Annual Inspections at Panda Sherman for Insulation and Heat Trace Before Winter

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Slide Topics

- Our Facility
- Heat Trace and Insulation Preparations
- Preparation History: Our First Winter (2014)
- Heat Trace, Insulation, and Winter Preparedness Lessons Learned
Our Facility

- 758 MW Natural Gas, 2 x 1 Combined Cycle Facility located in Sherman, Texas (Grayson County).

- Outdoor Plant Design: based on minimum temp of 15 F

- Key Project Dates:
  - Ground breaking - Nov 2012
  - First Fire – May 2014
  - Provisional Acceptance – July 2014
  - Commercial Operation – August 2014
  - Final Acceptance – July 2015
Heat Trace and Insulation Preparations: Approach

• We approach our preparation in four ways:
  – Walk downs & Surveys for Personal Safety and Equipment
  – Heat Trace and Insulation Audit
  – O&M Team Training
  – Procedures & Checklists
Heat Trace and Insulation Preparations: Walk downs & Surveys

- We divide the plant amongst our operations shifts to identify areas of concern (i.e. windbreaks, temporary buildings, heat trace needed, etc.) and recommendations.
Heat Trace and Insulation Preparations: Audits

- Annually, we hire a 3rd party contractor (August 2015) to conduct a full heat trace and insulation audit.

- For the Audit, we provide the following:
  - Heat Trace Circuit Spreadsheet for Readings
  - Heat Trace Plant Drawings
  - General Area Maps or P&IDs of the Plant for Identification of Insulation Defects

- A plant sponsor is also assigned to photo document deficiencies for location of repair.
## Heat Trace Spread Sheet Example

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<th>Rev</th>
<th>Type</th>
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<td></td>
<td>4</td>
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### Tracer Details

<table>
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<td>01BGA002BMB</td>
<td>01T111CM50100</td>
<td>01BGA10GH002-G0011</td>
<td>01BGA10GH002</td>
<td>CB/01</td>
<td></td>
</tr>
</tbody>
</table>

### Line / Instrument Details

- **System**: 01GC-02
- **Type**: CS
- **Size (Check)**: 1
- **Insulation**:
  - **Insulation Type**: MIL
  - **Insulation Thickness**: 1

### Tracer Section

- **Tracer Details**: 01BGA002BMA, 01BGA002BMB
- **Conduit Tag**: 01T111CM50100
- **Power JB**: 01BGA10GH002-G0011
- **Merging JB**: 01BGA10GH002
- **Heat Trace Panel**: 01BGA10GH002
- **Breaker**: CB/01
Heat Trace Circuit Plant Map Example
Heat Trace and Insulation Preparations: Audits (Continued)

• Once the Audit is complete, our entire plant management team meets with the contractor and IC&E team to review the deficiencies and formulate a plan to correct them (ideally mid September).
  – Based on the discrepancy, we may elect the contractor to stay onboard and fix the errors.
  – Otherwise, we upload the deficiencies in our CMMS system, assign risk factors (by priorities), and both the Plant Engineer and IC&E technicians will work diligently to mitigate the issues.

• Our goal is to complete the high risk and medium deficiencies by November 1 and work on the remaining issues throughout the winter.
Heat Trace and Insulation Preparations: Training

– We perform Winter Weatherization training with all employees.

• Topics include:
  – ERCOT lessons learned
  – Emergency heat trace equipment
  – Procedures and Checklists associated with 32 degrees F.
  – Winter Safety
    • Including use of Space Heaters in enclosures.
  – Emergency Contractor Contacts
Heat Trace and Insulation Preparations: Procedures & Checklists

• Our procedures were developed internally using notes & Best Practices from the December 2012 meeting, NERC Winter Weatherization Presentations, and the collective personnel experience from our team.

• During cold weather operations (ambient temperature <32 degrees F), our operators initiate “Extreme Cold Weather Readiness” and “Heat Trace, Insulation, and Building” Checklists.
Preparation History: Our First Winter (2014)

• ERCOT toured an identical facility also owned by Panda Power Funds in December 2013 (during construction).
  – Conducted a meeting with the EPC engineers and management from both sites discussing the following:
    • Weatherization plans and preparation
    • Heat Tracing Design and Implementation
    • Use of Glycol and Concentration for Effectiveness
    • Recommendations & Best Practices from ERCOT
Preparation History: Our First Winter (2014)

- **7/30/2014** (11 days after Provisional Acceptance): Conducted second Summer Seasonal Readiness meeting and engage in to hiring a 3rd party contractor to perform heat trace and insulation audit.

