IDEA Annual Conference

How Do You Reduce Potable Water Use by 50M Gallons per Year?

Presented by:
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Energy Center San Francisco, LLC
Agenda

01 The Setup
02 The Opportunity
03 The Design
04 The Execution
05 The Results and Lessons Learned
06 Questions & Answers
How Much is 80 Million Gallons?

- Enough Water to Fill the Largest Oil Tanker that Can Go Through the Suez Canal
- Over 1,000 Miles of 55-gal Drums Lying End-to-End
- The Combined Annual Wine Production of New York and Washington
The Setup

- 30 Mgal of nuisance ground water flows annually into the local subway stations and is disposed of into the City Sewer.

- The local District Energy System, Energy Center San Francisco (ECSF), is one of the largest potable water users in San Francisco with an annual water consumption of 100 Mgal.

- ECSF’s cost for water/sewer has increase by 8x over the last 15 years.

- The City of San Francisco is aggressively trying to reduce potable water usage to conserve natural resources.
Steam Cost of Sales
(as of Jan 2019)
$13.36/MLB Sold

Gas Cost 12 MRT per MLB Sold

Water/Sewer Cost 12 MRT per MLB Sold

Chemical Cost 12 MRT per MLB Sold

Electric Cost 12 MRT per MLB Sold

NOTE: 12 MRT = 12-Month Running Total
The Opportunity

- The Powell St. Subway Station is 2 blocks from ECSF and disposes of 30 Mgal of ground water intrusion per year.
- The San Francisco Public Utilities Commission is aggressively looking for large, water reuse projects and is offering up to $500k grants to bring them about.
- Is there a way to bring the needs of Public and Private entities together to create a solution that is a win for everyone?
The Opportunity

- Engage SFPUC, the various Subway entities, and ECSF in Project collaboration process.
- Recover/treat 30 million gallons annually of ground water from the subway station.
- Install the first production well permitted in decades in San Francisco at ECSF site to enhance project economics.
- Reduce ECSF potable water usage by 80%.
- Convert from 90% makeup in 2016 to 0% water makeup by 2026.
- Potential Project Payback, less than 3 years.
The Design
The Design

Ground Water Tank
- H₂O
- CaCO₃
- MgCO₃
- Silica
- HCO₃⁻, HCO₃⁻
- Oils
- Suspended Solids

Micro Filtration Trailer

Raw Water Tank
- H₂O
- CaCO₃
- MgCO₃
- Silica
- HCO₃⁻, HCO₃⁻

Reverse Osmosis Trailer

Treated Water Tank

New Well

Ground Water Cistern

New Installation
Existing System

City Water

Sodium Zeolite Softeners

Deareator

Direct Contact Economizer

To Boilers
The Execution - Pipeline

- ECSF Plant
- Subway Supply Water
- Station Entrance
The Execution - Plant

- All Piping & Structural Steel Work Done by Employees
- Water Treatment Plant Was Mostly Modular Construction
The Results

- Total Project Cost (Ground Water Only): $3.5M
- Total Annual Savings (Ground Water Only): $1M, 3.0 year payback
  - $800k Water Sewer, $200k Chemical Savings
- SFPUC Grant for $500k
- Enhanced Savings by Adding On-Site Well
  - Test Well Indicates Steady 200 gpm Available for an Incremental $250k
  - Improves Project Savings by Additional $800k per Year, 0.3 Year Payback
- Using a Combination of Ground Water and Well Water Will Allow ECSF to Market a New Product Called “Sustainable Steam”
  - Goal Would be to get USGBC LEED Points to Enhance Marketing of Steam in San Francisco
ECSF Projected Water Cost Improvement
w/ Ground and Well Water
2018-2024

Annual City Water Use (MMLB/yr)

12-Month Running Water Use (MMLB/yr)

12-Month Running Water/Sewer Cost ($ x 1000)

Annual City Water/Sewer Cost ($ x 1000/yr)
Lessons Learned
Lesson Learned #1

- Connecting to Existing Equipment
  - Electrical Failures
    - Higher Running Currents in Existing Lines
    - Higher Coincident Starting Currents
      - Caused Cogen Plant Trips
        » High Current
        » Islanding Due to Minimum Import
  - Carbon Steel Piping Downstream
Lesson Learned #2

• Not What We Expected in Subway Water
  – Did Not Show Up in Samples
Lesson Learned #3

- Chemicals
- .....Lots of Chemicals
## Chemicals Prior to RO Installation

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Gal/Mo.</th>
<th>Size</th>
<th>pH</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL4350</td>
<td>90-150</td>
<td>1000</td>
<td>high</td>
<td>Boiler Scale Inhibitor</td>
</tr>
<tr>
<td>BL1555</td>
<td>120+</td>
<td>1000</td>
<td>High</td>
<td>Amine</td>
</tr>
<tr>
<td>BL122</td>
<td>50-100</td>
<td>405</td>
<td>High</td>
<td>Sodium Bi-Sulfite</td>
</tr>
</tbody>
</table>
## Chemicals After RO Installation

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Gal/Mo.</th>
<th>Size</th>
<th>pH</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleach</td>
<td>30-120</td>
<td>TBD 405</td>
<td>Hi</td>
<td>Bleach tank</td>
</tr>
<tr>
<td>RL124</td>
<td>120</td>
<td>405</td>
<td>Low</td>
<td>Cl2 destruct</td>
</tr>
<tr>
<td>RL9909</td>
<td>90</td>
<td>405</td>
<td>Low</td>
<td>RO antiscalant</td>
</tr>
<tr>
<td>RL2016</td>
<td>90</td>
<td>405</td>
<td>Low</td>
<td>CIP cleaner</td>
</tr>
<tr>
<td>CL206</td>
<td>10</td>
<td>65</td>
<td>biocide</td>
<td>Biocide</td>
</tr>
<tr>
<td>RL1700</td>
<td>90</td>
<td>550</td>
<td>High</td>
<td>CIP Cleaning</td>
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<tr>
<td>BL1240</td>
<td>70</td>
<td>405</td>
<td>high</td>
<td>Sulfite</td>
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<tr>
<td>BL4350</td>
<td>90-150</td>
<td>1000</td>
<td>high</td>
<td>Boiler Scale Inhibitor</td>
</tr>
<tr>
<td>BL1555</td>
<td>120+</td>
<td>1000</td>
<td>High</td>
<td>Amine</td>
</tr>
<tr>
<td>BL1304</td>
<td>50-100</td>
<td>405</td>
<td>High</td>
<td>405 gal dual wall tank = 4’D, 59” H</td>
</tr>
</tbody>
</table>
Lesson Learned #4

• Chemistry is Different
  – Demin Water and Carbon Steel Piping
  – Demin Water in Direct Contact Economizer
    • Higher CO2 Absorption with No Alkalinity to Buffer
    • Will Convert to Indirect Contact
Lesson Learned #5

• Better Than We Thought
  – Adding Well Tripled Water/Sewer Savings with only additional 10% Cost to Project
  – Desalitech Process Works Well
    • RO is Running 85-90% Permeate
Questions?