



TENNESSEE VALLEY AUTHORITY BROWNS FERRY NUCLEAR PLANT

Steam Dryer RAI 15 Status

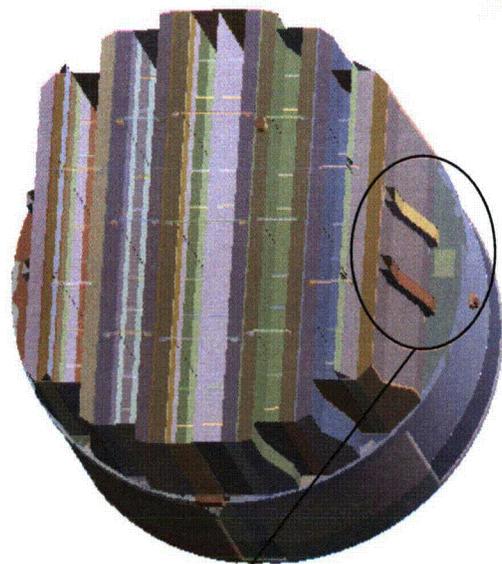
January 25, 2008

Finite Element Model Discrepancies



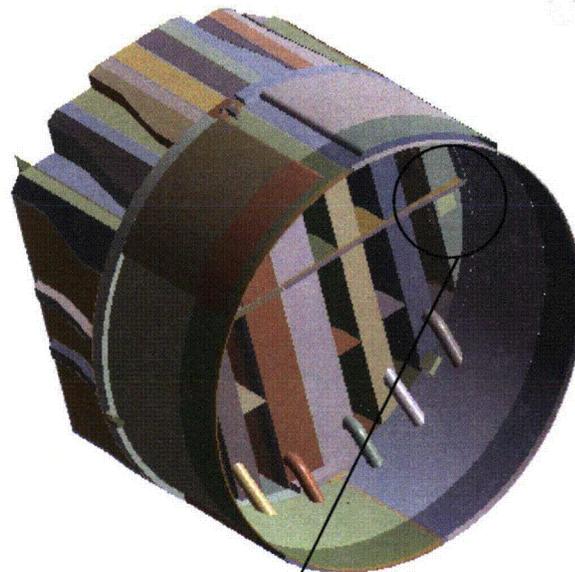
- Differences Between Unit 1 FEM and Actual Configuration
 - Cover Plate is 1” thick vs. ½” thick as modeled
 - Cover plate has no man-way as modeled
 - Outer hood vertical stiffeners have top covers that were omitted in model
 - Dryer support restraint was modeled as bolted restraint – now revised to pin connection
 - Support beam was disconnected from support ring (due to cracked welds) vs. modeled as attached to support ring

- FEM Verified



0.00 100.00 (in)
50.00

Increase cover plate thickness to 1"
Analyze with a 3/4" Fillet weld
Remove Man way
Revise Dryer support restraint
Add top covers to vertical stiffeners



