RAS M-210

NEC-JH_42

VY Piping FAC Inspection Program PP 7028 - 2007 Refueling Outage

Inspection Location Worksheets / Methods and Reasons for Component Selection

By: James C. Fitzpatrick 4/3/06 Reviewed: Thomas M. O'Connor 5/1/06

FAC PROGRAM INSPECTION PLANNING:

Piping components are selected for inspection during the Spring 2007 refueling outage (RFO26) are based on the following groupings and/or criteria.

Large Bore Piping

LA: Components selected from measured or apparent wear found in previous inspection results.

LB: Components ranked high for susceptibility from current CHECWORKS evaluation and /or identified as having the highest increases in flow velocities under EPU conditions.

LC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG.

LD: Components selected to calibrate the CHECWORKS models.

LE: Components subjected to off normal flow conditions. Primarily isolated lines to the condenser in which leakage is indicated from the turbine performance monitoring system. (through the Systems Engineering Group).

LF: Engineering judgment / Other

LG: Piping identified from EMPAC Work Orders (malfunctioning equipment, leaking valves, etc.)

LH: Components "De-Scoped" (inspections deferred) from Previous Outages

Small Bore Piping

SA: Susceptible piping locations (groups of components) contained in the Small Bore Piping data base which have not received an initial inspection.

SB: Components selected from measured or apparent wear found in previous inspection results.

SC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG.

SD: Components subjected to off normal flow conditions. Primarily isolated lines to the condenser in which leakage is indicated from the turbine performance monitoring system. (through the Systems Engineering Group).

SE: Engineering Judgment / Other.

SG: Piping identified from EMPAC Work Orders (malfunctioning equipment, leaking valves, etc.)

SH: Components "De-Scoped" (inspections deferred) from Previous Outages

Feedwater Heater Shells

No feedwater heater shell inspections will be performed during the 2007 RFO. All 10 of the feedwater heater shells have been replaced with FAC resistant materials.

Template Secy-028

DS03

LA: Large Bore Components selected (identified) from previous Inspection Results

From the 1996 though 2005 Refueling Outage Inspection Reports, references (2) to (8): Large Bore Piping components were identified as requiring future monitoring. The following components have either yet to be inspected as recommended, or the recommended inspection is in a future outage.

Inspect. No.	Loc. SK.	Component ID	Notes /Comments / Conclusions
96-18 96-19	001	FD13EL05 FD13SP06	1996 Report: calculated time to Tmin is 11.5 & 12 cycles based on a single measurement. The 2007 RFO is 7 cycles since the inspection. **UT inspect elbow and downstream pipe in 2008**
96-36	002	FD02SP05	1996 Report: calculated time to Tmin is 9.5 cycles based on a single measurement. The 2007 RFO is 7 cycles since the inspection. **UT inspect elbow and downstream pipe in 2007**
96-37	005	FD07SP01	1996 Report: calculated time to Tmin is 9.6 cycles based on a single measurement. The 2007 RFO is 7 cycles since the inspection. DS elbow shows significant margin RSL= 47 cycles from 1996. EPU flow will increase velocity ~22%. **UT inspect upstream pipe FD07SP01DS, elbow FD07EL02, and downstream pipe FD07SP02US in 2007 (repeat the 1996 inspections)**
96-39	005	FD07SP02US	1996 Report: calculated time to Tmin is 10.5 cycles based on a single measurement. The 2007 RFO is 7 cycles since the inspection. **UT inspect upstream pipe FD07SP01DS, elbow FD07EL02, and downstream pipe FD07SP02US in 2007 (repeat the 1996 inspections)**
98-05 98-07	005	FD07EL06 FD07EL07	1998 Report: calculated time to Tmin is 7.5 & 6.7 cycles based on a single measurement. The 2007 RFO is 6 cycles since the inspection. Review of 1998 data for FD07EL06, FD07SP07, and FD07EL07 shows recommendations were made based on wear rates conservatively calculated from single low point measurements at weld counterbores. Significant margins exist on body of pipe and elbows. Defer this inspection to RFO 27 in 2008. At that time components will have ~1.7 cycles of operation under increased EPU flows. **UT inspect elbow FD07EL07 and downstream pipe FD07SP08 in 2008**
99-13	011	FD08EL04 FD08SP04	1999 Report: calculated time to Tmin is 7.9 & 12.5 cycles based on a single UT inspection. The 2007 RFO is 5 cycles since the inspection. Review of 1999 data for FD08EL04, & FD08SP04, shows recommendations were made based on wear rates conservatively calculated from single low point measurements at weld counterbores. Significant margins exist on body of pipe and elbows. Defer this inspection to RFO 27 in 2008. At that time components will have ~1.7 cycles of operation under increased EPU flows. **UT inspect elbow and downstream pipe in 2008**
99-16	011	FD08SP05	1999 Report: calculated time to Tmin is 6.1 cycles based on a single measurement. The 2007 RFO is 5 cycles since the inspection. **UT inspect pipe in 2007.**
02-08 02-09	016	FD18EL01 FD18SP02US	2002 Report: calculated time to Tmin is 7.92 cycles based on a single UT inspection. The 2007 RFO is 3 cycles since the inspection. Review of 2002 data for FD18EL01, & FD18SP02US, shows recommendations were made based on wear rates conservatively calculated from single low point measurements at weld counterbores. Significant margins exist on body of pipe and elbows. Defer this inspection to RFO 27 in 2008. At that time components will have ~1.7 cycles of operation under increased EPU flows. **Re-inspect elbow and downstream pipe in 2008 (4 cycles from 2002).**

LA: Large Bore Components selected (Identified) from previous Inspection Results --continued

Inspect. No.	Loc. SK.	Component ID	Notes /Comments / Conclusions
04-03	001	FD01TE05	2004 recommendation to inspect tee in 2008 based on the default wear rate of 0.005 inch/cycle. Flow on B FDW pump increases from ½ usage/standby for CLTP to full time usage and 80% of CLTP flow for EPU. **Re-inspect upstream elbow and tee in 2008.**
04-06	002	FD02RD01	2004 recommendation to re-inspect in 2011 based on the default wear rate of 0.005 inch/cycle. Flow on B FDW pump increases from ½ usage/standby for CLTP to full time usage and 80% of CLTP flow for EPU. **Re-inspect reducer with downstream elbow and tee in 2008.**
04-08	001	FD02TE01	2004 recommendation to inspect tee in 2007 based on the default wear rate of 0.005 inch/cycle. Actual point to point measurements from 1999 to 2004 indicate no wear. Given EPU operation, **re-inspect with upstream elbow and reducer in 2008.**
04-09	001	FD03SP01	2004 recommendation to inspect pipe section in 2011 based on a single inspection and the default wear rate of 0.005 inch/cycle. **Re-inspect in 2011.**
04-10	001	FD07SP02DS	2004 recommendation to inspect pipe section in 2008 based on a single inspection. **Re-inspect with downstream elbow in 2008.**
04-13	001	FD14EL03	2004 recommendation to inspect Row 13 pup piece to DS valve in 2008 is based on a single UT inspection. **Re-inspect in 2008.**
04-23	001	MSD9TE01 to MSD9TE08	2004 recommendation to inspect pipe section in 2010 due to localized wear directly under 2 small bore lines entering flow at top of pipe. **Re-inspect in 2010.**
04-23	001	MSD9EL05	2004 recommendation to inspect pipe section in 2010 base on a single inspection. **Re-inspect In 2010.**
05-12	011	FD08RD03	2005 Recommendation to inspect this component and downstream straight pipe in RFO28 –Spring 2010 due to increases flow velocity from EPU. **Re-inspect FD08RD03 and FD08SP02 in 2010.**
05-03 05-04 05-05 05-06 05-07 05-08 05-09 05-10 05-11	017 018 019 	FD04RD01 FD04TE01 Cond Nzl 32A FD05RD01 FD05TE01 Cond Nzl 32B FD06RD01 FD06TE01 Cond Nzl 32C	During normal operation there is no flow in these lines. No current leakage is indicated since the upstream FCV repairs were performed during RFO24. This piping was inspected in RFO 25 to determine if past leakage has caused wear since the last inspections and to insure the condition of the piping for Extend Power Uprate conditions. 2005 Recommendation to use the Thermal Performance Monitoring (TPM) system to determine if flow is occurring in this pipe during normal operation. **The Thermal Performance Monitoring (TPM) system will be used as a trigger to determine if future inspections are required. The monthly TPM report will be monitored by the FAC program Engineer.**

LA: Large Bore Components selected(identified) from previous Inspection Results –continued

Turbine Cross-around Piping:

Summary of previous Internal Visual UT & Repair History:

Line	Mat.	Year Replaced	Internal Visual =V , Internal Thickness =UT, Repairs Performed =R									
			RFO16 S1992	RFO17 F1993	RFO18 S1995	RFO19 F1996	RFO20 S1998	RFO21 F1999	RFO22 S2001	RFO23 F2002	RFO24 S2004	RFO25 F2005
36"-A	GE**	1983		V	V	V	V				V	V
36"-B	GE**	1981	V	V	V	V	V	V			V	
36"-C	GE**	1981	V	V	V		V				V	V
36"-D	GE**	1983		V	V		V				V	
30"-A	P-22*	1985	V		V		V					
30"-B	C.S.	Original	V/UT/R	V/UT/R	V/UT/R	V/UT	V	V		V		V
30"-C	P-22*	1993	V/UT/R								V	
30"-D	P-22*	1985			V						V	

** 36" straight pipe sections replaced with GE B50A242E, elbows on the B & C lines are original GE specification D50A67D, elbows on A &D lines are D50A67E (Tnom =0.625 inch).

* 30" A,B,C replaced with A691 CL22 (2-1/4Cr), Fittings A234 WP22. (Tnom. = 0.625 inch)
30" B remains GE B50A242D, fittings and GE D50A67D carbon steel (Tnom = 0.50 inch).

