

ENCLOSURE 2

GE Letter No. 175528-011, Revision 1

GEH Slides for TVA Presentation to the NRC in Support of Steam Dryer
Replacement

Non-Proprietary Information

NON-PROPRIETARY NOTICE

This is a non-proprietary version of Enclosure 1 of GEH Letter No. 175528-011, Revision 1 which has the proprietary information removed. Portions of the document that have been removed are indicated by an open and closed bracket as shown here [[]].



Browns Ferry Nuclear Plant Replacement Steam Dryers

Gerry Doyle

Director EPU

April 22, 2015

Agenda

- Introductions G. Doyle
- Overview and Background G. Doyle
- Browns Ferry Replacement Steam Dryer Design P. Donahue
- Browns Ferry Replacement Steam Dryer Analysis P. Donahue
- Browns Ferry Replacement Steam Dryer Power Ascension Monitoring P. Donahue
- Browns Ferry Replacement Steam Dryer Inspection Plan P. Donahue
- Questions/Comments G. Doyle

Overview and Background

- New Replacement Steam Dryers (RSDs) will be installed in all three Browns Ferry Units
 - To resolve any issues that existing steam dryers may have under EPU conditions
 - Previous submittals, now withdrawn, had over 260 RAIs associated with steam dryers
 - New EPU License Amendment Request (LAR) submittal will address previous issues , look to minimize RAIs, and support NRC approval
- Current strategy and design complies with existing and contemporary regulatory requirements
- Contracted with GEH to build our RSDs as they are the Original Equipment Manufacturer and have experience in other recent RSDs
- We are here to present an overview of our RSDs design, analysis, monitoring plan and inspection plan with an expectation that NRC fully understands the RSD information we plan to submit as part of our EPU LAR
- Presenter is Pete Donahue, Senior Manager for EPU Engineering
 - Supported by GEH personnel

BFN Replacement Steam Dryer

- Based on the curved hood six bank prototype replacement dryer first used in a BWR/4 reactor.
- Design is significantly more robust than the original steam dryer it replaces.
- BFN acoustic load definition developed using MSL acoustic pressure measurements taken at the three Browns Ferry units.
- The FIV fatigue evaluation and primary stress methodologies used for BFN RSD analysis has been reviewed in detail on BWR/6 RSD and ESBWR projects.
- Analyzed for the applicable primary structural loads for normal operation and for transient and accident conditions.



Browns Ferry RSD Design



EPU Replacement Dryer Experience

Successful operating history for replacement dryers at EPU

- Quad Cities Units 1/2 RSD
- Dresden Units 2/3 RSD
- Susquehanna Units 1/2 RSD
- Grand Gulf RSD
- Vermont Yankee original dryer with modifications

Steam Dryer Structural Design Timeline

[[

]]

Steam Dryer Structural Design Timeline

[[

]]

Steam Dryer Structural Design Timeline

[[

]]

BFN Replacement Dryer Design

[[

- Changes to prototype dryer design
 - Dryer/vessel interface changes
 - Address OE lessons learned
 - Stress reduction

]]

BFN Replacement Dryer Design

[[

]]

BFN Replacement Dryer Design

[[

]]

BFN RSD Design Improvement

[[

]]

BFN RSD Design Improvement

[[

]]

BFN RSD Design Improvement

[[

]]

BFN RSD Design Refinement

[[

]]

BFN RSD Design Refinement

[[

]]

BFN RSD Design Refinement

[[

]]

BFN RSD Design Refinement

[[

]]

BFN RSD Design Refinement

[[

]]

BFN RSD Design Refinement

[[

]]



Browns Ferry RSD Analysis



BFN RSD Analysis Overview

[[



Browns Ferry RSD Load Definition



BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

Potential SRV Resonance Frequencies

[[

]]

SRV Resonance Fundamental Frequency

[[

]]

MSL Acoustic Mode Interaction

[[

]]

MSL Acoustic Mode Interaction

[[

]]

Postulated SRV Resonances

[[

]]

SRV Adders for Design Load Definition

[[

]]

EPU SRV Scale Factor

[[

]]

EPU SRV Scale Factor

[[

]]