0.00 100.00 (in)
50.00

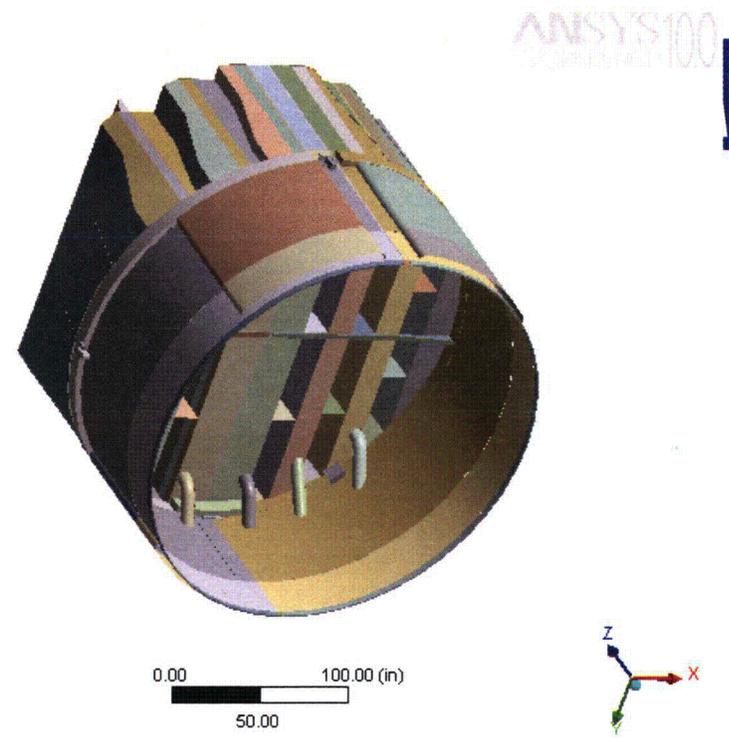
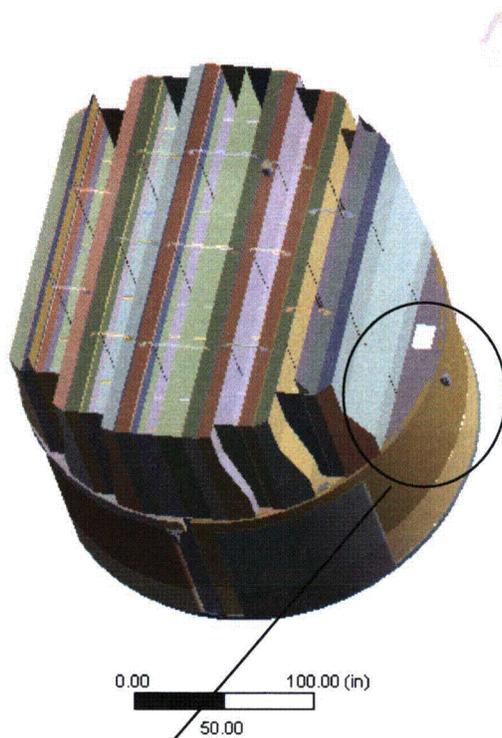
Revise support beam

Browns Ferry Unit 1 Finite Element Model

Finite Element Model Discrepancies



- Differences Between Unit 2/3 FEM and Actual Configuration
 - The cover plate attachment welds to support ring and hood were not described as undersized welds in stress analysis
 - The man-way attachment welds were not described as undersized welds in stress analysis
 - The cover plate was not modeled with a 2" rise to the hood attachment
- Modifications to Unit 2 Steam Dryer in 2009
 - Replace and upgrade dryer tie bar design
 - Reinforce cover plate and man-way welds
- Modifications to Unit 3 Steam Dryer in 2010
 - Replace and upgrade dryer tie bar design
 - Reinforce cover plate and man-way welds
- FEM Verified



- Clarify that Cover Plate & Man-way welds to be reinforced from 1/4" to 3/8"
- Cover plate slopes up 2" from support ring, was modeled as flat
- Revise Dryer Support Restraint from fixed to pinned

Browns Ferry Unit 2, 3 Finite Element Model

Potential for SRV Resonance



- Potential for Resonance Onset Between CLTP and EPU
 - Frequency range 105 Hz to 112 Hz most likely
 - No demonstrated SRV resonance at CLTP velocities (135 – 142.25 ft/sec) from plant data
- 1/5 Scale Testing of A & B Main Steam Lines (preliminary data)
 - A MSL has 3 SRVs and 4 Blind Flanges
 - B MSL has 2 SRVs in active steam flow region, and 2 SRVs and 2 Blind Flanges in dead leg
 - 1/5 Scale Test Report to be completed on 1/30/2008
 - Testing shows SRV frequency (109 Hz) onset starting at CLTP and small increase at EPU Mach numbers
 - Need to quantify SRV resonance through further testing

