INL/EXT-09-16120

Independent Review of Mitigating System Performance Indicator Reporting in the EPIX Database

Thomas E. Wierman

May 2009

The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance

INL/EXT-09-16120

Independent Review of Mitigating System Performance Indicator Reporting in the EPIX Database

Thomas E. Wierman

May 2009

Idaho National Laboratory
Idaho Falls, Idaho 83415
http://www.inl.gov

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Independent Review of Mitigating System Performance Indicator Reporting in the EPIX Database

May 28, 2009

Thomas E. Wierman (INL)

Table of Contents

Independent Review of Mitigating System Performance Indicator Reporting in the EPIX Database

The staff at the Idaho National Laboratory (INL) has been reading and classifying mitigating system performance index (MSPI) equipment performance information exchange (EPIX) data to support the industry trends program and to support the independent review of MSPI failure data as requested by the NRC. The purpose of the review is to verify the component, failure mode, and method of detection.

This task is to select reports from EPIX and determine if their categorization as MSPI or non-MSPI failures is consistent with the development of unreliability baseline failure rates, and whether this significantly affects estimates of plant risk.

This review is of all MSPI devices in EPIX that were reported as failures. The components include emergency generators; motor-driven, turbine-driven, and engine-driven pumps; and air and motor-operated valves. The date range for this report includes all MSPI device reported failures from 2003 to the most current EPIX data at the INL (up to the 3rd quarter 2008).

1 Overview of the EPIX Database

The EPIX database was developed as an improvement over the retired nuclear plant reliability database system (NPRDS) database and implemented in 1997 by the Institute of Nuclear Power Operations (INPO). The mission of EPIX is to promote excellence in nuclear power plant equipment performance through the exchange of component-level operating experience. Of primary interest to this discussion are the tables in EPIX that report failures of devices. The documents that describe and implement the EPIX data reporting requirements are: "*Equipment Performance and Information Exchange System (EPIX): Reporting Requirements*" (Reference 1) and "*Regulatory Assessment Performance Indicator Guideline*" (Reference 2).

The EPIX database is provided to the INL through the NRC sponsor to enable the analysis and reporting of U.S. Commercial Nuclear Power Plant (NPP) equipment operating performance. The EPIX database that is current at the INL is the 3rd quarter 2008 set of data.

This discussion will require the reader to have an understanding of some of the facets of the EPIX database. The following sections provide this background information.

1.1 Device

The device table (EPIX table "tblAlternateDevice") is essentially a list of all components at the plants that are tracked. Devices can be Key, Sub-component, or Supporting. For example: a motor-operated valve is the key component; the valve body, actuator, and circuit breaker are sub-components; and the instrumentation to actuate the valve is a supporting component. The most important function of the device table is to identify the plant, component, and system, which is accomplished with the key device. EPIX is not built to be PRA-data-friendly in that it does not use simplified component IDs like a MOV in the RHR system. For use at the INL (RADS and SPAR), a complete translation table is built to identify each key device in PRA terminology.

The device table contains almost a million devices, of which approximately 140,000 are key devices. Figure 1 shows raw counts of the key devices in the device table in three categories.

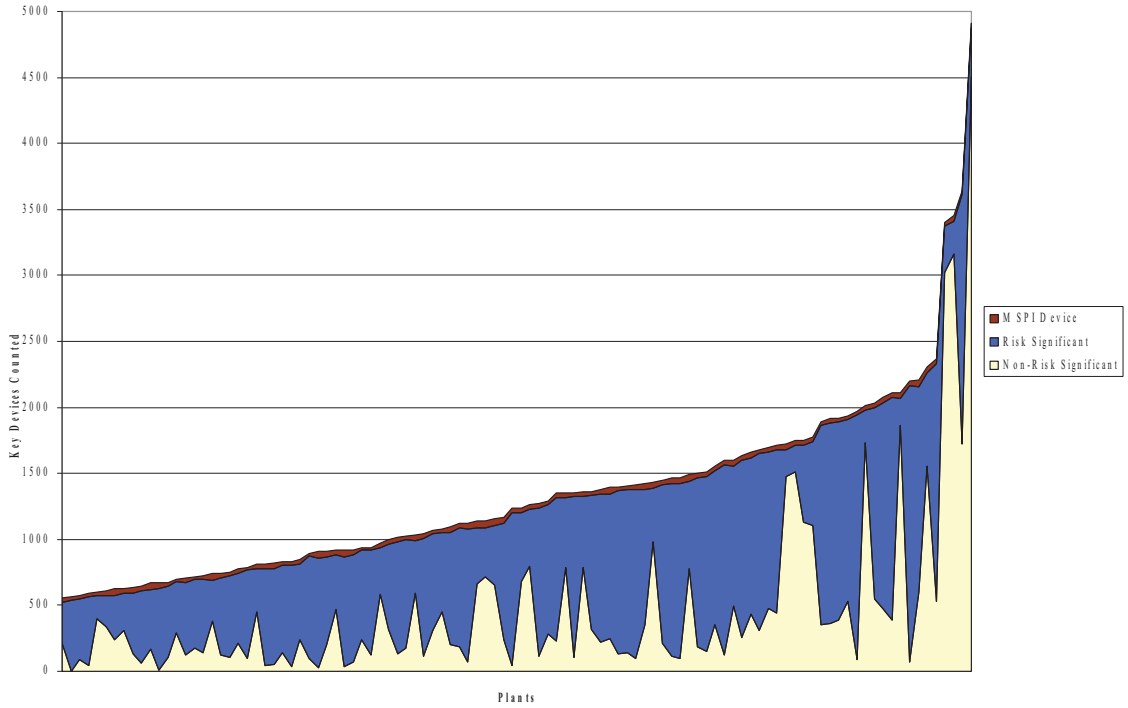

Figure 1. Distribution of MSPI and non-MSPI key devices by plant in EPIX.

The total key device count per plant ranges from 556 to 4,910 (the total area in Figure 1). The MSPI key device count per plant ranges from 17 to 59 (the red area in Figure 1, which is shown in detail in Figure 2). Risk-significant device counts per plant are shown in blue and the combined maintenance rule (MR) and generation loss devices are shown in yellow in Figure 1.

Each plant has determined the specific devices that are to be designated as MSPI in accordance with the controlling documents (References 1 and 2). The high Birnbaum devices (e.g., EDG, MDP, and TDP) appear to be representative of the installed device count in the MSPI systems. The plants at each end of the MSPI device count spectrum have large differences in the reports of valves. The plants at the low end report two or seven motor-operated valves (MOVs), while the plant at the high end reports 18 air-operated valves (AOVs) and 20 motor-operated valves (MOVs) per plant (total 38).

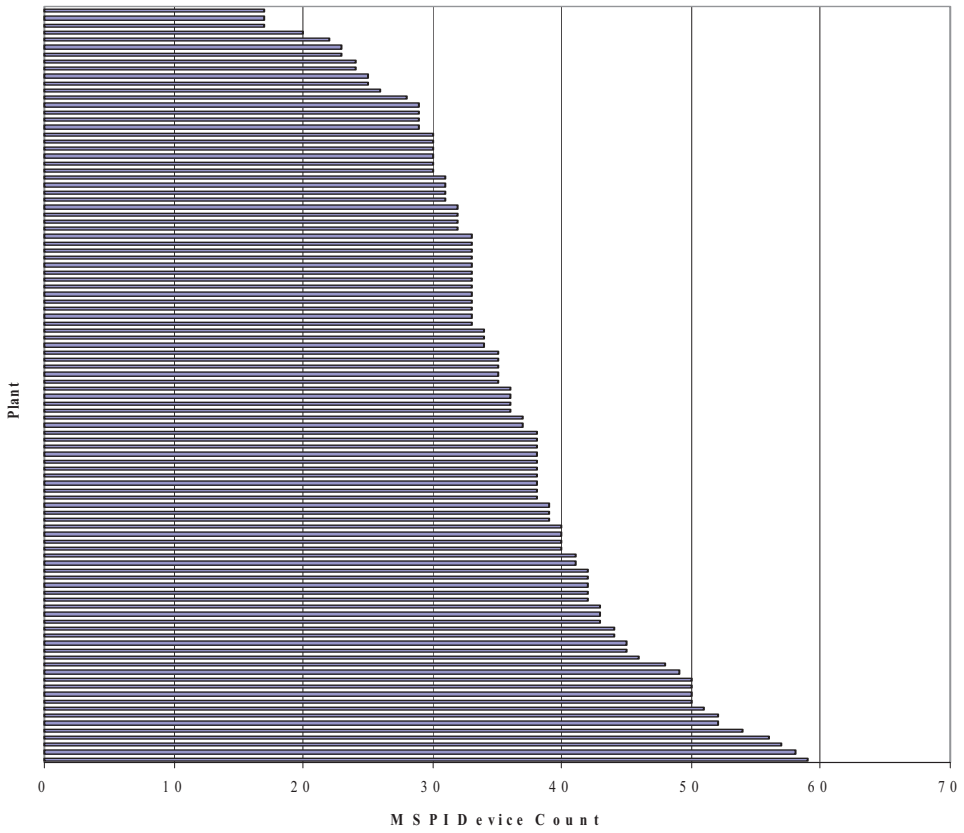

Figure 2. MPSI device count per plant in EPIX.

1.2 Failure

Component (key device) failures are reported in EPIX using two tables. The first is the table "dboFailure" and the second is "dboDeviceFailure." These two tables are joined (a database term) using the "FailureID." There can be more than one record in "dboDeviceFailure" joined to a single record in "dboFailure."

The table "dboFailure" contains information common to all individual component failures (failure discovery and end dates, plant status, discovery method, etc). The table "dboDeviceFailure" contains specific information about each device affected by the failure. For example: the MOV circuit breaker fails to shut causing the MOV key device to fail to operate. This event would contain two device failure records. The circuit breaker (supporting component) would have a device failure mode of fail-to-close. The MOV (key device) would have a device failure mode of fail-to-operate. In addition, the failure cause, preventive action, and corrective action would be listed for each device. The database also contains a table with the failure narrative(s).

A specialized sub-table to "dboFailure" contains MSPI failure information. It essentially answers the questions: "Is this an MSPI failure; and if not, why is it not?" This table has only 1,890 records (1,060 are MSPI failures) compared to 44,772 failure records in EPIX. Presumably, any failure not in the MSPI failure table is not an MSPI failure. The discovery date goes back to 1996.

