Commissioning and the Impact on District Energy at Oberlin College

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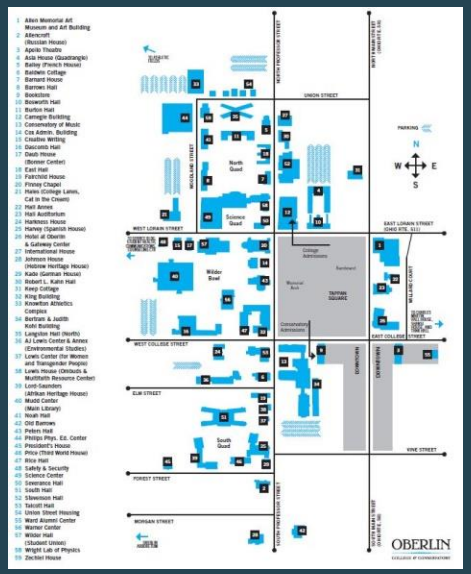
RMF Engineering
Reliability. Efficiency. Integrity.

OBERLIN
COLLEGE & CONSERVATORY
Office of Environmental Sustainability

Campus Background

- Ohio
- Founded in 1833
- 2,900 Students
- Distributed Heating and Cooling Systems
- 79 Campus Buildings
  - 56 building on central steam
  - 15 buildings on central cooling



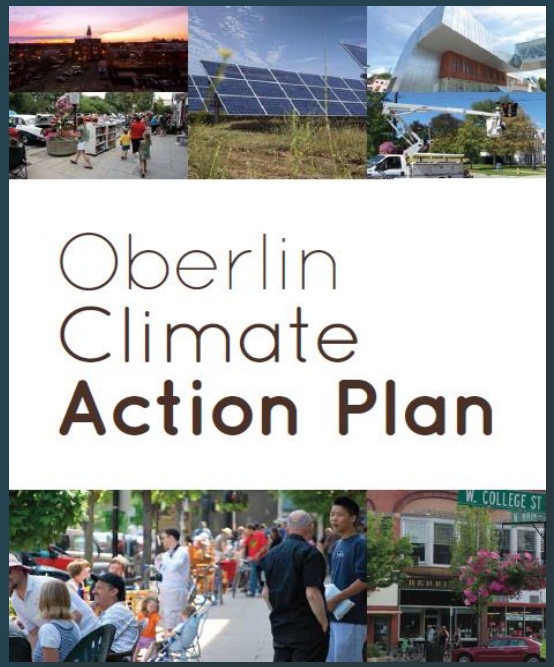
Science Center Background

- Largest energy consumer on campus
- 229,000sf
- Constructed in 2000; and fused four separated building spaces together
- Mixed-Use Facility
  - Teaching Labs
  - Research Labs
  - Vivarium
  - Lecture Theatres
  - Offices
  - Greenhouse

Project Motivation

- First re-commissioning project for Oberlin College

- Identify O & M enhancements that result in
  1. Energy efficiencies and savings
  2. Occupant comfort
  3. Indoor air quality
  4. Training opportunities



- Optimize control systems

- RCx value beyond energy savings to safety, campus planning, & operations.

- Impact our commitment to become a carbon neutral campus

Expectation of Re-Commissioning

- Reduced energy consumption in the Science Center
- Identification of building specific equipment deficiencies
- Identification and prioritization of ECM's
- Understanding of District Energy Systems

Project Approach

- Education
  - Student learning
- Collaboration
  - Oberlin teams
  - Other related Science Center and building system projects
  - Other relevant campus partners
- Holistic system thinking
  - Science Center as part of larger campus system

Unexpected Results

- Building performance issues due to timing of chilled water plant start-up
- Building performance issues due to plant steam delivery pressure
- Applicable to primary institution mission of education
- Additional value to airflow PM and carbon neutral campus planning efforts

Re-Commissioning Process

Planning	Investigation	Implementation and Turnover
• Initial Site Survey • Review System Design • Utility Benchmarking • Energy Audit • Energy Conservation Considerations • Detailed Re-Cx Plan	• Diagnostic Monitoring Plan • Current System Performance • Facilities Management Staff Interviews • Energy Conservation Analysis • Detailed Functional Testing Program • Functional Testing • Draft Report • Issues Log	• Detailed Scope of Work for Capital Improvement Projects • Budget Estimates • Implement Modifications • Final Re-Cx • Measurement and Verification • Operator Training • Re-Cx Manual • Recommendations for Future Initiatives

Review systems Operations → **Optimize Performance** → **Train Staff**

Our Re-Commissioning Goals

- Reduce Energy Consumption
- Optimize Efficiency
- Lower Maintenance Costs
- Improve System Reliability
- Improve Equipment Life