Potential for SRV Resonance



- 1/8 Scale Testing for EPU Prediction
 - Assess Stress Margins at EPU
 - Quantify the effects of potential resonance
 - Used to judge adequacy of CLTP stress margin
 - Used to determine the need for mitigation modifications

 - Test circuit includes reactor vessel, dryer, nozzles, 4 MSLs and components through turbine high pressure inlet
 - Provides flow interaction and potential coupling between steam lines
 - Comparison of CLTP and EPU flows provides “Bump up” factor for steam dryer stress margin at EPU conditions

 - BUMP UP Factor Applied to CLTP Results

Bias and Uncertainty Issues



- FEM Inputs Still Under NRC Review
 - Hope Creek 2 Dryer Benchmark Analysis (shake test)
 - Mesh Convergence
 - Frequency Discretization Errors
 - 75% Bias and Uncertainty Applied to the Peak
 - Other - NRC discuss

- Issue Resolution Impacts BFN FEM Results and Schedule

Margin Improvement



- Noise Reduction and Margin Improvement
 - FIV noise floor
 - Remove strain gage signals associated with minimal steam flow
 - 1000# data available for Unit 1
 - 0# data available for Unit 2
 - 1000# data will be taken for Unit 3
 - Will be incorporated in revised stress analyses

Clarification of RAIs



- RAI 15 Questions 139/106 & 145/112

- Follow-up Discussion from NRC/TVA Meeting 12/10/07
 - Questions cannot be answered as written
 - FEM Outputs in terms of displacement are not available

- Alternative Responses
 - Discussion

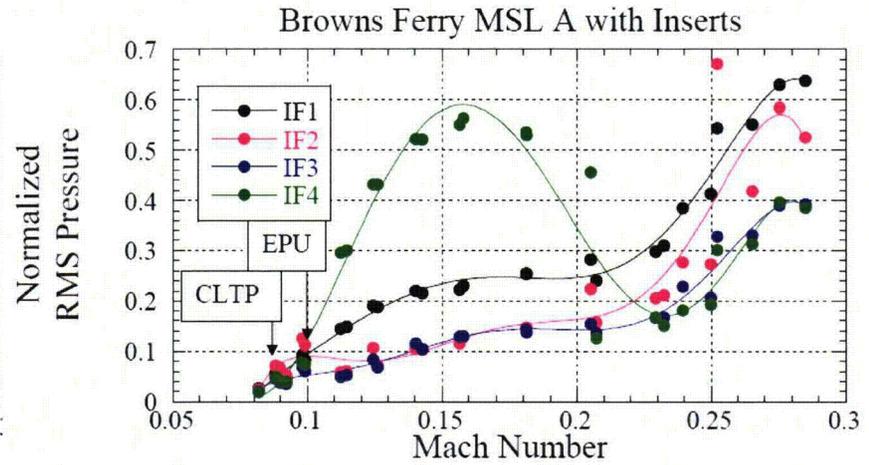
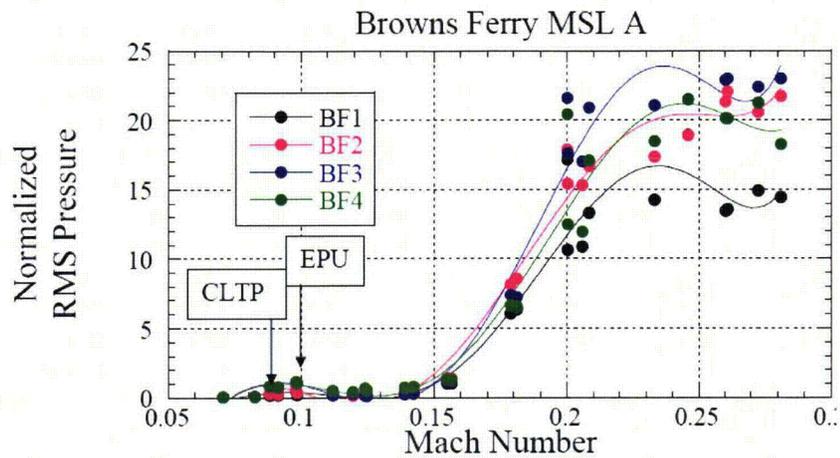
Schedule for RAI 15 Responses



