Susquehanna Steam Electric Station

Extended Power Uprate
Proposed License Amendment

Agenda

- Introduction
- Initial Staff Comments
- Objectives
- Overview of Changes
- Steam Dryer Analysis
- Comments from Public
- Conclusions and Closing Remarks

Objectives

- Describe why the dryer analysis techniques employed will provide a final dryer that:
  - Adequately defines and applies loads
  - Comprehensively analyzes the loads
  - Is benchmarked to actual Susquehanna plant data
  - Is robust and has a strong technical basis
  - Requires stress intensities to conform to ASME design limits.

Submittal Change Overview

- Addresses several areas in original submittal that NRC identified as lacking sufficient information
- Removed Standby Liquid Control proposed changes
- NRC approval is now requested for a change to the FSAR
  - PPL evaluation results indicate that a trip of a feedwater pump or condensate pump may result in a unit scram.

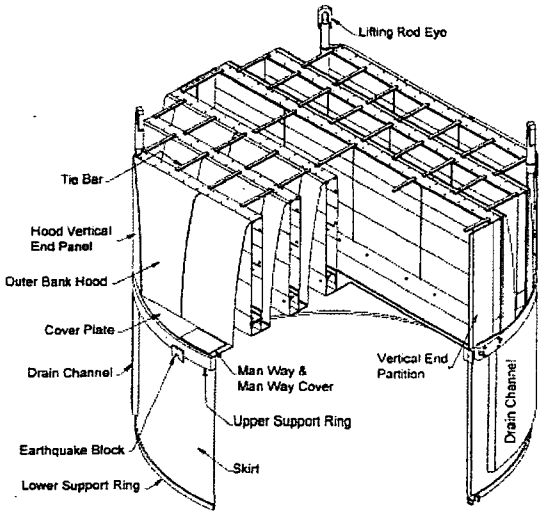
Submittal Change Overview

- Updated information:
  - Description of TS changes currently undergoing NRC review
  - Updated PRA analysis results
- Detailed Dryer Analysis now provided.

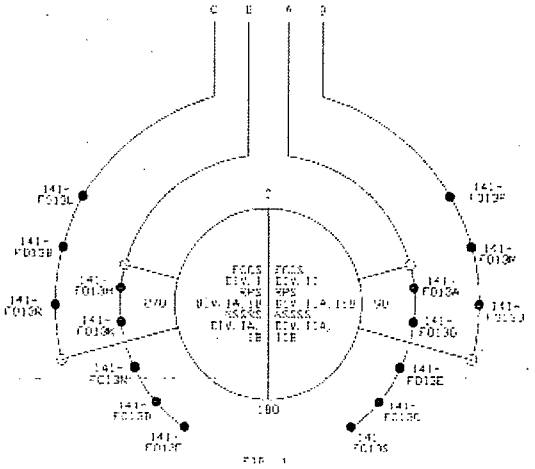
Susquehanna Steam Dryer Analysis Approach

- Determine if an acoustic resonance will be present after EPU implementation.
- Develop a design basis for cyclic stresses which include EPU conditions.
- Develop required actions to bring the steam dryer design into conformance with the cyclic stress design basis.

Susquehanna Steam Dryer



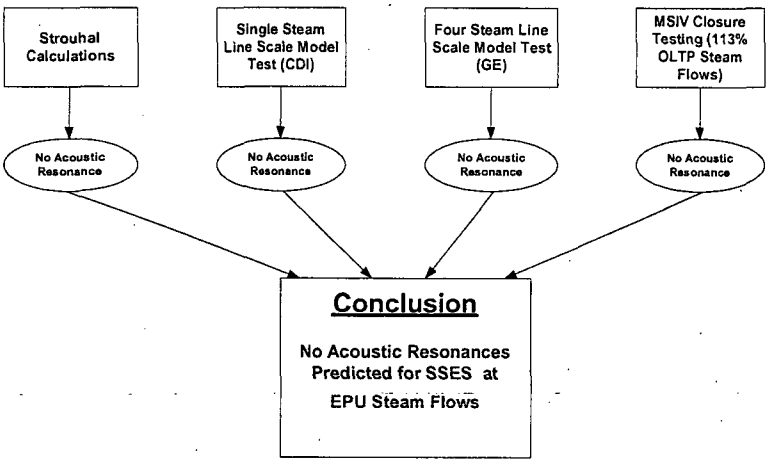
Susquehanna Main Steam Line Configuration



