Enclosure 2 to PLA-6542

Non - Proprietary Version of "SSES Replacement Dryer and Flow Induced Vibration Report, Unit 2 Start-up, 107% Power Test Plateau"

Non-Proprietary Version

SSES Replacement Steam Dryer and Flow Induced Vibration Report

Unit 2 Start-Up

107.0% Power Test Plateau

July, 2009

Prepared By: John A. Bartos

Reviewed By: Kevin G. Browning

Approved by: John E. Krais

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (cont'd.)

ACRONYMS AND ABBREVIATIONS

Short Form	Description
ASME	American Society of Mechanical Engineers
CLTP	Current License Thermal Power (Formerly 3489 MW_{th})
EPU	Extended Power Uprate
FE	Finite Element
FIV	Flow Induced Vibration
Hz	Hertz (Cycles per Second)
HPCI	High Pressure Coolant Injection
LCF	Limit Curve Factor
Mlb_m/hr	Millions Pound-Mass per Hour
MSL	Main Steam Line
MW_{th}	Mega-Watts – Thermal
OLTP	Original License Thermal Power (3293 MW_{th})
PSD	Power Spectral Density
RCIC	Reactor Core isolation Cooling
RHR	Residual Heat Removal
RMS	Root Mean Square
RWCU	Reactor Water Clean-Up
SRV	Safety Relief Valve (Main Steam)
VPF	Vane Passing Frequency

1.0 Executive Summary

This report provides a summary of the SSES Unit 2 replacement steam dryer monitoring instrumentation (Main Steam Line Strain Gage) and flow induced vibration (FIV) measurements at the targeted 107.0% CLTP test plateau (3733 MW_{th}). This data was collected at the actual power levels and core flows indicated in Table 1:

Table 1: Power/Core Flow Data Collection Conditions

Test Point	Thermal Power (MW_{th})	Core Flow (Mlb_m/hr)
1	3731	97.8
2	3728	92.8
3	3726	107.8

The main steam line (MSL) strain gage locations are documented in Reference 1. Plant data log sheets for each Table 1 test point is contained in Appendix A. The data log sheets provide a record of plant conditions at these power conditions.

The MSL strain gage data indicates that sufficient steam dryer margin (approximately 100%) to the ASME endurance limit of 13,600 PSI exists and that the power ascension can proceed to 3952 MWth. The analysis of the piping accelerometer FIV data confirms that there is adequate margin (greater than 100%) to the ASME limits in the SSES main steam, feedwater, and reactor recirculation system piping.

2.0 Main Steam Line Strain Gage Data Analysis

2.1 Power Spectral Density

Figures 1 through 32 provide power spectral density (PSD) plots of MSL strain gage readings. The level 1 and level 2 monitoring curves for each strain gage location are also plotted on each figure. The strain values represent average strain values observed over a 180 second test time period. A data sampling rate of 2500 Hz was used in the data processing. The test data was band-pass filtered between 3 and 250 Hz to be consistent with the load definition used in the replacement dryer structural analysis in Reference 2. There is substantial noise from the 60 Hz alternating current and the recirculation pump power supply, thus filtering of this electrical noise was performed. Also the reactor recirculation pump vane passing frequencies were filtered from the data sets. Testing on the instrumented Unit 1 steam dryer {{{

}}}

Reference 2 documented that the {{{

}}} The filters applied to the data collected at the respective test points are identified in Tables 2, 3 and 4 below:

Table 2: PSD Notch Filter Specifications for 97.8 Mlb_m/hr Data (Test Point 1)

{{{

}}}

Table 3: PSD Notch Filter Specifications for 92.8 Mlb_m/hr Data (Test Point 2)

{{{

}}}

Table 4: PSD Notch Filter Specifications for 107.8 Mlb_m/hr Data (Test Point 3)

{{{

}}}

PSDs were calculated on 2 second blocks of data from the test time period (180 seconds). In order to increase the number of spectral averages, the data blocks were overlapped by 50%. The PSDs were calculated using a Hanning window and a 0.5 Hz bin size. The resulting PSDs were then linearly averaged and are presented as Figures 1 through 32. This method of data processing was used to provide the results in a format consistent with the processing used to develop the monitoring curves.

There are also two monitoring (limit) curves included with the PSD plots. The level 1 monitoring curve represents the response of the SSES dryer finite element (FE) model under the design acoustic load conditions factored by the minimum component analysis margin to the endurance limit. The level 2 monitoring curve is based on 80% of the level 1 curve. A more complete description of the limit curves and how they are generated is included in Reference 3 and Reference 4. The limit curves were generated, in accordance with Reference 4, using a baseline data set from Unit 2 collected at 3611 MWth (103.5% CLTP). These monitoring curves provide guidance for evaluating the measured dryer response with respect to the structural analysis results.

Table 5 below shows the maximum strain gage reading for 3731 MW_{th} and 97.8 Mlb_m/hr (Test Point 1) as a percent of monitoring limits generated in accordance with Reference 4 using a baseline data set from Unit 2 collected at 3611 MWth (103.5% CLTP). All values of strain were below the level 1 and level 2 monitoring limits. The data is plotted with the monitoring limits in Figures 1 through 8.

Table 5: Maximum MSL Strain Gage Readings @ 3731 MW_{th} and 97.8 Mlb_m/hr Expressed as a Ratio of the Monitoring Limits (Test Point 1)

{{{

}}}

Table 6 below shows the maximum strain gage reading for 3728 MW_{th} and 92.8 Mlb_m/hr (Test Point 2) as a percent of monitoring limits generated in accordance with Reference 4 using a baseline data set from Unit 2 collected at 3611 MWth (103.5% CLTP). {{{

}}} The data is plotted with the monitoring limits in Figures 9 through 16.

Table 6: Maximum MSL Strain Gage Readings @ 3728 MW_{th} and 92.8 Mlb_m/hr Expressed as a Ratio of the Monitoring Limits (Test Point 2)

{{{

}}}

Table 7 below shows the maximum strain gage reading for 3726 MW_{th} and 107.8 Mlb_m/hr (Test Point 3) as a percent of monitoring limits generated in accordance with Reference 4 using a baseline data set from Unit 2 collected at 3611 MWth (103.5% CLTP). All values of strain are below the level 1 and monitoring limits. {{{

}}}

The data is plotted with the monitoring limits in Figures 17 through 24.

Table 7: Maximum MSL Strain Gage Readings @ 3726 MW_{th} and 107.8 Mlb_m/hr Expressed as a Ratio of the Monitoring Limits (Test Point 3)

{{{

}}}

As a result of the MSL A Upper exceeding its level 2 monitoring limit curve at a core flow of 107.8 Mlb_m/hr, a stress evaluation was conducted using the F-Factor and RMS methodology documented in Reference 3 and Reference 4. The results of that analysis are documented in Section 2.3 below and in Tables 8 through 10. {{{

}}}

2.2 Trending

For trending purposes, filtered MSL strain gage PSDs for powers up to 107.0% of CLTP (3733 MW_{th}) have been plotted in a waterfall format and are presented in Figures 33 through 40. Figure 41 is a trend plot of the RMS value of the sample time histories plotted against total steam flow. Figures 33 through 41 show that MSL strains are {{{ }}}

MSL strain gages mounted on the A and D steam lines have the highest magnitude readings. This is attributed to the 15 Hz peak being reinforced by the safety relief valve (SRV) dead-legs on these two steam lines, as discussed in References 5 and Reference 6.

2.3 Unit 1 vs. Unit 2 Data Comparison

The Unit 2 MSL strain gage PSDs are similar to the PSDs measured on Unit 1 in 2008 in both frequency content and magnitude. Figures 42 through 49 show Unit 1 3728 MW_{th} @ 97 Mlb_m/hr data plotted with Unit 2 3731 MW_{th} @ 97.8 Mlb_m/hr data. An examination of Figures 42 through 49 demonstrates that the acoustic signatures of Unit 1 and Unit 2 are similar.

As an additional comparison of the acoustic data generated by Unit 1 and Unit 2, an F-Factor and RMS analyses (as described in Reference 3 and Reference 4) were conducted on two similar sets of MSL strain gage data. These analyses were performed to generate estimates of dryer stresses at the current operating plateau. The Unit 1 data set was taken at a reactor power of 3716 MW_{th} and a core flow of 107.3 Mlb_m/hr. The Unit 2 data set was taken at a reactor power of 3726 MW_{th} and a core flow of 107.8 Mlb_m/hr.

