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: Loyola University Quinlan Life Science Heat Recovery Chiller

City/State: Chicago, IL

3. Project Description: New Heat Recovery Chiller to Reduce Campus CHW Plant Energy Usage

Project Study/Design Period: 12/2016 (Begin date (mm/yyyy)) to 01/2018 (End date (mm/yyyy))

Percent Occupancy at time of submission: 100%

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

a. Name: Diniz (Last) Cem (First) (Middle)

Membership Number: 8237793

Chapter: Illinois

Region: IV

b. Address (including country): 30 N. Wolf Road, Floor 2

Hillside (City) IL (State) 60162 (Zip) USA (Country)

c. Telephone: (O) 708-236-0300 x155 d. Email: cdiniz@elaraeng.com

e. Member's Role in Project: Lead Mechanical Engineer

f. Member's Signature: [signature]

5. Engineer of Record: [signature]

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.

Loyola University Chicago
Quinlan Life Science Building
Heat Recovery Projects

By Elara Engineering

Project Statement

The Quinlan Life Sciences Building on Loyola University Chicago's Lake Shore Campus is a 5-story building with a full basement and a mechanical penthouse. The building is approximately 134,000 sq.ft. and is mainly used for chemistry and biology research and teaching laboratories. Other spaces in the building include classrooms, offices and an auditorium.

The Quinlan Life Science building is supplied chilled water from the campus's central chilled water plant (four 750-ton water-cooled chillers) which operates March through September annually. The campus chilled water plant has an annual average efficiency of 0.6 kW/ton including all auxiliary systems such as cooling tower fans and pumps. The total annual chilled water usage for the Quinlan Life Science building is approximately 752,000 ton-hr/yr which equates to 451,000 kWh/yr. The building also has a large hot water reheat load that is supported by a recently installed high-efficiency condensing boiler plant that operates year-round to support heating loads at the makeup air units and reheat loads at room level terminal boxes.

Due to its operation as a laboratory building, Quinlan Life Science is one of the largest energy users on Loyola University's Lake Shore Campus. As a result, Elara Engineering was enlisted to perform an energy audit for the building aimed at identifying opportunities to improve the operation and energy efficiency of this energy intensive building. As part of Elara's Energy Audit, several energy conservation measures (ECMs) were identified including implementing two forms of heat recovery. Specifically, Elara recommended the following:

- Installing a glycol runaround loop that would recover heat from the laboratory exhaust and preheat/precool incoming makeup air
- Installing a heat recovery chiller that provides reheat for the building while reducing the chilled water load on the campus chilled water plant as well as reducing annual operation hours of the existing campus chilled water plant.
- Integrating these two heat recovery systems with each other using a heat exchanger so that exhaust heat recovery coils of the glycol runaround loop can be used to reject excess heat from the heat recovery chiller condenser loop when required.

Lab Exhaust Heat Recovery

The majority of air provided to the building is via a 100% outdoor air, once through system. The roughly 60,000 cfm of lab exhaust is combined at a plenum in the mechanical penthouse which included space for future heat recovery coils. The close proximity of the four laboratory make up air handling units presented the opportunity for a run-around heat recovery loop to provide a quick return on investment.

The new heat recovery system consists of two heat recovery coil banks installed in the exhaust plenum, and three preheat coil banks installed in the makeup air system, along with a pump, a heat exchanger, valves and controls. The glycol heat recovery loop transfers heat between the exhaust air and the makeup air to reduce loads and energy usage year-round. The system energy usage (pump and fan power) were optimized with the heat recovery effectiveness to minimize overall operating costs. This resulted in reduced air pressure drop across the coils and increased water pressure drop which maximized heat recovery at reduced loads by ensuring turbulent flow across the typical operating range. Further, the control sequences were designed to reduce pump speed based on measured air and water temperature differentials to maximize log mean temperature differential and therefore energy recovery while reducing pump energy. The result is an hourly weighted sensible heat recovery effectiveness over 80% during the winter.

Heat Recovery Chiller

In addition to the heat recovery runaround loop, a new heat recovery chiller was installed and tied into the building and campus chilled water distribution system. Heat rejected by the chiller was tied into the building's heating hot water loop. As such, the load on the campus central chilled water plant was reduced, facilitating expansion of chilled water loads elsewhere on campus while also recovering waste heat that can be used for summer reheat loads for the Quinlan Life Science Building. This allowed the campus hot water boiler plant to be turned off during summer months. Further, the Quinlan Life Sciences building, being the largest chilled water load on campus, was previously the driver of when the campus chilled water plant was enabled in the spring. With the implementation of the heat recovery chiller, the campus chilled water plant can remain off for a longer period.

An innovative feature of the heat recovery chiller project is the integration with the lab exhaust run-around loop described above. During the spring and fall when reheat loads are at their highest and cooling loads at their lowest there is excess heat in the loop that needs to be rejected. During these same times, the availability of heat for heat recovery via the run-around loop is at its minimum. Therefore, in lieu of installing a new fluid cooler to reject the heat, the heat is rejected via a plate heat exchanger from the reheat loop to the exhaust air stream. The same heat recovery coils in the exhaust plenum are utilized for heat rejection. As the temperature warms and cooling loads increase, the system reverts back to heat recovery. The same happens when temperatures drop and cooling is no longer needed.

