Centralized Renewable Energy System (C.R.E.S)

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Presentation Outline

- General Overview of Nebraska Innovation Campus (NIC)
- System Concepts
- Design
- Construction
- Operations
- Q/A
Nebraska Innovation Campus (NIC)

- Research campus built and operated under a Public / Private Partnership (P3) arrangement.
- 2.2 million square foot campus at full build out.
- Meant to foster In-depth partnerships between the UNL and private sector businesses.
  - Stimulate Ideas
  - Collaboration
  - Interaction / Innovation
Nebraska Innovation Campus (NIC) – Old State Fair Grounds
Nebraska Innovation Campus (NIC) – Old State Fair Grounds
System Concepts – Theresa Street Wastewater Treatment Facility

Theresa Street Wastewater Treatment Plant (TSWWTP)
System Concepts – Theresa Street Wastewater Treatment Facility Discharge
The system acts exactly like a geothermal heat source or heat sink.

Either centralized or distributed heat pump / chiller equipment is required at each building.

* WWTP = Waste Water Treatment Plant
* NIC = Nebraska Innovation Campus
System Concepts
Design

Three Main Project Components:

1. Theresa Street Waste Water Treatment Plant (TSWWTP) Pump Station
2. Heat Exchanger / Pump Facility
3. Distribution Piping
Design – TSWWTP Pump Station

To / From CRES Plant
One equipment “Train” including: Pump, HTX, Strainers, etc
Design – Heat Exchanger Pump Facility

Central Renewable Energy System
Design – Heat Exchanger Pump Facility
Design – Heat Exchanger Pump Facility

- Plant is fully automated and remotely monitored
- Pump Cycling
- Pump Speed Control
- Strainer Blowdown
- CCTV
- Flow / Pressure / Temperature
Design – Distribution Piping

UNL Geographic Information System
Screen Shot of “As-Built” Distribution System
Central Renewable Energy System
Customer Installation and Operational Guidelines

Design – Distribution Piping

General Notes:
1. Unless otherwise noted, all equipment, piping, valves, etc. shall be provided, installed and maintained by the building tenant.
2. Only the CRES supply/return water system is shown. Piping, layout and devices on the building side of the heat exchanger are not shown. A manual pressure gage and thermometer are required on the building supply and return lines.

Key Notes:
1. Heat exchanger flow control valve provided and controlled by building controls/endor. Flow control shall be pressure independent type with minimum flow set for heat exchanger design flow. Acceptable manufacturers are Belimo, Danfoss, and ThermaFrost.
2. Duplex basket strainer with 1/8" screen. Two single strainers may be provided in lieu of duplex unit. Pipe blowdown pipe to nearest floor drain.
3. Flow meter provided calibrated and maintained by ULI. Installed by contractor. Conduit and wire back to metering panel/cable gutter by contractor. See CRES building meter wiring detail. Provide minimum upstream and downstream pipe diameters as shown between meter and any valve/fitting.
4. Provide a minimum of 1/2" space between meter leg and bypass leg.
5. Provide pipe sleeve and link seal with 88 hardware at floor penetration. Install so that threaded nuts are exposed.
6. Tapping sleeves, isolation valves and reducers to be provided and installed by ULI, as part of connection fee.
7. Pressure sensor provided by ULI. Installed by contractor. Conduit and wire back to metering panel/cable gutter by contractor. See CRES building meter wiring detail.
8. Temperature sensor provided by ULI. Installed by contractor. Conduit and wire back to metering panel/cable gutter by contractor. See CRES building meter wiring detail.
9. Extra thermo-well for sensor. Calibration provided by ULI, installed by contractor.
10. Plate and frame heat exchanger to be installed in first floor or basement of tenant building.
11. Normally closed bypass to prevent zero flow conditions for extended outages.
Construction – WWTP Lift Station and Piping
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Construction – Heat Exchanger and Pump Facility
Construction – Heat Exchanger and Pump Facility
Construction – Heat Exchanger and Pump Facility
Construction – Heat Exchanger and Pump Facility
Construction – Distribution
## Current Buildings and Actual Cooling Peak Loads

<table>
<thead>
<tr>
<th>Building Area [GSF]</th>
<th>Peak Cooling Load [Tons]</th>
<th>Cooling Density [GSF/Ton]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commons Area (includes old 4H building)</td>
<td>151,990</td>
<td>385</td>
</tr>
<tr>
<td>RISE Building</td>
<td>75,000</td>
<td>250</td>
</tr>
<tr>
<td>Food Innovation Center (FIC)</td>
<td>161,900</td>
<td>680</td>
</tr>
<tr>
<td>Greenhouse Innovation Center (ICG)</td>
<td>45,950</td>
<td>630</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>434,840</strong></td>
<td><strong>1945</strong></td>
</tr>
</tbody>
</table>

Notes

(1) Actual peak from summer 2019
Operations
Operations
Operations
Operations
Operations
Operations
Operations
Building Heat Absorption / Rejection
54 Deg F < Supply Temp < 78 Deg F
Maintenance
Maintenance
Thank You!

Questions?
More Questions?

See the following slides for supplemental design and operational data
System Concepts

System Capacity Constraints

- Waste water treatment plant outfall rates average 24 Million Gallons per Day (MGD)
- \(24 \text{MGD} \times \frac{1}{24 \text{Hr}} \times \frac{1}{60 \text{ Min/Hr}} = 19,000 \text{ Gallons Per Minute (GPM)}\)
- 19,000 GPM is equivalent to 7,900 Tons of cooling at a 10 degree “delta T”
- This system will have the capacity to heat and cool roughly 1,875,000 SF of lab/office space (250 Sq Ft / Ton)
- There is a time-of-day fluctuation but it happens to align with the load profile of a building.
- Water leaving CRES back to Salt Creek MUST stay below 90 Deg F
Design – TSWWTP Pump Station

Non Clog Submersible Pumps

110 Hp, 5,000 GPM @ 62.4 Ft Head

Variable Speed Drives to Control Flow Rate

Initial Buildout: Three Pumps Total
(2 Pumps with 1 Spare) – 10,000 GPM

Final Buildout: Six Pumps Total
(5 Pumps with 1 Spare) – 25,000 GPM
Design – Heat Exchanger Pump Facility

**Pumps:**
- Horiz. Split Case
  - 3900 GPM, 140 Ft Head, 200 HP Motor

**Heat Exchangers:**
- Plate and Frame
  - 3900 GPM, 10 Deg F DeltaT, 1630 Tons

**Initial Buildout:** Three Equipment “Trains” (2 with 1 Spare) – 3260 Tons

**Final Buildout:** Six Equipment “Trains” (5 with 1 Spare) – 8150 Tons
Design – Distribution Piping

Distribution System

30-inch Diameter Ductile Iron Pipe

Twin Piping (Supply and Return)

Total of 6,100 LF Ductile Iron

Customer Installation Operational Guidelines:

- The CRES plant is funded and operated the same as any other University of Nebraska – Lincoln Utility plant.
- The City of Lincoln bills the University for lift station pump energy and maintenance.
- Nebraska Innovation Campus (NIC) buildings are individually metered and billed for the amount of heat extracted or rejected.
  - Heat extraction rates (winter) are tied to market price of natural gas.
  - Heat rejection rates (summer) are tied to market price of electricity.
  - Rates do include a low “delta-T” penalty and incentive.