Steam Dryer Analysis

- Acoustic Resonance and Acoustic Loading
- MSIV Closure Testing
- Analysis Methods
- Uncertainty Evaluation
- Analysis Results
- Needs

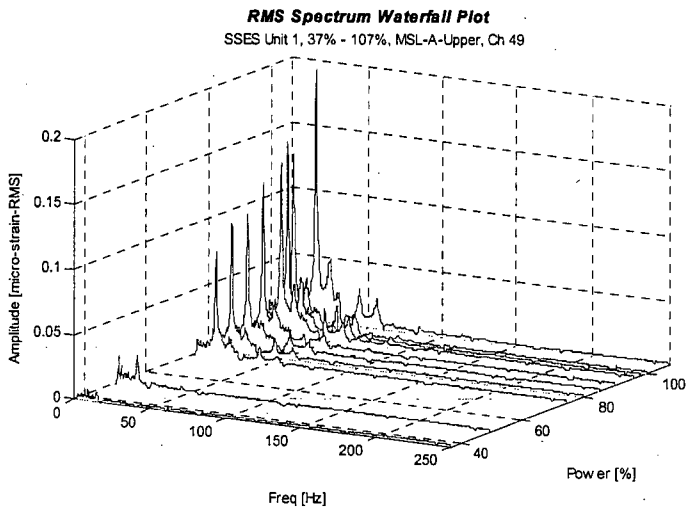
Acoustic Resonance Prediction



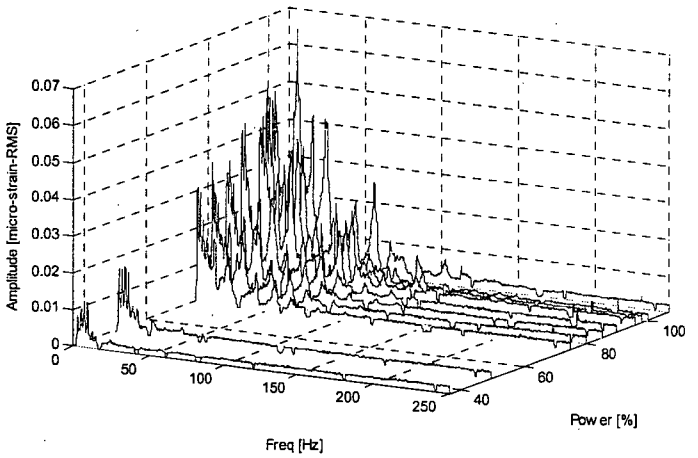
MSIV Closure Testing

- MSIVs Slow Closed at 75% CLTP
  - Simulates 100% CLTP flow through remaining open steam lines.
  - Used to benchmark strain gauge data for composite load methodology for EPU cases.
- MSIV's Slow Closed at 80% CLTP
  - Simulates 113% OLTP (first EPU step) flow through the remaining open steam lines.
  - Used to determine presence of acoustic resonances and steam line vibration levels at the first EPU step.
  - Strain gauge data used to develop ACM steam dryer loading for the first EPU step.

