WESTERN UNIVERSITY’S DEEP ENERGY RETROFIT OF THE CHILLER PLANT SOUTH

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WESTERN UNIVERSITY

- Located in London Ontario
  - 100 buildings with 10.5 M square feet
  - 40,000 students, staff and faculty
- South Chiller Plant
  - 4 chillers: 2 Trane 1,600 Tons; 2 McQuay 2,000 Tons
  - 7,200 tons cooling capacity
  - Supplies 5 M sq feet of space with cooling capacity
- Electricity usage
  - 9,000,000 kWh during operating season, peak demand of 6,500 kW.
  - Before project yearly energy costs: $3,750,000
CHILLED WATER PLANT
DESCRIPTION

From Secondary Distribution Loops

To Secondary Distribution Loops

South Loop: Two 3,200 gpm, 100 HP Distribution Pumps

North Loop: Three 4,000 gpm, 150 HP Distribution Pumps

East Loop: Two 2,100 gpm, 125 HP Distribution Pumps

Average return temperature to chillers: 50°F

Primary Pump: 3,440 GPM, 40 HP

Primary Pump: 4,150 GPM, 60 HP

Average supply temperature from chillers: 42°F

All pumps were equipped with VFD’s, but did not modulate speed.

Two 1,600 T Trane Centrifugal Chillers

Two 2,000 T McQuay Dual Compressor Centrifugal Chillers

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Because of the decoupler, more chillers than what the campus load required had to be operating: primary pumping flow had to be higher than secondary flow to avoid return water bypassing in the district supply. This created a false assumption that the plant was at full capacity.

Primary flow bypass in chiller return decreased entering temperature, thus decreasing chiller efficiency.
DEEP ENERGY RETROFIT MEASURES

- Modification of pumping strategy to reduce amounts of pumps in operation and allow variable flow through chillers;
- Modification of chilled water primary/secondary loops decoupler to eliminate secondary flow return water bypassing in supply.
- Modification of control sequences to allow variable pumping on primary and secondary chilled water loops.
- Modification of control sequences to allow variable pumping in condensers and modulate cooling tower fan speed according to chiller load.
- Piping modifications to reduce pressure drop in central plant: removal or opening of balancing valves on pumps.
- Cooling tower modifications to increase air flow: easing air intake to increase air flow (no fan modifications).
- Campus chilled water supply temperature reseat based on outdoor air wet bulb temperature.
- Implementation of an automatic peak demand reduction control sequence.
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Secondary pumps modulate to maintain their network’s pressure setpoint.

To Secondary Distribution Loops

Primary Pump: 3,440 GPM, 40 HP

Primary Pump: 4,150 GPM, 60 HP

Primary pumps modulate according to chiller load setpoint or to maintain evaporator minimum flow.

Supply temperature from chillers varies between 42°F and 50°F based on outdoor wet bulb temperature

Average return temperature to chillers: 56°F

New check-valve on decoupler

ΔP

Two 2,000 T McQuay Dual Compressor Centrifugal Chillers

Two 1,600 T Trane Centrifugal Chillers

Pumps VFD’s were commissioned and now operational.

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CHALLENGES

- Operators were skeptical in the beginning of success of chilled water flow variations in evaporators.
  - This was overcome with many training sessions with the entire plant’s operating staff.

- The entire control sequences of the plant was redone, including automatic starts and stops of chillers and pumps.
  - Many control work sessions were done directly with the programmer and operators to make sure the control sequences were optimized and operable.
Elimination of chilled water return into the distribution loops supply.
The plant now has an extra 1,000 tons for future buildings supply.
Increase of chilled water return temperature, improving chiller efficiency.
Substantial pumping energy savings with VFD operation.
Substantial chiller energy consumption reduction with starting sequences that follows load demand.
Operating improvement with automation of chillers starts/stops and peak demand reduction sequences.
Reductions of 3,000,000 kWh and 1,000 kW in peak demand.
Yearly costs savings of $630,000.
CONCLUSION

- This project was a success on the energy reduction level as well as on the operational level.
- Skepticism was overcome with training and demonstration.
- Variable flow through existing chillers is possible.
- Primary/secondary loops decoupler has to be unidirectional to maintain chiller minimum evaporator flow.