Figure 3 shows the counts of MSPI failures reported at each plant by year. The colored bars show the mean (top of the bar) and the median (bottom of the bar) of MSPI failure counts per plant and the whiskers show the 95th and 5th percentiles of MSPI failure counts at a plant. The trend line shows that the mean number of reported MSPI failures per plant has remained relatively constant since 2003. However, the number of MSPI failures reported varies considerably from plant-to-plant. Several plants have reported zero MSPI failures per year from 2003 - 2007 (the range for the whole period is 0 – 20 per plant with a single plant reporting zero MSPI failures for the 5-year period). Only the current 104 operating plants were considered.

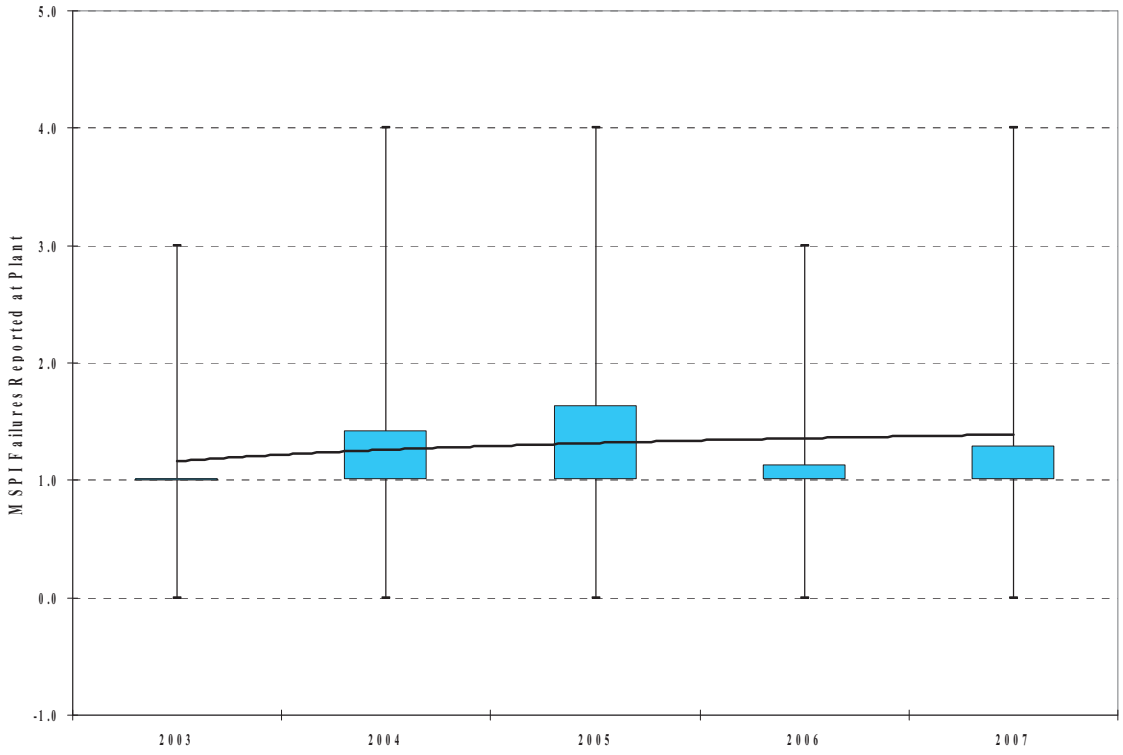

Figure 3. Distribution of MSPI failures at plants by year.

2 MSPI Data Review Methodology

The MSPI data review was implemented in the INL data collection database, which also collects information to support the common-cause failure (CCF) database and the component performance trending calculations. The MSPI data review data collection was set up so that INL staff had access to the original EPIX failure data and the guidance available in References 1 and 2. The staff reviewed the EPIX failure record and made a determination of what the appropriate failure mode should be based on how the failure would be applied in a probabilistic risk assessment (PRA).

2.1 Data Conversion

The failure mode selected for each failure record comes from Table 1. Since this effort also supports the standardized plant assessment risk (SPAR) models, the collection of

failure modes is broader than the MSPI collection. Table 1 shows the mapping of the collected failure modes to the MSPI failure modes. Note that the MSPI failure mode scheme does not have a failure mode to describe the failure to run < 1 hour (for pumps). The INL failure collection effort is now collecting that piece of information. It is uncertain whether to consistently convert these to fail-to-start or fail-to-run, so the failure to run < 1 hour is retained. This causes some of the differences noted in Section 3.

Table 1. Lookup table to convert INL failure mode to MSPI failure mode.

INL Collection Failure Modes	MSPI Failure Modes
Fail to Close	Fail on Demand
Fail to Control	Fail on Demand
Fail to Load/Run	Fail to Load/Run
Fail to Open	Fail on Demand
Fail to Operate	Fail on Demand
Fail to Run	Fail to Run
Fail to Run <1H	Fail to Run <1H
Fail to Start	Fail to Start
Fail to Stop	Unavailable (T&M)
Leak (External)	Unavailable (T&M)
Leak (Internal)	Unavailable (T&M)
Spurious Closing	Unavailable (T&M)
Spurious Opening	Unavailable (T&M)
Spurious Operation	Unavailable (T&M)
Unavailable (T&M)	Unavailable (T&M)

The MSPI failure modes reported in EPIX are inconsistent (MSPI-S, MSPI-D, and MSPI-SD are used interchangeably). Table 2 shows the lookup table developed at the INL to create enough consistency to perform this evaluation. The lookup table is based on component types and failure modes since demand failures have different meanings between pumps and generators and valves and circuit breakers. Whether or not the failure is a MPSI failure determines whether the MSPI failure mode is "Unavailable T&M" or the listed MSPI failure mode.

Table 2. Lookup table to convert MSPI failure mode to a consistent failure mode.

Component Type	MSPI FM	MSPI Failure?	MSPI Failure Mode Corrected	MSPI Failure Modes
AOV	(MSPI-D)	Y	(MSPI-D)	Fail on Demand
AOV	(MSPI-D)	N	(MSPI-D)	Unavailable (T&M)
AOV	(MSPI-SD)	Y	(MSPI-D)	Fail on Demand
AOV	(MSPI-SD)	N	(MSPI-D)	Unavailable (T&M)
CRB	(MSPI-SD)	Y	(MSPI-D)	Fail on Demand
CRB	(MSPI-SD)	N	(MSPI-D)	Unavailable (T&M)
EDP	(MSPI-D)	Y	(MSPI-S)	Fail to Start
EDP	(MSPI-D)	N	(MSPI-S)	Unavailable (T&M)
EDP	(MSPI-R)	Y	(MSPI-R)	Fail to Run
EDP	(MSPI-R)	N	(MSPI-R)	Unavailable (T&M)
EDP	(MSPI-SD)	Y	(MSPI-S)	Fail to Start
EDP	(MSPI-SD)	N	(MSPI-S)	Unavailable (T&M)
GEN	(MSPI-L)	Y	(MSPI-L)	Fail to Load/Run
GEN	(MSPI-L)	N	(MSPI-L)	Unavailable (T&M)
GEN	(MSPI-R)	Y	(MSPI-R)	Fail to Run
GEN	(MSPI-R)	N	(MSPI-R)	Unavailable (T&M)
GEN	(MSPI-S)	Y	(MSPI-S)	Fail to Start
GEN	(MSPI-S)	N	(MSPI-S)	Unavailable (T&M)
GEN	(MSPI-SD)	Y	(MSPI-S)	Fail to Start
GEN	(MSPI-SD)	N	(MSPI-S)	Unavailable (T&M)
HOV	(MSPI-D)	Y	(MSPI-D)	Fail on Demand
HOV	(MSPI-D)	N	(MSPI-D)	Unavailable (T&M)
MDP	(MSPI-D)	Y	(MSPI-S)	Fail to Start
MDP	(MSPI-D)	N	(MSPI-S)	Unavailable (T&M)
MDP	(MSPI-R)	Y	(MSPI-R)	Fail to Run
MDP	(MSPI-R)	N	(MSPI-R)	Unavailable (T&M)
MDP	(MSPI-SD)	Y	(MSPI-S)	Fail to Start

Component Type	MSPI FM	MSPI Failure?	MSPI Failure Mode Corrected	MSPI Failure Modes
MDP	(MSPI-SD)	N	(MSPI-S)	Unavailable (T&M)
MOV	(MSPI-D)	Y	(MSPI-D)	Fail on Demand
MOV	(MSPI-D)	N	(MSPI-D)	Unavailable (T&M)
MOV	(MSPI-SD)	Y	(MSPI-D)	Fail on Demand
MOV	(MSPI-SD)	N	(MSPI-D)	Unavailable (T&M)
TDP	(MSPI-D)	Y	(MSPI-S)	Fail to Start
TDP	(MSPI-D)	N	(MSPI-S)	Unavailable (T&M)
TDP	(MSPI-R)	Y	(MSPI-R)	Fail to Run
TDP	(MSPI-R)	N	(MSPI-R)	Unavailable (T&M)
TDP	(MSPI-SD)	Y	(MSPI-S)	Fail to Start
TDP	(MSPI-SD)	N	(MSPI-S)	Unavailable (T&M)

2.2 Device Failure Mode and MSPI Failure Mode Correlation

Table 3 shows the unique pairs of device failure modes in EPIX with the MSPI failure mode suffix removed and shown separately as column headings. For example, the "operated, but not within specified parameters" device failure mode always has the MSPI failure mode string "MSPI-SD" added as a suffix. The entry of a number at the intersection shows the number of times that device failure/MSPI failure mode was used in the data for that component.

In addition, the data collected in EPIX does not screen these failure modes as appropriate to the component type the failure is describing, which leads to MSPI failure modes of fail to start for valves as shown in Table 2 and Table 3. Also note that MSPI-S (start), MSPI-D (demand), and MSPI-SD (start demand except diesels) are used interchangeably

Table 3. Matrix of EPIX device failure modes and MSPI failure modes.