As described in Reference 3 and Reference 4, three separate analyses were performed on each of the data sets. The data sets were filtered to remove the recirculation system pump vane passing peaks. The results presented below exclude estimates of stresses that result from pump vane passing peaks. The effects of the vane passing peaks on total steam dryer stresses are discussed in Reference 2. Tables 8 through 10 contain the results of the analyses.

Table 8: Adjusted Stress with Bias and Uncertainty and LCF ACM Analysis F-Factor Method

{{{

}}}

Table 9: Adjusted Stress with Bias and Uncertainty and LCF Supplemental Analysis F-Factor Method

{{{

}}}

Table 10: Adjusted Stress with Bias and Uncertainty and LCF Supplemental Analysis RMS Method

{{{

}}}

An examination of Tables 8 through 10 further demonstrates the {{{

}}}

2.4 Steam Dryer Evaluation Summary

Based on the current margins shown in Tables 8 through 10 and in Figures 1 through 32, there is adequate projected margin (approximately 100%) to the steam dryer ASME endurance limit of 13,600 PSI for continued power ascension to 3952 MW_{th}. The presented data also validates the conclusion that the steam dryer stress analysis based on the instrumented Unit 1 steam dryer (presented in Reference 2), is applicable to the Unit 2 steam dryer.

3.0 Piping Flow Induced Vibration

3.1 Introduction

Piping accelerometers on the main steam, feedwater, reactor recirculation, residual heat removal (RHR), and reactor water cleanup (RWCU) systems were monitored during start-up. Key locations were selected based on geometry and the expected potential for vibration-related problems or maximum pipe stress. For main steam, the accelerometers were located on the "B" and "C" lines, since these are expected to be the most active. These steam lines have active flow under the SRV branch lines, as well as the HPCI and RCIC system steam supply branch connections. Accelerometers were also located at, or near, the above mentioned branch lines of interest. In all, 74 accelerometers at 33 locations were monitored during start-up.

Prior to the start-up, two RMS acceptance levels were calculated for each accelerometer on the main steam and feedwater systems. A level 1 value was determined based on vibration calculations using ASME OM-3 (Reference 7) allowable stresses. A level 2 value was conservatively established for each accelerometer at 50% of level 1. The accelerations used in the vibration analyses were "zero to peak" values (consistent with ASME OM-3) and conservative factors were used to determine equivalent RMS values.

The Reactor Recirculation/RHR/RWCU system accelerometers were assigned only conservative level 2 RMS and "zero-to-peak" allowable values, since these systems were negligibly affected by EPU. If both criteria (i.e., RMS and "zero-to-peak") were exceeded for a given instrument, then a more detailed engineering evaluation was performed.

3.2 Data Collection Scope

Formal monitoring for the effects of FIV on piping was initiated at the target test point of 2569 MW_{th} (~65% full EPU power). Data was also collected and analyzed at targeted test points of 3293 MW_{th} (OLTP), 3489 MW_{th} (CLTP), 3611 MW_{th} (103.5% CLTP), and for several core flow conditions at 3733 MW_{th} (107% CLTP), as described in Table 1 above. In addition, piping FIV was monitored on an hourly basis, and general plant walkdowns were continuously performed during power ascension from 3489 MW_{th} to 3611 MW_{th}, as well as from 3611 MW_{th} to 3733 MW_{th}.

Detailed plant walk downs of piping and components were performed for most systems affected by Extended Power Uprate located outside the drywell. These walk downs were performed at the targeted test points 2569 MW_{th}, 3489 MW_{th}, 3611 MW_{th}, and 3733 MW_{th}. The walk downs were performed for piping and components located in accessible and inaccessible (high radiation) areas. Two remote controlled, mobile cameras were used to observe the vibration in the inaccessible areas.

3.3 Data Analysis Methodology

Spectral analyses for each accelerometer were performed at each of the test points for a time period of 180 seconds. The data was evaluated based on 4 second blocks of data and to increase the number of spectral averages, the data blocks were overlapped by 50%. The data was band-pass filtered between 2 Hz and 250 Hz, with a 0.25 Hz bin size to provide for consistency with the method used to develop the acceptance criteria for the accelerometers.

Significant electrical noise was observed at the 60 Hz multiples of the power supply frequencies, so notch filters were applied as required. Multiples of the reactor recirculation pump vane passing frequency (VPF) were observed; however, the VPF frequencies were not filtered, since they represent true mechanical vibration (i.e., displacement/stress).

3.4 Results

Throughout power ascension, four (4) accelerometers degraded to the point where their output was judged to be questionable (i.e., a "near zero" output). This is acceptable since at these locations, nearby accelerometers indicated values within the ASME OM-3 acceptance criteria. Figures 50 through 52 indicate the percent of allowable RMS acceleration versus total main steam flow/feed water flow trends during the power ascension to 3733 MW_{th}. In addition, Figures 53 through 57 indicate the percent of allowable RMS acceleration versus core flow trends for the Reactor Recirculation, RHR, and RWCU system instruments.

The walk downs were performed for piping and components located in accessible and inaccessible (i.e., high radiation) areas. As expected, the vibration observed increased with power ascension. In general, all observed vibration was within previously established acceptance criteria. However, walk down observations of the feedwater venturi instrument tubing indicated that some additional locally mounted instrumentation was prudent. A tri-axial accelerometer was added at the maximum point of vibration. For all test points, venturi tubing vibration levels met the original plant design criteria. Consideration is being given to installing additional supports on this non-safety-related tubing to reduce vibration levels.

3.5 Piping Summary

During the Unit 2 power ascension to 3733 MWth, piping vibration levels were monitored to assess effects of flow induced vibration (FIV). Trending was performed, and all valid accelerations/displacements were within pre-established limits, based on ASME OM-3 allowable stresses.

The piping/components walkdown results were as expected; general vibration levels increased during power ascension and the overall response of piping and components were within established criteria.

4.0 References:

1. PPL Letter To USNRC, PLA-6176 (Figure 31-1), "Susquehanna Steam Electric Station Proposed License Amendment No. 285 For Unit 1 Operating License No. NPF-14 And Proposed License Amendment No. 253 For Unit 2 Operating License No. NPF-22 Extended Power Update Application Regarding Steam Dryer And Flow Effects Request For Additional Information Responses", dated 4/27/2007

2. GE-Hitachi Nuclear Energy Engineering Report 0000-0095-2113-P-R0, "Susquehanna Replacement Steam Dryer Updated Stress Analysis At Extended Power Uprate Conditions", Class III, February 2009 (Provided via PPL Letter To USNRC, PLA-6484, dated 2/27/09)

3. GE-Hitachi Nuclear Energy Engineering Report 0000-0096-5766-P-R1, "Revised Susquehanna Replacement Steam Dryer Limit Curves - Main Steam Line Mounted Instrumentation", Class III, February 2009 (Provided via PPL Letter To USNRC, PLA-6484, dated 2/27/09)

4. GE-Hitachi Nuclear Energy Engineering Report 0000-0101-0766-P-R0, "Main Steam Line Limit Curve Adjustment During Power Ascension", Class III, April 2009 (Provided via PPL Letter To USNRC, PLA-6510, dated 5/12/09)

5. PPL Letter To USNRC, PLA-6076 (Attachment 10), "Susquehanna Steam Electric Station Proposed License Amendment No. 285 For Unit 1 Operating License No. NPF-14 And Proposed License Amendment No. 253 For Unit 2 Operating License No. NPF-22 Constant Pressure Power Uprate", dated 10/11/2006

6. PPL Letter To USNRC, PLA-6176 (Questions 4, 7, and 31), "Susquehanna Steam Electric Station Proposed License Amendment No. 285 For Unit 1 Operating License No. NPF-14 And Proposed License Amendment No. 253 For Unit 2 Operating License No. NPF-22 Extended Power Update Application Regarding Steam Dryer and Flow Effects Request for Additional Information Responses", dated 4/27/2007

7. ASME OMb-S/G-2005, "Standards and Guides for Operation and Maintenance of Nuclear Power Plants", Part 3, "Requirements for Preoperational and Initial Start-Up Vibration Testing of Nuclear Power Plant Piping Systems" (ASME OM-3)

{{{

}}}

Figure 1: MSL A Upper Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 2: MSL A Lower Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 3: MSL B Upper Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 4: MSL B Lower Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 5: MSL C Upper Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 6: MSL C Lower Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 7: MSL D Upper Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 8: MSL D Lower Strain Gage PSD Plot at Test Point 1

