CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

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

☐ Commercial Buildings	☐ New	☐ Existing or	☐ EBCx	
Institutional Buildings:				
☐ Educational Facilities	☐ New	☐ Existing or	☐ EBCx	
☐ Other Institutional	☐ New	☐ Existing or	☐ EBCx	
☒ Health Care Facilities	☐ New	☐ Existing or	☒ EBCx	
☐ Industrial Facilities or Processes	☐ New	☐ Existing or	☐ EBCx	
☐ Public Assembly	☐ New	☐ Existing or	☐ EBCx	
☐ Residential (Single and Multi-Family)				

2. Name of building or project: SSM St. Mary's Janesville

City/State: Janesville, WI

3. Project Description: Existing building commissioning of a hospital

Project Study/Design Period: 09/2020 (Begin date (mm/yyyy)) to 10/2021 (End date (mm/yyyy))

Percent Occupancy at time of submission: 100%

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

a. Name: McCarthy, Fiona Martin and Varghese, Daiju
(Last First Middle)

Membership Number: 8138567 (McCarthy) and 8312970 (Varghese)

Chapter: Illinois

Region: VI

b. Address (including country): Grumman|Butkus Associates, 820 Davis, Suite 300

Evanston (City) IL (State) 60201 (Zip) USA (Country)

c. Telephone: (O) 847.328.3555 d. Email: dochen@grummanbutkus.com

e. Member's Role in Project: EBCx Provider

f. Member's Signature: Fiona Martin McCarthy
Digitally signed by Fiona Martin McCarthy
DN: cn=Fiona Martin McCarthy, o=Grumman/Butkus Associates, ou, email=fmmccarthy@grummanbutkus.com, c=US
Date: 2021.09.17 12:27:38 -05'00'

5. Engineer of Record: Fiona Martin McCarthy

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.

SSM HEALTH ST. MARY'S HOSPITAL – JANESVILLE, WI, EBCx

Project Summary

SSM Health St. Mary's Hospital - Janesville in Janesville, WI, is one of more than 23 acute care facilities within the SSM portfolio. The hospital, which opened in January 2012, consists of approximately 174,884 square feet with 50 staffed beds.

The submitting engineer was retained by SSM to implement a retro-commissioning (RCx) program for the hospital. The project scope was to identify energy savings opportunities, provide scopes of work or necessary design drawings, receive and review contractor bids, and work with contractors to implement the work. After the work was completed, trend data was reviewed, and a verification report was provided to confirm that the measures were completed and met the identified energy savings targets. The client's objective for the whole program, from measure identification through verification, was to have a four-year simple payback and save 10% of total energy costs compared with the 2019 calendar year. An application for all applicable incentives was made to Focus on Energy, which administers energy incentive programs for several Wisconsin utilities.

Starting in September 2020, the submitting engineer conducted multiple site visits to review operating procedures and equipment operation, review existing drawings and specifications, discuss any known deficiencies, tour the facility and collect nameplate data, perform some preliminary functional testing of major HVAC equipment, and identify energy saving opportunities. The submitting engineer utilized an internal monitoring-based commissioning (MBCx) software platform to help identify measures and to confirm persistence of measures.

The medical center has two original 750-ton constant speed electric centrifugal chillers. There is one open cooling tower, which has a remote sump located in a third-floor mechanical room. The chilled water plant was designed as variable volume primary flow, controlling to a constant differential pressure setpoint. The two dedicated condenser water pumps are constant volume.

A heat recovery chiller provides cooling to the OR air-handling unit (AHU). The heat recovery chiller heating loop consists of two heat exchangers: one connected to the cooling tower loop and the other to the domestic hot water piping. There are two heat recovery chillers in series that provide chilled water to AHU-B, which serves OR spaces and to other AHU.

The hot water plant consists of two steam boilers, two condensing hot water boilers, and two non-condensing hot water boilers. The steam boilers provide 60 psi low-pressure steam for humidifiers and sterile processing. The hot water boilers provide hot water for AHU preheat and zone reheat.