Comp Type	Device Failure Mode	(MSPI-D)	(MSPI-L)	(MSPI-R)	(MSPI-S)	(MSPI-SD)
AOV	discovered to be unable to close (MSPI-D)	2				
AOV	discovered to be unable to open (MSPI-D)	3				
AOV	external leakage (MSPI-D)	2				
AOV	failed to close on demand (stuck open) (MSPI-D)	1				
AOV	failed to close within setpoint tolerance (MSPI-D)	1				
AOV	failed to control (MSPI-D)	11				
AOV	failed to open on demand (stuck closed) (MSPI-D)	4				
AOV	failed to open within setpoint tolerance (MSPI-D)	1				
AOV	failed to remain closed (drifted off closed seat) (MSPI-D)	2				
AOV	found unavailable during nondemand observation (MSPI-SD)					1
AOV	internal leakage when fully seated (MSPI-D)	3				
AOV	misalignment-human error (MSPI-SD)					1
AOV	operated, but not within specified parameters (MSPI-SD)					7
AOV	partially opened on demand (not stuck closed) (MSPI-D)	1				
AOV	premature opening (MSPI-D)	1				
AOV	unaffected by failure (MSPI-SD)					2
CRB	operated, but not within specified parameters (MSPI-SD)					2
EDP	discovered to be unable to run for mission time (MSPI-R)			3		
EDP	discovered to be unable to start (MSPI-SD)					2
EDP	external leakage (MSPI-D)	2				
EDP	failed to start on demand (MSPI-D)	1				
EDP	found unavailable during nondemand observation (MSPI-SD)					1
EDP	spuriously started (MSPI-D)	1				
EDP	tripped/stopped during warmup (	4				
GEN	corrective maintenance prior to failure (MSPI-SD)					3
GEN	discovered to be unable to load (MSPI-L)		42			

Comp Type	Device Failure Mode	(MSPI-D)	(MSPI-L)	(MSPI-R)	(MSPI-S)	(MSPI-SD)
GEN	discovered to be unable to run for mission time (MSPI-R)			37		
GEN	discovered to be unable to start (MSPI-SD)					16
GEN	edg did not reach rated rpm & v on auto start (MSPI-S)				11	
GEN	edg did not reach rated rpm & v on manual start (MSPI-S)				24	
GEN	edg tripped after warmup (>1hr.) (MSPI-R)			35		
GEN	edg tripped during auto loading & warmup (		13			
GEN	edg tripped during manual loading & warmup (		36			
GEN	erratic output (MSPI-S)				15	
GEN	failed to start on demand (not edg) (MSPI-S)				1	
GEN	failed to stop (not edg) (MSPI-S)				1	
GEN	found during observation (MSPI-S)				3	
GEN	found unavailable during nondemand observation (MSPI-SD)					20
GEN	high output (MSPI-S)				3	
GEN	misalignment-human error (MSPI-SD)					7
GEN	not yet specified (MSPI-SD)					5
GEN	operated, but not within specified parameters (MSPI-SD)					34
GEN	preventive maintenance (MSPI-SD)					4
GEN	unaffected by failure (MSPI-SD)					81
GEN	unavailable, not failed (MSPI-SD)					45
GEN	unstable v/a/frequency control (not edg) (MSPI-S)				3	
HOV	failed to close on demand (stuck open) (MSPI-D)	1				
HOV	failed to open on demand (stuck closed) (MSPI-D)	2				
MDP	corrective maintenance prior to failure (MSPI-SD)					10
MDP	design change to improve reliability/efficiency (MSPI-SD)					2
MDP	discovered to be unable to run for mission time (MSPI-R)			30		
MDP	discovered to be unable to start (MSPI-SD)					21
MDP	external leakage (MSPI-D)	22				
MDP	failed to start on demand (MSPI-D)	112				
MDP	failed to stop on demand (MSPI-D)	3				
MDP	found unavailable during nondemand observation (MSPI-SD)					34
MDP	misalignment-human error (MSPI-SD)					16
MDP	not yet specified (MSPI-SD)					11
MDP	operated, but not within specified parameters (MSPI-SD)					37
MDP	ran, but failed to develop adequate flow/pressure (MSPI-D)	17				
MDP	spuriously started (MSPI-D)	4				
MDP	tripped/stopped after warmup (>1 hr.) (MSPI-R)			37		
MDP	tripped/stopped during warmup (	17				
MDP	unaffected by failure (MSPI-SD)					60
MDP	unavailable, not failed (MSPI-SD)					36
MOV	corrective maintenance prior to failure (MSPI-SD)					4
MOV	discovered to be unable to close (MSPI-D)	3				
MOV	discovered to be unable to open (MSPI-D)	5				
MOV	external leakage (MSPI-D)	4				
MOV	failed to close on demand (stuck open) (MSPI-D)	24				
MOV	failed to close within setpoint tolerance (MSPI-D)	1				
MOV	failed to control (MSPI-D)	12				
MOV	failed to open on demand (stuck closed) (MSPI-D)	13				
MOV	failed to open within setpoint tolerance (MSPI-D)	3				
MOV	found unavailable during nondemand observation (MSPI-SD)					10
MOV	internal leakage due to being improperly seated (MSPI-D)	1				
MOV	internal leakage when fully seated (MSPI-D)	10				
MOV	operated on required demand (MSPI-D)	2				
MOV	operated, but not within specified parameters (MSPI-SD)					8
MOV	partially closed on demand (not stuck open) (MSPI-D)	3				

Comp Type	Device Failure Mode	(MSPI-D)	(MSPI-L)	(MSPI-R)	(MSPI-S)	(MSPI-SD)
MOV	partially opened on demand (not stuck closed) (MSPI-D)	3				
MOV	unaffected by failure (MSPI-SD)					4
MOV	unavailable, not failed (MSPI-SD)					9
TDP	corrective maintenance prior to failure (MSPI-SD)					1
TDP	discovered to be unable to run for mission time (MSPI-R)			13		
TDP	discovered to be unable to start (MSPI-SD)					7
TDP	external leakage (MSPI-D)	4				
TDP	failed to start on demand (MSPI-D)	18				
TDP	failed to stop on demand (MSPI-D)	1				
TDP	found unavailable during nondemand observation (MSPI-SD)					12
TDP	misalignment-human error (MSPI-SD)					1
TDP	not yet specified (MSPI-SD)					2
TDP	operated, but not within specified parameters (MSPI-SD)					22
TDP	ran, but failed to develop adequate flow/pressure (MSPI-D)	5				
TDP	spuriously started (MSPI-D)	2				
TDP	tripped/stopped after warmup (>1 hr.) (MSPI-R)			8		
TDP	tripped/stopped during warmup (	13				
TDP	unaffected by failure (MSPI-SD)					15
TDP	unavailable, not failed (MSPI-SD)					21

3 MSPI Data Review Results

The review of the EPIX MSPI component failure data either verified the EPIX MSPI supplied failure mode or identified a more appropriate failure mode.

The comparison of the failure modes is accomplished through the translations shown in Table 1 and Table 2. Tables 4 through 10 show these results at a high level. In Tables 4 through 10, the columns labeled “EPIX MSPI Failure Mode” are the MSPI failure modes entered into EPIX by the industry, the subsequent column headings are the failure modes determined by INL staff. Appendix A gives a detailed presentation of the individual failures that do not fall in the green highlighted table entries (those where there is no match between the failure modes).

The column, EPIX MSPI Failure Mode, is a translation of the EPIX supplied MSPI failure mode which is appended to the device failure mode in the device failure table. The failure mode “Unavailable T&M” was created to show that the event was not a countable MSPI failure; rather the event was an unavailability of the piece of equipment. “Unavailable T&M” is equivalent to “Not an MSPI failure.”

The green highlighted cells indicate the number of failure records observed for each failure mode where the INL review agreed with the original EPIX determination. All other cells indicate the degree of disagreement between the two. It is not unusual for the INL EPIX check to reclassify a MSPI failure as a non-MSPI failure. A listing of some of the reasons why there are differences is shown after these tables.

Table 4 shows the results for the comparison of emergency generator failure modes. The failure mode with the highest rate of error is the MSPI fail-to-start failure mode. Of the 104 reported EDG fail-to-start events, the INL review agreed with that failure mode assignment for only 64 events. The INL review determined that 17 events should have

been fail-to-Load/Run, four should have been fail-to-run and 19 should have been Unavailable T&M. Most of the misclassification is due to a systemic (not random) problem with the EPIX data collection software. The proliferation of device failure modes mapped to the MSPI-S and -SD MSPI failure mode leads to the large variation shown for the fail-to-start failure mode.

Table 4. Emergency generator failure mode comparison matrix.

EPIX MSPI Failure Mode	Fail to Start	Fail to Load/Run	Fail to Run	Unavailable (T&M)	Total
Fail to Start	64	17	4	19	104
Fail to Load/Run		75		5	80
Fail to Run		2	53	2	57
Unavailable (T&M)	5	9	6	178	198
Total	69	103	63	204	439

Table 5 and Table 6 show the results of failure mode comparisons for motor-operated valves (MOVs) and air-operated valves (AOVs). For valves (and circuit breakers), the EPIX assignment of whether the failure is an MSPI failure is dependent on the direction of the observed failure (fail-to-open or fail-to-close) and the PRA required direction of the failure for that specific device. If the PRA failure is fail-to-open, and the observed failure is fail-to-close, the event is designated as a non-MSPI failure (which typically maps to Unavailable T&M).

To meet the wide range of data applications, the INL data collection allows for collecting the specific failure direction, or fail-to-operate when the failure direction could not be determined, regardless of the PRA failure direction. This item alone accounts for most of the reclassifying of "Unavailable T&M" to fail-on-demand.

Table 5. Motor operated valve failure mode comparison matrix.

EPIX MSPI Failure Mode	Fail on Demand	Unavailable (T&M)	Total
Fail on Demand	52	10	62
Unavailable (T&M)	24	33	57
Total	76	43	119

Table 6. Air operated valve failure mode comparison matrix.

EPIX MSPI Failure Mode	Fail on Demand	Unavailable (T&M)	Total
Fail on Demand	22	5	27
Unavailable (T&M)	4	12	16
Total	26	17	43

Table 7, Table 8 and Table 9 show the results for the comparison of motor, turbine, and engine-driven pump failure modes. The failure mode with the highest rate of error is the MSPI fail-to-start failure mode. Most of the misclassification is due to a systemic (not random) problem with the EPIX data collection software as noted in Section 2. The proliferation of device failure modes mapped to the MSPI-S and -SD MSPI failure mode leads to the large variation shown in the fail-to-start row in Table 7, Table 8 and Table 9.

Table 7. Motor driven pump failure mode comparison matrix.

EPIX MSPI Failure Mode	Fail to Start	Fail to Run <1H	Fail to Run	Unavailable (T&M)	Total
Fail to Start	138	14	24	31	207
Fail to Run <1H					0
Fail to Run	1	5	46	5	57
Unavailable (T&M)	15	2	19	169	205
Total	154	21	89	205	469

Table 8. Turbine driven pump failure mode comparison matrix.

EPIX MSPI Failure Mode	Fail to Start	Fail to Run <1H	Fail to Run	Unavailable (T&M)	Total
Fail to Start	38	11	8	3	60
Fail to Run <1H					0
Fail to Run	1	4	10		15
Unavailable (T&M)	10	2	2	56	70
Total	49	17	20	59	145

Table 9. Engine driven pump failure mode comparison matrix.