{{{

}}}

Figure 9: MSL A Upper Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 10: MSL A Lower Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 11: MSL B Upper Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 12: MSL B Lower Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 13: MSL C Upper Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 14: MSL C Lower Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 15: MSL D Upper Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 16: MSL D Lower Strain Gage PSD Plot at Test Point 2

{{{

}}}

Figure 17: MSL A Upper Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 18: MSL A Lower Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 19: MSL B Upper Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 20: MSL B Lower Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 21: MSL C Upper Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 22: MSL C Lower Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 23: MSL D Upper Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 24: MSL D Lower Strain Gage PSD Plot at Test Point 3

{{{

}}}

Figure 25: MSL A Upper Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 26: MSL A Lower Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 27: MSL B Upper Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 28: MSL B Lower Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 29: MSL C Upper Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 30: MSL C Lower Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 31: MSL D Upper Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 32: MSL D Lower Strain Gage PSD Plot at Test Point 3 with Revised Limit Curves

{{{

}}}

Figure 33: MSL A Upper Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 34: MSL A Lower Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 35: MSL B Upper Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 36: MSL B Lower Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 37: MSL C Upper Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 38: MSL C Lower Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 39: MSL D Upper Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 40: MSL D Lower Strain Gage PSD Waterfall Plot

{{{

}}}

Figure 41: MSL Strain Gage Time History RMS Trends

{{{

}}}

Figure 42: MSL A Upper Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 43: MSL A Lower Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 44: MSL B Upper Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 45: MSL B Lower Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 46: MSL C Upper Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 47: MSL C Lower Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 48: MSL D Upper Unit 1 vs. Unit 2 Comparison

{{{

}}}

Figure 49: MSL D Lower Unit 1 vs. Unit 2 Comparison

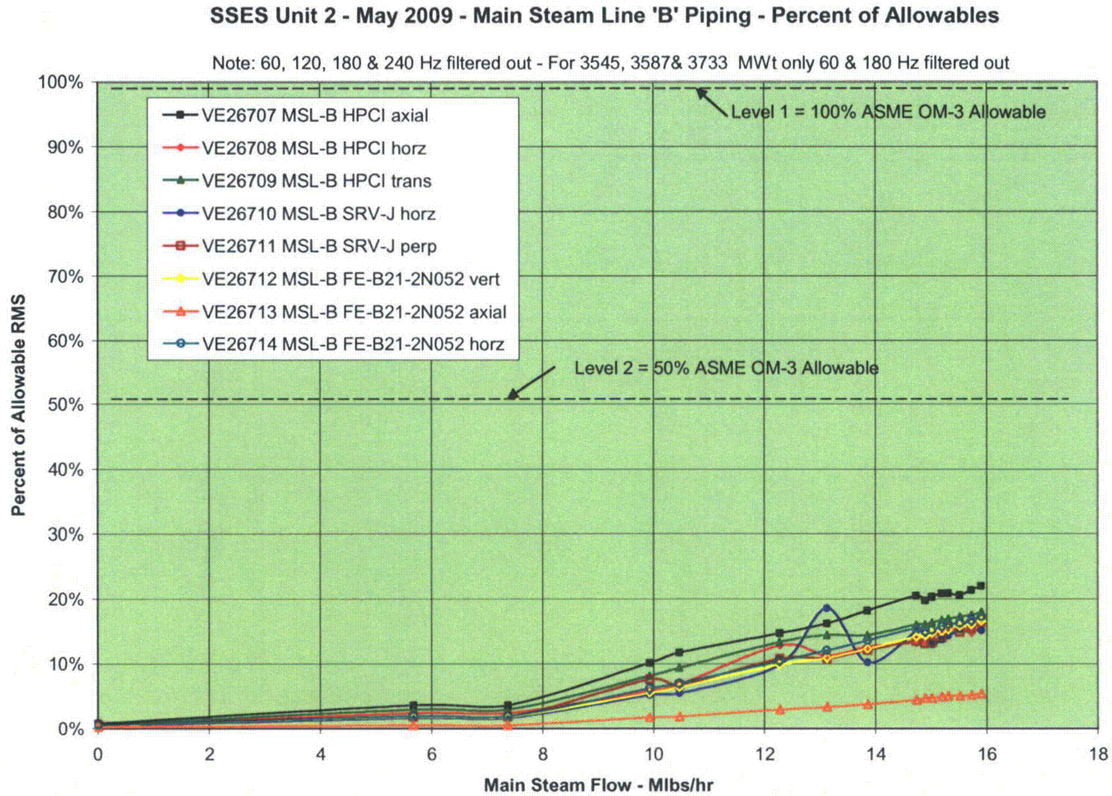

Figure 50: Main Steam Line 'B' Piping - % of Allowables (RMS)

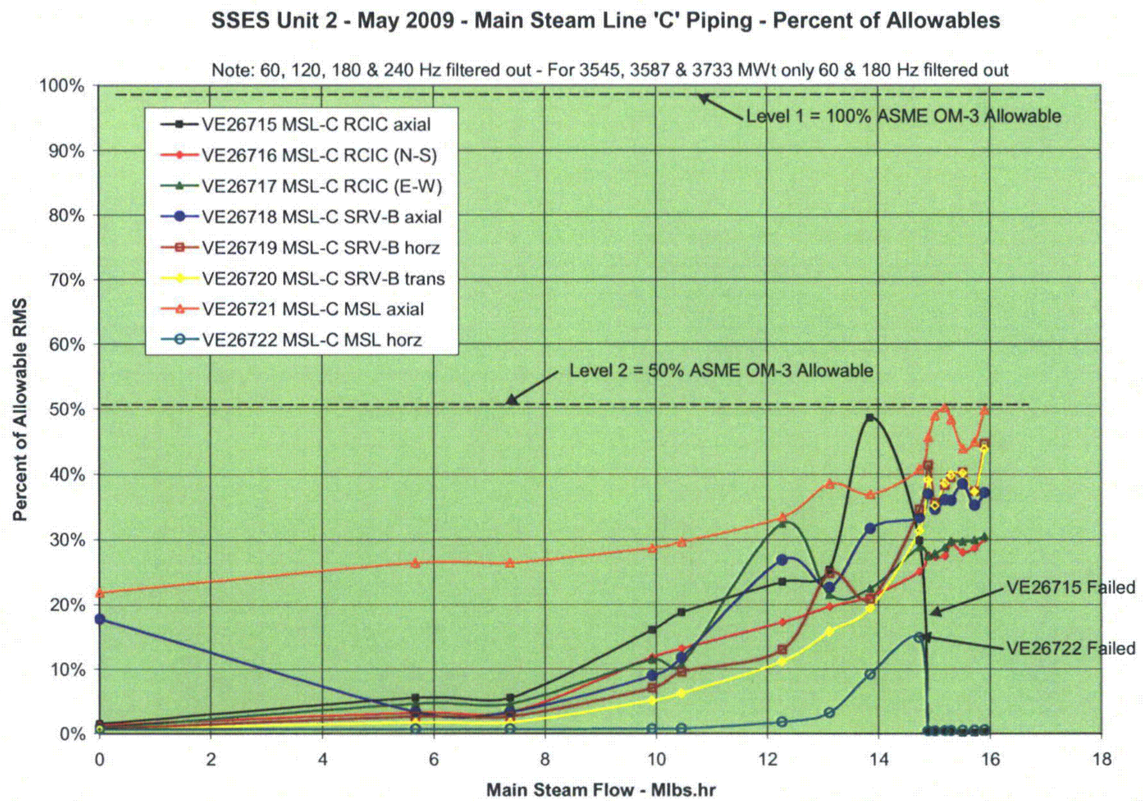

Figure 51: Main Steam Line 'C' Piping - % of Allowables (RMS)