- **8/15/2014**: Panda O&M inquires with the EPC about the status of heat trace system completion (most of the EPC had demobilized and left the site) and are told that the systems are still being completed.

- **8/18/2014**: Receive confirmation from EPC that the heat trace system is complete, with no turnover documentation.

- **9/30/2014**: Secure 3rd party contractor for audit.

- **10/6/2014**: 3rd party independent contractor conducts audit on heat trace and insulation and estimates the cost of any repairs.
Preparation History: Our First Winter (2014)
Audit Results

- 10/10/14: 3rd party contractor and operator walk downs identified at least 470 heat trace and insulation deficiencies.
  - Common problems with heat trace:
    - Piping <2” in diameter not heat traced.
    - Heat trace breakers continuously tripping.
    - Heat trace power heaters not wired.
    - Heat trace lines not completely wired.
    - Pre-insulated tubing bundles with no power (due to causing breaker faults).
    - Obrien box heaters that were left unpowered.
Heat Trace Deficiency Example 1:

Power Connector Wires not Shielded resulting in shorting to the case.
Heat Trace Deficiency Example 2:

Heat Trace Power Connector not Terminated (No Wires Landed)
Common problems with insulation:

- Piping left uninsulated in many areas
- Piping insulation not finished
- Missing insulation blankets
Insulation Deficiency Example 1:

Insulation Around the Heat Trace line Not Complete
Insulation Deficiency Example 2:

- Insulation
- Taping Not complete

Insulation Taping Not complete
Insulation and Heat Trace Deficiency Example:

This is a sump drain line (~1") not insulated or heat traced.
Preparation: Our First Winter (2014)
Audit Results (continued):

• Results of 3rd Party Audit revealed a significant list of deficiencies.
• They estimated the repair to take at least a month with approximately 10-12 men.
• Documentation from Project turnover was limited further exasperating the challenge.
Preparation: Our First Winter (2014): EPC Response

- Warranty work commenced early November, 2014 anticipating 2-3 weeks to complete the corrections.
  - 6-8 electricians
  - 8-10 insulators
- 3rd party contractor kept 2 electricians and 1 insulator on site as well to assist in the efforts.

- Remedial work scope largely completed by January 21, 2015 along with a ckt by ckt amp draw evaluation.
Preparation: Our First Winter (2014)
Plant Trip – 1/8/2015

• 0137: the steam turbine unloaded due to high HP steam inlet pressure indication.
  – Ambient temperature: 15F Wind Speed: 5-10 MPH

• 0146: only one combustion turbine was online and in danger of tripping offline.

• 0422: the root cause of the initial trip was identified:
  – Frozen Steam Turbine HP Inlet Pressure Transmitter due pre-insulated tubing bundle and Obrien Box heater not wired.
  – We would find 7 more frozen transmitters throughout the morning with the same issue (not wired/powered).
  – Due to scaling issues, frozen transmitters were unable to reach their “Bad Quality” set point (displayed on next two slides).

• Plant was back online by 1317.
  – Ambient temperature: 32F
Indication of freezing transmitter with excessive scaling:

Steam Turbine HP Inlet Pressure indication rising as the transmitter started to freeze.
Indication of frozen transmitter with excessive scaling:

Same Steam Turbine HP Inlet Pressure indication now frozen.
Heat Trace, Insulation, and Winter Preparedness Lessons Learned

• Preparation – Earlier is better.
• **Heat Trace Audits are essential.**
  – Check that every heat trace branch circuit has power (amp draw), not just the junction box supplying several branches.
  – Heat Trace Spreadsheets and Accurate Drawings are equally important.
  – Install operator aides in heated instrumentation boxes for verification that the box has power.

• Do not rely on a “bad quality” indication for a frozen transmitter.
• Communication – Share incidents Lessons Learned to prevent repeating the same mistakes.
• Improve – We are working to improve systems for this winter (i.e., remote indications for heated instrumentation boxes, detailed maps of each box, corrected heat trace drawings, etc.)
• Good quality control on Heat Trace and Insulation is essential for every project (even a new one).
Questions?
Thank You for Your Time.