EPIX MSPI Failure Mode	Fail to Start	Fail to Run <1H	Fail to Run	Unavailable (T&M)	Total
Fail to Start					0
Fail to Run <1H					0
Fail to Run			3		3
Unavailable (T&M)				3	3
Total	0	0	3	3	6

Table 10 shows the results of failure mode comparisons for hydraulic-operated valves (HOVs) and circuit breakers.

Table 10. Hydraulic operated valve and circuit breaker failure mode comparison matrix.

Component Type	EPIX MSPI Failure Mode	Fail on Demand	Unavailable (T&M)	Total
HOV	Fail on Demand	2		2
HOV	Unavailable (T&M)	1		1
CRB	Fail on Demand			0
CRB	Unavailable (T&M)	1	1	2
	Total	4	1	5

Comments on a sampling of failure events reviewed during this effort on why MSPI failure modes are different than the INL coded failure modes. A detailed listing of the EPIX failure events where there is disagreement between industry and the INL can be found in Appendix A.

1. According to the EPIX guidelines, failure of a component outside the key component boundary should be coded as the failure of that component and the key component should be Unavailable, unless the key component subsequently fails. There are several instances in EPIX where this guidance is not followed.

2. Incorrect application of the Load/Run or 1-hour failure criterion for running devices.
3. Reporting of only the EDG output breaker (a supporting component) and not the full EDG key component. To correct this error, the INL manually adds the EDG key component and assigns the applicable failure mode to it. Most of these changes result in adding a fail-to-load/run MSPI failure.
4. Cases have been observed where EPIX has called an event an MSPI failure when a component failure would only occur given another event, but the conditioning event never happened. For example, a component might not be able to function during a seismic event. Unless there was a seismic event, the INL deems these events as Unavailable, not a failure.
5. The pump circuit breaker trips open while the pump is running; the pump is designated as "Unaffected by Failure (MSPI-SD)". Reference 2 shows that EPIX considers the breaker to be inside the pump boundary, therefore this event should have been counted as an MSPI failure.
6. The RCIC pump flow controller failed and the RCIC pump was not considered failed. The INL review felt that this should have been an MSPI failure.
7. A post-maintenance test (PMT) revealed a failure due to the maintenance and the event was designated as an MSPI failure. Reference 2 guidance indicates that PMT should not be classified as a failure, rather as Unavailable.
8. The EDG established load but experienced erratic output. The failure mode was designated as "Erratic Output (MSPI-S)", which maps to fail-to-start instead of fail-to-load/run. This is an example of the problems with the MSPI failure mode string being automatically appended to the device failure mode string. For those device failure modes that are not descriptive of the PRA failure mode, the appended MSPI failure mode is always MSPI-S,-D, or –SD. This biases these entries towards the fail-to-start failure mode and away from the fail-to-run and fail-to-load/run failure modes.
9. The TDP governor did not regulate speed and the pump was manually tripped before automatically tripping. The event was designated as a non-MSPI failure. The INL review felt that this should be an MSPI failure.
10. Pump seal water flow problems. There seems to be inconsistency in the interpretation of pump operability when seal water flow is lost or degraded.
11. A leaking water jacket was called an MSPI failure, but there was no indication that the amount of water leaking would have harmed the component. The INL review felt that this should not be an MSPI failure.
12. A tagged-out pump was called an MSPI failure. The INL review felt that this should not be an MSPI failure.
13. A non-functioning delta-pressure gauge was called a pump MSPI failure. With no indication that this would lead to failure of the pump, the INL review felt that this should not be an MSPI failure.

14. Valves are designated as MSPI failures or not, based on the direction of the failure and whether or not that failure direction is safety-significant. This is a source of many observed differences between the INL determined failure mode and the EPIX listed failure mode. The INL coding identified these events as a failure to reposition in the intended direction: fail-to-open or fail-to-close (when that can be discerned).
15. There have been a number of instances where the key component was called Unavailable Not Failed when a sub-component (e.g., pump motor) failed. The INL contends that it is a pump failure when the pump motor fails. In addition, due to the idiosyncrasies of EPIX, Unavailable Not Failed is always mapped to fail-to-start, which is not necessarily correct.
16. Hydrogen voiding in the suction of the spare HPI Charging Pump was listed as not an MSPI failure. INL felt otherwise.
17. Circuit breaker charging motor/spring failures are designated as Unavailable if detected right away. Failure of the breaker charging motor/spring results in a possible failure on the next demand to start. The INL feels that these failures should be an MSPI failure if the breaker is left in that condition for any length of time. The only ones to qualify for Unavailable are those where the operator is there at the breaker and detects the condition (noise, indicating lights).
18. A service water pump experienced high vibration and failed bearings but was not called an MSPI failure. The INL review felt that this should be an MSPI failure.
19. The loss of control power to an AFW pump governor was not listed as an MSPI failure. The INL review felt that this should be an MSPI failure.
20. A 6 drop per minute leak on the EDG radiator was called an MSPI failure, but there was no indication that this amount of water leaking would have harmed the component. The INL review felt that this should not be an MSPI failure.
21. Significant (17 of 20 tubes) fouling of the HPI pump lube oil coolers was not labeled as an MSPI failure. The INL review felt that this should be an MSPI failure-to-run.
22. An EDG was leaking water into the oil while shutdown. Discovered while preparing for a test run. The test run was not conducted. The EDG had been inoperable for 5-days. The leakage would have been greater when running. EPIX listed this as not an MPSI failure. The INL review felt that this should be an MSPI failure.
23. Sand filling the service water pump motor coolers resulted in a complete loss of service water flow but was not called an MSPI failure in EPIX. INL lists this as an MSPI failure.
24. An EDG experienced an elevated crankcase pressure over two times normal, with oil spraying from shaft seals, and high exhaust temperature. This event was coded as not an MSPI failure. The INL review felt that this should be an MSPI failure.

25. EDGs operating in droop-mode experience load swings. Some EPIX records say this is not an MSPI failure, others say it is. The INL position is that these are not MSPI failures.

The following is reproduced from the EPIX guidance and shows how to classify failures where the failed device is outside the MSPI devices boundary:

> Failures and Discovered Conditions of Non-Monitored Structures, Systems, and Components (SSC)
> Failures of SSC's that are not included in the performance index will not be counted as a failure or a demand. Failures of SSC's that would have caused an SSC within the scope of the performance index to fail will not be counted as a failure or demand. An example could be a manual suction isolation valve left closed which would have caused a pump to fail. This would not be counted as a failure of the pump. Any mis-positioning of the valve that caused the train to be unavailable would be counted as unavailability from the time of discovery. The significance of the mis-positioned valve prior to discovery would be addressed through the inspection process. (Note, however, in the above example, if the shut manual suction isolation valve resulted in an actual pump failure, the pump failure would be counted as a demand and failure of the pump.)

4 Conclusions

A full review of MSPI device failures from 2003 to current was performed by INL staff for the purposes of collecting data for the NRC industry trends program and to support the MSPI Technical Analysis and Support program.

The review shows that there were 275 device failure records for when the INL review did not agree with the EPIX coding for the failure mode, out of a total of 1,234 MSPI device failure records in the current dataset available at the INL. The INL staff believes that the MSPI failure mode is correct approximately 78 percent of the time.

The review also shows that there remain some significant problems in the collection of data for the MSPI.

- Misunderstanding by coding personnel of component boundaries.
- Post maintenance testing failures are misclassified as MSPI failures.
- There exists a systemic bias to the fail-to-start failure mode due to an inadequate data collection scheme that does not allow the data input to reflect independent assessment of the device failure mode and the MSPI failure mode.
- There exists a systemic confusion resulting from not screening the failure mode pick list to only those failure modes applicable to the component the failure is being applied to.

Inaccurate reporting contributes significantly to undercounting failures. Examples of this include assigning the observed failure to the wrong component, and not tying the failure to a key component; but the major quality shortcoming of the EPIX data is the prevalence of incorrect assignment of the component failure mode.

5 References

1. *Equipment Performance and Information Exchange System (EPIX): Reporting Requirements*, INPO 98-001, Revision 5, January 2007.
2. *Regulatory Assessment Performance Indicator Guideline*, NEI 99-02, Revision 5, July 2007.

MSPI Failure Compare NoMatch

Component Type *AOV*

Component Type AOV

EPIX MSPI Failure Mode Fail on Demand

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1106	AFW	Spurious Operation			Test
27778		Fail on Demand			
5/23/2003		failed to remain closed (drifted off closed seat) (MSPI-D)			
		(MSPI-D)	Y		

Inadvertent unlatching of the (1MS52) trip valve when the (1MS132) steam admission valve popped open, caused the AFW pump trip.
The MS132 valve popped off its closed seat as the plug and cage were binding during initial opening of the valve. As a result, an initial in-rush of steam caused mechanical agitation (shaking and vibration) of the steam line and the latching mechanism on the trip valve (1MS52) during the ST, causing it to unlatch.
The popping of the 1MS132 appears to have been caused by the valve plug and cage binding during initial opening of the piloted, cage guided, globe valve. This binding only occurred when steam was applied to the valve. A steam vortex and pressure wave formed as the inrush of steam through the cage impacted the valve plug immediately after the pilot lifted. As a result, the valve plug and stem assembly could shift slightly to the side and be rotated (much like a corkscrew) if the valve stem is not properly restrained at the coupling block.

1100	RHR	Leak (External)			Test
29200		Fail on Demand			
9/19/2003		external leakage (MSPI-D)			
		(MSPI-D)	Y		

On 09/19/03 at 22:40, during performance of IC-ST-IA-3004, HCV-386, SIRW tank SI-5 recirculation valve, failed acceptance criteria of pressure drop less than or equal to 3 PSIG in an hour. The actuator was leaking around the hand wheel stem and bonnet diaphragm.

1100	RHR	Leak (External)			Test
29200		Fail on Demand			
9/19/2003		external leakage (MSPI-D)			
		(MSPI-D)	Y		

On 09/19/03 at 22:40, during performance of IC-ST-IA-3004, HCV-386, SIRW tank SI-5 recirculation valve, failed acceptance criteria of pressure drop less than or equal to 3 PSIG in an hour. The actuator was leaking around the hand wheel stem and bonnet diaphragm.

Component Type AOV

EPIX MSPI Failure Mode Fail on Demand

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1131	AFW	Spurious Opening			Inspection
32903		Fail on Demand			
11/29/2004		failed to remain closed (drifted off closed seat) (MSPI-D)			
		(MSPI-D)	Y		

At 1449 on 11/29/04 it was noted that the loop 2 MDAFW 4" LCV was in the throttled position. AUOs were sent to the valve and they noticed the diaphragm was leaking and going out the vent on the bottom of the valve. This was an unplanned entry into LCO 3.7.1.2. WO 04-783506 was written. It was discovered that the air diaphragm in the valve operator was torn such that it could not keep the valve closed.
Justification: This is considered a functional failure. The 4" LCV is required to be able to close during a faulted steam generator accident to isolate AFW flow to the faulted S/G. The valve would not close with the torn diaphragm in the actuator. This is not considered a preventable functional failure. There was no ability to foresee the diaphragm manufacturing defect, the overpressure of the diaphragm, and the loss of torque on the capscrew which captures the diaphragm to the diaphragm plate. This was a manufacturing defect.

