Presentation Outline

I. General Overview
II. CRES Financial Operations
III. Methods of Collecting Revenue
IV. Preliminary Design
V. Final Design
VI. Project Delivery and Construction
Theresa Street Wastewater Treatment Facility

- Nitrification Capacity 27.4 MGD
- Hydraulic Capacity 91 MGD
- Nitrification, De-Nitrification
  Fine Bubble Aeration
- Vortec Grit Removal
- Anaerobic Sludge Digestion
- Methane Fueled Electrical
  Generation (900 kW)
- UV Disinfection
- Enhanced SCADA/Process
  Automation
- Chemical Wet Scrubber Odor
  Control
General Overview

1. This system will have the capacity to heat and cool:
   - 1,875,000 SF of lab/office space
   - 1,500 houses at 2,000 SF each

2. 18,000 GPM is equivalent to 7,500 Tons of cooling at a 10 degree delta T.

3. The C.R.E.S. essentially works like a geothermal system but rather than pumping from water from the ground, the water is pumped from the City of Lincoln wastewater plant.

4. Water temperatures range from 57 to 75°F. At these temperatures, buildings will be able to utilize geothermal heat pumps that can operate up to 30% more efficient than standard equipment.
General Overview

Comparison vs. Traditional Systems

<table>
<thead>
<tr>
<th>System</th>
<th>End User Cost (1)</th>
<th>Efficiency (2)</th>
<th>Cooling savings (3)</th>
<th>Heating Savings (4)</th>
<th>Lifespan (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chillers &amp; Boilers (base system)</td>
<td>100</td>
<td>92%</td>
<td>0%</td>
<td>0%</td>
<td>30 years</td>
</tr>
<tr>
<td>Steam &amp; Storage (East Campus)</td>
<td>100</td>
<td>90%</td>
<td>10%</td>
<td>20%</td>
<td>30 years</td>
</tr>
<tr>
<td>CRES</td>
<td>100</td>
<td>95%</td>
<td>25%</td>
<td>30%</td>
<td>50 years</td>
</tr>
</tbody>
</table>

(1) Capital cost to install mechanical systems to use source of energy
(2) Annual Fuel Utilization Efficiency (AFUE)
(3) Cooling months energy savings
(4) Heating months energy savings over traditional systems
(5) Project lifespan of mechanical systems

Calculations/Assumptions:
1. Base system uses an air-cooled chiller that meets ASHRAE minimum standards of 2.8 COP.
2. CRES system utilizes a water to water heat pump system that meets ASHRAE minimum standards of 4.2 COP. In this system, the electrical pumping energy is included from the CRES.
3. This savings is only based on summer cooling, as the system will use more electrical energy over the entire year. The reason for this is due to the base system utilizing gas for heating and the CRES using water to water heat pumps. It is important to understand the peak that sets demand will be less in summer and therefore will save demand charges throughout the year.
4. This evaluation considers making the same amount of chilled water throughout the year in both the base and the CRES.
5. Savings could even be larger as this evaluation does not consider additional free cooling available from the CRES.
General Overview

C.R.E.S. Bottom Line

1. **More efficient** than geothermal system due to consistent water temperatures and no issues from raising ground temperatures over time

2. System **can easily and economically add on new users** up to the 28 million gallons per day capacity

3. **Renewable and sustainable source of energy** with no risk of commodity rate increase

4. Fewer systems exposed to elements = **longer lifespans**

5. System is controlled through **sophisticated monitoring devices** that are networked and provide real-time information

6. Building mechanical systems **costs the same** as a traditional systems

7. Up to **30% more efficient** than traditional boiler and chiller system

8. Up to **25% energy savings** in the summer cooling months
Business Pro Forma

• Pro Forma Developed to Show Project Payback
  – Pro Forma Included:
    • Assumptions
    • Financing
    • Energy Rates and Rate Increases for Gas and Electric
    • Wastewater Effluent Energy Value (MMBtu)
    • Cash Flow Analysis
CRES Financial Operations