Three major AHUs (AHU-A, AHU-B, and RTU-1) serve the hospital. These three AHUs are variable volume recirculating units. All air-handling units typically have a hot water preheat coil, chilled water-cooling coil, and steam humidifiers as temperature and humidity controlling components.

All of the main air-handling units have VFDs on their supply and return fans. Full outside air economization is available at each of the AHUs. Individual zones served by air-handling units in general have variable or constant air volume terminal units with hot water heating coils for reheat.

The kitchen area is served by RTU-1 and does not have a dedicated make-up air unit. The kitchen area hood exhausts are turned on and off mechanically with switches in the space. Fans are cycled when the staff arrives and leaves for the day.

Energy Efficiency

During the investigation phase, the chiller plant, boiler plant, and each AHU were reviewed to determine the existing sequence of operations. Energy saving measures were identified and grouped by system type (see Table1 on the art page). Measures implemented included:

- AHU optimization: Discharge air temperature setpoint reset, static pressure setpoint reset, AHU economizer optimization, kitchen and lobby area night setback, and OR space night setback.
- Chilled water optimization: Condenser water temperature reset and chilled water supply temperature reset. In addition, several balancing valves were opened.

Indoor Air Quality (IAQ)

The annual economizer hours were increased, which provides additional fresh outside air to the hospital.

Innovation

In addition to typical existing building commissioning investigation strategies, an MBCx platform was launched. This allowed for repetitive data review and continuous monitoring, quickly pulling data from all AHUs, the chiller and boiler plants, and all terminal units. Review of the MBCx platform has provided remote monitoring support of the implemented measures' persistence, since the submitting engineer is not local to the project.

An additional innovation opportunity presented itself with the relationship between submitting engineer, site staff, and contractors. The submitting engineer was not local to the project; on-site work occurred during the Investigation phase, but would not have been cost-effective while the contractors were implementing the measures. Under normal operating conditions, additional support from the EBCx engineer is unnecessary during implementation; however, a complex operating room night setback, including occupancy sensors and manual overrides, was implemented. This work was completed during off hours, but since the hospital is active and OR schedules are full, the surgical team was concerned about cleanliness and resuming normal operations in the morning. The submitting engineer held daily construction calls that included facilities and surgical staff and the contractors, reviewing night work and addressing any past or future concerns from the surgical staff. Full coordination was necessary for what resulted in a successful project completion.

Finally, the lobby and kitchen area had a history of poor pressurization since the building opened. A previous RCx project had been attempted, but recommendations for the lobby/kitchen spaces had built distrust between the site and contractors and the prior consulting firm. The submitting engineer utilized the MBCx platform in addition to thorough up-front functional testing of the space, and then had new airflow measuring stations installed and controls sequence programmed to achieve energy savings through night setback—all while addressing the known pressurization issues.

Operations & Maintenance (O&M)

Several O&M issues were identified, including several VAV box sensors that were no longer operating properly. All identified operation and maintenance items were provided to facility staff. In addition to identifying issues, another deliverable was a thorough facilities staff training and a systems manual explaining controls sequences and design intent for major HVAC systems.