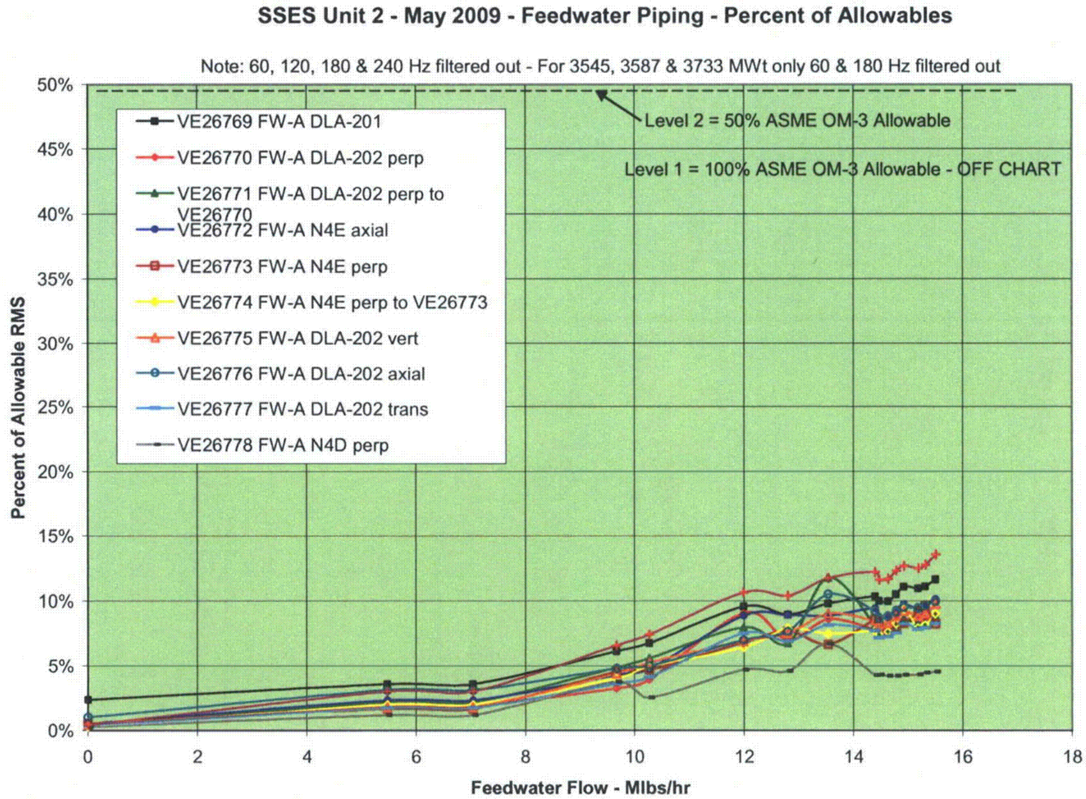

Figure 52: Feedwater Piping - % of Allowables (RMS)

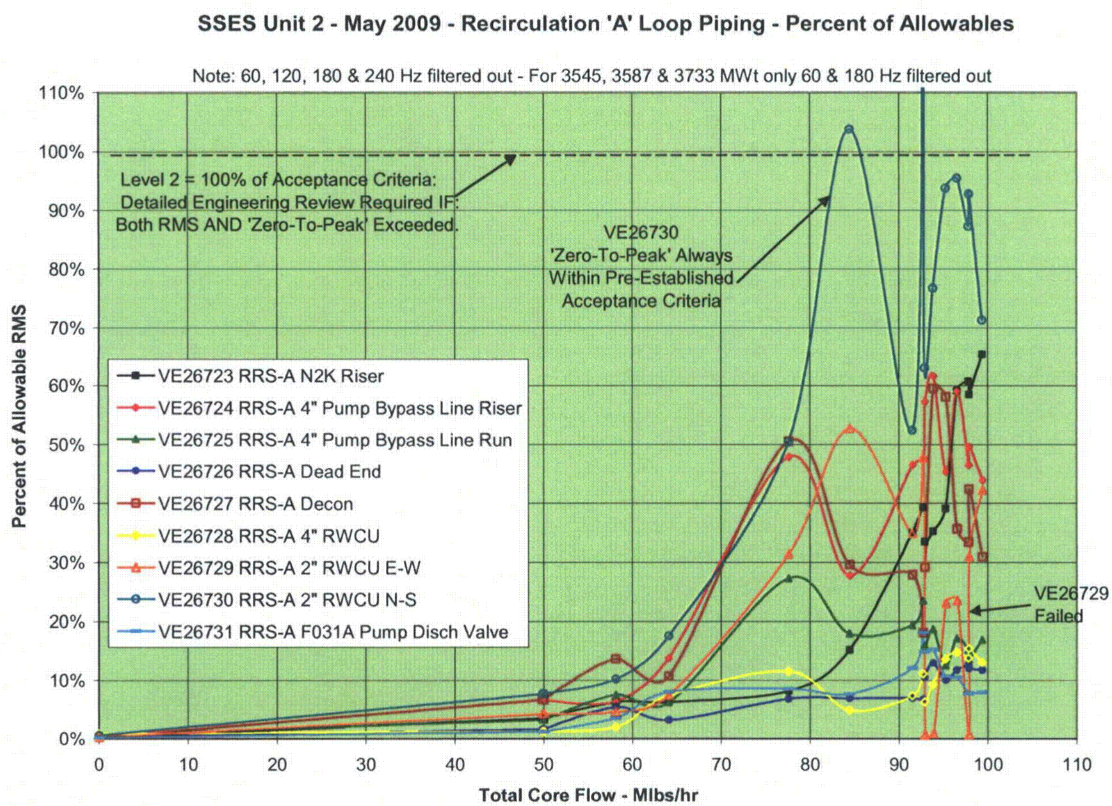

Figure 53: Reactor Recirculation 'A' Loop Piping - % of Allowables (RMS)

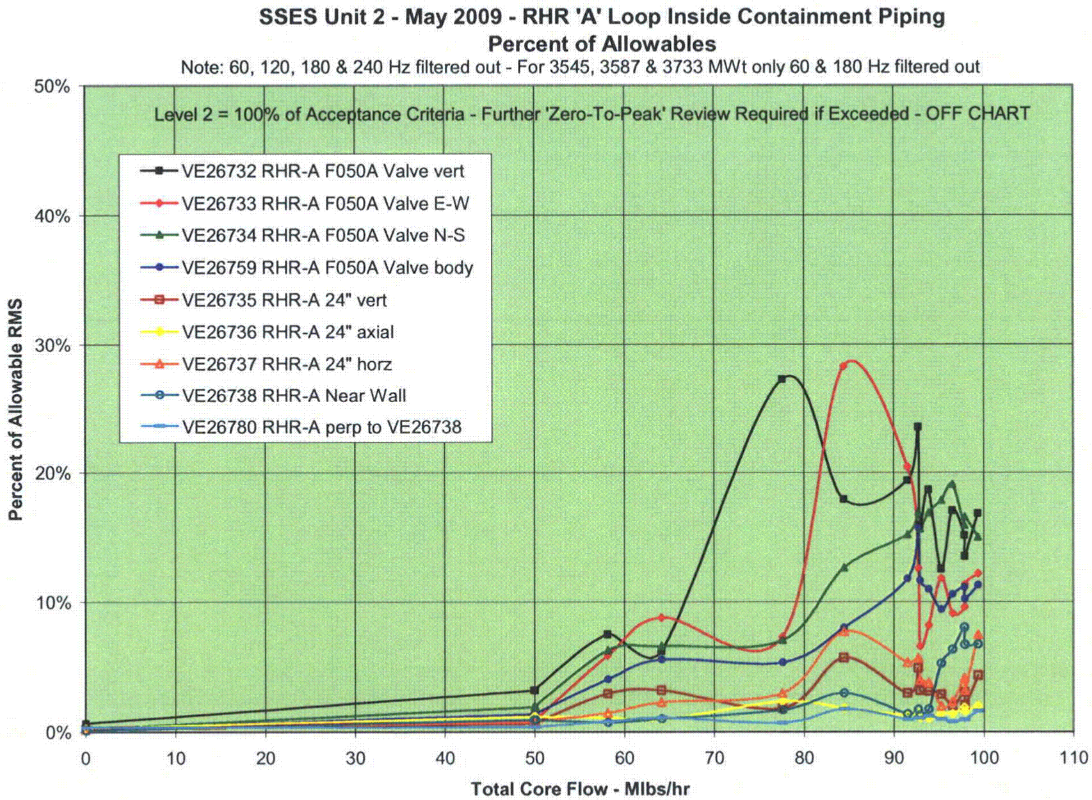

Figure 54: RHR 'A' Loop Inside Containment Piping - % of Allowables (RMS)