Typical Re-Cx Opportunities

- Simultaneous heating and cooling
- BAS programming vs. actual operation
- Chilled water bypass and leaks
- Corroded coils
- Equipment not responding to controls/disconnected
- Controls sensors out of calibration
- Lack of water treatment
- Incorrect cooling load calculations
- Low Delta-T syndrome

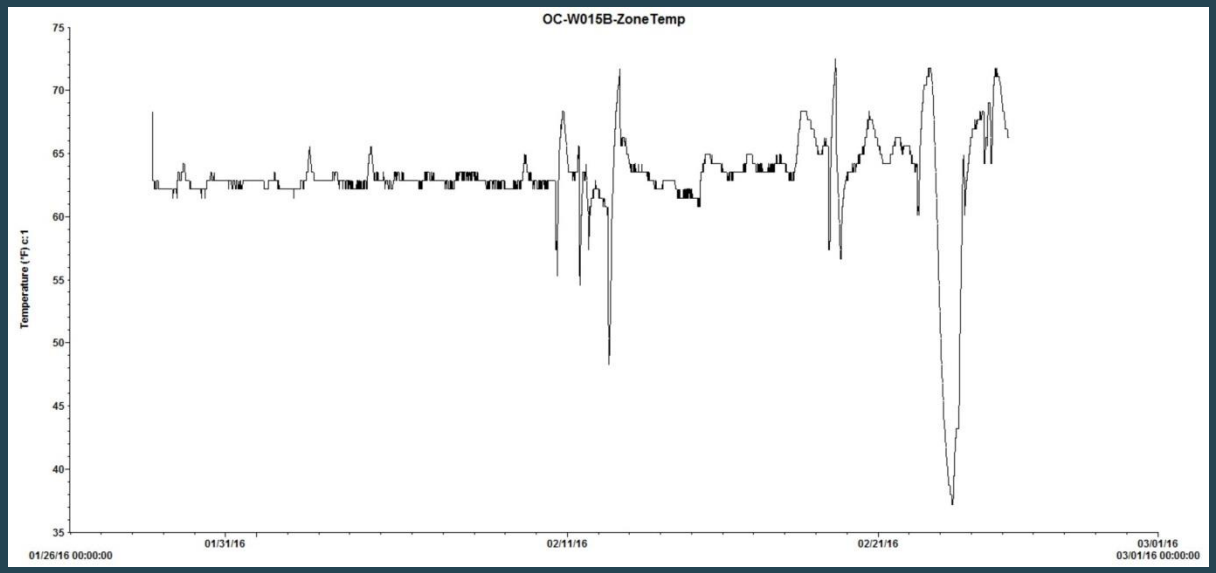
Planning

Interview Technical Support Staff

- Owner occupants
- Operations staff
- Facility team
- HVAC/controls staff

Investigation – Winter Operation

- Recurring interview comment – Cold In Winter!
- AHU and terminal equipment heating coils and actuators were operational and in fair condition
- So why are we cold?



Investigation – Winter Operation

- System designed for an building inlet steam pressure of 25 psig.
- Building receiving between 8 and 9 psig
- Majority of the heating systems in the building not achieving design capacities

6/95 S201 DWG

STEAM PRESSURE REDUCING VALVE SCHEDULE

UNIT NUMBER	LOCATION	SERVICE	INLET TEMP °F	INLET PSIG	OUTLET PSIG	LBS/HR	SIMILAR TO	SILENCER	ORIFICE	NOTES SEE BELOW
PRV-1A	WEST PENTHOUSE M.E.R.	BLDG. HTG.,HUMIDIFICATION DHW HEATERS	274	25	10	16,700	SPENCE 6"ED	YES	YES	1,2
PRV-1B	WEST PENTHOUSE M.E.R.	BLDG. HTG.,HUMIDIFICATION DHW HEATERS	274	25	10	8,300	SPENCE 4"ED	YES	YES	1,2