Cost Effectiveness

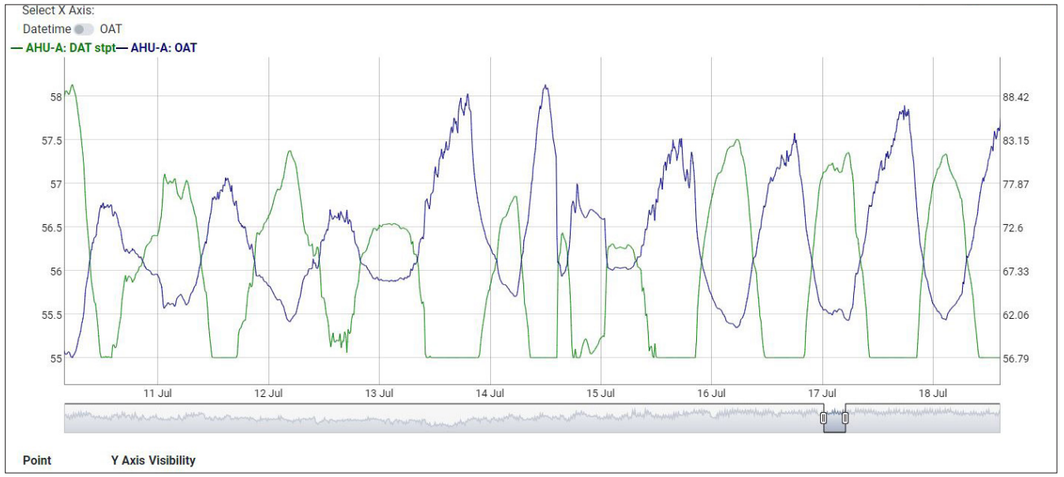
The project exceeded its goal of 10% of total energy cost reduction goal with a bundled simple payback of 3.06 years; applying incentives, payback was 2.20 years (Table 1, art page). The project costs included the planning/investigation phase, all contractor costs to implement the measures, and project management overseeing implementation. Measure-level M&V was calculated utilizing TMY3 weather and trend data. Additional measures continued to be identified after implementation was complete.

Environmental Impact

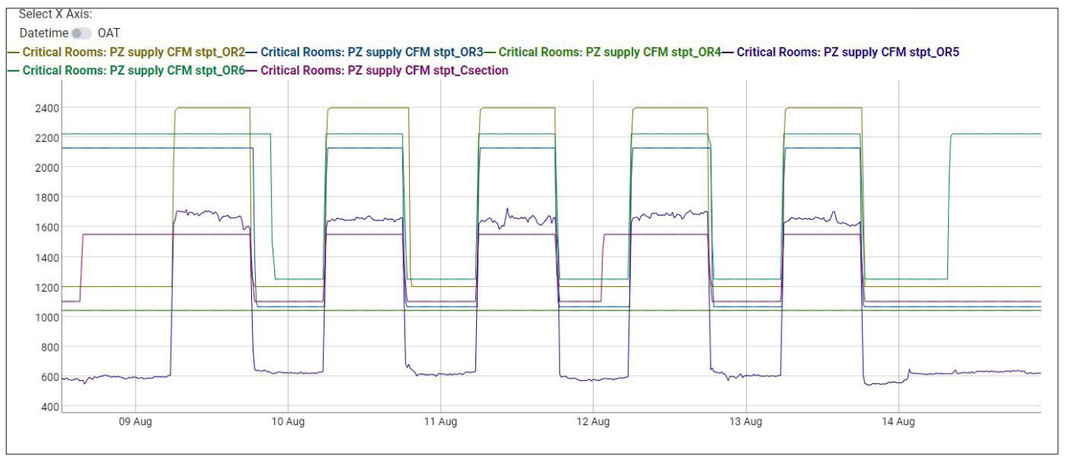
Reducing a building's energy consumption by 10% will clearly have a beneficial environmental impact and is expected to reduce greenhouse gas emissions by 923 equivalent metric tons of CO_2. The hospital EUI is expected to decrease from 195 kBtu/ft^2 to 180 kBtu/ft^2 over the year since final verification.