2007 RFO:

The last remaining carbon steel 30 inch, (30" B, upper east), line was inspected to confirm its condition prior to power uprate flows. Increased EPU flows and an expected drop in Moisture Separator efficiency will most likely result in resumption of FAC in this line. Results of the planned MS efficiency tests at EPU flows will quantify any drop in steam quality in these lines and provide some basis for estimating the increase in susceptibility to FAC damage. If the proposed testing at EPU flows shows no loss in MS efficiency, this inspection could be deferred until RFO27. For planning purposes:

Perform a complete visual inspection of 30" B line in RFO 26 will be planned to insure wall loss due to FAC has not resumed under EPU flow conditions. This will require coordination with planned LP turbine work scheduled for RFO26.

LB: **Components ranked high for susceptibility from current CHECWORKS evaluation and for identified as having the highest increases in flow velocities under EPU conditions.**

The current CHECWORKS wear rate calculations contain inspection data up to the 1999 RFO and wear rate predictions are current to the 2001 RFO. The 2001 and 2002 RFO inspection data has been entered into the CHECWORKS database. CHECWORKS predictive models for Piping FAC Inspection Program are updated as required per Appendix D of PP 7028. This is documented in CR-2005-2239. This is a procedure compliance issue. There are no operability concerns. Actual measured wear rates from 2001, 2002, 2004, and 2005 inspections are an order of magnitude less than the CHECWORKS predicted wear rates. If the 2002, 2004, and 2005 inspection data were incorporated into the models the CHECWORKS predicted wear rates would be reduced. Use of the un-updated CHECWORKS model results as a basis for inspection planning is conservative in that scoping decisions documented in the Inspection Location Worksheets were based on the CHECWORKS Predicted wear rates significantly greater than actual measure wear.

The updated wear rate calculations are in progress, and won't be complete in time to support the outage schedule milestone date for issuing the inspection scope for the 2007 outage. Based on a review of the 2001 thru 2005 RFO inspection data for components on the Feedwater, Condensate, and Heater Drain Systems, the CHECWORKS models still appear to over-predict actual wear. The existing model results will be used to rank components for inspection in 2007. **The component selections will be reviewed upon completion of the CHECWORKS model updates.**

Feedwater System

Listed below are components which meet the following criteria:
a) Negative time to Tmin from the predictive CHECWORKS runs which include inspection data up to the 1999 RFO.
b) No inspections have been performed on these components or the corresponding components in a parallel train since the 1999 RFO.

Component ID	Location Sketch	Location	Notes
FD07EL05	005	TB FPR Elev. 241	Comparable component on other train FD08EL04 was inspected in 1999 and results indicate minimal wear. **After updating the Checworks model with newer data, assess need for inspections in 2008 RFO.** (Note upstream components FD07RD02 and FD07SP03 will be inspected in 2007)
FD07TE01 FD07EL11	006	T.B Heater Bay Elevs 228 & 248	Components on other train were inspected in 1998. Results indicate minimal wear. **Inspect FD07TE01, FD07EL01, and FD07SP11 in 2007 RFO.**
FD07EL12	006	T.B Heater Bay Elev. 248	Feedwater heater replacement occurred in 2004 RFO. Informal visual inspections of internals and cut pipe profile indicated a stable red oxide and no distinguishable wear pattern. **After updating the Checworks model with newer data, assess need for inspection**
FD08TE01 FD08EL07	012	T.B Heater Bay Elevs 228 & 248	Intermediate components FD08EL06 & FD08SP06 were inspected in 1998. Results indicate minimal wear. **After updating Checworks model with newer data, assess need for inspecting components.**
FD08EL08	012	T.B Heater Bay Elev. 248	Feedwater heater replacement occurred in 2004 RFO. Informal visual inspections of internals and cut pipe profile indicated a stable red oxide and no distinguishable wear pattern.
FD15EL08	013	RX Steam Tunnel El. 266	Internal visual of elbow performed in 1996 during check valve replacement, no indication of wall loss at that time. Corresponding component on line 16"-FDW-14 was inspected in RFO24. **After updating Checworks model with inspection data, assess need for inspection in 2008 RFO.**

LB: **Components ranked high for susceptibility from current CHECWORKS evaluation and /or identified as having the highest increases in flow velocities under EPU conditions - continued**

Condensate System

Only one component was identified as having a negative time to Tmin. This was CD30TE02DS, the downstream side of a 24x24x20 tee on the condensate header in the feed pump room. The CHECWORKS prediction for the downstream side or the tee has a small negative hrs relative to the remainder of the components in the system and relative to the upstream side of the same tee. Other tees on the same header have been previously inspected and show no significant wear. The CHECWORKS model includes UT data up to the 1999 RFO. The inspections on this system performed in 2001, 2004, and 2005 indicate minimal wear.

Components CD30TE02 and CD30SP04 were inspected in 2004. Additional components downstream of condensate Flow elements FE-102-2A and FE-102-2B on inlets to FDW pumps A & B were performed in 2005 with no significant wear observed. This inspection data will be input to CHECWORKS to better calibrate the model.

Moisture Separator Drains & Heater Drain System

No components identified as having negative times to Tmin. No components were selected for inspection in 2001, 2002, or 2004 based on high susceptibility. However, operation under HWC changes dissolved oxygen in the system. A separate CHECWORKS evaluation was performed to assess the differences in projected wear rates between Normal water chemistry and Hydrogen water chemistry. Selected HD components were inspected in 2002 to obtain pre-HWC operation wall thickness data. See Section LD below.

Extraction Steam System

Three components on this system with negative time to code min. wall: The piping is Chrome-Moly. ES4ATE01 & ES4ATE02, 30inch diameter tees inside the condenser have negative prediction (-3428Hrs.) for time to min wall. The negative times to tmin may be conservative based on the modeling techniques used. Refinement of the model of this system is in progress. The negative time to tmin is most likely a function of lack of inspection data vs. actual wear. Due to external lagging on this piping and the location inside the condenser, no components are selected for external UT inspection in 2007 based on high susceptibility.

Note the short section of straight pipe on line 12"-ES-1A at the connection to the 36 inch A cross around is assumed to be A106 Gr. B carbon steel is not modeled in CHECWORKS. This component was inspected in 2004 by external UT and an internal visual inspection from the 36" cross around line was performed in both 2004 and 2005.

LC: Large Bore Components Identified by Industry Events/Experience.

Review of FAC related Large Bore Operating Experience (OE) and/or piping failures reported since April 2003

Date	Plant – Type	Description & Recommended Actions at VY
5/9/01	Grand Gulf – BWR	Pin Hole Leak in 4 inch carbon steel elbow in RHR min flow line. System has low use at VY (<2% of time). Perry also found thinning at elbow per C.Burton at CHUG meeting.) A review of VY drawings VYI-RHR-Part 14 Sht.1/1 and VYI-RHR Part 15 Sht.1/1 show elbows downstream of restriction orifices. Previous VY Inspections downstream of orifices on HPCI and CS systems found no problems. Keep this OE listed for future consideration if similar industry events are identified.
1/15/02 CHUG Meeting	Surry 1-PWR	Leak in 8 inch Condenser drain header for 3rd/4th pt. FDW Heater vents. Also thinning in Gland Steam Piping inside the condenser and the 12" Condenser Drain header from MS Drain trap lines. The only large bore drain collector at VY is the 8 inch diameter low point drain header, line 8"MSD-9. This line is now part of the AST ALT boundary. Inspections of selected components on this line were performed during RFO24 with recommendations for repeat inspections in 2010 (Section LB above). Given this line is part of the ALT Boundary, **inspect approx. 2 ft. long section at condenser wall during RFO26 (2007) MSD9SP07 at condenser nozzle 67 (Location Sketch 097)**
6/26/03	Wolf Creek – PWR	OE16181: Leak in Main Feedwater Thermowell. The Thermowell is unused and was sealed with a pipe plug. Once the integrity of the plug was determined by RT, the main concern was potential for internal FME from the degraded Thermowell to affect downstream control valves. PWR feedwater piping more susceptible to FAC than BWR piping due to low DO. Keep this OE listed for future consideration if similar industry events are identified.
9/24/03	South Texas Project - PWR	OE17378: Pitting & internal wear found on discharge piping of Condensate Polishing System. Pipe is carbon steel, low water temperature (90 to 130F), neutral pH, and velocity of 12.2 Ft./sec Tortuous flow path and control valves, wear may be impingement. PWR system Low dissolved oxygen. Equivalent system at VY is Condensate Demineralizer System which is low temp and screens per NSAC-202L as not susceptible to FAC based on temperature. No OE on BWR Condemin systems.
10/10/03	Browns Ferry 3 -BWR	6/04 CHUG Meeting PER: Failure of No.2 Extraction Steam bellows inside condenser caused collateral damage in No.3, No.4A,& No.5B east bellows. In service for only 2-1/2 cycles. Failure due to welds/weld flaws in bellows. Additional erosion found in the carbon steel Extraction Steam lines inside the condenser was found during the unplanned mid-cycle outage for bellows repairs. At VY, the Extraction Steam piping inside condenser is Cr-Mo. The bellows were replaced in 1995. The System Engineer performed limited bellows inspections in RFO25. No new actions with respect to FAC for this OE.
10/17/03	Duane Arnold –BWR	OE17300: Through wall leak on 8 inch pipe between 6A feedwater heater and condenser. The pipe was chrome-moly. Temporary pipe configuration installed prior to replacing feedwater heater for power uprate. Cause of leak was droplet impingement erosion from use of bypass control valve. No actions required for VY. However, it should be noted that chrome-moly pipe is not immune to droplet impingement erosion.
10/31/03	Clinton -BWR	OE17412 / OE18478: Through-wall leaks in 2A/ B heater vent lines to the condenser (lager bore lines assumed given description of backing rings in piping). Apparent cause attributed to steam jet impingement from wet steam. Equivalent line at VY is common 4 inch feedwater heater vent line for No.4 FDW heaters. AT VY this line is included in the SSB database since it connects to (2) 2-1/2" lines. **Inspect this line at the condenser in RFO26 in 2007 [Inspection No.07-SB09]**

LC: Large Bore Components Identified by Industry Events/Experience - continued.

