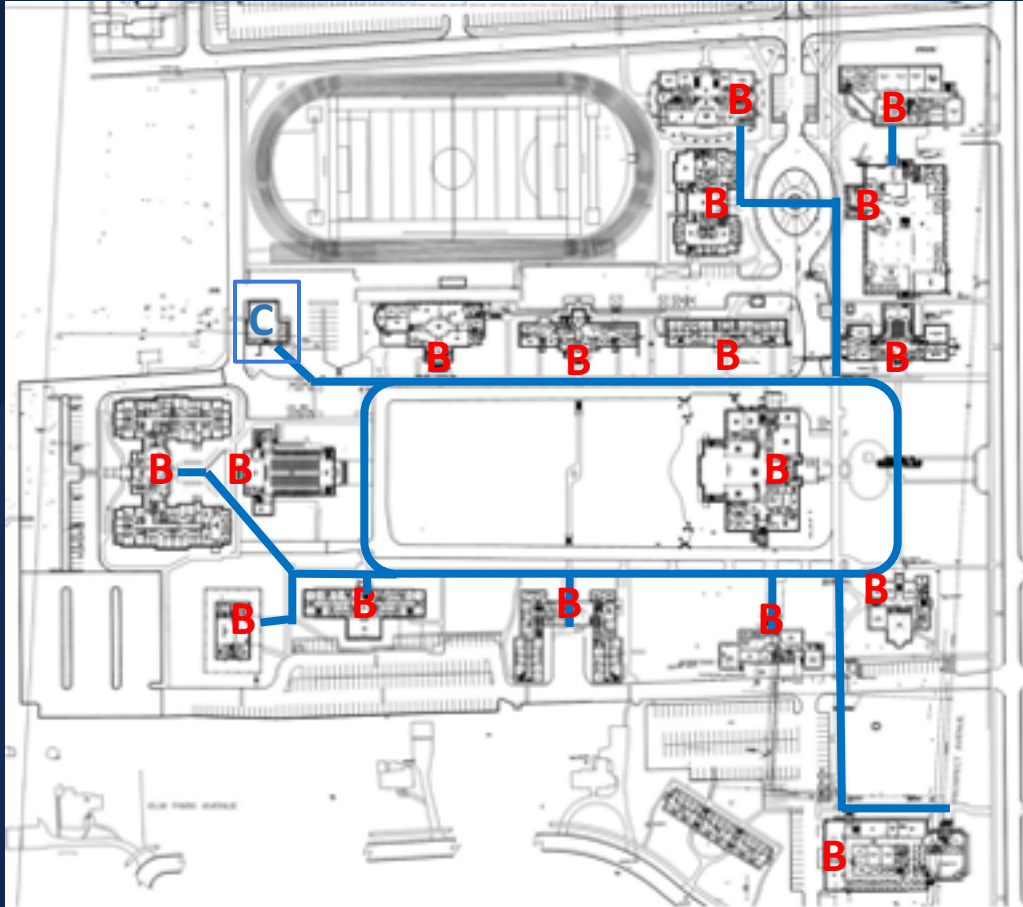
Operation and Maintenance

Plant and building operation were substantially improved with all new automation. Upgrades to building controllers allow for future modernization of HVAC systems as well as new sequences to existing. Maintenance efforts and costs were substantially reduced by eliminating 50 year old steam boilers, 33 year old chillers and a very old cooling tower that all had obsolete parts and significant wear and tear. The entire maintenance staff was trained, including at the factory, on the operation and maintenance procedures for the new equipment. The operations team also participated with the commissioning efforts.

Environmental Impact

New chillers use a next generation R-514a refrigerant while the previous used the phased out R-22. In addition to the electric and natural gas savings from the project, water savings are 38% less water than the previous systems. New chemical treatment systems monitor water quality more accurately and conserve water and chemical use. The biggest impact to the environment from the project was no building was built or torn down while expanding the campus cooling capacity by 33% and replacing all plant equipment.

Boiler Decentralization and Chiller Optimization



- **Previous Central Plants**
 - **Chilled Water Plant**
 - (4) 300T Screw Chillers
 - (1) Wooden Cooling Tower
 - **Steam Plant**
 - (3) Fire-tube Steam Boilers
 - (1) Water-tube Steam Boiler
- **Renovated**
 - **Chilled Water Plant**
 - (3) 600T VFD Centrifugal Chillers
 - (2) VFD Cooling Towers
 - **Decentralized Heating Hot Water**
 - (25) Condensing Boilers
 - (3) Steam Boilers