Winter Operation Solution

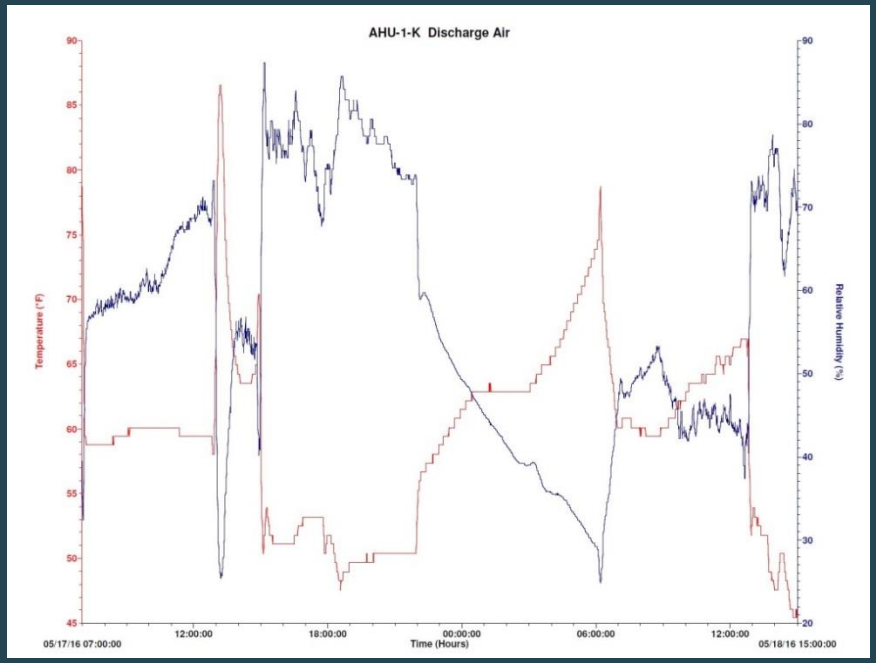
- 2 buildings are driving the need for lower than design delivered steam pressure
- Consider new design efforts at those buildings to either modify the size of the PRV station or install de-centralized steam generation

Investigation – Spring Operation

- Recurring interview comment – Hot and cold swings in the spring!
- Science Center has a local air-cooled chiller to carry the springtime cooling load

Investigation – Spring Operation

- AHU Supply Air Temperature swings of up to 22 deg F
- Manual manipulation of air handling equipment to “choke off” chilled water usage
- District chilled water not available during shoulder season



Investigation – Spring Operation

- Local chillers/pumps are undersized for building load
- Chillers at full capacity equate to less than 45% of building design cooling load

AIR COOLED CHILLER SCHEDULE

UNIT NUMBER	NOM TONS	ELECTRICAL DATA		EVAPORATOR							CONDENSER			COMPRESSOR DATA					SIMILAR TO	NOTES SEE BELOW	EMER POWER
		VOLTS (3ø)	MAX. CIRC. AMP.	EWT °F	LWT °F	GPM	FLUID	# OF PASSES	ΔPRESS FT. H_2O	FOULING FACTOR	AMBIENT TEMP. °F	CFM	NUMBER OF FANS	QTY	FLA (EA)	STAGES UNLOAD. (TOT)	KW RATING (EA)	KW/TON MAX			
ACWC-1	53.5	480	142	55	45	125	WATER	---	10	0.0005	95	30,300	2	2	57	5	---	1.2	YORK 2448A3	1	YES
ACWC-2	193.4	480	488	55	45	450	WATER	---	11	0.0005	95	143,000	8	2	188	7	---	1.2	YORK J200	1	NO
ACWC-3	10	208	35	55	45	15	WATER	---	---	----	95	---	2	2	-						

WATER PUMP SCHEDULE

UNIT NUMBER	LOCATION	SERVICE	TYPE	GPM	TOTAL HEAD (FT. H O)	MOTOR DATA @ 60 HZ					SIMILAR TO	EMER POWER
						BHP	MHP	RPM	VOLTS	PHASE		
HWP-1	WEST PENTHOUSE	H.W. REHEAT & RADIATION	END SUCTION	500	75	11.9	15	1750	480	3	BELL AND GOSSETT 1510	YES
HWP-2	WEST PENTHOUSE	HWP-1 STAND BY	END SUCTION	500	75	11.9	15	1750	480	3	BELL AND GOSSETT 1510 (STANDBY)	YES
CHP-1A	NORTH PENTHOUSE	CHILLER #1	END SUCTION	120	75	3.3	5	1750	480	3	BELL AND GOSSETT 1510	YES
CHP-1A (STAND-BY)	NORTH PENTHOUSE	CHILLER #1	END SUCTION	120	75	3.3	5	1750	480	3	BELL AND GOSSETT 1510	YES
CHP-2	NORTH PENTHOUSE	CHILLER #2	END SUCTION	450	75	11.0	15	1750	480	3	BELL AND GOSSETT 1510	YES
CHP-2A (STAND-BY)	NORTH PENTHOUSE	CHILLER #2	END SUCTION	450	75	11.0	15	1750	480	3	BELL AND GOSSETT 1510	YES

Spring Operation Solution

- Fix failed chilled water valves that lead to excessive chilled water usage

- Consider de-centralized cooling for the critical Vivarium AHU during shoulder season

Lessons Learned

- When performing building level Re-Cx, consider scope to investigate district energy systems

- Consider review of district energy delivery conditions during either building renovations or new building design

Questions?

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Field Services

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