Date	Plant – Type	Description & Recommended Actions at VY
11/07/03	Braidwood 2-PWR	OE17454: Wall thinning found on FDW pump discharge nozzles and extending into downstream pipes on all 3 FDW pumps. Material has high chromium content. PWR feedwater system chemistry has low D.O. therefore more susceptible to wall loss due to single phase FAC than BWR feedwater piping. At VY all three feedwater pump discharge nozzles and downstream piping have multiple inspection data. No further actions are anticipated from this OE.
11/19/03	Hope Creek – BWR	OE17700: Pinhole leak and wall thinning in 8" in carbon steel Extraction Steam supply line to Steam Seal Evaporator. Location of wear is downstream of pressure safety valves. Apparent Cause of leak & wear is due to liquid droplet impingement due to high flows from failure of pressure safety relief valves. No equivalent configuration at VY.
1/24/04	LaSalle 1 - BWR	OE17199 / OE18381: Through-wall holes in extraction steam piping inside condenser. Location of holes at inlet nozzles to No.2 FDW heaters located in the neck of the condensers (2nd lowest stage). All 12 nozzles are C.S. with A335-P11 upstream piping. VY has only the No. 5 FDW heaters in the neck of the condenser. The No. 5 FDW heaters were replaced with Chromo-moly shells and ES piping nozzles. ES piping is A335-P11 or equivalent which is FAC resistant. No further actions are anticipated from this OE.
2/17/04	Peach Bottom 2 - BWR	OE18637: On line leak in 10 inch main steam drain line header to the condenser. Hole was located directly below the connection of 1" main steam lead drain. The header was replaced with 1-1/4 Chrome material approx. 6 years before the leak. Also, R.O.s in steam drains were modified. The cause was attributed to steam impingement. Additional information to follow after next RFO. The only large bore drain collectors at VY are the 8 inch diameter low point drain header, line 8"MSD-9, and line 3"-MSD-4 near the condenser. Flow is through steam traps and LCVs vs. a continuous flow through a restriction orifice. These lines are now part of the AST ALT boundary. For MSD-9, inspection of the entire bottom of this header under the MSD lines was performed during RFO24 with recommendations for repeat inspections in 2010. **Inspect 8"-MSD-9 at the Condenser in RFO26 (2007). For line 3"MSD-4, see Small Bore OE in section SC below.**
3/17/04	Farley 2 - PWR	OE18059: Nameplate Screws Holes Found Extended Into Flow Nozzle Pipe. 16 in. Sch.60, A106 Gr.C. Evaluated as a flaw and found acceptable. Only a concern if FAC wear is occurring in the pipe at the location of the nameplate. VY inspections to date for FDW and Condensate flow elements show no wear in pipe. No further actions for this OE.
3/27/04	Perry -BWR	6/04 CHUG PER: Through wall leak in a 12" diameter drain header (Main Steam, Reheat Steam, Extraction Steam, and Misc Drains collector) connecting to the condenser. The only large bore drain collectors at VY are the 8 inch diameter low point drain header, line 8"MSD-9, and line 3"-MSD-4 near the condenser. Flow is through steam traps and LCVs vs. a continuous flow through a restriction orifice. These lines are now part of the AST ALT boundary. For MSD-9, inspection of the entire bottom of this header under the MSD lines was performed during RFO24 with recommendations for repeat inspections in 2010. **Inspect 8"-MSD-9 at the Condenser in RFO26 (2007). For line 3"MSD-4 See Small Bore OE in section SC below.**
7/05/04	Ohi-1 --PWR (Japan)	OE19492: OE describes wall thinning in PWR feedwater components between the feedwater isolation valves and the steam generators. No leaks, wall thinning was found through planned UT inspections. Components will be replaced with the same materials and additional inspections (increased frequency) will be performed. PWR feedwater piping more susceptible to FAC than BWR piping due to low DO. VY inspects final feedwater piping components. No wear found to date.

LC: Large Bore Components Identified by Industry Events/Experience - continued.

Date	Plant – Type	Description & Recommended Actions at VY
7/30/04	Darlington Unit 4 - PHWR	INPO Event No.934-040730-1. Leak in 10 inch diameter Sch.60, HP Drains manifold. Material is low chrome-moly (2.25/1) alloy carbon steel. Darlington plans to increase inspection scope for HP Drains manifold piping. Cause of leaks attributed to liquid impingement. [**See 2/17/04 Peach Bottom 2 OE and 3/27/04 Perry OE evaluation of for VY above. Also, note that this OE demonstrates that Cr-Mo P22 material may not be the ultimate solution if liquid impingement is occurring.**]
8/9/04	Mihama 3 - PWR	OE19368/OE18895: Rupture of Condensate line downstream of restriction orifice. PWR system highly susceptible to single phase FAC due to low DO. Similar region of system as 1986 Surry event (5 fatalities). Based on info gathered by INPO/CHUG/FACnet the location was omitted from previous inspections due to clerical error, once discovered management missed opportunity to inspect and deferred inspection until 9/04. Too late. Lesson: make sure all highly susceptible locations get inspected. PWR Condensate/feedwater piping is much more susceptible to single phase FAC than BWR with O2 injection. A review of previous inspections DS of Flow Elements at VY shows: Condensate piping at and downstream of FE-102-2A & -2B was inspected in RFO25(2005) and piping at and downstream of FE-102-2C was inspected in RF022(2001). Also feedwater piping downstream of FE-6 -11A was inspected in RFO23(2002). See section LF below for discussion of Flow Elements in lower temperature Condensate piping.
8/10/04	Sequoyah 2 – PWR	OE19074: Leak in Heater Drain Tank Recirculation line downstream of the recirc. nozzle of the automatic recirculation valve. Suspected leakage by Normally Closed Valve. No similar configuration at VY.
8/26/04	Palo Verde 3- PWR	OE20386: Through wall leak found on a 10 inch flashing tee cap on the LP feedwater heater drains. Problems with inspection of flashing tees in program. Only 14 out of 153 susceptible locations have UT data at Palo Verde 1,2,3. At VY there are 4 flashing tees D.S. of LCV-103-23A to -23D on the Moisture Separator Drain system at VY. These along with the blind flanges were replaced with Cr-Mo in 1992. The only other flashing tees at VY are located on the FWD pump min flow lines at the condenser. These have welded pipe caps. Inspection of all 3 lines 6"FDW-4, 6"FDW-5, and 6"FDW-6 performed in RFO25. No other actions for this OE.
9/18/04	Catawaba 2 – PWR	OE19350: Wall thinning found four different areas on FDW piping. Two areas are not considered specific to Catawba: 1)Area where main feedwater bypass reg valves reenters the feedwater header and 2) downstream of the main feedwater reg valves. PWR feedwater system chemistry has low D.O. therefore more susceptible to wall loss due to single phase FAC than BWR feedwater piping. At VY area 1) doses not exist (bypass lines dump to the condenser). 2) Inspections have been performed upstream and downstream of both main feed reg. valves. Inspections downstream of FCV-12B (FD08RD03 & FD03SP02) were performed in RFO25. **Inspections downstream of FCV-12A planned for RFO26 given the increased velocities under EPU. No further actions are anticipated from this OE.**
9/24/04	Palisades - PWR	OE19494: Wear found in carbon steel 12" Sch 40, Extraction Steam line downstream of bleeder trip valve. Wear found through FAC inspections. No through wall leak. This OE identifies potential for FAC damage in ES piping and problems with partial line (selected component) replacements. ES piping at VY is low alloy A335-P-11 Cr.Mo piping which is FAC resistant: No further actions for this OE

LC: Large Bore Components Identified by Industry Events/Experience - continued.