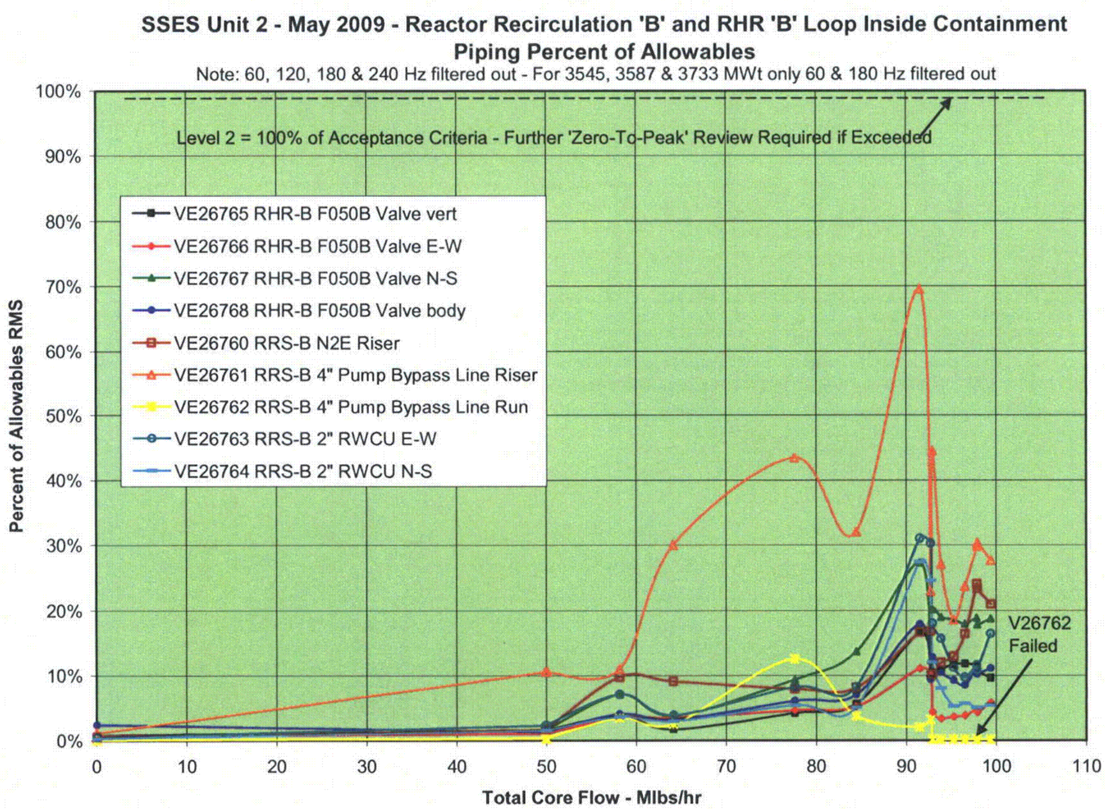

Figure 55: Reactor Recirculation 'B' and RHR 'B' Loop Inside Containment Piping % of Allowables (RMS)

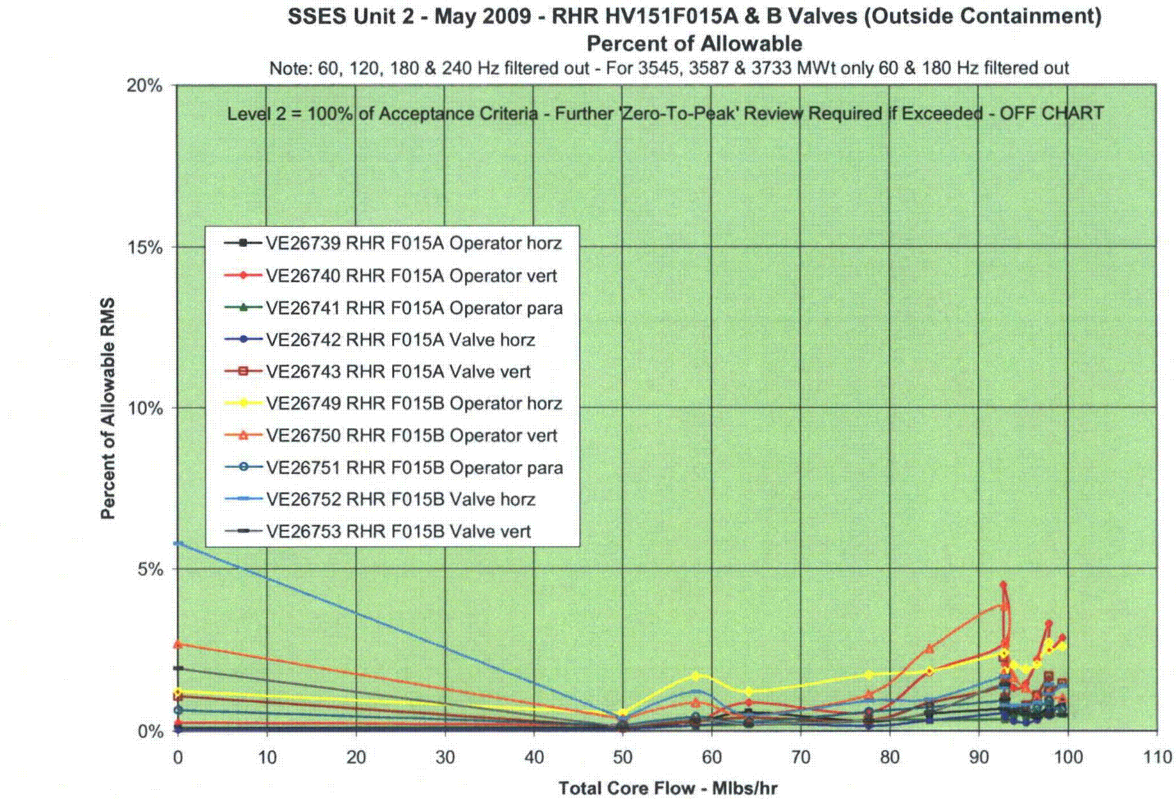

Figure 56: RHR HV151F015A & B Valves (Outside Containment)% of Allowables (RMS)

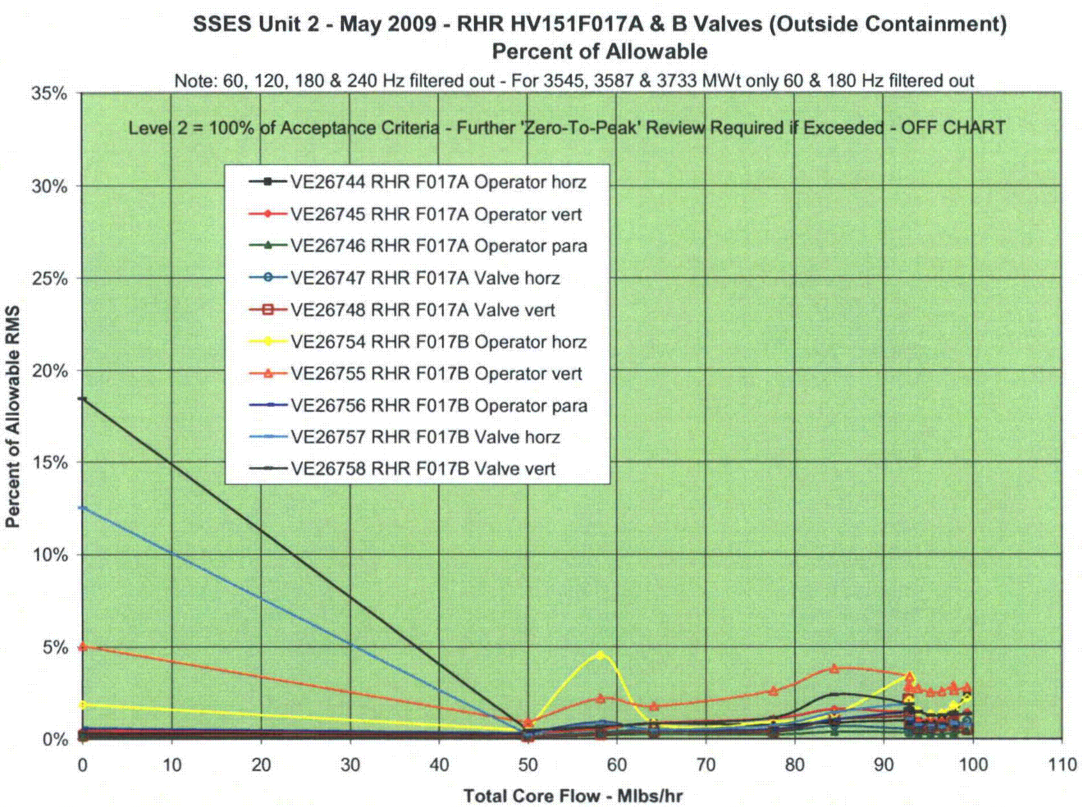

Figure 57: RHR HV151F017A & B Valves (Outside Containment)% of Allowables (RMS)