Results

The most dramatic result of this project is its energy savings and reduction in load to the chilled water plant. The two forms of heat recovery implemented at Quinlan Life Science allow for heat energy to be recovered year-round either in the form of runaround heat recovery for preheat/precool of makeup air or hot water heating via the heat recovery chiller. This project is a great example of how energy intensive buildings, like research laboratories that operate continuously, can incorporate energy efficient features that improve the building's energy efficiency and reduce operating costs without sacrificing comfort or processes.

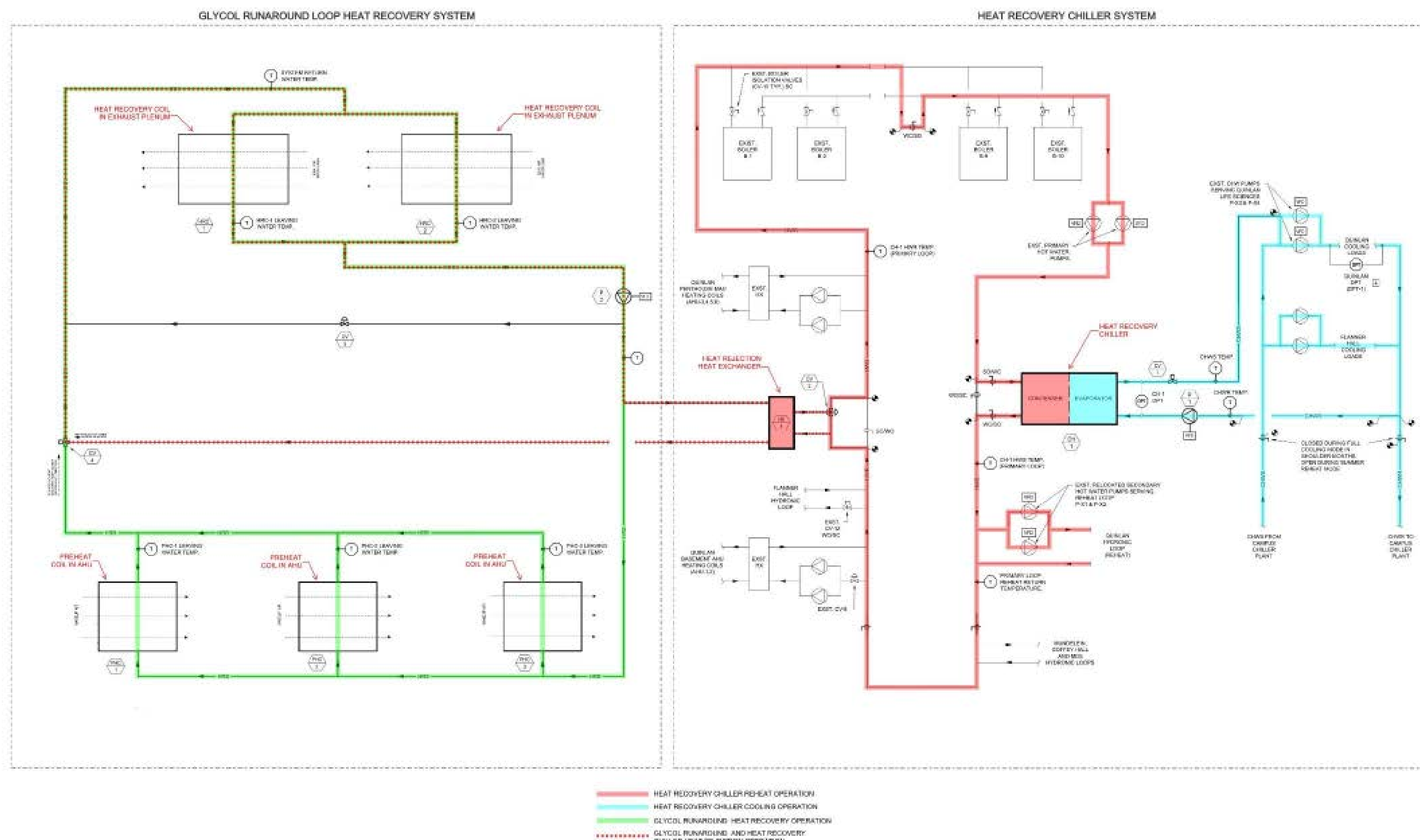
The results of the combined heat recovery improvements for Quinlan Life Science were calculated to result in an annual natural gas savings of 94,000 therms/yr with an electrical energy increase of 66,100 kWh/yr. Despite the increase in electrical energy usage, the project is projected to result in an annual energy cost savings of $62,000 and also successfully received $85,900.00 in incentive funding in recognition of its energy conservation from Peoples Gas. Lastly, by integrating the two (2) heat recovery systems, significant implementation cost avoidance was achieved by eliminating the need for additional heat rejection equipment.

Additionally, ancillary benefits can also be realized by looking outside the building itself and examining its impact on campus utilities such as chilled water. By reducing the load on the central chilled water plant, Loyola University can support additional chilled water loads on its Lake Shore Campus (represented by new buildings, building expansions and other modifications) without the substantial cost of increasing the capacity of the campus' central chilled water plant.

Loyola University Chicago Quinlan Life Science Building Heat Recovery Projects

Heat Recovery Chiller

Heat Rejection Heat Exchanger



Heat Recovery Schematic

ELARA