Table 1: Selected Energy Conservation Measures

ECM	Description	Electric Savings (kWh)	Electric Demand Savings (kW)	Natural Gas Savings (therms)	Equivalent Tons CO_2 Savings (tons)	Total Cost Savings ($)	ECM Project Cost ($)	Simple Payback w/o incentives (yrs)	Incentives ($)
1	Condenser Water Supply Temperature Reset	121,000	0	0	178.51	$9,746	$3,000	0.3	$6,050
2	Discharge Air Temperature Setpoint Reset	54,000	0	21,400	186.66	$13,758	$4,425	0.3	$17,680
5	Chilled Water Supply Temp Reset	2,000	0	0	2.95	$161	$1,525	9.5	$100
6	OR Space Setback	69,000	0	4,300	123.29	$7,412	$59,841	8.1	$6,460
8	Kitchen and Lobby Area Setback	97,000	0	5,300	169.60	$10,098	$14,955	1.5	$8,560
10	AHU Economizer Optimization	140,000	0	0	206.54	$11,276	$3,050	0.3	$7,000
11	Static Pressure Setpoint Reset	45,000	0	0	66.39	$3,625	$300	0.08	$2,250
12	Open Balancing Valves	8,000	0	0	11.80	$644	$1,000	1.55	$400
Total	**Implemented Measures**	**536,000**	**0**	**31,000**	**946**	**$56,540**	**$88,096**	**1.56**	**$48,500**
Total	**RCx Program Costs**						**$85,000**		
	Totals Including Program Costs and Incentives	**536,000**	**0**	**31,000**	**946**	**$56,540**	**$173,096**	**3.06**	**2.20**



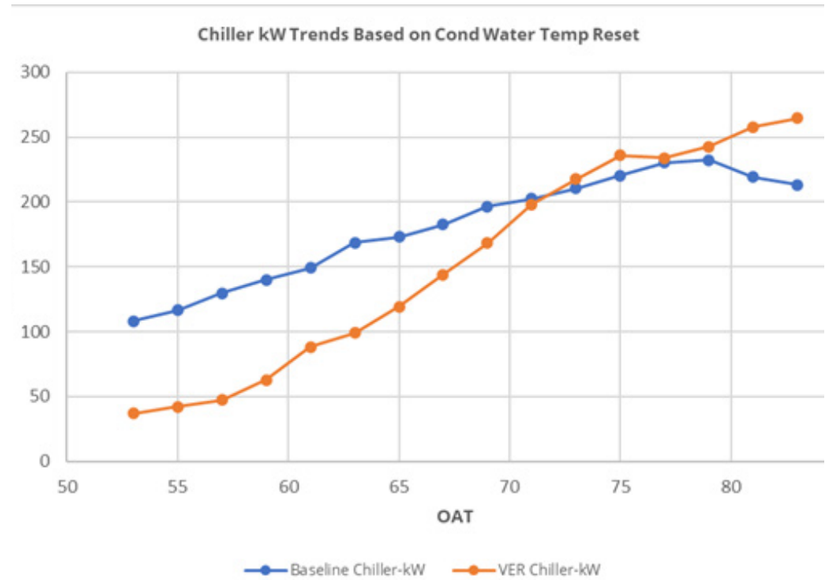
Right: Verification through the submitting engineer's FDD platform, showing patterns of performance after discharge air temperature setpoint reset for AHU-A. DAT reset for three air handlers resulted in annual savings of 54,000 kWh and 21,400 therms, representing 186.66 tons in equivalent CO_2 savings and $13,758 in annual cost savings.



Right: Verification through the submitting engineer's FDD platform, showing patterns of performance after OR setback was implemented. The measure resulted in annual electric savings of nearly 70,000 kWh, plus 4,300 in therms, for annual savings of more than $7,000 and equivalent CO_2 reduction of 123.29 tons.

Operating room monitors were key equipment for implementing OR space setback. Close coordination between the clinical staff, the installing contractor, and the submitting engineer was necessary to ensure safe operations during and immediately after the installation.

On-site investigations in the kitchen/lobby area revealed a clogged honeycomb straightener (left) and nonfunctional airflow measuring station. A new AMS was installed as part of implementation of the kitchen and lobby area night setback ECM, while also addressing known pressurization issues. The setback saved 97,000 kWh and $10,098 annually.



Condenser water supply temperature reset resulted in annual kWh savings of 121,000, a CO_2 savings equivalent of 178.51 tons.