Appendix A

Plant Data Log Sheets

Steam Dryer Data Log Sheets
Start

Date/Time	6/4/2009 16:10	(Start)

	Computer ID	Value	Units
Thermal Power (Instantaneous)	u02.nba01	3730.72	MWth
Thermal Power (15 min Ave.)	u02.nba101	3731.86	MWth
Electrical Power	u02.gnj02	1238.53	Mwe
Total Core Flow	u02.nff12	97.81	M lbm/hr
Recirc Loop Flow A	u02.njf02	49.29	M lbm/hr
Recirc Loop Flow B	u02.njf03	48.60	M lbm/hr
Recirc Loop A Suction Temperature	u02.nrt01	524.78	°F
Recirc Loop B Suction Temperature	u02.nrt02	524.48	°F
Core Plate D/P	u02.njp51	15.47	PSI
Indicated Steam Flow Line A	u02.nff01	3.91	M lbm/hr
Indicated Steam Flow Line B	u02.nff02	4.09	M lbm/hr
Indicated Steam Flow Line C	u02.nff03	4.00	M lbm/hr
Indicated Steam Flow Line D	u02.nff04	3.92	M lbm/hr
Indicated Total Steam Flow	u02.nff10	15.90	M lbm/hr
Indicated Feedwater Flow	u02.nff11	15.50	M lbm/hr
Feedwater Temperature Line A	u02.fpt01	398.09	°F
Feedwater Temperature Line B	u02.fpt02	396.30	°F
Feedwater Temperature Line C	u02.fpt03	393.68	°F
Rx Dome Pressure Narrow Range	u02.nfp01	1019.73	PSIG
Rx Dome Pressure Wide Range	u02.nfp02	1018.97	PSIG
Steam Dome Temperature	u02.nfa05	548.55	°F
Recirculation Pump A Speed	vm.2p401a/2a_rrp_tac	1464.00	RPM
Recirculation Pump B Speed	vm.2p401b/2b_rrp_tac	1441.00	RPM
Recirculation Pump A Power	u02.nrj51	3.90	MWe
Recirculation Pump B Power	u02.nrj52	3.71	MWe
CRD Cooling Header Flow	u02.nef03	62.36	GPM
CRD System Flow	u02.nef01	62.32	GPM
CRD System Temperature	u02.ndt05	131.99	°F
Bottom Head Drain Temp	u02.nlt01	528.35	°F
Reactor Water Level Narrow Range	u02.nfl01	36.07	Inches H2O
Reactor Water Level Narrow Range	u02.nfl02	35.90	Inches H2O
Reactor Water Level Narrow Range	u02.nfl03	34.04	Inches H2O
Reactor Water Level Wide Range	u02.nbl02	28.88	Inches H2O
Recirculation Pump A Vane Passing Freq.	n/a	122.00	Hz
Recirculation Pump B Vane Passing Freq.	n/a	120.08	Hz
Recirculation Pump A Motor Frequency	n/a	49.29	Hz
Recirculation Pump B Motor Frequency	n/a	48.52	Hz

Enhanced Steam Flow Calculations

Feed Flow Line A (LEFM)	u02.nff77	5.18	M lbm/hr
Feed Flow Line B (LEFM)	u02.nff78	5.19	M lbm/hr
Feed Flow Line C (LEFM)	u02.nff79	5.14	M lbm/hr
CRD Flow	u02.ndf01	0.03	M lbm/hr
Total Feedwater Flow	n/a	15.54	M lbm/hr
Steam Flow Line A	n/a	*3.81*	M lbm/hr
Steam Flow Line B	n/a	*4.00*	M lbm/hr
Steam Flow Line C	n/a	*3.90*	M lbm/hr
Steam Flow Line D	n/a	*3.83*	M lbm/hr
Total Steam Flow	n/a	*15.54*	M lbm/hr

Test Point 1 – 3731 MW_{th} / 97.8 Mlb_m/hr – Start

Steam Dryer Data Log Sheets
Finish

Date/Time	6/4/2009 16:13	(Finish)

	Computer ID	Value	Units
Thermal Power (Instantaneous)	u02.nba01	3730.58	MWth
Thermal Power (15 min Ave.)	u02.nba101	3731.73	MWth
Electrical Power	u02.gnj02	1235.60	Mwe
Total Core Flow	u02.nff12	97.59	M lbm/hr
Recirc Loop Flow A	u02.njf02	48.97	M lbm/hr
Recirc Loop Flow B	u02.njf03	48.92	M lbm/hr
Recirc Loop A Suction Temperature	u02.nrt01	524.56	°F
Recirc Loop B Suction Temperature	u02.nrt02	524.37	°F
Core Plate D/P	u02.njp51	15.45	PSI
Steam Flow Line A	u02.nff01	3.90	M lbm/hr
Steam Flow Line B	u02.nff02	4.10	M lbm/hr
Steam Flow Line C	u02.nff03	3.99	M lbm/hr
Steam Flow Line D	u02.nff04	3.93	M lbm/hr
Total Steam Flow	u02.nff10	15.95	M lbm/hr
Feedwater Flow	u02.nff11	15.50	M lbm/hr
Feedwater Temperature Line A	u02.fpt01	398.09	°F
Feedwater Temperature Line B	u02.fpt02	396.30	°F
Feedwater Temperature Line C	u02.fpt03	393.57	°F
Rx Dome Pressure Narrow Range	u02.nfp01	1019.59	PSIG
Rx Dome Pressure Wide Range	u02.nfp02	1018.99	PSIG
Steam Dome Temperature	u02.nfa05	548.62	°F
Recirculation Pump A Speed	vm.2p401a/2a_rrp_tac	1464.00	RPM
Recirculation Pump B Speed	vm.2p401b/2b_rrp_tac	1441.00	RPM
Recirculation Pump A Power	u02.nrj51	3.90	MWe
Recirculation Pump B Power	u02.nrj52	3.72	MWe
CRD Cooling Header Flow	u02.nef03	62.34	GPM
CRD System Flow	u02.nef01	62.32	GPM
CRD System Temperature	u02.ndt05	131.99	°F
Bottom Head Drain Temp	u02.nlt01	528.37	°F
Reactor Water Level Narrow Range	u02.nfl01	35.52	Inches H2O
Reactor Water Level Narrow Range	u02.nfl02	37.29	Inches H2O
Reactor Water Level Narrow Range	u02.nfl03	35.52	Inches H2O
Reactor Water Level Wide Range	u02.nbl02	29.13	Inches H2O
Recirculation Pump A Vane Passing Freq.	n/a	122.00	Hz
Recirculation Pump B Vane Passing Freq.	n/a	120.08	Hz
Recirculation Pump A Motor Frequency	n/a	49.29	Hz
Recirculation Pump B Motor Frequency	n/a	48.52	Hz

Enhanced Steam Flow Calculations

Feed Flow Line A (LEFM)	u02.nff77	5.18	M lbm/hr
Feed Flow Line B (LEFM)	u02.nff78	5.19	M lbm/hr
Feed Flow Line C (LEFM)	u02.nff79	5.14	M lbm/hr
CRD Flow	u02.ndf01	0.03	M lbm/hr
Total Feedwater Flow	n/a	15.54	M lbm/hr
Steam Flow Line A	n/a	*3.81*	M lbm/hr
Steam Flow Line B	n/a	*4.00*	M lbm/hr
Steam Flow Line C	n/a	*3.90*	M lbm/hr
Steam Flow Line D	n/a	*3.83*	M lbm/hr
Total Steam Flow	n/a	*15.54*	M lbm/hr

Test Point 1 – 3731 MW_{th} / 97.8 Mlb_m/hr – Finish

Steam Dryer Data Log Sheets
Start

Date/Time	6/10/2009 10:04	(Start)