• $12 Million CRES Infrastructure financed with Qualified Energy Conservation Bonds (QECBs)
• CRES Utility Rates Equivalent to Local Market Utility Rates
• CRES Revenue Pays QECB Bonds and CRES Operational Expenses
• CRES Partners Share in Future Operational Savings
Preliminary Design
Preliminary Design
Preliminary Design
THE RESA ST WWTP

• Use of Theresa St. WWTP Effluent
  – Current NPDES Permit Must be Met – Temperature Limits
  – Project Avoided Second Permit by Discharging Return Water to Same Location
  – WWTP Effluent Available Flow Rate (Up to 28 MGD)
• Lift Station at Theresa St. WWTP
  – WWTP Effluent Available Flow Rate
    Up to 28 MGD to Supply the Heat Exchangers
  – Pump Design
    • Match Heat Exchangers Capacity
    • Phased Installation of Pumps (Modular by Design)
    • Pumps are Operated by VFD’s
    • Spare Pump
SYSTEM CURVE

Preliminary Design
THERESA ST WWTP

FLOW (GPM)

HEAD (Ft.)
• Pumps Were Sized Based Upon System Curves
  – **Initial Build**: Three Pumps Total
    (2 Pumps with 1 Spare)
  – **Peak Flow**: 16.5 MGD
  – **Average Flow**: Winter 9.9 MGD
  – **Average Flow**: Summer 6.5 MGD
Pumps Were Sized Based Upon System Curves

– **Final Build**: Six Pumps Total
  (5 Pumps with 1 Spare)

– **Peak Flow**: 28 MGD

– **Average Flow**: Winter 16.5 MGD

– **Average Flow**: Summer 10.4 MGD
Preliminary Design
THERESA ST WWTP

• Pump Selection
  – Non Clog Submersible Pumps
  – All pumps are the same size
  – 110 Hp, 5,000 GPM @ 62.4 Ft Head
  – Flow and Head Vary with speed and number of pumps in use
  – VFD’s to Control Flow Rate
• Theresa St. WWTP
  – Lift Station and Piping Layout
  – 30-Inch Diameter Ductile Iron Pipe – 4,000 LF
  – Connection to UV Channel for Supply and Return
Preliminary Design
Preliminary Design
HEAT EXCHANGE FACILITY
Preliminary Design

Summer

From WWTP

75°

78°

85°

88°

To NIC

Winter

From WWTP

57°

54°

47°

44°

To NIC
Preliminary Design
HEAT EXCHANGE FACILITY

• Sized Based Upon Effluent Flow and Temperature
• Sized and Phased Based Upon Projected Innovation Campus Building Loads
• All Phases Include a Redundant Heat Exchange Unit
Preliminary Design
Preliminary Design

• Distribution System
  – 36-inch Diameter HDPE Pipe
  – Twin Piping (Supply and Return)
  – Total of 6,100 LF
Preliminary Design
BUILDING SERVICE ENTRANCE

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 CONTROL VENTIL.
2. DUPLEX BASKET STRAINER WITH 1½" SCREEN. TWO SINGLE STRAINERS MAY BE PROVIDED IN LINE OF DUPLEX UNIT. PIPE BYPASS DOWN PIPE TO NEAREST FLOOR DRAIN.
3. FLOW METER PROVIDED BY UNL 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 DIMENSIONS AS SHOWN BETWEEN METER AND ANY VALVE / FITTINGS.
4. PROVIDE A MINIMUM OF 1/2" SPACE BETWEEN METER LEG AND BYPASS LEG.
5. PROVIDE PIPE SLEEVE AND LINING SEAL WITH SS HARDWARE AT FLOOR PENETRATION INSTALL SO THAT THREADED NUTS ARE EXPOSED.
6. ALTERNATE WALL PENETRATION LOCATION IF SERVICE ENTRANCES LOCATED IN BASEMENT. PROVIDE SLEEVE AND SEAL PER NOTE 7.
7. PRESSURE SENSOR PROVIDED BY UNL 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 UNL INSTALLED BY CONTRACTOR, CONDUIT AND WIRE BACK TO METERING PANEL CABLE GUTTER BY CONTRACTOR. SEE CRES BUILDING METER WIRING DETAIL.
9. EXTRA THERM-O-METER FOR SENSOR CALIBRATION PROVIDED BY UNL INSTALLED BY CONTRACTOR.
10. PLATE AND FRAME HEAT EXCHANGER TO BE INSTALLED IN FIRST FLOOR OR BASEMENT OF TENANT BUILDING.
11. 1" NORMALLY CLOSED BYPASS TO PREVENT ZERO FLOW CONDITIONS FOR EXTENDED OUTAGES.