1032	SWN	Spurious Opening			Non-Test Demand
46020		Fail on Demand			
5/22/2008		premature opening (MSPI-D)			
		(MSPI-D)	Y		

While transferring SW (Salt Water) heat loads from 11 to 12 CCHX (Component Cooling Heat Exchanger), the 12 CCHX SW outlet flow control valve, 1-CV-5208, unexpectedly went from full shut to full open with only a 25% open control signal applied. The 12 CCHX was declared out of service and Unit 1 (U1) entered an unplanned LCO (Limiting Condition for Operation). Troubleshooting revealed the valve positioner for 1-CV-5208 was bound and would not rotate with valve movement.

Component Type AOV

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1039	HPI	Fail to Open			Non-Test Demand
31666		Unavailable (T&M)			
3/30/2004		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the performance of I&C PM, LP BACKUP N2 STATION 3B pressure regulator PCV-2277 was found low out of range. Desired range was 80-90 PSIG. PCV-2277 as found was 57.8 PSIG. The as found regulator output gauge read 100 PSIG, but until the regulator was isolated per the work order, the actual setting of the regulator was found to be 57.8 PSIG. Nitrogen Station 3B was not capable of performing its function to provide motive force to CV-0824 and CV-3070. Nitrogen Station 3B was not capable of performing its function due to a leaking check masking the actual pressure setting of the nitrogen station header. The leaking check valve was a known problem that had not been corrected yet. The lower pressure would prevent opening CV-3070 and would also affect the ability of CV-0824 to fully close if instrument air pressure had been allowed to drop below 60 psig

1039	SWN	Fail to Close			Non-Test Demand
31666		Unavailable (T&M)			
3/30/2004		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the performance of I&C PM, LP BACKUP N2 STATION 3B pressure regulator PCV-2277 was found low out of range. Desired range was 80-90 PSIG. PCV-2277 as found was 57.8 PSIG. The as found regulator output gauge read 100 PSIG, but until the regulator was isolated per the work order, the actual setting of the regulator was found to be 57.8 PSIG. Nitrogen Station 3B was not capable of performing its function to provide motive force to CV-0824 and CV-3070. Nitrogen Station 3B was not capable of performing its function due to a leaking check masking the actual pressure setting of the nitrogen station header. The leaking check valve was a known problem that had not been corrected yet. The lower pressure would prevent opening CV-3070 and would also affect the ability of CV-0824 to fully close if instrument air pressure had been allowed to drop below 60 psig

1106	SWN	Fail to Control			Non-Test Demand
32598		Unavailable (T&M)			
10/2/2004		failed to control (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

The SW flow for 11 CC heat exchanger failed high due to the flow device indicating low, causing 11CC heat exchanger to be inoperable.

Component Type *AOV*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1100	AFW	Fail to Close			Test
35272		Unavailable (T&M)			
5/23/2005		failed to control (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

On 5/23/05 at 1213, while removing jumpers, OP-ST-AFW-3007 was stopped due to a fuse opening for HCV-1107A, Steam Generator RC-2A Auxiliary Feedwater Inlet Valve. The fuse was replaced and HCV-1107A was taken to close, at which time both fuses opened.
Procedure was exited and AFW aligned IAW OI-AFW-1-CL-B with the exception of HCV-1107B, HCV-1108A and HCV-1108B which were closed. HCV-1107A switch was placed in the closed position. Work Request 83163 was written to facilitate repairs.
Troubleshot and found the diode wired in parallel with the coil of relay 94/1107A-2 shorted. Work Order 207440 was generated. A varistor was installed in place of diode. The PMT was satisfactory and the equipment was returned to service.

Component Type *CRB*

Component Type *CRB*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1064	ACP	Fail to Operate			Non-Test Demand
41762		Unavailable (T&M)			
2/15/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

The fast contacts located on the auxiliary switch of Normal Bus Breakers (N-Bkrs) were set incorrectly. This setting allowed the fast contacts to operate slower than designed. The slower operation of the contacts prevented the transfer from completing its fast transfer in less than 60 milliseconds (approximately 70-90 milliseconds).

Component Type *EDP*

Component Type EDP

EPIX MSPI Failure Mode Fail to Start

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1044	AFW	Fail to Run <1H			PMT
29394		Fail to Start			
7/11/2003		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

On 7/11/03 at 13:00 the 1B AF pump was started per a routine run per BwOP AF-7. It was noted ~2 minutes after engine start that gray smoke/mist was coming from the valve cover breathers. The engine was manually tripped at 13:04 by Operations and a troubleshooting team was formed to investigate the failure.
During the inspection, aluminum material was found in the airbox, this discovery lead to a detailed inspection of the combustion air blowers. This inspection revealed a failed combustion air blower and what appear to be failed bearings and indication of lubrication/cooling starvation. Definitive confirmation of bearing failure cannot be made without performing disassembly of the failed blower.

1047	AFW	Fail to Run <1H			Test
33672		Fail to Start			
3/3/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

During performance of the 2B Auxiliary Feedwater (AF) Pump ASME Surveillance, the diesel engine tripped on overspeed at approximately six minutes into the run. The 2B AF Pump was declared inoperable and On Line Risk went to yellow.

1046	AFW	Fail to Run <1H			Test
44528		Fail to Start			
3/21/2008		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

On 3/21/08, during a full load run of the 1B Aux Feedwater pump, small flames were observed between the exhaust manifold insulation and the engine block approximately 9 minutes into the run. The engine was tripped and the flames extinguished with a dry chemical fire extinguisher. The exhaust manifold was removed, the gasket was replaced with a new gasket (different design per the manufacturer), the rocker cover gasket was replaced, temporary insulation installed, and the pump was declared "available."

Component Type *EDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1044	AFW	Fail to Run <1H			Test
45820		Fail to Start			
6/16/2008		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

1B AF Pump tripped. 1B AF Pump was started at 10:31 and tripped at 10:46 on OVERSPEED. No speed adjustments had been made during this run.
This pump was being run to perform surveillances and troubleshooter in the following order.
1B AF Pump tripped while taking the initial vibration readings before any speed changes were made. The alarm on the local panel, which is still locked in, is OVERSPEED.
Bench testing of three PMGs (2008 event PMG, old 1995 PMG, and a new PMG out of stores) was performed. Bench testing revealed the output signal from the PMGs fluctuated (50-100Hz) and became more unreliable with slight changes in drive angle. Therefore, the troubleshooting effort concluded the failure of the 1B AF pump on Overspeed was due to the PMG output anomalies.

Component Type *GEN*

Component Type GEN

EPIX MSPI Failure Mode Fail to Load/Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1085	EPS	Unavailable (T&M)			PMT
38541		Fail to Load/Run			
4/22/2006		discovered to be unable to load (MSPI-L)			
		(MSPI-L)	Y		

While performing post maintenance testing on the Unit 2, 2CD EDG (2-OME-150-CD) between April 18th and April 24th, 2006, seven fuel injection pumps (2-PP-163-*-CD) seized. All failures were limited to the 2CD EDG only.

Summary of Root Cause and Corrective Actions to Prelude Recurrence

These events stem from two (2) Root Causes. The first was an inadequate barrier that permitted new fuel injection pumps to contain foreign material of sufficient size and hardness to damage the pumps. The second was due to an inefficient duplex filter design that ultimately allowed foreign material to enter the supply of fuel oil to the fuel injection pumps that was of sufficient size to damage the pumps.

1138	EPS	Unavailable (T&M)			Test
38636		Fail to Load/Run			
5/23/2006		discovered to be unable to load (MSPI-L)			
		(MSPI-L)	Y		

#3 EDG ABT did not swap back over to its normal power supply after being transferred to its emergency power supply IAW 0-OSP-EG-004.
The EDG #3 ABT transfer switch failed to operate due to an ABT control system failure (failure of ASCO transfer switch, SE control relay). The SE control relay was determined through impedance measurement to have an open circuit in the SE relay coil.
The SE relay is required in the voltage sensing circuit to initiate transfer switch operation(s). Failure of the SE relay coil (open circuit) was principally due to age related electrical/thermal stress fatigue. Component has been in service since approximately 1984 (> 20yrs).

1084	EPS	Unavailable (T&M)			Test
40668		Fail to Load/Run			
11/17/2006		discovered to be unable to load (MSPI-L)			
		(MSPI-L)	Y		

Bad testing procedure

As wire jumpers for the multi-meter are connected from phase 1 to phase 2 (neutral) to monitor frequency, and the associated fuse failed, it is surmised that the same faulted jumpers were used on the 1AB that were used on the 1CD on 11/28/2006 (see AR 805984). The faulted wire jumpers were not isolated as intended, but rather were shorted together, connecting phase 1 and 2 together. Shorting these phases resulted in the failed fuse upon development of the generator field (EDG start). This failure mode was not determined until 11/28/2006.

Component Type GEN

EPIX MSPI Failure Mode Fail to Load/Run

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1084	EPS	Unavailable (T&M)			Test
40667		Fail to Load/Run			
11/28/2006		discovered to be unable to load (MSPI-L)			
		(MSPI-L)	Y		

Bad testing procedure

On 11/28/06 Maintenance I&C technicians were assisting with the testing of the slow speed start on 1-OME-150-CD (Unit 1 CD Emergency Diesel Generator) per 1-OHP-4030-132-027CD (CD DIESEL GENERATOR OPERABILITY TEST TRAIN A) . The technician hooked up a set of test leads to the diesel watt meter. The leads the technician was using had both wires hooked up to one lead. This lead shorted phases 1 & 2 of the 1-CD diesel metering circuits resulting in an open fuse and loss of indication (i.e., phase, voltage, etc.) in the control room and locally at the 1-CD diesel.

The special test leads had been made up for other uses in the past and were accidentally used in this instance.

The inappropriate act was the failure of the technician to ensure the leads were hooked up correctly to prevent shorting the phases. The organization involved in the inappropriate act was Maintenance (MNT). The Work Process in use during the event was maintenance (MN). The Key Activity involved was Fieldwork (FW). The Human Error Type was Skill based.

1130	EPS	Unavailable (T&M)			Test
44658		Fail to Load/Run			
3/13/2008		discovered to be unable to load (MSPI-L)			
		(MSPI-L)	Y		

Looks like a sequencer issue.