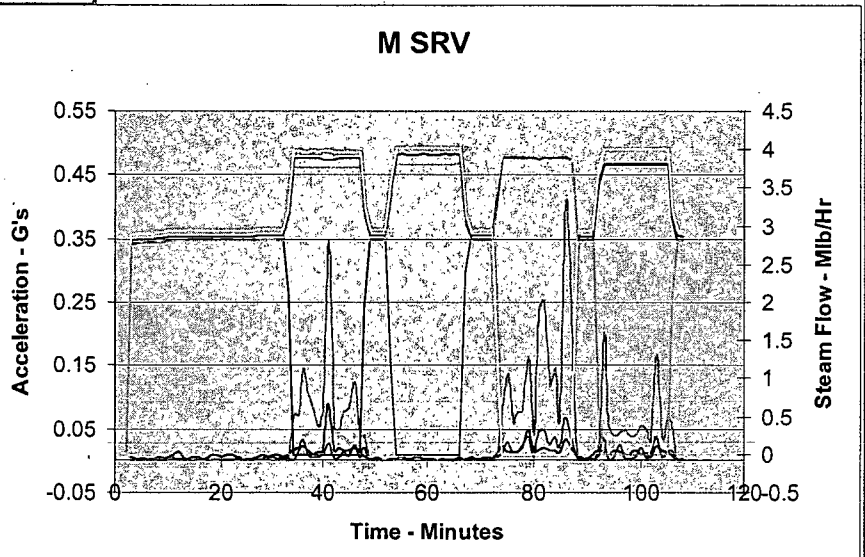
Main Steam Line Strain Gauge Test Results



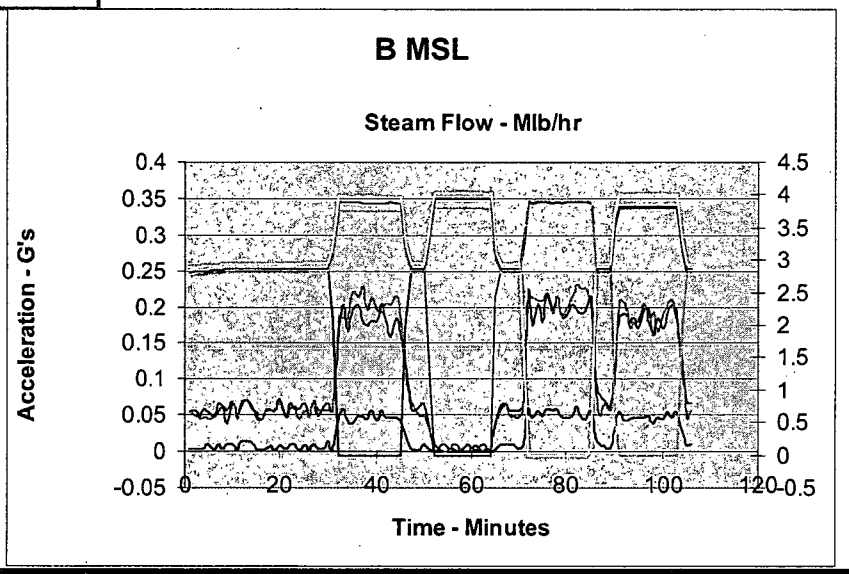
Main Steam Line Strain Gauge Test Results



