UVM Central Utility Plant: A Half Century of Growth, Innovation, & Efficiency

IDEA Campus Energy 2018 Baltimore, MD

Presenters: Sal Chiarelli, UVM, Mike Pelletier, UVM, Bill Mahoney, RMF
Time: 10:30 AM – 11:00 AM March 8, 2018 (Thursday)
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Director of Physical Plant  
University of Vermont

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Senior Project Engineer  
University of Vermont

Bill Mahoney, PE  
Mechanical Engineer  
RMF Engineering
Chartered in 1791

Fifth oldest university in New England (after Harvard, Yale, Dartmouth and Brown)

Called UVM for Universitas Viridis Montis, Latin for “University of the Green Mountains”

Mascot: Catamount

460-acre campus, 6 million Sq. Ft.

100+ majors in 7 undergraduate schools and colleges

Undergraduate Students: 10,513

Graduate Students: 1,542

Medical Students: 461

1,600 full and part-time faculty
EXISTING CAMPUS UTILITIES

Electric Distribution from 125 Municipal Utility Services & Gas from Municipal service at 125 points

Central Steam Boiler Plant

Four 40,000 PPH + One 64,000 PPH Dual Fuel Boilers

200 PSI Steam Delivered Year-Round to 80 Buildings

Converted From No. 6 Fuel Oil Backup to No. 2 Low Sulfur

Central Chiller Plant

Two 1,365 Ton Steam Turbine Drive Centrifugal Chillers

Interconnected Satellite Chiller Plants (Absorbers and Electric Chillers)

42F CHW Delivered May Through October (minimal winter load) to 15 Buildings
CHW Generation & Distribution

- Central Chiller Plant
  - Inside Cage Boiler Plant
  - Cooling Towers to North
- Satellite Chillers
- Variable Primary & P/S Pumping
- Radial Feed Distribution
  - Migrating to Being Looped
  - Up to 20” Diameter
  - Direct Buried
  - Pre-insulated Ductile Iron
- Adding Service to Existing Buildings
- STEM
- Residence Hall
CHILLED WATER CAPACITY NEEDS

- N+1 Reliability Goal
- Unreliable Smaller Remote Units
- Two 1,600 Ton Chillers
- Potential for Future 3rd

New equipment to be located in a physical addition to the “Cage Plant”
A Building Full of UVM History
A Building Full of UVM History

- National Register of Historic Places

- 1901 Original Construction

- 1915 Addition
  - Glass Roof
  - Dirt Floor
  - Drill Hall
  - Indoor Track
  - Batting Cage

The structure was erected in stone on a brick and concrete foundation in 1901. Andrews, Jacques and Rantoul were the architects. Originally, the building measured 90 by 150 feet. In 1915 A.L. Lawrence designed the 100 by 120 foot extension at the east end of the building. This addition, with its glass roof and dirt floor, contributed to the building's historic significance.

The building's strange location, out of line with the rest of the buildings along University Place, is explained by the fact that the University did not own the land to the south at that time. In fact, in order to have the building face west as its neighbors do, it was necessary to purchase a small strip of the adjacent corner lot.

From its construction in 1901 until 1927, when the city erected Memorial Auditorium, the building played a dual role as a University and civic cultural center. It was the scene of University convocations, public concerts, balls, plays and the home of the Burlington Symphony Orchestra. When the University built a new gym in 1963, the building was remodeled to accomodate the ROTC program and various offices. In 1973-74 the interior was again reworked on the plan of Burlington Associates to serve as theatre.
In 1918, the gymnasium was used as an infirmary during Spanish influenza outbreak.
Early events held inside the “Gymnasium Addition” included skits, banquets, and Commencement ceremonies. Notice the windows, the dirt floor, and the batting cage nets suspended from ceiling.
A Building Full of UVM History

After 1962, the vacated “Old Gym” served as ROTC headquarters, Military Studies department, a testing facility for civil engineering, and a research laboratory for forestry and zoology.

In 1974, the west portion of building became the Royall Tyler Theater.
To improve safety and efficiency, a major project was underway to remove the original direct buried piping and HTHW system entirely to steam. The underground piping was removed to free up valuable space for other needs.

This multi-phase multi-year project involved miles of new and replacement piping, the installation of a metal insulating jacket and the original direct buried piping removed to free up valuable space for other needs.

New steam piping laid in pre-cast concrete. Insulated with a metal insulating jacket and buried underground. The condensate polishing system was expanded to handle up to 400 gallons per minute of polished feedwater. Four tanks were installed to handle the increased steam demand on cold winter days when the boilers were installed, and the first generation of underground distribution piping was laid out to deliver steam to many other buildings.

Two 40,000 pound per hour watertube boilers were installed in the space that once held the HTHW equipment. These were the first ever steam-driven chillers in the State of Vermont. The chillers are efficient because most of the energy used comes from excess steam from the boilers that would otherwise be wasted.

Chilled water was initially piped to Davis Center, Bailey-Howe, Royall Tyler and Old Mill/Lafayette.

The chilled water piping was extended to supply Jeffords Hall, HSRF and Given buildings.

Converted boilers from No.6 to No.2 fuel oil and the underground tanks were emptied, cleaned and replaced with No. 2 fuel.

What will the next 50 years bring?
SITE CONTEXT
COOLING TOWER SITING
PLANT EXPANSION
PLANT EXPANSION LAYOUT
Congested Utilities

- Busy Area
- Telecomm Backbone
  - Zero Interruptions
  - Vault in Expansion
- Multiple Relocation
  - Out of Expansion
  - Out of CT Basin
- Vault below Expansion
- New Services
  - Municipal Electric Switch
  - STEM Building
CHILLED WATER CIRCUIT
CONDENSER WATER CIRCUIT
PROJECT RESULTS

- 1,500 ton (0.57 Kw/Ton) electric centrifugal chiller
- Auxiliaries
- A future 1,500 ton unit
- Ultimate installed cooling capacity to 5,730 tons
- Free cooling system
ACCESSIBLE FLOOR TRENCH
PLANT FEATURES
Steam Freeze Protection
  – Concrete Basins and
  – Concrete Collection Trough

Free Cooling
  – Standalone OR
  – Series / Upstream of Chiller

Electric or Steam Cooling - as Rates Dictate

Can Meet Loads as Low as 200 Tons
Control Migration
Discuss early & often
Rehearse / Walk Thru
Contingency Fund
Unknown Utilities
Existing Systems
Improvements

Lessons Learned
Test pits
Clear scope (Level A/B/C)
Consider full excavation for busy areas
Maintain records (esp. under protective slabs)
Open House Celebration

The University community is invited to join us to celebrate the completion of the UVM Central Plant expansion.

Get a behind-the-scenes look inside the Plant where steam and chilled water is produced for heating and cooling university buildings.

Wednesday, August 2, 2017
12:00 noon – 2:00 pm

Free Ice Cream, Refreshments and Facility Tours
RSVP and details at: go.uvm.edu/cage

Please enter the site via the sidewalk between the Catherine Sculpture and the Saltzman Library entrance. Signs lead down towards the Plant.

*Wear closed toe shoes if you want to tour the inside of the plant.**
Community Education

Hosted 20 small group tours through the entire Plant

140 attendees

123 scoops of Ben & Jerry’s Ice Cream
NEXT STEPS

4th & 5th Chillers

Electric Service in place
Revisit Steam
Space to expand in cooling tower yard
Identify space for 5th chiller

Complete CHW Loop & Upgrade Satellite Pumps
Thank you

Audience Q & A