Decentralization of Central Heating Plants: Misawa AB Case Study
DISCUSSION TOPICS

- Central Heating Plant history and set-up
- Energy losses in a typical central heating plant
- Results of Misawa AB Decentralized Heating Plant Study
- Decentralized Heating Plant benefits and issues
- Q&A
BRIEF HISTORY

- A steam district heating system has been in use at military installations since 1853.
- A recent census by the Department of Energy found more than 30,000 Central Heating Plants in the United States.
- Central Heating Plants can use a variety of energy sources, including geothermal, cogeneration plants, and waste heat from industry.
- Most existing central heating plants on AF Bases have coal, NG, diesel, or oil-fired boilers.
TRADITIONAL CENTRAL HEATING PLANT

- All boilers typically located in a single plant building.

- Underground or overhead steam or hot water mains originating at central plant distribute steam or hot water to various and numerous buildings often located miles away.

- These buildings use heat directly or indirectly for:
  - Building heating
  - Domestic hot water
  - Snow melting
  - Absorption chillers
WHY CENTRAL PLANTS WERE BUILT?

- **Maintenance:**
  - All primary and auxiliary equipment in one building.
  - Easier to monitor and troubleshoot.

- **Fuel Storage and Delivery:**
  - Diesel fuel is stored in centrally-located tanks.
  - Reduced gas piping runs.
  - Centralized fuel metering.

- Multiple fuels capability (fuel oil & NG).

- Flexibility to add or remove buildings.
CENTRAL PLANT ISSUES

- Overhead Distribution Piping

  - High energy losses due to insulation losses due to water intrusion
  - Mains that are often many miles long
  - Difficult to identify and maintain drip traps

1” dia hole ~ $1300/wk (150psig steam)
Underground Distribution Piping

- Mains are in tunnels, conduits, or are direct buried – difficult to access and maintain insulation.

- Manholes are required to house expansion joints, shutoff valves, drip traps, groundwater removal pumps. Manholes are major sources of heat losses.
MISAWA AB CENTRAL STEAM PLANT STUDY
EXISTING STEAM PLANT

- Existing Steam Plant has been recently upgraded with 82%-efficiency steam boilers equipped with economizer stacks and makeup water preheat.

- Steam plant is located about 1 mile away from the most remote area it serves.

- Steam piping varies from 12” to 1.5”.

- Steam Condensate is pumped back to the Plant, which adds to the piping network.

- Steam and condensate piping is direct buried and is scheduled for upgrade due to multiple leaks.
Almost 20% of plant output energy is lost in steam distribution piping

<table>
<thead>
<tr>
<th></th>
<th>Average Annual Consumption, MMBtu</th>
<th>Annual Energy Losses, MMBtu</th>
<th>Annual Capital Losses $US</th>
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</thead>
<tbody>
<tr>
<td>Fuel Input to Steam Plant</td>
<td>115,336</td>
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<tr>
<td>Energy Output of Steam Plant</td>
<td>94,576</td>
<td>23,644*** Combustion/Blow Down Losses</td>
<td></td>
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<tr>
<td>Steam Energy Delivered to Buildings</td>
<td>77,115</td>
<td>18,670 Steam Distribution Losses**</td>
<td>$149,360*</td>
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</tbody>
</table>

*Based on $8.00 per 1 MMBtu of steam

**Distribution losses estimated by sampling 5% of existing buildings

***Based on 82% boiler combustion efficiency
## MISAWA AB CENTRAL STEAM PLANT STUDY RESULTS (CONTINUED)

<table>
<thead>
<tr>
<th></th>
<th>Existing Central Plant</th>
<th>Decentralized Plant</th>
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<tbody>
<tr>
<td>Total Annual Energy (MMBtu)</td>
<td>94,576</td>
<td>77,115</td>
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<tr>
<td>First Cost Equivalent</td>
<td>$8,543,000*</td>
<td>$9,085,000</td>
</tr>
<tr>
<td>Annual Fuel Oil Cost @ $2.73/gal</td>
<td>$1,655,000</td>
<td>$1,288,000</td>
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<tr>
<td>Routine Maintenance Cost</td>
<td>$210,000</td>
<td>$362,000</td>
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<tr>
<td>Annual Electric Cost</td>
<td>$416,000</td>
<td>$416,000</td>
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<tr>
<td>Total Annual Operating Cost (Energy and O&amp;M)</td>
<td>$2,281,000</td>
<td>$2,066,000</td>
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</table>

*Cost of scheduled repairs of existing underground distribution piping.

**Estimated payback is less than 4 years**
OTHER REASONS TO DECENTRALIZE?

- Existing central plant may be vulnerable to security threat with severe consequences
- No need for licensed boiler operators to run low-pressure boilers in individual buildings
- Smaller condensing high-efficiency hot water boilers (up to 95% efficient) can be used
**DECENTRALIZED HEATING SYSTEM DESIGN ISSUES**

- **Equipment Room** with proper access to individual boilers
- **Boiler Venting** options (roof or wall)
- **Boiler Noise** consideration
- **Retrofit or Replacement** of existing air handling coils and radiators
CONCLUSIONS

- Decentralized Heating Plant can help meet Energy Cost reduction goals by:
  - Eliminating distribution pipe heat losses.
  - Eliminating energy-inefficient building heat exchangers.
  - Using more-efficient boilers.
- Reduced Heating System overhaul costs.
- Reduced security vulnerability.
- Examples of Successful Decentralization Projects:
  - Elmendorf AFB, 2005. 330 new boilers. Annual savings – over 1 million MMBTU.*
    *Project feature sheet provided by Ameresco
  - Kirtland AFB, 2007. 134 new hot water boilers. Annual savings – 12 million gallon of fresh water per year and 60% energy reduction.**
    **Publication: Consulting-Specifying Engineer; Date: Sep 1, 2010; Section: Case Study; Page: 59
Questions and Answers

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