Date	Plant – Type	Description & Recommended Actions at VY
10/12/04	Prairie Island 1 – PWR	OE19365: Pipe Failure Internal to the Main Condenser Found During Outage Inspection. Failure in 14 x 8 reducing elbow and wall thinning in 8 inch pipe on line connecting heater drain tank to condenser. Failure discovered during routine condenser inspections before tube damage had occurred. VY performs internal condenser walkdowns each RFO with additional inspections during equipment maintenance. At VY piping attached to the condenser either has impingement plates to protect the tubes or spargers internal to the condenser to disburse flow. Extraction steam piping inside the condenser is Cr-Mo. Material. Visual inspection of the condenser stream space will be performed by System Engineering. No new inspections will be performed under the FAC Program for this OE.
11/3/04 (Note Follow-up present. at 6/05 CHUG Meeting]	Duane Arnold – BWR	OE19701: Wall thinning downstream of Torus Cooling Test Return Header Isolation Valve. Apparent cause was cavitation erosion due to throttling in valve during HPCI & RCIC testing. At VY, the equivalent valves are V10-34A & 34B. The degree of cavitation present is dependent of the system design and may vary from plant to plant. Previous UT inspections at VY were performed on valve bodies and downstream reducers in early 90s. No significant wear was found. **Consider inspection of downstream piping in RFO27 if additional OE warrants it.**
2/17/05	Clinton – BWR	OE20246 and CHUG PER 1/06: Through wall leaks found in 12", 20", and 30" Extraction Steam Piping inside the condenser. These lines were not in the FAC program according to the Heat Balance they carry superheated steam. Equivalent piping at VY is in the FAC program and is Cr-Mo, A335 P-11
2/26/05	Calvert Cliffs 1 - PWR	OE20127: Through wall leak in 6 inch steam vent header from MSR drain tank to hot reheat header. Location of leak was at the end of elbow which had a backing ring. Leak location was at the backing ring. At VY, there are no backing rings in piping systems containing primary steam/water. Also, there are No MSRs at VY.
5/23/05	Vogtle Unit 2 -PWR	OE20793: Extraction Steam expansion bellows failure inside condenser caused collateral damage to feedwater heater shroud and condenser tubes. Not FAC. No further actions require for this OE.
6/05 CHUG Meeting	TEPCO Fukushima Dani-1 (2F-1) - BWR	Wall thinning downstream of a restriction orifice in the CRD pump supply line from Condensate System. Pipe Size 100A (approx. 4.5 inch O.D.). Location is DS of Control valve and restriction orifice on supply line to CRD pumps from the condensate system. VY has a similar configuration but without the Restriction Orifice. This line screens out of the VY FAC Susceptibility Evaluation based on low temperature. Comparison with VY: 1. Condensate supply is upstream of the oxygen injection point, same at VY. 2. MOV is a globe valve the same size as pipe. The valve is operated at 8% open to control flow with a restriction orifice just downstream of the valve. VY has a smaller size control valve than the main line. A 1-1/2" control valve (LCV-102-1A-3) with expanders from 1-1/2" to 2-1/2 then to the 4" diameter line with no restriction orifice. 3. Supply line is downstream of low pressure condensate pump. At VY supply is directly from hotwell. This results in a higher DP across the MOV & RO at TEPCO than across the LCV at VY. TEPCO has higher potential for cavitation and/or flashing due to the higher DP. At VY, UT measurements on the valve body were performed 1992, but no measurements on the downstream piping. TEPCO root cause was FAC with cavitation contributing at the RO . Given there is no RO at VY and the LCV is operated at 60% open. The potential for a similar situation at VY is significantly less. **Scope out possible inspection locations on piping down stream of LCV-102-1A-3 during RFO26 in 2007.**
6/05 CHUG Meeting PER	Wolf Creek – PWR	Eroded elbow found in 12 Inch LP feedwater heater drain line inside condenser. Erosion was external to pipe from main steam dump to condenser. No equivalent piping at VY. At VY only the No.5 FDW Htrs. are in the neck of the condenser. Heater drain piping is external to the condenser. The extraction steam piping inside the condenser has external lagging for protection and thermal efficiency.

LC: Large Bore Components Identified by Industry Events/Experience - continued

Date	Plant – Type	Description & Recommended Actions at VY
6/05 CHUG Meeting	Hatch Units 1 and 2 - BWR	Pinhole leaks in 3 inch line between Steam Packing Exhauster Drain Tank and Condenser in both units. The leak locations were at the first elbow downstream of the tank level control valves. The equivalent piping at VY is 6"C-44 at condenser nozzle 63. This line screens out of the VY FAC Susceptibility Evaluation based on low temperature. VY has two LCVs in parallel vs. the single valve on each of the Hatch units. **Given that a leak in this line would affect condenser vacuum and challenge plant availability, inspect locations downstream of valves LCV-102-8-1 and LCV-102-8-2 in RFO26 (2007)**
6/22/05	Callaway - PWR	OE19965: Failure of the carbon steel body section of an internal pipe flow element manufactured by Badger Meter blocked flow in a Heater Drain tank Pump discharge line. A separate evaluation of this OE was performed for VY. 3 Flow elements in the Condensate System; FE-102-2A to -2C have been identified as the same construction. UT inspections of piping US, the pipe at the flow element, and DS of each of the flow elements shows no wear is occurring. This is not a pressure boundary issue. **An ER will be generated to develop the best scheme for inspection and evaluation of the internal portions of the pipe flow elements.**
6/23/05	Palo Verdi Unit 1 PWR	1/06 CHUG PER: Leak on 8"x 12" expander downstream of level control valve on MSR Drain tank to Heater Drain tank. No MSR or heater drain tank at VY. This is high pressure piping. The closest components would be the Moisture Separator Drain Piping down stream of LCV-103-24A to 24D. This piping is A335 P-22 material. Other components would be piping downstream of Heater Drain System LCV-103-1A-1/1B-1, LCV-103-2A-1/2B-1, and LCV-103-3A-1/3B-1. Piping downstream of these valves is either chrome moly or stainless steel. No new actions with respect to FAC for this OE.
8/15/05	Dresden 3 - BWR	OE21421/OE21968 Loss of Main Condenser vacuum due to air in leakage and a degraded SJAE train. Age related degradation of the 2nd stage steam jets at Dresden. VY replaced the SJAE nozzles in 1993 (JO 92-0140). However, US & DS piping is original. **ER 06-1190 was written to evaluate SJAE replacement including the need for additional FAC inspections of the piping.** With respect to the vent line internal to the condenser at Dresden which experienced external wear due to steam erosion, the equivalent section of piping at VY is stainless steel. The need to establish PMs for AE lines in the condenser will be addressed in the response to ER 06-1190.
9/26/05	Hatch Unit 1 – BWR	OE21591: Through wall leak in a Fisher control valve body. MSR Reheater 2nd Stage High Level Dump. Hole in the 1 inch thick valve body was attributed to leakage past the seat. The valve had been modified for power uprate. The trim was changed to avoid installing a larger actuator on the valve. This OE was forwarded to the Systems/ TPM Engineer. **The TPM system will be used to identify leakage by normally closed valves to the condenser.. The monthly TPM report will be monitored by the FAC program Engineer.**
1/06 CHUG Meeting	Surry – PWR	Hidden spool piece discovered. Plant replacement practices in two separate local material replacements (Cr-Mo) on a 6 inch line at the upstream elbow and the downstream elbow resulted in a carbon steel spool piece remaining in the line. **This situation highlights importance of configuration control, potential hazards of partial replacement strategy, and the need for alloy sampling.**
1/06 CHUG Meeting	Susquehanna Unit 2 - BWR	Through wall damage found in 3" and 4" diameter FW heater vent piping and associated condenser nozzles during pipe replacement activities. Caused increased condenser in-leakage. Heater Vent Piping at VY is monitored for FAC in Small Bore Program.

LD: Large Bore Components Selected to Calibrate CHECWORKS

The CHECWORKS wear rate calculations have been upgraded to include the 96, 98, & 99 RFO inspection data. The 2001 and 2002 inspection data has been loaded however wear rate analyses have not been completed at this time.

Condensate:

In 2001 components on the higher temperature end of the Condensate System were inspected to calibrate the CHECWORKS models. The inspection data indicate minimal wear and should reinforce the assessment of low wear in the Condensate System. Additional inspections were performed on lines CD-30, CD-31 and CD-32 in 2004 and 2005. There is no inspection data on line 20"-C-28 between the E-4-1B and E-3-1B feedwater heaters for CHECWORKS calibration. Given the increase in operating temperature & flows for EPU, inspect components **CD28EL04 & CD28SP03US in RFO26 (2007).**

Heater Drains/ Moisture Separator Drains:

Prior to the 2002 RFO there was limited inspection data for the Heater Drain system. The current CHECWORKS models (Pass 1 and some Pass 2) indicate low wear rates. During 2002 a number of new inspections were performed on the carbon steel piping upstream of the level control valves (LCV) to obtain a baseline prior to operation on hydrogen water chemistry. The 2002 inspection data indicate significant margin for future wear in the components inspected.

Piping downstream of the level control valves (LCV) for the feedwater heaters is FAC resistant material, except for inlet to No.5 Feedwater heaters. The carbon steel piping downstream of the normal flow LCV-4B-1 will be inspected in RFO26. Additional components on lines which do not already have inspection data will be inspected in RFO26. (2007) are listed below.

Inspection	Component ID	Loc. Sketch	Location	Previous Inspections	Reasons / Comments / Notes
2007-27	HD1AEL06	043	T.B. Htr. Bay Elev. 235.	NO	Checworks Calibration, HWC, and increased flow and temperature effects form EPU
2007-28	HD1ASP08	043	" " "	NO	
2007-29	HD3BTE01	051	T.B. Htr. Bay Elev. 239.	NO	Checworks Calibration, HWC, and increased flow and temperature effects form EPU
2007-30	HD3BEL02	051	" " "	NO	
2007-31	HD3BSP05US	051	" " "	NO	
2007-32	HD5ATE01	045	T.B. Htr. Bay Elev. 239.	NO	Checworks Calibration, HWC, and increased flow and temperature effects form EPU
2007-33	HD5ASP06	045	" " "	NO	
2007-31	HD3BSP05US	045	" " "	NO	
2007-32	HD25RD02	053	T.B. Htr. Bay Elev. 253	NO	Checworks Calibration, HWC, and increased flow and temperature effects form EPU
2007-33	HD5ASP02	053	Inlet to ES-1-B	NO	
2007-34	HD12TE01	057	T.B. Htr. Bay Elev. 229.	NO	Checworks Calibration, HWC, and increased flow and temperature effects form EPU
2007-35	HD12SP01	057	MS-1-1A drain	NO	
2007-36	HD12EL06	058	T B. Htr. Bay Elev. 230.	1989	Checworks Calibration, HWC, and increased flow and temperature effects form EPU
2007-37	HD12SP07US	058	MS-1-1B drain	1989	

Main Steam and Feedwater:

None for RFO26.

LE: **Large Bore Components subjected to off normal flow conditions identified by turbine performance monitoring system (Systems Engineering Group).**

The Systems Engineering Production Variance Report for January 1 to January 31, 2006 lists 3 of the 10 normally closed Turbine Bypass Valves as suspected of having seat leakage. Elevated tailpipe temperatures (Approx. 250F vs. Approx 200F) have been recorded on valves 1, 5, & 7. (See Attached Plot) The tailpipes are 10 inch diameter carbon steel lines connecting directly to the condenser. Each line ends inside the condenser at multi-stage restriction orifice supplied by GE. This indicates that any pressure drop in these lines should occur inside the condenser. The steam temp at the bypass valve is approx 540F. The 250F temp measured on the three suspected leaking lines is approx. 50 F above the lines considered as not leaking. Any water condensing out of the steam should occur in the restriction orifices inside the condenser. Consider inspections on these lines only if temperatures continue to increase.

