GGNS EPU Steam Dryer Review

Non-Proprietary Slides

January 30, 2012

Meeting Objectives

1. **Review Steam Dryer Safety Basis (Closed)**
   1. **Replacement Steam Dryer Improvements**
   2. **Analysis Methodology**
   3. **Dryer Instrumentation & Power Ascension Testing**

2. **Review Planned RAI Response Approach (Closed)**

3. **Review Schedule**

Steam Dryer Safety Basis

Replacement Steam Dryer Design Improvements

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Analysis Conservatism

- **End-to-end benchmarking demonstrates load definition & structural FEA methodology have overall conservatism of approximately 25%**
- **Inherent 100% margin based on applied ASME material strengths**
- **Analysis & structural design of dryer maintains 2.0 MASR in addition to margins described above**

Third Party Expert Review/Oversight

- **Third party review has been conducted by technical experts from LPI & MPR**
  - **Independently assessed related GEH Corrective Action Reports**
  - **Reviewed prior RAI responses and sampling of GGNS analyses & design documentation**

- **Third Party Review Focus Areas and GGNS steam dryer design & qualification is being independently assessed by Expert Panel**

- **Expert Panel comprised of:**
  - **Dr. Fred Moody – Retired GE**. Expert in fluid transients and behavior of structures under fluid loads. National Academy of Engineering member.
  - **Dr. M. K. Au-Yang – Retired Areva**. Author of "Flow-Induced Vibration of Power and Process Plant Components".
  - **Dr. Peter Griffith – MIT Professor Emeritus**. Prior consultant to NRC.

Expert Panel Review

Review scope:

- **Numerous GEH documents including the Grand Gulf dryer submittals, GEH analysis reports, and the RAIs**
- **Design and analysis methodology – reviewed interactively with GEH staff**
- **Data taken on prior dryers**
- **Operating experience, including failures and cracks**
- **Design improvements made in the GGNS dryer at previously cracked locations**
- **The MSL velocity at GGNS compared to other plants**

Expert Panel Review

- **The Panel performed a PIRT (Phenomena Identification and Ranking Table) to help focus experience, current understanding, objectives, expert opinion, and actions necessary to complete the review.**

- **The Panel concluded that the new GGNS dryer is stronger at locations where cracks have previously occurred.**

- **Based on a review of the analysis that has been performed by GEH, the Panel concluded the stress margins calculated by the analysis are consistent with the changes that have been made in the hardware.**

- **The Panel continues to review specific data from GEH prior to completion of the review.**

Expert Panel Review

The preliminary conclusion is that the risk of a dryer structural failure is considered small because:

1) **All known dryer prior cracking experience has been incorporated into strengthening the replacement dryer,**

2) **Large conservative margins are included in the current analysis,**

3) **Important data will be attained during power ascension monitoring of MSL pressures and dryer instrumentation,**

4) **The dryer will be inspected following 24 months of operation.**

Steam Dryer Instrumentation & Test Plan

Steam Dryer Instrumentation & Test Plan

Vibration Measurement Program Goals

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Bases for Sensor Locations

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GGNS RSD Instrumentation Summary

Component	Strain Gages	Accelerometers	Pressure Transducers
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On-Dryer Instrumentation

Complexity/Schedule

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On-Dryer Instrumentation

Sensitivity/Life Span

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Power Ascension Test Plan

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Planned RAI Response Approach

Planned Response Approach – RAI 1

Re-benchmarking and Re-analysis

- ***The response will:***
  - **Describe how each issue impacting benchmarks, modeling approximations, etc., has been addressed in an adequate manner using acceptable technical approaches**
  - **Provide a quantitative evaluation of the impact of these various modeling approaches and approximations**
  - **Reference use of on-dryer instrumentation to demonstrate analytical conservatism**

Planned Response Approach – RAIs 2-4

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Planned Response Approach – RAIs 5-6

- **RAI 5 - Dryer Inspection Plan**
  - **The response will:**
    - **Describe how partial penetration welds will be inspected as part of dryer inspection program**
    - **Describe industry OE does not indicate any concerns or problems associated with partial penetration welds**

- **RAI 6 - Partial Penetration Welds**
  - **The response will:**
    - **Modify SDAR to include discussion of fatigue factors for partial penetration welds**
    - **List all partial penetration welds in GGNS RSD**
    - **List component, weld size, plate thickness, & weld size reduction factor for each partial penetration weld**
    - **Explain why loose parts are not a concern for partial penetration welds**

Planned Response Approach – RAIs 7-8

- **RAI 7 - Assessment of FE Modeling Bias and Uncertainty (SSES Dryer Hammer Test Data)**
  - **RAI deleted from GGNS scope**

- **RAI 8 - GGNS Steam Dryer Finite Element Model Verification**
  - **The response will:**
    - **Describe the review of the FEM**
    - **Explain how unconnected nodes, mesh quality, and mesh density convergence are evaluated & addressed in the analysis**

Planned Response Approach – RAI 9

Instrumentation of the Steam Dryer

- **Planning to install two strings of on-dryer instrumentation (as described earlier)**

- **The response will:**
  - **Demonstrate validation of predicted loads using both on-dryer and MSL data during power ascension testing**
  - **Describe how loads determined by MSL data will be compared to dryer pressure measurements**
  - **Predicted strain and acceleration will be compared to measured strain and acceleration**
  - **Bias and uncertainty will be calculated based on a data taken at a minimum of three power plateaus**
  - **Describe calibration methods**
  - **Propose a License Condition for Power Ascension Testing**

Planned Response Approach – RAIs 10-12

- **RAI 10 - References to ESBWR LTRs**
  - **The response will:**
    - **Remove reference to ESBWR Topical Reports**
    - **Provide GGNS-specific basis**

- **RAI 11- Repair/Rework of the Replacement Steam Dryer**
  - **The response will:**
    - **Describe the measures utilized to minimize IGSCC potential.**
    - **Confirm procedures implement BWRVIP guidance.**

- **RAI 12 - Analysis vs. Operating Dryer Cracking Experience**
  - **The response will:**
    - **Summarize root cause of SSES cracking**
    - **Describe the impact on the GGNS model and dryer design**
    - **Describe the location of strain gages to address OE**

Schedule

- **RAIs 2-6, except 4: Responses by 2/6/2012**
- **RAIs 1, 4, 8-12: Responses by 2/15/2012**
- **Current outage schedule supporting mid-May power ascension**
- **License Amendment needed to support optimum data collection capability considering on-dryer instrument life**

Summary

- **Current set of draft RAIs represent all outstanding questions applicable to GGNS. Proposed responses to Draft RAIs address identified issues and provide a basis for a safety determination.**

- **All modeling inconsistencies, inaccuracies, and approximations have been properly accounted for and justified in the current analysis. This demonstrates that the GGNS replacement steam dryer is adequately designed for service under EPU conditions.**

- **Adequacy of the replacement steam dryer will be further confirmed through implementation of on-dryer instrumentation and power ascension monitoring and analysis.**