	Computer ID	Value	Units
Thermal Power (Instantaneous)	u02.nba01	3727.73	MWth
Thermal Power (15 min Ave.)	u02.nba101	3722.08	MWth
Electrical Power	u02.gnj02	1231.93	Mwe
Total Core Flow	u02.nff12	92.80	M lbm/hr
Recirc Loop Flow A	u02.njf02	45.92	M lbm/hr
Recirc Loop Flow B	u02.njf03	45.94	M lbm/hr
Recirc Loop A Suction Temperature	u02.nrt01	523.64	°F
Recirc Loop B Suction Temperature	u02.nrt02	523.28	°F
Core Plate D/P	u02.njp51	13.85	PSI
Indicated Steam Flow Line A	u02.nff01	3.92	M lbm/hr
Indicated Steam Flow Line B	u02.nff02	4.07	M lbm/hr
Indicated Steam Flow Line C	u02.nff03	4.01	M lbm/hr
Indicated Steam Flow Line D	u02.nff04	3.91	M lbm/hr
Indicated Total Steam Flow	u02.nff10	15.91	M lbm/hr
Indicated Feedwater Flow	u02.nff11	15.48	M lbm/hr
Feedwater Temperature Line A	u02.fpt01	397.95	°F
Feedwater Temperature Line B	u02.fpt02	396.17	°F
Feedwater Temperature Line C	u02.fpt03	393.70	°F
Rx Dome Pressure Narrow Range	u02.nfp01	1019.24	PSIG
Rx Dome Pressure Wide Range	u02.nfp02	1017.94	PSIG
Steam Dome Temperature	u02.nfa05	548.47	°F
Recirculation Pump A Speed	vm.2p401a/2a_rrp_tac	1376.00	RPM
Recirculation Pump B Speed	vm.2p401b/2b_rrp_tac	1360.00	RPM
Recirculation Pump A Power	u02.nrj51	3.24	MWe
Recirculation Pump B Power	u02.nrj52	3.13	MWe
CRD Cooling Header Flow	u02.nef03	61.25	GPM
CRD System Flow	u02.nef01	62.33	GPM
CRD System Temperature	u02.ndt05	133.59	°F
Bottom Head Drain Temp	u02.nlt01	526.96	°F
Reactor Water Level Narrow Range	u02.nfl01	33.39	Inches H2O
Reactor Water Level Narrow Range	u02.nfl02	36.82	Inches H2O
Reactor Water Level Narrow Range	u02.nfl03	35.04	Inches H2O
Reactor Water Level Wide Range	u02.nbl02	29.33	Inches H2O
Recirculation Pump A Vane Passing Freq.	n/a	114.67	Hz
Recirculation Pump B Vane Passing Freq.	n/a	113.33	Hz
Recirculation Pump A Motor Frequency	n/a	46.33	Hz
Recirculation Pump B Motor Frequency	n/a	45.79	Hz

Enhanced Steam Flow Calculations

Feed Flow Line A (LEFM)	u02.nff77	5.24	M lbm/hr
Feed Flow Line B (LEFM)	u02.nff78	5.04	M lbm/hr
Feed Flow Line C (LEFM)	u02.nff79	5.21	M lbm/hr
CRD Flow	u02.ndf01	0.03	M lbm/hr
Total Feedwater Flow	n/a	15.53	M lbm/hr
Steam Flow Line A	n/a	*3.82*	M lbm/hr
Steam Flow Line B	n/a	*3.97*	M lbm/hr
Steam Flow Line C	n/a	*3.91*	M lbm/hr
Steam Flow Line D	n/a	*3.82*	M lbm/hr
Total Steam Flow	n/a	*15.53*	M lbm/hr

Test Point 2 – 3728 MW_{th} / 92.8 Mlb_m/hr – Start

Steam Dryer Data Log Sheets
Finish

Date/Time	6/10/2009 10:07	(Finish)

	Computer ID	Value	Units
Thermal Power (Instantaneous)	u02.nba01	3728.34	MWth
Thermal Power (15 min Ave.)	u02.nba101	3724.92	MWth
Electrical Power	u02.gnj02	1231.20	Mwe
Total Core Flow	u02.nff12	92.78	M lbm/hr
Recirc Loop Flow A	u02.njf02	46.16	M lbm/hr
Recirc Loop Flow B	u02.njf03	45.89	M lbm/hr
Recirc Loop A Suction Temperature	u02.nrt01	523.61	°F
Recirc Loop B Suction Temperature	u02.nrt02	523.26	°F
Core Plate D/P	u02.njp51	13.85	PSI
Steam Flow Line A	u02.nff01	3.91	M lbm/hr
Steam Flow Line B	u02.nff02	4.08	M lbm/hr
Steam Flow Line C	u02.nff03	4.02	M lbm/hr
Steam Flow Line D	u02.nff04	3.93	M lbm/hr
Total Steam Flow	u02.nff10	15.92	M lbm/hr
Feedwater Flow	u02.nff11	15.49	M lbm/hr
Feedwater Temperature Line A	u02.fpt01	397.95	°F
Feedwater Temperature Line B	u02.fpt02	396.30	°F
Feedwater Temperature Line C	u02.fpt03	393.83	°F
Rx Dome Pressure Narrow Range	u02.nfp01	1019.59	PSIG
Rx Dome Pressure Wide Range	u02.nfp02	1018.08	PSIG
Steam Dome Temperature	u02.nfa05	548.48	°F
Recirculation Pump A Speed	vm.2p401a/2a_rrp_tac	1375.00	RPM
Recirculation Pump B Speed	vm.2p401b/2b_rrp_tac	1359.00	RPM
Recirculation Pump A Power	u02.nrj51	3.24	MWe
Recirculation Pump B Power	u02.nrj52	3.13	MWe
CRD Cooling Header Flow	u02.nef03	61.43	GPM
CRD System Flow	u02.nef01	62.33	GPM
CRD System Temperature	u02.ndt05	133.59	°F
Bottom Head Drain Temp	u02.nlt01	526.89	°F
Reactor Water Level Narrow Range	u02.nfl01	34.46	Inches H2O
Reactor Water Level Narrow Range	u02.nfl02	37.06	Inches H2O
Reactor Water Level Narrow Range	u02.nfl03	35.08	Inches H2O
Reactor Water Level Wide Range	u02.nbl02	29.21	Inches H2O
Recirculation Pump A Vane Passing Freq.	n/a	114.58	Hz
Recirculation Pump B Vane Passing Freq.	n/a	113.25	Hz
Recirculation Pump A Motor Frequency	n/a	46.30	Hz
Recirculation Pump B Motor Frequency	n/a	45.76	Hz

Enhanced Steam Flow Calculations

Feed Flow Line A (LEFM)	u02.nff77	5.24	M lbm/hr
Feed Flow Line B (LEFM)	u02.nff78	5.05	M lbm/hr
Feed Flow Line C (LEFM)	u02.nff79	5.22	M lbm/hr
CRD Flow	u02.ndf01	0.03	M lbm/hr
Total Feedwater Flow	n/a	15.54	M lbm/hr
Steam Flow Line A	n/a	*3.81*	M lbm/hr
Steam Flow Line B	n/a	*3.98*	M lbm/hr
Steam Flow Line C	n/a	*3.92*	M lbm/hr
Steam Flow Line D	n/a	*3.83*	M lbm/hr
Total Steam Flow	n/a	*15.54*	M lbm/hr