Since startup from 2005 (RFO25), only one small bore valve and no steam traps have been identified (to date) using the Turbine Performance Monitoring (TPM) system. The small bore valve is LCV-101-3B this is addressed in Section SD below. Piping Downstream of this valve, 2"-ES-9B is Cr.-Mo steel and is resistant to FAC. However, if new data indicates leaking valves then additions to the outage scope may be required.

LF: **Engineering Judgment / Other**

Nine ASME Section XI Class 1 Category B-J welds are to be inspected by the FAC program per Code Case N-560 in lieu of a Section XI volumetric weld inspection. The VY ISI Program Interval 4 schedule for inspection of these welds is as follows:

Refueling Outage	Section XI ISI Program Weld ID	Description	FAC Program Components
Spring 2004 (RFO24) Interval 4 Period 1, Outage 1.	FW19-F3B FW19-F3C FW19-F4 FW21-F1	upstream pipe to tee tee to reducer reducer to pipe tee to pipe	"A" Feedwater on Sketch 010 FD19TE01 FD19RD01 FD19SP04 FD21SP01
Fall 2011 (RFO29) Interval 4 Period 3, Outage 6.	FW18-3A FW20-3A FW20-F1 FW20-F1B FW18-F4	upstream pipe to tee tee to reducer reducer to pipe horizontal pipe to pipe tee to pipe	"B" Feedwater on Sketch 016 FD18TE01 FD20RD01 FD20SP01 FD18SP04

Extended Power Uprate (EPU)

Feedwater system:

EPU evaluation for Feedwater System: The primary focus of work to date (for PUSAR and RAIs) was on velocity changes given only slight increases in temps and no chemistry changes. With all 3 FDW pumps running the 16 inch diameter lines to the 24 inch FDW header have approx. [1.2(2/3) = 0.80] 20% reduction in velocity. Velocities in the remainder of the system increase approx. 20%. The highest velocities are at the 10 inch reducers upstream and downstream of the FDW REG valves. The expander and downstream piping have multiple inspection data with FD07RD03/FD07SP03 last inspected in 2001 and FD08RD03/FD08SP02 last inspected in 2005. **Both of these segments should be re- inspected after some time of operation at EPU flows. Assuming EPU starting early in 2006, inspect components FD07RD03 and FD07SP03 in 2007 for a post EPU measurement.**

Continued

LF: Engineering Judgment / Other –continued

Condensate System:

Given the 8/04 Mihama event: consider additional components in the condensate system for inspection : downstream of flow orifices & venturies:

FE-102-4 and downstream pipe on 24"C-8 venturi type (TB condensate pump room overhead) Given low operating temperatures and upstream of oxygen injection point, **scope out and evaluate for inspection in RFO27 in 2008**
FE-52-1A to FE-52-1E on Condensate De-mineralizer System (Restriction Orifices). Given low operating temperatures and upstream of oxygen injection point, **scope out and evaluate for inspection in RFO27 in 2008**
FE-102-7 and downstream pipe on 14"C-21 venturi type TB Heater Bay El 237.5 Given low operating temperatures and used for start-up, **scope out and evaluate for inspection in RFO27 in 2008**

Extraction Steam

All Extraction Steam piping is A335-P11, a 1-1/4 chrome material, except for a short carbon steel stub piece in line 12"-ES-1A at the connection to the 36" A cross around line. Internal visual inspections of this stub piece were performed with the cross around inspection in RFO24 and RFO25. Also an external UT inspection of ES1ASP01 was performed in RFO24.

LG: Piping identified from EMPAC Work Orders (malfunctioning equip., leaking valves, etc.)

Word searches of open work orders on EMPAC were performed for the following keywords: trap, leak, valve, replace, repair, erosion, corrosion, steam, FAC, wear, hole, drain, and inspect. No previously unidentified components or piping were identified as requiring monitoring during the Fall 2005 RFO.

Note: the internal baffle plate in Condenser B for the AOG train tank return line to the condenser was to be replaced in RFO 25 (ER 04-1454/ ER 05-232 /ER 05-0274). Erosion on baffle plate is from condenser side (not piping side). This work was deferred from RFO25. See W.O. 04-1462.

Internal visual inspection of LCV-103-3A-2 during RFO 24 indicated some type of casting flaw. The System Engineer suspects possible leaking by the normally closed valve. The downstream piping was last inspected in 1990. The line typically has no flow. Re-evaluate using the Thermal Performance Monitoring System Data and consider inspection of downstream piping in RFO27.

A through wall leak in the steam seal header supply line 1SSH4 was discovered on 9/24/04 (CR-VTY-2004-02985). A temporary leak enclosure was installed and a planned permanent repair was scheduled for RFO25. The leaks are on the bottom of un-insulated piping upstream of the gland seal. Field inspection of the leak location shows that the piping at the leak sloping down to the gland seal, not sloping up to the seal a shown on the design drawings. UT data on the top of the piping near the leak shows full wall thickness. At this time, the exact mechanism which caused the leak is not known. Additional inspections to determine the extent of condition on the 3 other gland seal steam supply lines are were recommended. **Inspection of the 90 degree elbow and approx. 2 ft. of downstream piping on lines 1SSH3, 1SSH4, 1SSH5, and 1SSH6 was planned for RFO 25. Also based on industry OE and similar piping geometry, inspection of 2 of the SPE lines 1SPE3 and 1SPE5 was planned for RFO 25. These inspections were deleted from the RFO26 scope due to higher priority LP turbine work. (References 9 & 10). Perform these inspections in RFO26. See Section LH below.**

Small Bore Piping

SA: Susceptible piping locations (groups of components) contained in the Small Bore Piping data base which have not received an initial inspection.

Locations on the continuous FDW heater vents to the condenser on the No. 3 heaters were inspected in 2002. The continuous vents on the No. 4 heater were installed new in 1995. The start up vents operate less than 2% of operating time. No wear was found in previous inspections on Heater Vent piping from the No.1 & 2 heaters. Given that and the lower pressure in the No. 4 heater shells, a complete inspection of the remainder of the No. 4 heater vent piping can be deferred. The existing small bore date base and the piping susceptibility analysis is under revision. No additional components from Revision 1 of the data base will be inspected.

SB: Components selected from measured or apparent wear found in previous inspection results.

Small Bore Point No. 20. 2-1/2" MSD-6 @ connection to condenser A at Nozzle 33 (Inspection No. 96-SB01 identified a low reading at weld on stub to condenser). Upstream valves are normally closed. TPM system does not indicate any abnormal flow. **Inspect this piping in RFO 26**

SC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG.

Date	Plant – Type	Description & Recommended Actions at VY
4/29/99	Darlington 1 - PHWR	Severed line at steam trap discharge pipe at threaded connection. Equivalent to HHS system at VY. (INPO Event 931-990429-1) Threaded connections typically on condensate side of HHS piping. Lower energy/consequence of leak. **Include HHS piping in FAC Susceptibility Review, and in the Small Bore Database. Include ranking and consequences of failure.**
9/1/01	Peach Bottom 3 -BWR	(From 1/14/02 CHUG Meeting), leak on 1 inch Sch. 80 line from Off Gas Re-combiner pre-heater drain line to condenser. An additional review of AOG steam supply system was performed and incorporated into the FAC Susceptibility Review. **Update small bore database to include ranking and consequences of failure.**
1/15//02 CHUG Mtg.	Hatch1/2 -BWR	Condenser in leakage due to through wall erosion (external) of 1-1/2 inch "slop" drains lines inside the condenser. Lines in each unit were cut and capped, similar events at Byron Unit 1 (OE 12609) and Columbia (OE12145). Limerick & Dresden. VY slop drain lines inside condenser were walked down during RFO24 and RFO25. Some external erosion on piping and supports was found. **Slop Drain Issue. Coordinate with Systems Engineer**
4/2/03	Peach Bottom 3 -- BWR	OE16287: Steam leak found on 3"x2" elbow on RFP Turbine sealing steam system small bore piping. Leak was on piping susceptible to FAC but was not included in the scope of the FAC Program. This occurred as the piping was part of a vendor supplied skid and was not reflected on the drawings used for the FAC program. The VY FAC Susceptibility Evaluation has been updated to include all known vendor supplied piping (VY-RPT-05-00012, Rev.0.)
10/31/03	Clinton -BWR	OE17412 / OE18478: Through-wall leaks in 2A/B heater vent lines to the condenser (larger bore lines assumed given description of backing rings in piping). Apparent cause attributed to steam jet impingement from wet steam. Equivalent line at VY is common 4 inch feedwater heater vent line for No.4 FDW heaters. This line is included in the SSB database since it connects to (2) 2-1/2" lines. Inspection priority will be determined in the small bore ranking and prioritization.

