Power Quality Study Offers Solutions with Added Benefits - Improved Operability and Energy Savings

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Agenda

1. Background and History
2. Field Investigation and Findings
3. Recommendations
4. Other Considerations and Implementation Plan
5. Questions
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Background and History
Project Background and History

Issues at the Easterly and Westerly Treatment Facilities Included:

- Disruption of Utility Power
- Problems Starting Blowers
- Random Undervoltage Trips
- Brief Power Fluctuations
- Generators Unable to Sync Back with the Utility After an Outage
Project Background and History

Project Scope Consisted of Three General Tasks for Easterly and Westerly:

- Assessment of Electrical Utility Services
- Energy Efficiency Audit
- Internal Power Quality Investigations and Analysis
Request for Proposal/Selection

NEORSD Issued a Qualifications-Based RFP

• Three (3) Proposals Submitted
• NEORSD Internal Review Committee Evaluated Proposals
• Stantec Proposal Evaluated as Most-Responsive
  • Proposal Identified Easterly Blowers for Energy Efficiency Improvement AND a Possible Solution for Some Electrical Issues
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Field Investigation and Findings
Field Investigation

- Installed sensitive recording metering on the main breakers at each plant for a 5-6 month period
- Installed meters on each unit substation and switchgear lineup for one month, and rotated each month to capture all substations/switchgear over a 6-month period.
Field Investigation

- Meters measured amps, volts, power factor, harmonic distortion, KW/KVA demand, outage events
- Utilized existing plant instrumentation for blower performance testing
- Used District’s ETAP Electrical Model to simulate voltage dips during blower starts, and validated the model using actual field metering data
Field Investigation

Blower Testing identified some loss of performance over the 80 equipment year lifespan (1938 vintage blowers)
Based on field data, air demands and historical flow data, the aeration system annual power costs were estimated.

<table>
<thead>
<tr>
<th>Aeration SCFM</th>
<th>Channel Air SCFM</th>
<th>Total SCFM</th>
<th>Blowers Required</th>
<th>SCFM per Blower</th>
<th>BHP per Blower</th>
<th>Total KW</th>
<th>Time (%)**</th>
<th>Annual Usage (kWh)</th>
<th>Annual Costs*</th>
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*Assuming $0.08 / kWh
** Estimated from 2011-2012 Easterly Flow Data

Annual Costs $675,200
Analysis and Findings

• Voltage dips were measured under “two-utility line” operation, and modeled in the plant electrical model to validate results.
• Model was used to estimate “single-utility line” voltage dips.

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<td>1500</td>
<td>6%</td>
<td>6%</td>
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<tr>
<td>2000</td>
<td>12%</td>
<td>9%</td>
<td>17%</td>
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Field Investigation and Findings

Alternatives were considered:
• Use variable frequency drive to vary flow and eliminate voltage dip.
  • Very limited turn-down capabilities due to affinity laws – no energy benefit
  • VFD starters were considered, but eliminated due to complexity and cost.
• Increase electric utility service capacity
  • No energy efficiency improvement
  • Short circuit limitations on plant switchgear
• Replace one or more blowers with smaller motors
  • Higher efficiency
  • Reduced HP
  • Lower starting current (reduced voltage dip)
  • Wide turn-down capabilities/Ability to implement DO control
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Recommendations
Recommendations

Existing Plant has 3 large (40,000 cfm) and 2 small (25,000 cfm) blowers with space for one additional blower

- Add Blower #6 and Replace Blower #2 with new 35,000 cfm single-stage, integrally-geared, centrifugal blowers
- New configuration would have 2@25,000 cfm (existing), 2@35,000 cfm (new) and 2@40,000 cfm (existing) blowers for redundancy
## Recommendations

New Blower is estimated at 1350 hp with **55%** turn-down capability

**ESTIMATED ANNUAL ENERGY COST SAVINGS – OVER $170,000**

<table>
<thead>
<tr>
<th>Aeration SCFM</th>
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<th>Blowers Req’d</th>
<th>SCFM per Blower</th>
<th>HP per Blower</th>
<th>Total KW</th>
<th>Time (%)*</th>
<th>Annual Usage (kWh)</th>
<th>Annual Costs*</th>
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<td>143,314</td>
<td>$ 11,465</td>
</tr>
</tbody>
</table>

*Assuming $0.08 / kWh

**Estimated from 2011-2012 Easterly Flow Data**
Recommendations

Smaller motor with reduced starting current solves voltage dip issues under single line conditions.

8% Voltage Dip vs. 17% Voltage Dip on a single utility line!
Recommendations

• Approximately $5M total cost for blower modifications (study-level estimate)
• Retain four (4) existing 1938 vintage blowers and motors for redundancy—existing units are still serviceable
• Salvage Blower #2 as spare parts for Blowers #3 and #4
• Re-use existing starter for new Blower #2, and add new starter for Blower #6 (existing space provision)

Utilize blower turndown capabilities to implement DO control for improved operability and efficiency!
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Other Considerations and Implementation Plan
Other Considerations

• Found that two primary electrical service lines share a common duct bank to the plant
• Investigation is ongoing with utility for a cost-effective solution to separate the lines using existing infrastructure
• Multiple standard energy conservation methods being implemented over multiple projects
Blower Upgrade Implementation Plan

• Installation of the new blowers to be part of a larger project.
• $11M CIP project focusing on aeration system improvements.
• Design contract currently in negotiations. Design NTP scheduled for November 2018
• Construction NTP tentatively scheduled for late 2019.
• Construction substantial completion scheduled for early 2022
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Questions