Not sure why there are two records associated with this event. Looks like it should be a maintenance unavailability.

During the performance of 3-SR-3.8.1.9(3D OL) Diesel Generator breaker 1836 failed to trip when given a simulated Common Accident logic signal during step 7.8.26.1 of the SR.
Maintenance Troubleshooting Work Order 04-712707-000 was initiated to identify and correct the problem. Subsequent troubleshooting revealed that the 52STA switch contact 4-4C was not Closed when the diesel generator breaker 1836 was in the Closed position. Also, found Damaged Breaker Grounding Clamp Device, see attached supporting documentation.

Subsequent troubleshooting on WO 04-712707-000 revealed that the 52STA switch contact 4-4C was not Closed when the diesel generator breaker 1836 was in the Closed position. Replaced Breaker Ground Contact on the breaker which was damaged during racking in. The 52STA switch was also found to be defective and is being replaced under the Troubleshooting WO. OP's acquired the breaker contact for briefings on proper racking of this type of breaker.

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1144	EPS	Fail to Load/Run			Test
31651		Fail to Run			
11/5/2003		edg tripped after warmup (>1hr.) (MSPI-R)			
		(MSPI-R)	Y		

During performance of OSP-ELEC-S701 (Diesel Generator 1 semi-annual Operability Test), E-CB-DG1/7 tripped immediately upon parallel and DG-GEN-DG1 locked out.
During the Semi-Annual Operability test, the Division One EDG tripped and locked out (86 Lockout Relay actuated) when the DG1 output breaker was being closed to parallel the unit to offsite power. The unit was verified to be shut down and in a stable condition, and the local panels were inspected to attempt to determine the cause of the trip. An inspection of the Protective relays showed that the LOSS OF FIELD Relay DG-RLY-40/DG1 had a target dropped. DG-RLY-30/2/DG1 also had a target dropped indicating the 40 relay had tripped.
Maintenance and engineering personnel evaluated the population of relays affected by maintenance activities prior to the DG1 surveillance. Sixteen relays were replaced with calibrated spares. One of the calibrated spare relays failed causing this event. Five of the calibrated spare relays were tested by the initial start of DG1 and worked satisfactorily. Ten relays required further inspection. Maintenance personnel performed this inspection. No problems were identified.

1125	EPS	Unavailable (T&M)			PMT
37703		Fail to Run			
1/20/2006		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

ONE EDG WAS DECLARED INOPERABLE FOR APPROXIMATELY THREE MINUTES WHILE SWAPPING COMPONENT COOLING WATER PUMPS WHILE THE OTHER EDG WAS UNKNOWINGLY INOPERABLE FROM IMPROPER TORQUING OF AN EXHAUST VALVE LASH LOCK NUT DURING A PREVIOUS ENGINE OVERHAUL. After completion of the maintenance activities, a three hour test run of EDG 2 was performed. During this test run, a tapping noise was identified in the area of cylinders 4 and 5 at approximately 2000 hours on January 13, 2006. Discussions between the vendor representative and FENOC personnel present as well as examination of test data concluded that the tapping noise was due to a lash adjustment being off and that the cylinders were operating normally. Follow-up documentation was initiated to further investigate the noise at a later time. EDG 2 was declared operable on January 14, 2006 at 0000 hours. On January 20, 2006, at 1557 hours, the air start motors were tagged out for barring of the EDG prior to running the engine for post-maintenance testing after change out of a fuel filter. The top deck on EDG 2 was opened to investigate the tapping noise heard on January 13, and damage was discovered to the cylinder 4 left valve bridge. The left rocker arm of cylinder 4 was found with the lash adjustment screw lock nut missing from the top of the rocker arm. The missing lash adjustment screw lock nut was eventually located in the oil trough. The extent of damage to EDG 2 was isolated to cylinder 4. Repairs to the EDG 2 engine were initiated. On January 23, 2006, after completion of maintenance and testing activities, EDG 2 was declared operable at 0642 hours.
As a result of of the damage discovered to the cylinder 4 left valve bridge of EDG 2, the EDG would not have been able to supply power to its respective 4160 Volt Essential Bus for the seven days specified in the Safety Analysis Report. This condition existed from January 14, 2006, when EDG 2 was declared operable following preventive maintenance, until January 23, 2006, at 0642 hours when repairs to the engine were completed and EDG 2 declared operable.
During this timeframe, both EDG 1 (except for approximately 3 minutes as explained later under theAnalysis of Occurrence Section) and the non-Class lE diesel generator were Operable.

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1145	EPS	Unavailable (T&M)			Test
39395		Fail to Run			
6/28/2006		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

The Keep Warm system appears to be malfunctioning.

At 17:35 on 8/17/06, after approximately 10 minutes of operation during a planned surveillance test on Emergency Diesel Generator (EDG) A, a previously identified minor fuel oil leak (approximately 1 drop/minute) increased and required an unplanned engine shutdown.

The EDG had been declared inoperable at the start of the surveillance test and remained so following the leak. At its maximum, the leakrate was estimated at between 0.12 and 0.25 gpm. By 05:53 on 8/18, the leak had been repaired, the surveillance test completed, and the EDG restored to OPERABLE status. The fuel oil leak was initially identified on 6/28/06 at 16:48. Between 6/28 and 8/17, the EDG had been operated four times with a cumulative run time of approximately 3.1 hours. Note: Numerous Train B components were inoperable at varoius times during the EDG's period of inoperability.

On 10/26/06, the leak was determined to be from an approximately 350 degree circumferential crack in the copper tubing of the fuel supply line inside a 3/8" fitting to a pressure gauge. On 12/15/06, the cracked tubing was tested on a similar diesel generator. The tubing fully severed after approximately one hour of diesel generator operation at rated load. Thus it is concluded that the EDG was not capable of meeting its design basis between the originally identified leak on 6/28/06 and its return to operability on 8/18/06.

1024	EPS	Fail to Load/Run			Test
44632		Fail to Run			
3/3/2008		edg tripped after warmup (>1hr.) (MSPI-R)			
		(MSPI-R)	Y		

During performance of scheduled surveillance, FNP-1-STP-80.1, at 26 minutes into the one hour run at rated load, the 1B D/G Trouble alarm VA3 was received. Shortly after receipt of the trouble alarm, annunciator VA1 1B DG ENG SHUTDOWN was received coincident with all EPB parameters for the 1B DG falling to minimum and the output breaker DG08-1 opened.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1032	EPS	Fail to Load/Run			Test
26389		Fail to Start			
1/5/2003		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

EPIX coded this event as an MSPI Start Demand failure. The INL review believes that this event is not an MSPI Start Demand failure.

Unit 1 was at 100% and the 4Kv and 480 Volt Electrical Systems and Emergency Diesel Generator (EDG) System were in service. While performing STP O-008B-1 on 1B EDG, operators discovered that 1BKR152-1403, DG 1B TO 4KV BUS 14 Feeder Breaker, failed to close on demand. The breaker's Maintenance Rule function to provide power to vital loads was lost. The failure caused a delay in restoration of the 1B EDG. There were no other effects on plant operation Troubleshooting identified the problem to be with the 152B contact which failed. This prevented the close coil from being energized dues to a broken Lexan Cam follower. Lab results indicated the failure was due to low cycle fatigue. 1BKR152-1403 was replaced with a spare breaker. The replacement breaker was tested satisfactorily and returned to service. The broken cam follower was replaced with a different material cam follower.

1136	EPS	Unavailable (T&M)			Inspection
25824		Fail to Start			
1/6/2003		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	Y		

Changed the FM

1133	EPS	Unavailable (T&M)			PMT
27326		Fail to Start			
2/28/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

The cause of this failure was determined to be a loose wire on contact 3-6 of relay ES2AY. Fault exposure hours are being calculated due to the loose contact wire discovered on relay ES2AY which prevented the 86LOR relay from toggling after an emergency start of Diesel Generator 2A-A. The last time that the contact function was verified to operate correctly was on September 27, 2002 at which time the diesel generator emergency started following a loss of off site power from the Watts Bar Hydroelectric Plant. An evaluation of the 86LOR functions determined that as long as the diesel was aligned for "unit" operation, which is the normal alignment, the diesel would have functioned as designed. The 86LOR normally removes voltage droop from the system in the event of an emergency start. With the diesel aligned for "parallel" operation, it is inconclusive as to whether the presence of voltage droop would have maintained the bus above the voltage load shedding trip setpoint.

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1114	EPS	Fail to Load/Run			Test
27792		Fail to Start			
3/19/2003		erratic output (MSPI-S)			
		(MSPI-S)	Y		
	EPIX coded this event as an MSPI Start Demand failure. The INL review believes that this event is not an MSPI Start Demand failure.				
1142	EPS	Fail to Load/Run			Test
27401		Fail to Start			
3/28/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		
	Open and inspect for damage and clean heat exchanger, suspect debris intrusion due to failure of fine mesh SW strainer. Light lakeweed material on second pass inlet -- no tubing plugged -- inlet clean. Opened heat exchanger, cleaned and inspected. Replaced covers.				
1135	EPS	Unavailable (T&M)			Inspection
27944		Fail to Start			
4/15/2003		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		
	EPIX coded this event as an MSPI failure. The INL review believes that this event is not an MSPI failure.				
	At approximately 1100 on 4/15/03, an Equipment Operator (EO) reported that handswitch KJHS0183 for the "B" Diesel Generator (DG) Lube Oil Keepwarm Pump had been damaged. The switch was damaged when the panel door for MCC NG04DDF1 was opened during E-max testing per Preventive Maintenance document P705122.				
1117	EPS	Unavailable (T&M)			PMT
36921		Fail to Start			
6/11/2003		edg did not reach rated rpm & v on manual start (MSPI-S)			
		(MSPI-S)	Y		
	Changed the FM				

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1126	EPS	Fail to Load/Run			Test
30333		Fail to Start			
6/11/2003		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

PROBLEM DESCRIPTION: OPT-214A, TRAIN B DIESEL GENERATOR 1-02 OPERABILITY TEST.

AS FOUND CONDITION: OPERABLE WITH KNOWN (IDENTIFIED) JACKET WATCH LEAK.

CORRECTIVE ACTION: DURING THE RUN PROMPT TEAM ATTEMPTED TO TIGHTEN FLANGE WITH JACKET WATER LEAK. LEAK RATE INCREASED IN EXCESS OF ALLOWABLE LEAKAGE OF 2.4.2 GPH OPT DATA ALL MEETS ACCEPTANCE CRITERIA AND THE OPT IS CONSIDERED SAT WITH THE DG LEFT INOPERABLE DUE TO THE JW LEAK .

PROBABLE CAUSE: NORMAL EQUIPMENT DEGRADATION.