SC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG. – continued

Date	Plant – Type	Description & Recommended Actions at VY
11/7/2003	Limerick 1, BWR	OE17818: Through wall leak in 1 inch drain line back to condenser off ES piping at the connection to the large bore line. Normally no flow in line due to N.C. valve. Piping downstream of valves to condenser on all 3 lines was scheduled for replacement. Location US of valve was thought not to be susceptible. ES piping at VY is FAC resistant A335-P1. Lesson from this event is that any carbon steel line in a wet steam system is susceptible & should be monitored. Also full line replacement insures all susceptible piping is replaced.
1/16/04	Clinton – BWR	OE17654: Potential trend for adverse equipment condition downstream of orifices. (Ref. Previous experience a Clinton with CRD pump min flow ROs) Inspected CRD pump min flow orifices also piping DS of RO-64-2 in RFO25. Additional inspections will be performed if further OE is obtained.
12/06/04	V.C. Summer - PWR	OE19798/OE20075: Complete failure of a 1 inch ES line at the location of a previously installed Fermanite clamp repair. Previous leak at weld installed in May 2004. See presentation at January 2005 CHUG meeting. (They did not do UT on the pipe to assure structural integrity prior to installing the clamp.) Problems with leaving CS in system DS of material replacements. **Review of previous replacements at VY has identified 2 locations at the condenser with similar configuration. Planned Inspections Nos. 07-SB04 and 07-SB05.**
2/3/04	Columbia - BWR	6/04 CHUG Meeting PER: Through wall leak in 2" CS A106 Gr.B section of Misc drain line from bleed steam trap station to collection header. Location of leak is just upstream of where discharge piping enters the into the collection header. Piping upstream of location is stainless steel. At VY MSD piping downstream of ST-60A to 60D and LCV-101-38A to 38D connecting to 8"MSD-9 is carbon steel and is included in the Small bore Piping Database. Most locations have already been inspected. No further actions for this OE.
2/17/04	Peach Bottom 2 BWR	OE18637: On line leak in 10 inch main steam drain line header to the condenser. Hole was located directly below the connection of 1" main steam lead drain. The header was replaced with 1-1/4 Chrome material approx. 5 years before the leak. Also, ROs in steam drains were modified. The cause was attributed to steam impingement. Additional information to follow after next RFO. The only large bore drain collector at VY is the 8 inch diameter low point drain header, line 8"MSD-9. Flow is through steam traps and LCVs vs. a continuous flow through a restriction orifice. This line is now part of the AST ALT boundary. Inspections of the entire bottom of this header were performed during RFO24 with recommendations for repeat inspections in 2010. Also similar SSB configuration on 3"-MSD-4 near condenser. **Inspect 3"-MSD-4 from the two 2 steam trap drains connections to the condenser.**
3/2/04	Calvert Cliffs Unit 1 - PWR	OE18730: Though wall leaks in MSR drain piping at socket welded elbow fittings. Piping was replaced with Cr-Mo in the early 1990s. Cause attributed to liquid impingement. Plant is considering changing piping to eliminate SW elbows by using pipe bends. To date at VY: no leaks have been found on Cr-Mo piping replacements. No New action required for this OE.
5/9/04	Susquehanna Unit 2 - BWR	1/05 CHUG Meeting PER: Through wall leak in 1" Main Steam Bypass line drip leg drain to the condenser. The leak was at coupling joint at the condenser. The piping was replaced with P-22 in 1992. However, the coupling was not replaced at the condenser nozzle. A similar situation exists at VY for replacement of 2"MSD-406 (Steam Leads Drains) at the condenser. **Inspect the CS and P11 piping next to the condenser in RFO26 (Small Bore Insp. 07-SB04 at condenser Nozzle 35)**

SC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG. – continued

Date	Plant – Type	Description & Recommended Actions at VY
7/4/04	Hope Creek - BWR	1/05 CHUG Meeting PER: Through wall leak in 2" turbine bleed steam drain from HP extraction. Piping and coupling was 2-1/4% Cr-Mo. Leak attributed to abnormal fit-up into the coupling. Installation quality issue not FAC wear. No further actions for this OE.
10/1/04	Confrentes (Spain) - BWR	1/05 CHUG Meeting PER: Leak in 1-1/2" P-22 pipe bend on a turbine driven (feedwater) pump drain line in the Main & Re-Heated Steam System immediately downstream of an orifice. The only steam turbine driven pumps at VY are the HPCI and RCIC pumps These pumps have low usage. No further actions for this OE.
12/8/04	TEPCO Fukushima1-4 - BWR	1/05 CHUG Meeting PER: Through wall leak in drain line from steam turbine driven feedwater pump steam supply line. The drain line runs to the condenser. The only steam turbine driven pumps at VY are the HPCI and RCIC pumps These pumps have low usage. No further actions for this OE.
1/05 CHUG Meeting PER	River Bend – BWR	Through wall leak at condenser nozzle on the 2-1/2" emergency high level drain line from the steam seal evaporator drain receiver tank to the condenser. Sections of this line are stainless steel, but the condenser nozzle is carbon steel. The apparent cause is using this high level drain line for normal level control increased wear in the CS nozzle. The equivalent piping at line at VY is 3" and 6" C-44 downstream of valves LCV-102-8-1 and LCV-102-8-2 to condenser nozzle 63. **Given that a leak in this line would affect condenser vacuum and challenge plant availability, inspect locations downstream of valves LCV-102-8-1 and LCV-102-8-2 in RFO26 (2007)**
1/21/05	D.C. Cook 1 - PWR	OE20165: Leak in Middle Heater Drain Pump Emergency Leakoff Line assumed to have no flow when the pump was not running. Geometry different from North and South Heater Drain Pumps. However flow, was in the 1 inch line when the pumps were not running. Incorrect assumption in the FAC SSE. Assumption that pump was not in service and no flows in line. **No additional inspections as a result of this OE. However, one of the DC Cook Corrective Actions should be performed at VY: "Assumptions used in the SSE will be re-validated to confirm they are still accurate". Generate PCRS/WT or ER to have reviews performed by Systems Engineers and OPS**
2/4/05	TEPCO Kashiwazaki Kariwa (K-1) – BWR	6/05 CHUG Meeting Presentation and follow up at 1/06 CHUG Meeting PER**: Through wall leak at MS Leads Low Point Drains connecting to the condenser. Pipe 50A (approx. 2 inch dia.) **Pipe material is Cr-Mo. Steel**. Leak location is approx. 9 meters downstream of orifice in pipe on extrados of exit from a 90 degree SW. TEPCO root cause is two-phase flow incorporating droplet induced erosion. VY has similar geometry. Piping at VY was originally carbon steel and was replaced with Cr-Mo in 1998. TEPCO piping has a more tortuous path to the condenser (tee and 8 SW elbows) while VY only has the SW tee. **TEPCO plans to replace the line and move the RO into the condenser. **Consider inspection of Cr-Mo Piping immediately DS of the SW tee in either 2008 or 2010 due to expected increase in drain flows at EPU conditions. CS stub piece at the condenser and upstream Cr-Mo piping will be inspected in RFO26 (2007).**
3/1/05	McGuire 2- PWR	OE20163 : Though-wall leak in a 2 inch carbon steel vent line on the MSR heating steam vent line. Caused by FAC when flashing occurred upstream of RO (design location). No MSRs or equivalent locations at VY. At VY the only Restriction Orifices are in the FDW Heater Vent System Continuous vent lines . These are already in the scope of the FAC program.

SC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG. – continued

Date	Plant – Type	Description & Recommended Actions at VY
6/05 & 1/06 CHUG Meetings	Peach Bottom Unit 3 –BWR	Through wall leak in RCIC Steam Supply Drain line to condenser. Location on CS section of line (running through the off gas pipe tunnel) which was not replaced with Cr-Mo P-11 material. The remainder of the line was previously replaced with P11. Event stresses importance of complete line replacements. A review of VYs combined HPCI/RCIC drains as shown on Drawing VYI-HPCI RCIC Drain Rev.1 and page 15 of JO file 89-0060 shows a carbon steel stub piece at the condenser was left in the line. **Inspect the CS and P11 piping next to the condenser in RFO26 (Small Bore Inspection 07-SB05)**
6/05 CHUG Meeting PER	Wolf Creek – PWR	Pinhole leak in body of 2 inch MS drain line check valve due to erosion from leak-by through upstream steam trap. Thinning was found in 2" tee downstream of steam trap. At VY, piping downstream of MS steam traps has been previously inspected. Given expected increases in flow from EPU, piping DS of ST-60-3 will be inspected in RFO26 (Small Bore Inspection 07-SB02)
8/17/05 CHUG PER 1/06	Hope Creek – BWR	Through wall leak in 1-/1/2" line from Steam Seal Evaporator Drain Tank to #3 FDW Htr. Temporary welded clamshell used for repair. Plant documentation indicated line was Cr-Mo P11 material. Lab analysis of metal filings indicates piping was carbon steel. No equivalent line at VY. However, note the installed material / documentation issue.
8/24/05 Presented at 1/06 CHUG Meeting	LaSalle Unit 1	Through wall leak in RCIC Steam Supply Pot Drain line to main condenser. Leak on straight section of pipe 11 ft D.S. of SW elbow. Major portion of line was replaced with Cr-Mo P-22 material. However this section running through a wall penetration was not replaced by field. Plant documentation indicated that the line was completely replaced. Event stresses importance of complete line replacements. Similar situation to peach Bottom leak presented at 6/05 CHUG meeting. A review of VYs combined HPCI/RCIC drains as shown on Drawing VYI-HPCI/RCIC Drain Rev.1 and page 15 of JO file 89-0060 shows a carbon steel stub piece at the condenser was left in the line. **Inspect the CS and P11 piping next to the condenser in RFO26 (Small Bore Inspection 07-SB05 at condenser Nozzle 56)** Also, a similar situation exists at the previous replacement of 2"MSD-406 (Steam Leads Drains) at the condenser. **Inspect the CS and P11 piping next to the condenser in RFO26 (Small Bore Inspection 07-SB04 at condenser Nozzle 35)**
9/14/05	Waterford 3 -PWR	OE21577: Pinhole leak in carbon steel drain line from Main Steam drip pot. Un isolable from the steam generator. Cause attributed to external corrosion, NOT FAC. Waterford has no turbine building and the MS drain piping is exposed to the weather. All steam process piping at VY is indoors. External corrosion is not a significant concern.
9/15/05 (1/06 CHUG Meeting PER)	Byron Unit 2 -PWR	Through wall leak in No.7 (highest) HP FDW Heater vent line to condenser. 2" schedule 80 line. Previous RT on elbows near FDW Heaters did not identify FAC wear. Location of wear in lines was toward the condenser. At VY all HP FDW Htr. vent lines were replaced with Cr-Mo in RFO24. No further actions for this OE.
9/23/05, 1/06 CHUG Meeting	Cooper –BWR	OE21586: Fatigue failure of 1-1/4" turbine slop drain piping inside condenser. Caused loss of condenser vacuum and manual scram. Lines were previously replaced in January 2005 due to external erosion from the steam space. Inadequate pipe supports and recent change out of LP turbines attributed as causes. RFO25 inspection at VY indicates piping has supports and some external surface wear is occurring. Markings on fittings indicate P-11 material is installed. This indicates previous replacements at VY. Keep OE listed for future reference (Also reference: OE20044-Calvert Cliffs-1/05, OE20032-Palisades-1/05, OE20112-Oconee-1/05, OE19961-Turkey Point-12/04, OE13108-St. Lucie-9/01, OE12609-Byron-3/01, and OE12601-Hatch-10/00.)