- Project Schedule Impacts
 - Resolution of Bias and Uncertainty Issues
 - Performance of Scale Model Tests
 - Collection of Unit 3 Data
 - Re-perform FEM Analyses

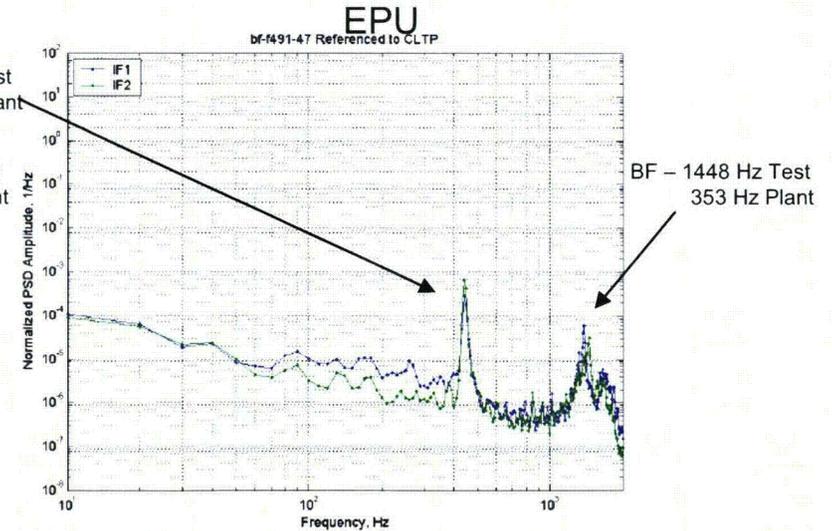
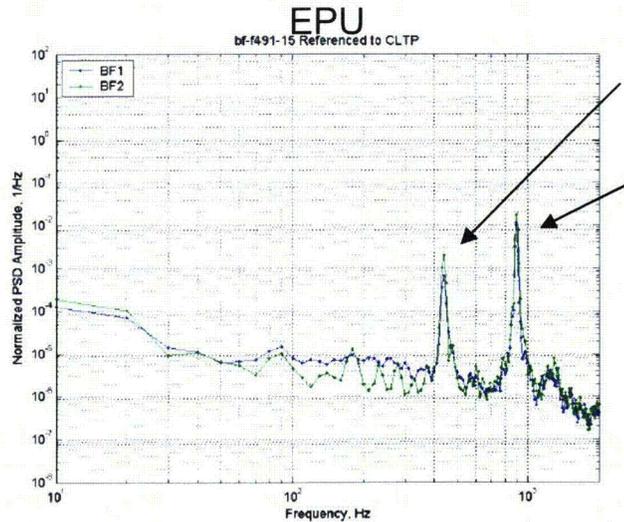
Preliminary Data