1040	EPS	Fail to Load/Run			PMT
28850		Fail to Start			
7/24/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

During performance of 0PT-12.2C on 7/24/03 following the DG3 outage the DG was loaded to 3500KW and 2000KVAR. After 1 to 3 minutes at this load, the AO noted that KW had risen to 3800 and Kvar had decreased to 250. The AO got the SROs attention and attempted to raise KVAR and lower KW. KW responded as expected but KVAR did not increase. With SRO and Tech. Reps. Concurrence, the AO attempted to raise KVAR again. At this time the KVAR indication pegged high greater than 2500 and generator stator amps indicated greater than 800 amps. The decision was made to lower load, separate from the bus and shutdown the DG. While the AO was lowering the load, generator stator amps and KVAR did not decrease until the generator circuit breaker was opened. 2.Problem Description / Investigation Summary The AC regulator board had been replaced as part of the exciter tuning activities during the DG outage. The board had been replaced due to material condition of the on-board components, not because the original board had failed. Prior to removal, a gain check was made on the original board in order to establish a base line operating point. The new board was installed and calibration performed utilizing the as-found gain in the set-up. A gain range test was made on the replacement board which supported the as-found gain of the original board. Dynamic testing of the newly calibrated voltage regulator was performed during the OP-39 unloaded maintenance run and excitation system operated as expected. The 0PT-12.2C operability test was then performed with the results as described in Section 1. Event Description. After the EDG was shutdown following the excitation system malfunction, the decision was made to replace the AC regulator board with another one from Stores. During the voltage regulator recalibration following board replacement the new board was found to have a gain adjustment range with a low and high value greater than the original and first replacement boards. The voltage regulator tuning was completed using experience gained with the DG1 tuning effort and the excitation system performed satisfactorily and DG declared operable.

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1027	EPS	Unavailable (T&M)			Inspection
28751		Fail to Start			
9/26/2003		corrective maintenance prior to failure (MSPI-SD)			
		(MSPI-SD)	Y		

EPIX coded this event as an MSPI failure. The INL review believes that this event is not an MSPI failure.

1105	EPS	Unavailable (T&M)			PMT
38529		Fail to Start			
10/3/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

During retest activities for DCP 80060791, the B Diesel Generator (B EDG) failed to reach and maintain rated speed. The EDG speed stabilized at 430 rpm vs the rated speed of 514 rpm. The EDG was subsequently removed from service after running for approx 3 minutes.
As noted in notification 20160932, no physical problems were observed with B EDG. In the main control room, the START light and normal overhead alarms were received. Generator voltage was normal at 4100 volts. Generator frequency was off scale on the low end (<55Hz), speed was 430 rpm vs normal speed of 514 rpm.
DCP 80060791 provides a modification to the Isochronous-Droop Relay IDR and Electric governor EGA control circuitry for B EDG. The design change consists of rewiring part of control cable that connects the IDR and EGA and installing a supplemental IDRX relay. The purpose of the DCP is to minimize / eliminate electrical noise induced in the EGA module, enhancing the loading of EDG to maintain desired load without severe load fluctuations at the top loading.

1136	EPS	Unavailable (T&M)			Inspection
29649		Fail to Start			
12/29/2003		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

EPIX coded this event as an MSPI failure. The INL review believes that this event is not an MSPI failure.

1127	EPS	Unavailable (T&M)			Inspection
30337		Fail to Start			
1/22/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

EPIX coded this event as an MSPI failure. The INL review believes that this event is not an MSPI failure.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1130	EPS	Fail to Load/Run			Test
33568		Fail to Start			
2/25/2004		erratic output (MSPI-S)			
		(MSPI-S)	Y		
	On April 14, 1997, at 1142, an unexpected Engineered Safety Feature (ESF) actuation occurred when Emergency Diesel Generator (EDG) was inadvertently manually started. During the scheduled performance of the Diesel Generator 3C Redundant Start Test, EDG 3D was manually started from the Unit 3 Main Control Room. EDG 3D was returned to the pre-event configuration by 1153 CDT. The root cause of the event was personnel error. Output breaker failed to close on demand.				
1136	EPS	Unavailable (T&M)			Inspection
35322		Fail to Start			
2/29/2004		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		
	A coolant leak of 6 drops per minute was discovered on the control side radiator of the 1H Emergency Diesel Generator (1-EE-EG-1H).				
1041	EPS	Fail to Load/Run			Non-Test Demand
32492		Fail to Start			
8/14/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		
	EPIX coded this event as an MSPI Start Demand failure. The INL review believes that this event is not an MSPI Start Demand failure.				
1025	EPS	Fail to Run			Test
32447		Fail to Start			
8/23/2004		erratic output (MSPI-S)			
		(MSPI-S)	Y		
	2B DG declared inoperable due to apparent blown fuse in control circuit. Blew Diesel Running lamp on local control panel when changing bulb.				

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1110	EPS	Unavailable (T&M)			Test
35720		Fail to Start			
2/17/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

During Diesel Engine Generator (DEG) 2-1 Surveillance Test Procedure (STP) M-9A manual start the voltage stabilized at 119 volts at 13:31 seconds as measured by a stop watch. This is outside the less than or equal to 13 seconds. The speed and frequency were stable within their acceptance limits. Inspection revealed that the automatic voltage regulator (AVR) card that one of the stems on the thyristor CR10 was found to be cracked and separated ~3/4 of the way around it.
The manufacturer, MPR, troubleshot the AVR card and could not repeat the same problem. MPR concluded that a possible cause of the abnormal DEG 2-1 startup voltage transient was malfunction of the SCR CR10due to lowered resistance from anode to gate or anode to cathode resulting in improper voltage regulator control current. Another possible cause would be improper control of SCR gating my MAGAMP L1 due to poor connections at cracked solder joints.

1118	EPS	Fail to Load/Run			Non-Test Demand
35974		Fail to Start			
6/10/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

Diesel generator breaker failed to close on undervoltage on bus 17. Troubleshoot/repair "B" D/G breaker to bus 17.
CAUSE: Investigation found the breaker alarm switch was actuated with no indication of a fault on the breaker's Amptector overcurrent protection device. This indicated the breaker attempted to close but tripped free. Work order 20502911 performed GME-50-02-DBTROUBLE. The investigation found the breaker required more force then typical to manually close and an out of tolerance trip bar load weight. These indicated a need for lubrication. The breaker consistently closed properly when tested on the bench.
Westinghouse was contacted and came to Ginna for an onsite failure investigation. The breaker had sat in the electric shop for two days since its failure. Initial inspection and manual operation of the breaker found the operating mechanism lacked sufficient lubrication. The breaker was hard to close by hand. When electrically operated the breaker failed to close approximately 50% of the attempts. Further inspection of the operating mechanism found the control relay kicker operation timing was not optimal, the close contact was released earlier then the Westinghouse technician would set it. Westinghouse concluded the breaker failure was due to inadequate lubrication of the operating mechanism. The control relay release timing was a contributing factor in that if set to release later in the close cycle the breaker may have been able to close, however, the lack of lubrication would probably have resulted in a breaker failure prior to operating the 200 cycles a properly lubricated breaker is designed to successfully perform between preventive maintenance periods.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1136	EPS	Unavailable (T&M)			Inspection
35252		Fail to Start			
7/20/2005		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

Removal from service of the 01-EE-EG-1J, Emergency Diesel Generator due to imminent failure of the 1-EG-P-4J, Standby Lube Oil Circulating Pump. Due to system configuration it is impractical to remove the 1-EG-P-4J pump from service to perform corrective actions required with out removing the 1J-EDG from service. Imminent failure of the 1-EG-P-4J pump would not of resulted in immediately declaring the 1J-EDG inoperable but would have allowed a decrease in oil temperature to occur resulting in eventually declaring the 1J-EDG inoperable based on low oil temperatures. Based on imminent failure of the 1-EG-P-4J, Standby Lube Oil Circulating Pump and unplanned entry into a LCO for the 1J-EDG the condition meets the requirements to be considered a MRFF.
Analysis:Motor was taken out service due to high vibrations and for the motor/pump making louder than usual noise. When motor outboard end bell was removed to inspect the motor for damage, the outboard bearing came apart and the roller balls fell out of the bearing. The bearing inner race remained on the motor shaft and the outer race remained in the end bell.

1141	EPS	Unavailable (T&M)			Inspection
38623		Fail to Start			
10/30/2005		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

At 20:16 on October 30, 2005 control room received a status panel alarm for the B emergency diesel generator. Dispatched the turbine watch to investigate. The turbine watch reports that the thermals for the B EDG lube oil keep warm pump are tripped. Directed him to reset. The pump did not turn, so the breaker was turned off. The B emergency diesel was declared inoperable at that time.
When the pump was removed from the system a broken tooth from the pump drive gear was seen looking into the suction side of the pump.

1141	EPS	Unavailable (T&M)			Inspection
38562		Fail to Start			
11/14/2005		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

On 11/14 at 0628 hours the A EDG was declared inoperable, its master transfer switch was placed in local and emergent work was declared due to failure of the L.O. keep warm pump. In the LCO section of T/S basis for T/S 3.8.1 it states Upon failure of the DG lube oil keep warm system, the DG remains operable until the applicable temperature alarm condition is achieved. The decisions to declare the A D/G inoperable when the L.O. keep warm pump failed and to place the master transfer switch in local (done to prevent D/G from auto starting) were based on information supplied by the D/G system engineer on 10/30/05 when the L.O. keep warm pump on the B D/G failed. His concern was that oil would drain away from the bearings and if the D/G were to experience an auto or manual start we could damage the bearings. Based on his concern the B D/G was declared inoperable on 10/30/05.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1109	EPS	Unavailable (T&M)			Test
38076		Fail to Start			
11/21/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

During the performance of a Surveillance Test, STP V-2J3, to verify the position indications for Residual Heat Removal valve, RHR-1-HCV-638, the monitor light did not come on as required when the valve was closed. The valve was fully closed per field observation. About 5 minutes after the valve was shut an operator noticed that the light had come on. The actual cause of the light failure was not identified. The position switches tendency towards intermittent faulted behavior, followed by multiple successful tests is usually the result of dirty or oxidized switch contacts. The position switch contacts were cleaned which helped the position switch performance.

1117	EPS	Fail to Load/Run			Test
36931		Fail to Start			
12/7/2005		erratic output (MSPI-S)			
		(MSPI-S)	Y		

During a surveillance run of DG-1B on 12/7/05, voltage failed to maintain the expected 4160 VAC level. Voltage spiked to a value in excess of 5331 VAC and could not be controlled from the MCB in auto voltage control mode. The engine was subsequently declared inoperable and shut down. A trouble shooting team was formed and repairs were completed by 12/8/05.
Based on the failure mechanisms discovered in the testing and analysis, the apparent cause of the overvoltage events is the degraded performance of the Gate Firing circuit board. A contributing factor to the events is a potential intermittent failure of the AVR circuit board K1 relay output contact 3-4.