SC: Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG. – continued

Date	Plant – Type	Description & Recommended Actions at VY
9/21/05 CHUG PER 1/06	Nilo Mile Pt. 1 – BWR	Through wall leak in 1" GE supplied turbine Bypass Valve 2nd stage leakoff line 2SLBPV line to SSH. Leak location at bend in 1" line off BPV. Similar layout to VY. VY has replaced the entire 1SLBPV line with Cr-Mo in RFO25. Previous FAC inspections on common 2-1/2" header to SSH line. No inspections in 1" lines. Schedule inspection of most probable BPV leakoff lines (1 to 10) based on ranking and consequences of failure in Small Bore Database.
11/15/05 CHUG PER 1/06	Peach Bottom 3 – BWR	Through wall leak in 1" schedule 160 Main Steam Leads drain downstream of orifice to condenser. Leak repair clamp installed. Equivalent piping at VY 2"MSD-406 Steam Leads Drains replaced with Cr-Mo steel except for piping stub at condenser. **Inspect the CS and P11 piping next to the condenser in RFO26 (Small Bore Inspection 07-SB04 at condenser Nozzle 35)**
11/1/05 CHUG PER 1/06	Susquehanna Unit 1 – BWR	Through wall leak in 2" fabricated coupling in Steam Seal Evaporator Drain at Feedwater Nozzle (SSE drains to #2 FW Htr). Attached piping was replaced with Cr-Mo. However, nozzle fitting was never replaced. No equivalent line at VY.
1/06 CHUG Meeting	Diablo Canyon – PWR	Trough wall leak in 2 inch MSR LP Vent Condenser Drain line. Plant documentation indicated that all the lines were replaced with Cr-Mo material. Inspections subsequent to the leak found 6 pieces of carbon steel (not Cr-Mo) during the pipe replacements. Only found through in-situ alloy sampling. Plant includes alloy sampling in their large bore piping FAC inspections. Apparent Cause indicates problem with plant QA (replacements were part of a large fixed price contract). To date at VY, reviews of previous piping replacements have found no such discrepancies. This information should be factored into the evaluation whether or not alloy sampling should be incorporated into the VY FAC program.

SD: Components subjected to off-normal flow conditions, as indicated from the turbine performance monitoring system (Systems Engineering Group).

The Systems Engineering Production Variance Report for January 1 to January 31, 2006 lists LCV-103-3B as having seat leakage to the condenser. Extraction Steam piping small bore valve is LCV-101-3B is a drain back to the condenser. Piping downstream of the valve on line "-ES-10B is Cr.-Mo steel and is resistant to FAC. The piping was previously inspected in 1993 (Inspection No. 93-SB27) and in 1998 (Inspection No. 98-SB09). No further actions will be performed for RFO26.

Since startup from 2005 (RFO25), no other small bore valves and no steam traps have been identified (to date) using the Turbine Performance Monitoring (TPM) system. However, if new data indicates leaking valves then, additions to the outage scope may be required.

LH: Components "De-Scoped" (inspections deferred) from Previous Outages

This is a new category. Planned inspections had never been deferred at VY before RFO25.

Inspection	Component	Evaluation / Reasons for Recommendation
2005-24 2005-25 2005-26 2005-27 2005-28 2005-29 2005-30 2005-31	1SSH3EL05 1SSH3SP06US 1SSH4EL01 1SSH4SP02US 1SSH5EL01 1SSH5SP02US 1SSH6EL06 1SSH6SP08US	Planned inspections on the turbine Steam Seal header (SSH) and the Steam Packing Exhauster (SPE) lines to determine the extent of condition for CR-VTY-2004-02985 CA 03 were "de-scoped" from the 2005 RFO due to higher priority LP turbine work in the same location. **Inspect these locations during RFO26 in Spring 2007.**
2005-32 2005-33 2005-34 2005-35	2SPE3EL01 2SPE3SP01US 2SPE5EL01 2SPE5SP01US	Planned inspections on the turbine Steam Seal header (SSH) and the Steam Packing Exhauster (SPE) lines to determine the extent of condition for CR-VTY-2004-02985 CA 03 were "de-scoped" from the 2005 RFO due to higher priority LP turbine work in the same location. **Inspect these locations during RFO26 in Spring 2007.**

Small Bore Piping

SE: Engineering judgment

Look at piping DS of orifices based on BWR OE

Condensate: Given the 8/04 Mihama event: consider additional component in the condensate system for inspection downstream of flow orifices & venturies.

FE-102-6 and downstream pipe on 21/2"C-43 venturi type (TB heater bay elev. 230+/- Given low operating temperatures and upstream of oxygen injection point, scope out and evaluate for inspection in R27 in 2008

Main Steam Drains: Concerns with increased Moisture Carryover under EPU operating conditions: Inspect SSB components with may experience increase flow from EPU

Component	SSB DataBase Number	Location	Reasons/ Comments
1" & 2-1/2" Pipe & Fittings D.S. of Steam Trap ST-60-3	002	Rx Bldg. off Torus Catwalk - West	EPU concerns with increased Moisture carryover. Note this is part of AST ALT Boundary. Last inspected in 1993.
1" & 2-1/2" Pipe & Fittings D.S. LVC -2-143 of Steam Trap ST-60-3	003	Rx Bldg. off Torus Catwalk - West	EPU concerns with increased Moisture carryover. Note this is part of AST ALT Boundary. Last inspected in 1993.
2" CS pipe stub at Condenser wall on line 2"-MSD-406 at condenser nozzle 35 (Steam Lead Drains)	30B	Turb. Bldg. Heater Bay. Condenser A –North	EPU concerns with increased Moisture carryover. Also, recent industry experience OE with leaks in CS components in lines with partial material replacements.
2" CS pipe stub at Condenser wall on line 2"-HPCI/RCIC Drain line at condenser nozzle 56	33	Turb. Bldg. Heater Bay, Condenser B Northeast	Recent industry experience OE with leaks in CS components in lines with partial material replacements.

SG: Piping identified from EMPAC Work Orders (malfunctioning equip., leaking valves, etc.)

See LG above. The EMPAC search performed in LG above is applicable to both Large bore and Small bore components.

SH: Components "De-Scoped" (Inspections deferred) from Previous Outages

None

Feedwater Heater Shells

No feedwater heater shell inspections will be performed during the 2007 RFO. All 10 of the feedwater heater shells have been replaced with FAC resistant materials.

Recent / Relevant Industry OE Regarding Feedwater Heater Shells.

Date	Plant – Type	Description & Recommended Actions at VY
1/24/04	LaSalle Unit 1, BWR	OE18381/OE17919: Through indication indications in #2 LP feedwater heater extraction steam inlet nozzles Carbon steel nozzles with Cr-Mo upstream piping. Similar situation existed at VY prior to replacement of all feedwater heater shells with FAC resistant materials. No new actions required at VY.
4/14/25	Browns Ferry 2 -BWR	OE20797: Higher wear rates than expected found in carbon steel Extraction Steam Inlet nozzles on No.3 LP feedwater heaters. Upstream pipe had been replaced with Cr-Mo and C.S. weld build-up had been performed on nozzles. Also a 105% power uprate increased flows. VY has Cr-Mo. ES piping with either Cr-Mo Nozzles or S.S. nozzles. No further actions are required for this OE.
7/26/05 Presented at 1/06 CHUG Meeting	LaSalle Unit 1, BWR	OE:21384: Through Wall Leak in #3 LP feedwater heater shell. Hrs were scheduled for inspection at next RFO. Ranked as lowest priority due to high ES steam quality. Through wall erosion primarily caused by heater design with common axial location for HD inlet and outlet, and to ES inlet nozzles. Through wall leak determined to be result of weld defect (porosity) aggravated by FAC and leading edge effect..