1/5 Scale Testing



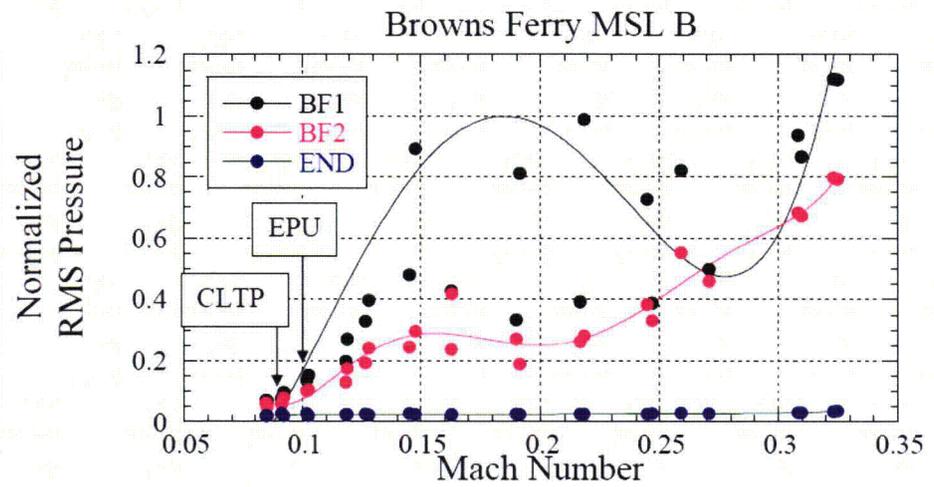
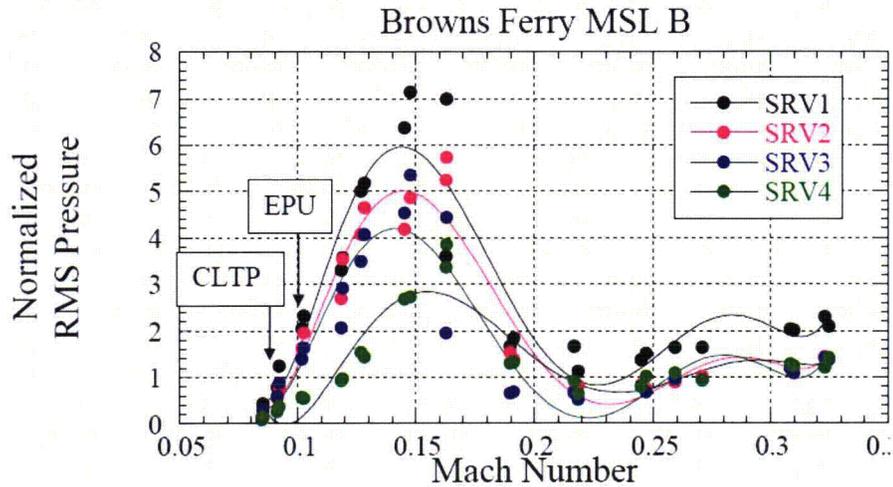
CLTP M = 0.087, EPU M = 0.1

Significant effect seen from BF Inserts at the BF Chamber

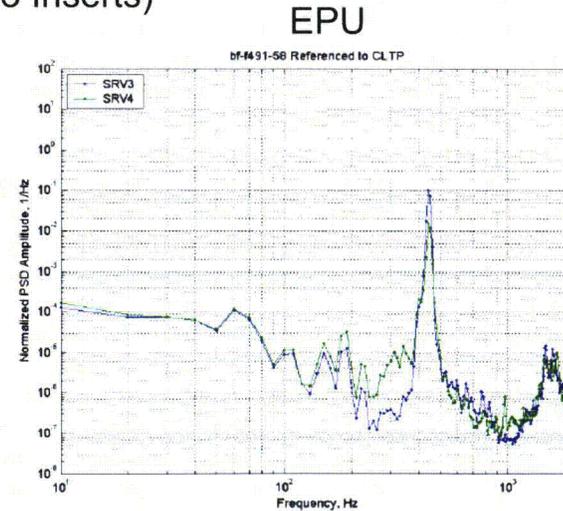
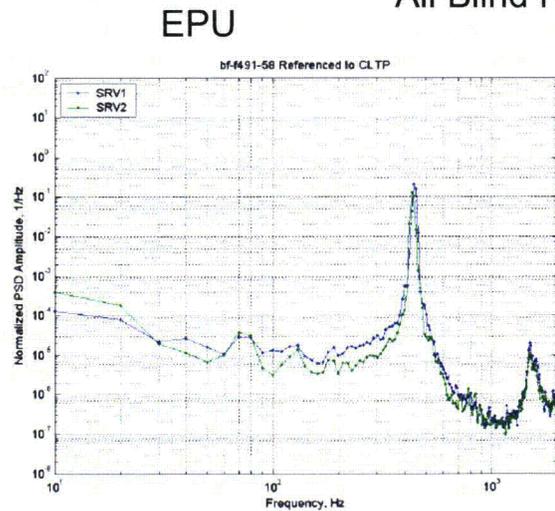