Test Point 2 – 3728 MW_{th} / 92.8 Mlb_m/hr – Finish

Steam Dryer Data Log Sheets

Start

Date/Time	6/11/2009 12:22	(Start)	
	Computer ID	**Value**	**Units**
Thermal Power (Instantaneous)	u02.nba01	3726.14	MWth
Thermal Power (15 min Ave.)	u02.nba101	3725.51	MWth
Electrical Power	u02.gnj02	1224.24	Mwe
Total Core Flow	u02.nff12	107.82	M lbm/hr
Recirc Loop Flow A	u02.njf02	54.07	M lbm/hr
Recirc Loop Flow B	u02.njf03	53.90	M lbm/hr
Recirc Loop A Suction Temperature	u02.nrt01	526.71	°F
Recirc Loop B Suction Temperature	u02.nrt02	526.20	°F
Core Plate D/P	u02.njp51	18.23	PSI
Indicated Steam Flow Line A	u02.nff01	3.94	M lbm/hr
Indicated Steam Flow Line B	u02.nff02	4.09	M lbm/hr
Indicated Steam Flow Line C	u02.nff03	4.02	M lbm/hr
Indicated Steam Flow Line D	u02.nff04	3.93	M lbm/hr
Indicated Total Steam Flow	u02.nff10	15.93	M lbm/hr
Indicated Feedwater Flow	u02.nff11	15.50	M lbm/hr
Feedwater Temperature Line A	u02.fpt01	398.09	°F
Feedwater Temperature Line B	u02.fpt02	396.30	°F
Feedwater Temperature Line C	u02.fpt03	393.69	°F
Rx Dome Pressure Narrow Range	u02.nfp01	1019.65	PSIG
Rx Dome Pressure Wide Range	u02.nfp02	1018.33	PSIG
Steam Dome Temperature	u02.nfa05	548.58	°F
Recirculation Pump A Speed	vm.2p401a/2a_rrp_tac	1603.00	RPM
Recirculation Pump B Speed	vm.2p401b/2b_rrp_tac	1577.00	RPM
Recirculation Pump A Power	u02.nrj51	5.11	MWe
Recirculation Pump B Power	u02.nrj52	4.86	MWe
CRD Cooling Header Flow	u02.nef03	62.34	GPM
CRD System Flow	u02.nef01	62.32	GPM
CRD System Temperature	u02.ndt05	136.53	°F
Bottom Head Drain Temp	u02.nlt01	530.60	°F
Reactor Water Level Narrow Range	u02.nfl01	34.44	Inches H2O
Reactor Water Level Narrow Range	u02.nfl02	35.90	Inches H2O
Reactor Water Level Narrow Range	u02.nfl03	36.75	Inches H2O
Reactor Water Level Wide Range	u02.nbl02	26.02	Inches H2O
Recirculation Pump A Vane Passing Freq.	n/a	133.58	Hz
Recirculation Pump B Vane Passing Freq.	n/a	131.42	Hz
Recirculation Pump A Motor Frequency	n/a	53.97	Hz
Recirculation Pump B Motor Frequency	n/a	53.10	Hz

Enhanced Steam Flow Calculations

Feed Flow Line A (LEFM)	u02.nff77	5.22	M lbm/hr
Feed Flow Line B (LEFM)	u02.nff78	5.08	M lbm/hr
Feed Flow Line C (LEFM)	u02.nff79	5.18	M lbm/hr
CRD Flow	u02.ndf01	0.03	M lbm/hr
Total Feedwater Flow	n/a	15.52	M lbm/hr
Steam Flow Line A	n/a	*3.83*	M lbm/hr
Steam Flow Line B	n/a	*3.97*	M lbm/hr
Steam Flow Line C	n/a	*3.90*	M lbm/hr
Steam Flow Line D	n/a	*3.82*	M lbm/hr
Total Steam Flow	n/a	*15.52*	M lbm/hr

Test Point 3 – 3726 MW_{th} / 107.8 Mlb_m/hr – Start

Steam Dryer Data Log Sheets
Finish

Date/Time	6/11/2009 12:25	(Finish)

	Computer ID	Value	Units
Thermal Power (Instantaneous)	u02.nba01	3726.26	MWth
Thermal Power (15 min Ave.)	u02.nba101	3725.99	MWth
Electrical Power	u02.gnj02	1223.51	Mwe
Total Core Flow	u02.nff12	107.86	M lbm/hr
Recirc Loop Flow A	u02.njf02	54.10	M lbm/hr
Recirc Loop Flow B	u02.njf03	53.66	M lbm/hr
Recirc Loop A Suction Temperature	u02.nrt01	526.71	°F
Recirc Loop B Suction Temperature	u02.nrt02	526.22	°F
Core Plate D/P	u02.njp51	18.23	PSI
Steam Flow Line A	u02.nff01	3.89	M lbm/hr
Steam Flow Line B	u02.nff02	4.10	M lbm/hr
Steam Flow Line C	u02.nff03	4.02	M lbm/hr
Steam Flow Line D	u02.nff04	3.92	M lbm/hr
Total Steam Flow	u02.nff10	15.93	M lbm/hr
Feedwater Flow	u02.nff11	15.50	M lbm/hr
Feedwater Temperature Line A	u02.fpt01	398.22	°F
Feedwater Temperature Line B	u02.fpt02	396.30	°F
Feedwater Temperature Line C	u02.fpt03	393.70	°F
Rx Dome Pressure Narrow Range	u02.nfp01	1019.41	PSIG
Rx Dome Pressure Wide Range	u02.nfp02	1018.08	PSIG
Steam Dome Temperature	u02.nfa05	548.58	°F
Recirculation Pump A Speed	vm.2p401a/2a_rrp_tac	1602.00	RPM
Recirculation Pump B Speed	vm.2p401b/2b_rrp_tac	1578.00	RPM
Recirculation Pump A Power	u02.nrj51	5.12	MWe
Recirculation Pump B Power	u02.nrj52	4.87	MWe
CRD Cooling Header Flow	u02.nef03	62.26	GPM
CRD System Flow	u02.nef01	62.34	GPM
CRD System Temperature	u02.ndt05	136.53	°F
Bottom Head Drain Temp	u02.nlt01	530.60	°F
Reactor Water Level Narrow Range	u02.nfl01	35.21	Inches H2O
Reactor Water Level Narrow Range	u02.nfl02	35.98	Inches H2O
Reactor Water Level Narrow Range	u02.nfl03	35.76	Inches H2O
Reactor Water Level Wide Range	u02.nbl02	25.91	Inches H2O
Recirculation Pump A Vane Passing Freq.	n/a	133.50	Hz
Recirculation Pump B Vane Passing Freq.	n/a	131.50	Hz
Recirculation Pump A Motor Frequency	n/a	53.94	Hz
Recirculation Pump B Motor Frequency	n/a	53.13	Hz

Enhanced Steam Flow Calculations

Feed Flow Line A (LEFM)	u02.nff77	5.23	M lbm/hr
Feed Flow Line B (LEFM)	u02.nff78	5.08	M lbm/hr
Feed Flow Line C (LEFM)	u02.nff79	5.18	M lbm/hr
CRD Flow	u02.ndf01	0.03	M lbm/hr
Total Feedwater Flow	n/a	15.52	M lbm/hr
Steam Flow Line A	n/a	3.79	M lbm/hr
Steam Flow Line B	n/a	3.99	M lbm/hr
Steam Flow Line C	n/a	3.92	M lbm/hr
Steam Flow Line D	n/a	3.82	M lbm/hr
Total Steam Flow	n/a	15.52	M lbm/hr

Test Point 3 – 3726 MW_{th} / 107.8 Mlb_m/hr – Finish

Enclosure 3 to PLA-6542

Affidavit

CONFIDENTIAL INFORMATION
SUBMITTED UNDER 10 C.F.R. §2.390

AFFIDAVIT OF RICHARD D. PAGODIN

I, Richard D. Pagodin General Manager-Nuclear Engineering PPL Susquehanna, LLC, do hereby affirm and state:

1. I am authorized to execute this affidavit on behalf of PPL Susquehanna, LLC (hereinafter referred to as "PPL").

2. PPL requests that the information attached and identified by text inside triple brackets {{{This sentence is an example.}}} be withheld from public disclosure under the provisions of 10 C.F.R. 2.390(a)(4).

3. The PPL Documents contain confidential commercial information, the disclosure of which would adversely affect PPL.

4. This information has been held in confidence by PPL. To the extent that PPL has shared this information with others, it has done so on a confidential basis.

5. PPL customarily keeps such information in confidence and there is a rational basis for holding such information in confidence. The information is not available from public sources and could not be gathered readily from other publicly available information.

6. Public disclosure of this information would cause substantial harm to the competitive position of PPL, because such information has significant commercial value to PPL.

7. The information identified in paragraph (2) above is classified as proprietary because it details the results of test data derived from test instrumentation installed specifically to collect this data. This instrumentation was installed at a significant cost to PPL. The data and the conditions under which it was collected constitute a major PPL asset.

8. Public disclosure of the information sought to be withheld is likely to cause substantial harm to PPL by foreclosing or reducing the availability of profit-making opportunities. The information is of value to other BWR Licensee's and would support evaluations and analyses associated with extended power uprate license amendment submittals. Making this information available to other BWR Licensee's would represent a windfall and deprive PPL the opportunity to recover a portion of its large investment in the test instrumentation from which this data is derived.

PPL SUSQUEHANNA, LLC

Richard D. Pagodin

Subscribed and sworn before me,
a Notary Public in and for the
Commonwealth of Pennsylvania
This 30th day of July, 2009

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Pamela M. Vincent, Notary Public
Sugarloaf Twp., Columbia County
My Commission Expires May 31, 2010
Member, Pennsylvania Association of Notaries