CRES BUILDING SERVICE ENTRANCE PIPING SCHEMATIC

SCHEDULED:  NO SCALE

CWS = CRES WATER SUPPLY
CWR = CRES WATER RETURN

NEBRASKA INNOVATION CAMPUS
Final Design
THERESA ST WWTP

• Lift Station Full Build-out = 5 pumps with a spare
• Prepackaged Pump Control Building
• Generator
• Pipe and Lift Station Within Levee Critical Zone
Final Design
THERESA ST WWTP
Final Design
THERESA ST WWTP

**North Elevation**
- Scale: $\frac{3}{8}" = 1'-0"$
- LED fixtures with photoflation (TOP of 24)
- 36" x 80" Insulated Aluminum door with security deadbolt

**South Elevation**
- Scale: $\frac{3}{8}" = 1'-0"$
- Intake air louver with motorized shutter
- Masonry sash exterior to match existing lamp buildings

**East Elevation**
- Scale: $\frac{3}{8}" = 1'-0"$
- Metal roof cap
- Steel over fiberboard roof

**West Elevation**
- Scale: $\frac{3}{8}" = 1'-0"$
- Combo A/C & Electric heater
Final Design
THERESA ST WWTP

100% Design Required For Regulatory Review by:

– NDEQ

– USACE and NRD
Final Design
THERESA ST WWTP

Corps Requirements
- Shoring
- Dewatering

- Emergency Plan for High Flows in Salt Creek
- Flowable Fill
Final Design
HEAT EXCHANGE FACILITY
Final Design
HEAT EXCHANGE FACILITY
Final Design
HEAT EXCHANGE FACILITY
Final Design
HEAT EXCHANGE FACILITY
Final Design

HEAT EXCHANGE FACILITY
Final Design

CONTROLs

- LWWS LIFT STATION EFFLUENT
- CRES HEAT EXCHANGER PLAN
- NIC CAMPUS LOOP
• LWWS LIFT STATION EFFLUENT
  3 Variable speed pumps. Pump speed is automatically modulated to maintain a discharge pressure on HX primary side.
Final Design

CONTROLS

- **NIC CAMPUS LOOP**
  3 Thermal Loop VFD Pumps
  Automatically maintain differential pressure to campus.

- **CRES HEAT EXCHANGER PLANT**
  3 Heat Exchangers
  Automatically vary flow through heat exchangers to maintain thermal loop temperature to campus
Project Delivery and Construction

Project Schedule

- Phased
- Initial Coordination With Developer and City
- All agreements in place
- Complete design near Levee
Project Delivery and Construction

Project Schedule

– Selection of Construction Manager at Risk (CMAR)
– 30% CD’s and GMP
– Funding by UNL
– NDEQ, USACE and NRD Review and Approval
– Beginning of Construction October 2013
– Final Completion August 2014
Project Delivery and Construction
THeresa ST. LIFT STATION AND PIPING
Project Delivery and Construction
THERESA ST. LIFT STATION AND PIPING
Project Delivery and Construction

THERESA ST. LIFT STATION AND PIPING
Project Delivery and Construction
HEAT EXCHANGE FACILITY
Project Delivery and Construction

HEAT EXCHANGE FACILITY
Project Delivery and Construction

HEAT EXCHANGE FACILITY
Project Delivery and Construction
HEAT EXCHANGE FACILITY
Project Delivery and Construction
HEAT EXCHANGE FACILITY
Project Delivery and Construction
© Nebraska Innovation Campus
230 Whittier Research Center
Lincoln, NE 68583-0859
Phone 402.472.5535 • Fax 402.472.9277

INNOVATE.UNL.EDU

@NIC_Innovates

Not just a place, a state of mind.