Preliminary Data

1/5 Scale Testing



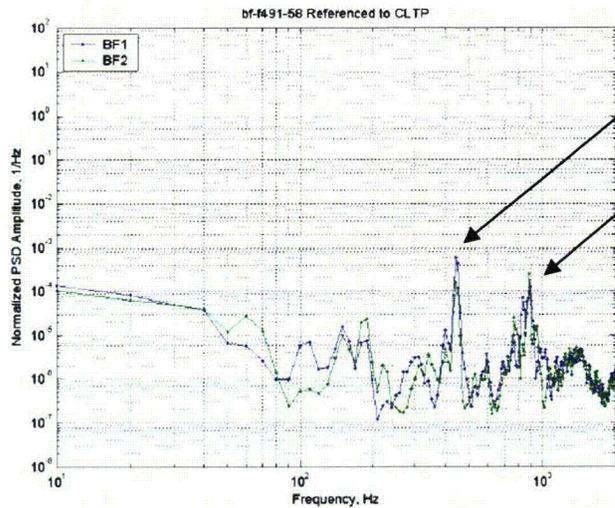
MSL B Has SRV 1, 2 in Steam Flow, SRV 3, 4 in Dead Leg
All Blind Flanges in Dead Leg (w/o Inserts)



Preliminary Data

1/5 Scale Testing

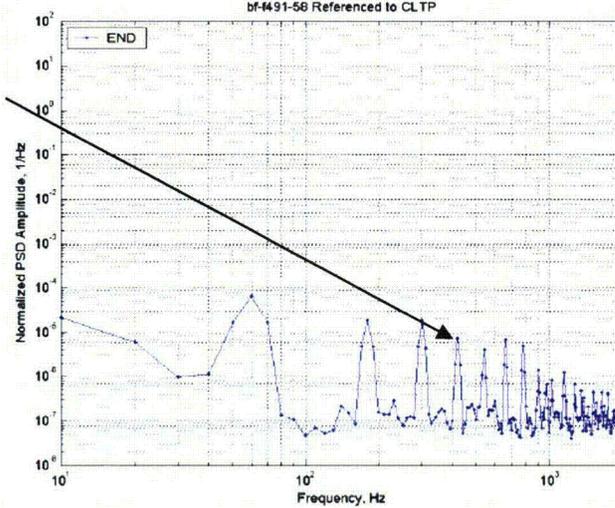
EPU



SRV - 450 Hz Test
109 Hz Plant