MSIV Closure Test Results



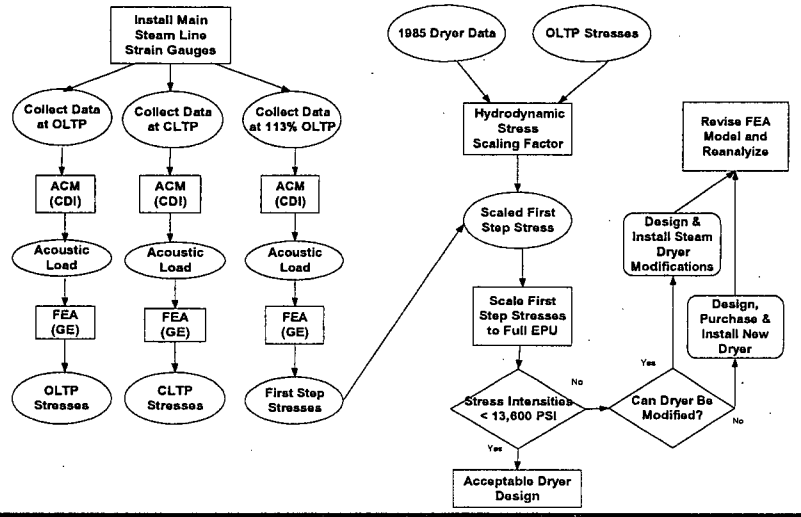
MSIV Closure Test Results



Steam Dryer Analysis Methods

- Main steam line strain gauges used as inputs to ACM.
- Structural Integrity Associates provided strain to pressure conversion factors.
- Steam dryer load definition generated using CDI acoustic circuit methodology (ACM).
- Load definition input into GE ANSYS finite model of SSES steam dryer.
- GE model used 1% Raleigh damping factor.
- GE performed $\pm$ 10% frequency shifts to bound structural uncertainty.
- Strains from GE ANSYS finite model were benchmarked against 1985 SSES strain gauge data.
- Stress intensities were scaled as a result of the benchmarking effort.
- The ASME stress intensity design limit of 13,600 PSI for 304 stainless steel was applied to the finite element analysis stress intensity results.

Steam Dryer Structural Evaluation Process



Uncertainty Considerations

Uncertainty Component	Symbol	Bias (Note 1)	Precision (Note 2)
Acoustic Pressure Measurement	U1	0%	+/-6.2%
Difference in MSL Strain Gauge Locations Between Susquehanna and Quad Cities Unit 2	U2a	0%	+/-16.9%
Ability of ACM to Determine Acoustic Dryer Pressure Loads	U2b	-	-
Measurement of Dryer Pressures in 1985 Susquehanna Measurements	U3a	0%	+/-10%
Ability of ACM to Determine Spatial Distribution of Non-Acoustic Pressure Loads	U3b	0%	+/-7.6%
Use of a Two-Second Time History in FE Calculations	U4a	-2%	0%
Ability of FE Model to Represent Dryer Structure	U4b	(*)	(*)
Determination of CPPU Scale Factor	U5a	(*)	(*)
Conservatism in 113% OLTP Load Definition	U5b	+24%	0%
Bias / Precision – Totals		+22%	+/-22.8%

Uncertainty Considerations

- Notes to Uncertainty Table:
  1) Negative bias values indicate an under-prediction of the dryer loads or stress intensities and a positive bias value indicates an over-prediction.
  2) The precision value indicates either an over-prediction or an under-prediction of the dryer loads or stress intensities.
  3) NA indicates that an uncertainty value is not applicable for this uncertainty component.

  (*) Indicates proprietary information, as provided in PPL letter to the NRC PLA-6076.

Significant Contributors To Uncertainty

- Structural uncertainties applied at the component level.
- Conservatism In 113% OLTP Load Definition
  - + 24% Over prediction (Positive Bias)
- Ability of ACM to Determine Spatial Distribution of Non-Acoustic Pressure Loads
  - Non-Acoustic Loads Developed Based On Benchmark Of 1985 Instrumented Dryer Test
- Overall Approach Results In A Conservative Estimate Of End-To-End Uncertainty Evaluation Of Dryer Stresses

Finite Element Analysis Results

- Two steam dryer components exceeded allowable design peak stress intensities (13,600 PSI) prior to applying structural and analytic uncertainties.
- Four additional steam dryer components have insufficient peak stress intensity margin to cover uncertainties.

Summary

- Analysis shows no acoustic resonances are expected to exist at full EPU conditions.
- Steam line testing demonstrates that no acoustic resonances will exist at the first EPU step.
- Steam line testing demonstrates that the main steam lines and attached equipment will be subject to low levels of vibration at the first EPU step.
- Analysis techniques are comprehensive and utilize actual Susquehanna plant data.
- The steam dryer analysis method was benchmarked against measured Susquehanna strains.
- The EPU steam dryer design will conform to the ASME design criteria ensuring the steam dryer will maintain it's structural integrity.

Needs

A decision to modify or replace the steam dryer by end of November.

We would like feedback on steam dryer analysis methodology.