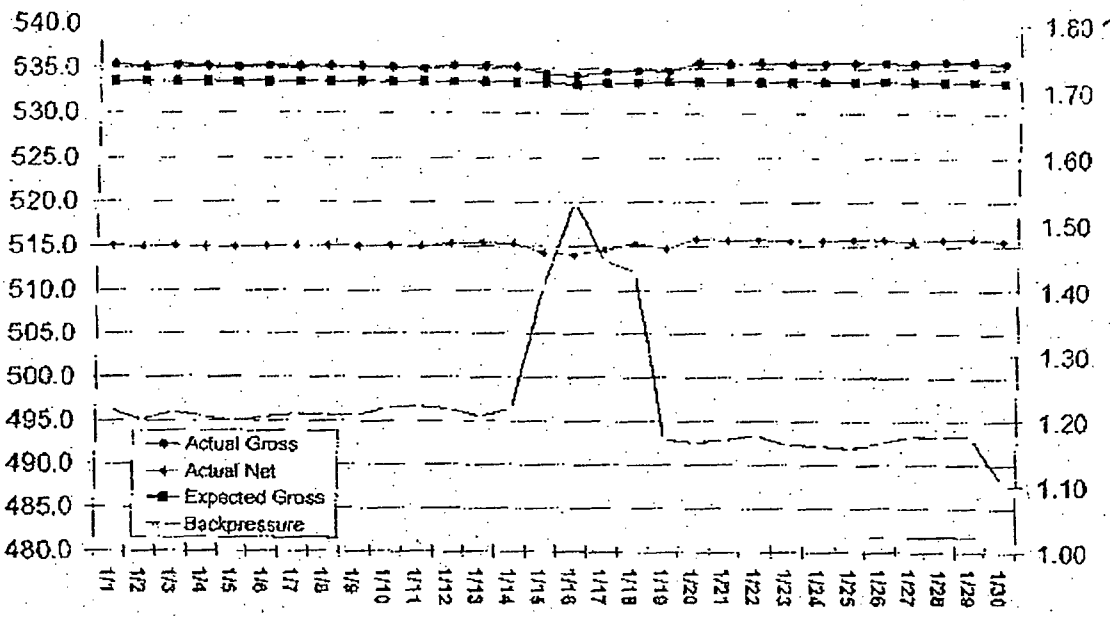
References

1. PP 7028 Piping Flow Accelerated Corrosion Inspection Program, LPC 1, 12/6/2001.
2. V.Y. Piping F.A.C. Inspection Program - 1996 Refueling Outage Inspection Report, March 23,1999.
3. V.Y. Piping F.A.C. Inspection Program - 1998 Refueling Outage Inspection Report, April 2,1999.
4. V.Y. Piping F.A.C. Inspection Program - 1999 Refueling Outage Inspection Report, February 11, 2000.
5. V.Y. Piping F.A.C. Inspection Program - 2001 Refueling Outage Inspection Report, August 11,2001.
6. V.Y. Piping F.A.C. Inspection Program - 2002 Refueling Outage Inspection Report, January 20, 2003.
7. VY-RPT-04-00010, Revision 0 ," Vermont Yankee Piping Flow Accelerated Corrosion Inspection Program (PP 7028) 2004 Refueling Outage Inspection Report (RFO 24)"
8. VY-RPT-06-00002, DRAFT ," Vermont Yankee Piping Flow Accelerated Corrosion Inspection Program (PP 7028) 2005 Refueling Outage Inspection Report (RFO 25 –Fall 2005)"
9. VYPPF 7102.01 RFO25 Scope Deletion of Restoration of TM 2004-031 (WO 04-4884-06), dated 10/24/05.
10. VYPPF 7102.01 RFO25 Scope Deletion of FAC Inspections 2005-24 to 2005-35 (WO 04-4983-000/010). dated 11/1/05.

VY 2007 OUTAGE RFO26 SCOPING WORK SHEET

SYSTEM ENGINEERING
PRODUCTION VARIANCE REPORT

Actual vs. Expected Production January 1 to January 31, 2006



EVENTS

Date	Loss	Event
1/16/06	1 MWe/hr	Recirc Gate open to de-ice intake bay

Full Power Averages For Previous Four Weeks

- Actual Gross 535.3, Expected Gross 533.5, Net 515.2, Condenser Back Press: 1.22"HGA, Circ Water Inlet: 38° F, Average Difference in Heat Balance to actual: ~ 1.8 MWe (Gain)

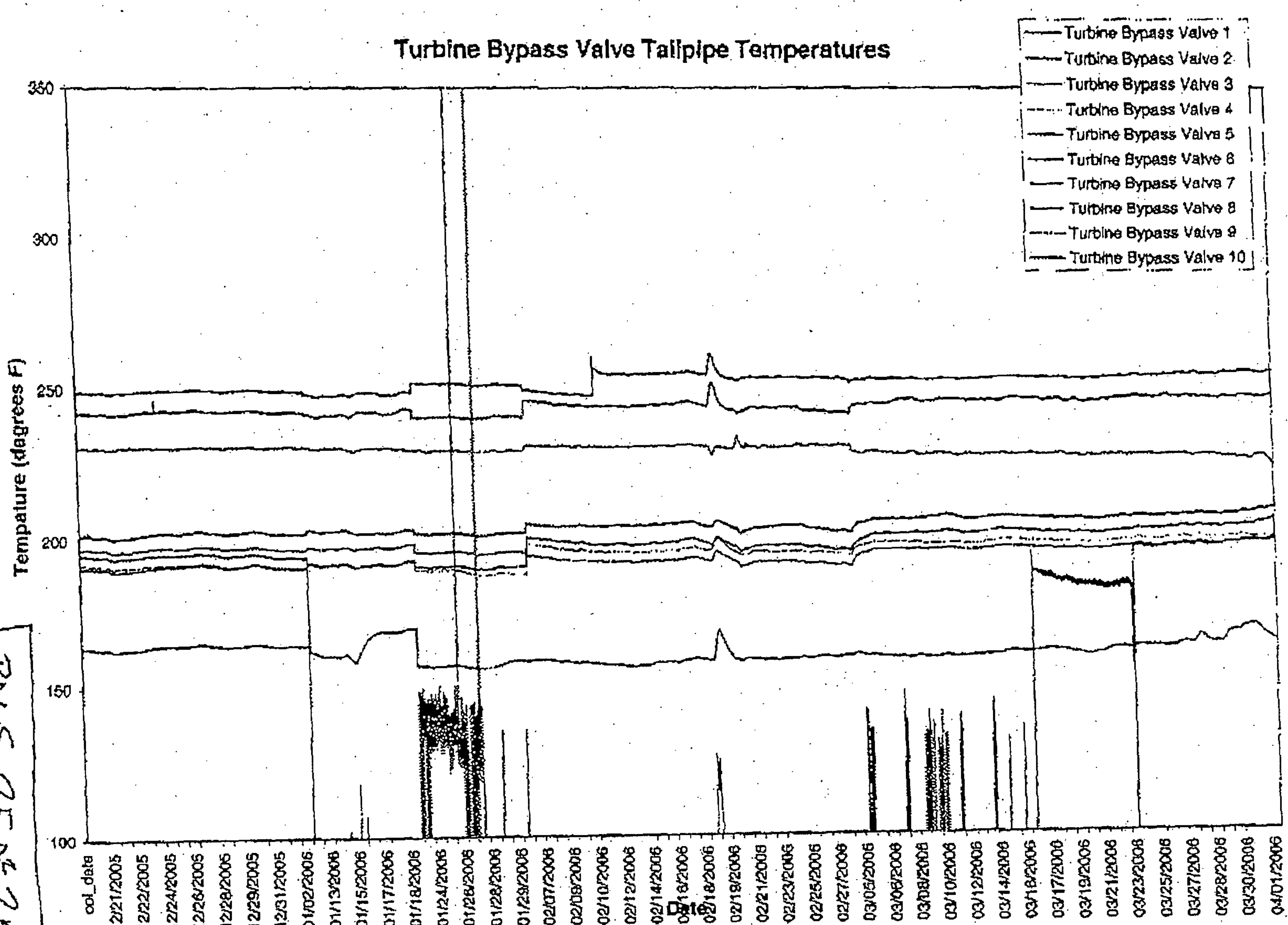
Known Losses (MWe per hour)	Loss	Tracking Item
• Operation < 1593	~ 0.1	N/A
• Actual Operation < Indicated Operation	~ 0.7	ER 04-1187
• LCV-101-3B Seat Leakage	~ 0.13	WO 05-4597
• Main Steam Bypass Valves 1,5 & 7	~ 0.85	PM due in RFO26

System Engineering Observations and Recommendations:

- High Circ Water traveling screen dp's resulted because of ice and debris flushed into the river from the heavy rains this weekend. The Control Room needed to open the Recirc Gate to de-ice the intake bay to address this. As a result, the Condenser is operating at a higher backpressure and net generation is down by approximately 1 MWe. This will not be categorized as a loss per the PI's because it is caused by environmental conditions beyond plant managements control.
- Lower backpressure was achieved on 1/31/06 by throttling open the SJAE suction valves, PCV-OG-516A/B. Opening these valves during EPU summer operation may provide for lower backpressure.
- Cycle Isolation has been restarted. A blown fuse was found, presumably as a result of the UPS-2A restart. The work order is being left open to troubleshoot several computer points that are not indicating properly.

Thermal Performance Work Status

- Performed Heater Bay Thermography walkdown of un-instrumented high energy line valves to inspect for leaks during the 2/2/06 downpower. All valves inspected holding tight.


Turbine Bypass Valve Tailpipe Temperatures
350
300
250
200
150
100
Tempature (degrees F)
Date
col_date
12/21/2005
12/22/2005
12/24/2005
12/26/2005
12/28/2005
12/29/2005
12/31/2005
01/02/2006
01/13/2006
01/15/2006
01/17/2006
01/18/2006
01/24/2006
01/26/2006
01/28/2006
01/29/2006
02/07/2006
02/09/2006
02/10/2006
02/12/2006
02/14/2006
02/16/2006
02/18/2006
02/19/2006
02/21/2006
02/23/2006
02/25/2006
02/27/2006
03/05/2006
03/06/2006
03/08/2006
03/10/2006
03/12/2006
03/14/2006
03/16/2006
03/17/2006
03/19/2006
03/21/2006
03/23/2006
03/25/2006
03/27/2006
03/28/2006
03/30/2006
04/01/2006
Turbine Bypass Valve 1
Turbine Bypass Valve 2
Turbine Bypass Valve 3
Turbine Bypass Valve 4
Turbine Bypass Valve 5
Turbine Bypass Valve 6
Turbine Bypass Valve 7
Turbine Bypass Valve 8
Turbine Bypass Valve 9
Turbine Bypass Valve 10

NEC017912