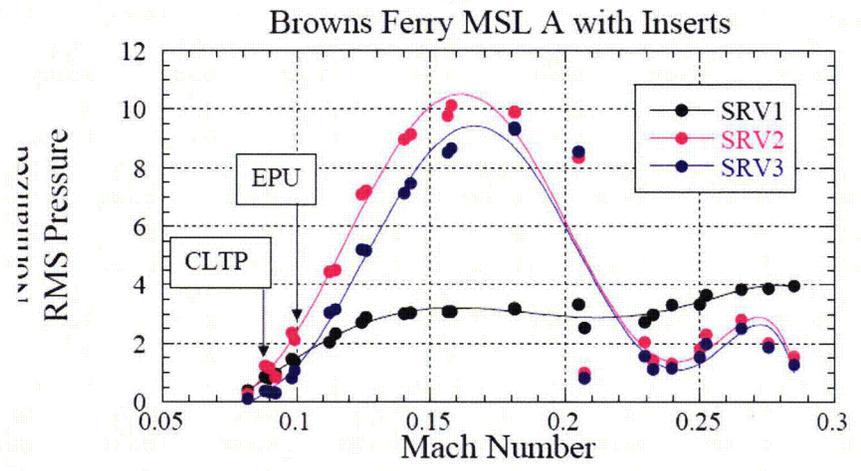
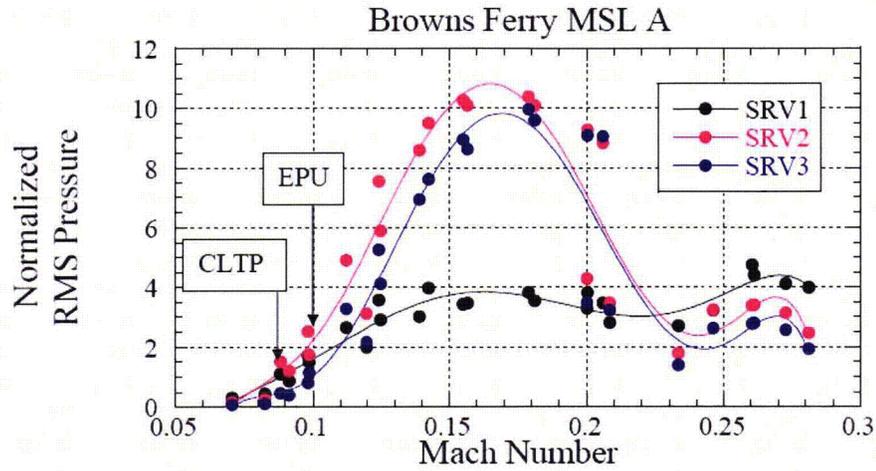
BF - 900 Hz Test
218 Hz Plant

EPU

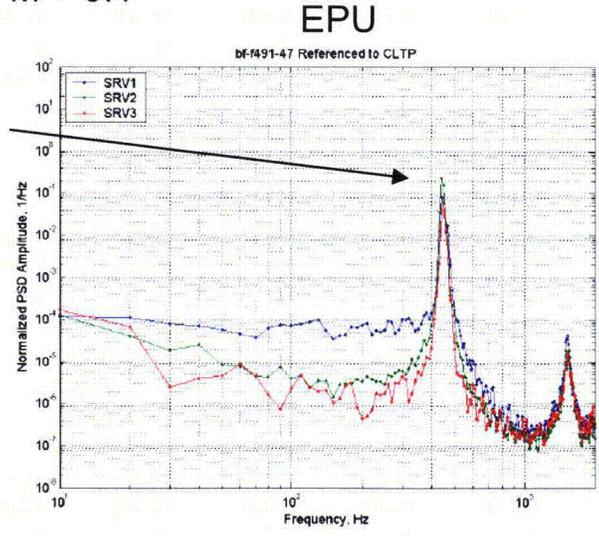
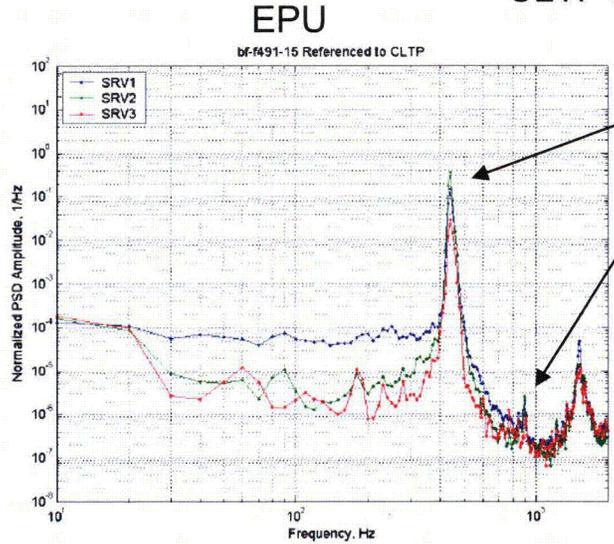


Preliminary Data

1/5 Scale Testing



CLTP M = 0.087, EPU M = 0.1



No significant effect seen on SRVs from Blind Flange Inserts