BFN RSD Analysis Load Definition

[[

Dryer Load Comparison

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]

BFN RSD Analysis Load Definition

[[

]]



Browns Ferry RSD FIV Analysis



BFN RSD Finite Element Model

[[

]]

BFN-Specific Design Improvements

[[

]]

BFN-Specific Design Improvements

[[

]]

BFN-Specific Design Improvements

[[

]]

BFN RSD FEM Mesh Convergence

[[

BFN RSD FIV Analysis

[[

]]

BFN RSD FIV Analysis

[[

]]

End to End Bias and Uncertainty

[[

]]

End to End Bias and Uncertainty

[[

]]

FIV Stress Adjustment

[[

]]

FIV Stress Adjustment

[[

]]

BFN RSD Fatigue Analysis Results

[[

]]



Browns Ferry RSD Primary Stress Evaluation



BFN RSD Primary Stress Evaluation

- The steam dryer is a non-safety related item and is classified as an Internal Structure as defined in ASME Subsection NG, Paragraph NG-1122.
- The steam dryer is not an ASME Code component, [[
]]

Non-Proprietary Information – Class I (Public)

Load Case	Service Conditions	Operating Condition	Load Combination
[[
]]

BFN RSD
 Primary Stress
 Analysis Load
 Combinations

BFN RSD Primary Stress Results

[[

]]



Browns Ferry RSD Power Ascension Monitoring



BFN Power Ascension Monitoring

- The BFN lead unit is classified as a [[
]]
- Power ascension monitoring process similar to previous RSD projects
- BFN Lead Unit
 - Both RSD and MSLs instrumented
 - Monitor using strain gauges, on-dryer pressure transducers, and accelerometer

BFN Power Ascension Monitoring

- BFN Lead Unit (continued)

[[

]]

- Confirmatory structural analysis for lead unit at EPU [[

]]

- Follow-on Units

- MSLs instrumented

[[

]]

- Confirmatory structural evaluation based on MSL measurements

BFN RSD Instrumentation Locations

[[

]]

[[BFN RSD Instrumentation

BFN On-dryer Acceptance Limits

[[

]]

BFN MSL Acceptance Limits

[[

]]

BFN Lead Unit CLTP Evaluation

[[

]]

BFN Lead Unit Test Plan

[[

]]

BFN Power Ascension Monitoring

[[

]]

BFN RSD Inspection Plan

- During the first two scheduled refueling outages after reaching EPU conditions, a visual inspection will be conducted on the replacement steam dryer for each unit. The inspection plan will be consistent with the industry guidance. The inspection plan will include all accessible exterior and interior critical locations identified in the vibration and stress analyses for the Browns Ferry RSDs.



Acronyms



Non-Proprietary Information – Class I (Public)

Short Form	Description
ASME	American Society of Mechanical Engineers
ASR	Alternating Stress Ratio
AVS	Acoustic Vibration Suppressor
BFN	Browns Ferry Nuclear Plant
BWR	Boiling Water Reactor
CLTP	Current Licensed Thermal Power
DP	Differential Pressure
DW	Deadweight
EPU	Extended Power Uprate
FE	Finite Element
FEM	Finite Element Model
FIV	Flow Induced Vibration
FRF	Frequency Response Function
HF	High Frequency
IN	Information Notice
LAR	License Amendment Request
LF	Low Frequency
MASR	Minimum alternating stress ratio

Short Form	Description
MPC	Multi Point Constraint
MSL	Main Steam Line
MSLB	Main Steam Line Break
OBE	Operating Basis Earthquake
PBLE	Plant Based Load Evaluation
PBLE01	PBLE Input On-Dryer Based
PBLE02	PBLE Input MSL Based
PSD	Power Spectral Density
RMS	Root-Mean-Squared
RPV	Reactor Pressure Vessel
RSD	Replacement Steam Dryer
SDAR	Steam Dryer Analysis Report
SG	Strain Gauge
SRV	Safety Relief Valve
SSE	Safe Shutdown Earthquake
TSV	Turbine Stop Valve
VFD	Variable Frequency Drive
VPF	Vane Passing Frequency

Thank you!

Questions?

Comments?