1136	EPS	Fail to Load/Run			Test
37901		Fail to Start			
3/13/2006		erratic output (MSPI-S)			
		(MSPI-S)	Y		

EMER DIESEL GENERATOR FUEL OIL SUPPLY GOVENOR failed to control speed.
The hydraulic actuator electric governor needle valve was not optimally adjusted for actuator/oil temperature increase and resultant viscosity decrease.

1121	EPS	Unavailable (T&M)			PMT
40516		Fail to Start			
8/12/2006		unstable v/a/frequency control (not edg) (MSPI-S)			
		(MSPI-S)	Y		

On August 12, 2006 at approximately 22:00, during a surveillance test of emergency diesel generator 2G003, MVAR output became erratic while in droop mode. The problem was determined to be associated with the Automatic Voltage Regulator (AVR).

PMT with failure directly related to maintenance.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1117	EPS	Fail to Load/Run			Test
39441		Fail to Start			
8/31/2006		erratic output (MSPI-S)			
		(MSPI-S)	Y		

While inoperable for a planned maintenance outage, the train-A EDG received a voltage regulator diode failure light during a test run. During subsequent testing to confirm operability, the train-B EDG displayed a diode failure light, experienced an over-voltage condition, and was declared inoperable.

An on going root cause evaluation is analyzing this event to determine the cause of the failures of the EDG voltage regulator components. The investigation of the train-B EDG voltage regulator malfunction attributed the failure to degradation of one of the seven capacitors [EK, CAP] in the noise-reduction circuits in the power chassis. Following replacement of the seven capacitors, EDG-B operated satisfactorily and was restored to operable status. These components were replaced and sent to an off-site laboratory for testing. Preliminary troubleshooting on the train-A EDG determined that a malfunction of either the T5 transformer circuit [EK, XFMR] or a gate firing board caused the voltage regulator diode failure. These components were replaced and sent to an off-site laboratory for testing. In addition, the same capacitors that were replaced on the train-B EDG were also replaced on the train-A EDG.

1031	EPS	Fail to Load/Run			Test
39955		Fail to Start			
10/25/2006		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

On 10/25/2006 during planned monthly surveillance test 8.9.1, fuel oil leakage on B Emergency Diesel Generator (EDG) was of a magnitude that the engine was shutdown and declared inoperative. Leakage was predominantly from cylinder 1R. After engine shutdown the fuel rail to fuel pump supply tube cap screws of cylinder 1R, were found finger tight.

1068	EPS	Fail to Load/Run			Test
40617		Fail to Start			
11/1/2006		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

At 14:00, on November 1, 2006, Progress Energy Florida, Inc. (PEF), Crystal River Unit 3 (CR-3) was operating in MODE 1 (POWER OPERATION) at 100 percent RATED THERMAL POWER when attempts to close Emergency Diesel Generator EGDG-1A output Breaker 3209 during a surveillance test were not successful. The breaker charging motor direct current (DC) power control switch was found in the OFF position and the breaker closing spring was not charged, rendering EGDG-1A inoperable. A review concluded that EGDG-1A was inoperable from October 4, 2006 through 18:11 on November 1, 2006. Also, EGDG-1 B was taken out of service for scheduled maintenance from 04:31 on October 18, 2006 through 15:30 on October 19, 2006, rendering both emergency diesel generators inoperable during this time.

FOLLOWING PERFORMANCE OF SP-907A, FLUR/SLUR TESTING, OPERATIONS PERFORMED SP-354A, EGDG TESTING. WHEN THE OUTPUT BREAKER WAS SELECTED TO CLOSE, IT WOULD NOT CLOSE AFTER SEVERAL ATTEMPTS. AN OPERATOR WAS DISPATCHED TO DETERMINE THE PROBLEM AND IT WAS DISCOVERED THAT THE CONTROL POWER TOGGLE SWITCH ON THE LOWER PORTION OF THE BREAKER WAS SELECTED TO OFF, THEREFORE THE BREAKER WOULD NOT CLOSE. OPERATIONS CLOSED THE TOGGLE SWITCH AND THE BREAKER CLOSED AS EXPECTED. THIS TOGGLE SWITCH IS IS NOT INCLUDED IN SP-907A.

Component Type *GEN*

EPIX MSPI Failure Mode Fail to Start

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1031	EPS	Fail to Load/Run			PMT
41125		Fail to Start			
1/4/2007		high output (MSPI-S)			
		(MSPI-S)	Y		

During a routine surveillance run on January 4, 2007 of the B EDG, Engineering was performing troubleshooting for the fuel rack hunting which was reported during the October and December surveillances. Engineering had an approved PNPS 3.M.1-34 plan which included instrumenting both the engine governor and voltage regulator controls with digital recorders. The engine was started per PNPS procedure 8.9.1 EDG & Associated Emergency Bus Surveilance and an abnormal alarm PT blown fuse (C3 RC D5) was received and cleared immediately. With maintenance and engineering at the engine, no fuel rack oscillations were observed. The engine was run unloaded for 30 minutes.
The control room was then requested to proceed with paralleling the EDG to A6 bus. The operator exercised both the governor and the voltage regulator with no problems reported. The control room operator proceeded, by turning on the sync scope preparing to sync to the grid. While adjusting the voltage regulator to get the incoming voltage slightly above the running voltage per the 8.9.1 procedure the control room operator reported erratic upward swings in the incoming voltage meter. The operator again adjusted the voltage regulator to align the incoming voltage to be slightly higher than the running voltage. Once this was performed the control room operator closed the A609 breaker and immediately picked up 500 KW per the 8.9.1 procedure. Before adjusting the KVAR to 250 per procedure the operator observed the KVAR meter ramping up to roughly 1600 KVAR. At this time the operator took action and proceeded to lower the KVAR down. The abort criteria of 1500 KVAR was exceeded so the control room operator reduced the load and opened the A609 breaker. This evolution took approximately 30 seconds. The diesel remained running unloaded. A call to the field operator was made to notify him that they exceeded an abort criteria and that the A609 breaker was opened. Fuel rack troubleshooting continued until the steps in the 3.M.1-34 were completed and the engine was secured per the procedure. The engine was declared inoperable and a 72 hour LCO was declared on 1/4/07 after the run was aborted.

The most probable direct cause of the sudden KVAR increase was a poor quality connection on the potential transformer circuitry which supplies the necessary feedback voltage for the voltage regulator. The potential transformers convert the output voltage of the Emergency Diesel Generator (4160 vac) to 120 vac to be used in the engines control and metering circuits. The same potential transformer also supplies a signal proportional to the generator frequency to the Woodward governor to control the engines speed.

The investigation found one slightly loose fuse (F1) when compared to the other three fuses on the primary side of the transformer and oxidation and corrosion on the secondary side solid link. The primary fuses are accessed via a roll out drawer configuration. As the drawer is opened, the fixed and movable contacts on the primary side of the PT fuses opens. During a later inspection on January 22, the fixed and movable contacts on the primary side of the PT fuses were found to be slightly misaligned. This caused less than full contact on one set of contacts. The screw that holds the movable contact was found to be slightly loose and the contact seating force on this one phase was less than the other two phases. Both items were adjusted by Maintenance after the inspection of the as-found conditions.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1031	EPS	Fail to Load/Run			Test
41104		Fail to Start			
2/23/2007		erratic output (MSPI-S)			
		(MSPI-S)	Y		

On February 23, 2007 while operating the "B" Emergency Diesel Generator (EDG)", oscillations in Kilowatt (KW) output were observed that reached administrative abort criteria of > 200 KW total span. The "B" EDG was manually shutdown. Previously on January 25, 2007 during an operability test
following an overhaul of the "B" EDG, unexpected KW oscillations up to 150 KW were observed but these oscillations did not reach the abort criteria.
The root cause of the oscillations was clogging of internal passages in the Woodward hydraulic governor due to the intrusion of foreign material. It was discovered that the oil in the governor was contaminated with particles of aluminum of varying size. The source of the particles was an aluminum label from the shutdown solenoid that separated from the solenoid and was free to move about inside the governor.

1122	EPS	Unavailable (T&M)			Test
42639		Fail to Start			
3/3/2007		unstable v/a/frequency control (not edg) (MSPI-S)			
		(MSPI-S)	Y		

EPIX coded this event as an MSPI failure. The INL review believes that this event is not an MSPI failure.

On March 3, 2007 at approximately 21:36, during 3G003 monthly Tech Spec surveillance testing, MVAR was found to be erratic in droop mode. AVR channel A was the selected voltage regulator. MVAR oscillations continued throughout the test.

1039	EPS	Unavailable (T&M)			Test
42126		Fail to Start			
6/19/2007		edg did not reach rated rpm & v on manual start (MSPI-S)			
		(MSPI-S)	Y		

During performance of MO-7A-2 Emergency Diesel Generator 1-2 (EDG 1-2) on 06/19/2007, EDG 1-2 failed MO-7A-2 section 5.4, Diesel Generator Starting Time Test. MO-7A-2 section 5.4.7 specifies a start time acceptance criterion of less than or equal to 9.5 seconds, while the actual value measured was 10.91 seconds, exceeding the procedures acceptance criterion by 1.41 seconds. Apparent Cause was identified as INEFFECTIVE MAINTENANCE STRATEGIES EXIST FOR AGED ELECTRONIC EQUIPMENT WITHIN EMERGENCY DIESEL GENERATOR 1-2 RESULTING IN UNRELIABLE EQUIPMENT OPERATION.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1122	EPS	Unavailable (T&M)			Test
43577		Fail to Start			
12/22/2007		unstable v/a/frequency control (not edg) (MSPI-S)			
		(MSPI-S)	Y		

EPIX coded this event as an MSPI failure. The INL review believes that this event is not an MSPI failure.

On 12/22/07, Diesel Generator 3G002 was paralleled to the grid for a monthly load test. Toward the end of the test, while the DG was still paralleled to the grid and loaded, the control room operator noted a perturbation on the DG megawatt meter in the control room.

1102	EPS	Fail to Load/Run			Test
43681		Fail to Start			
1/12/2008		edg did not reach rated rpm & v on manual start (MSPI-S)			
		(MSPI-S)	Y		

During performance of RT-6-092-503-2 "D23 DIESEL GENERATOR GOVERNOR TUNING RESPONSE TEST", D23 Bus voltage exceeded 4900V (>5200V indicated) immediately followiing a '2C' RHR Pump start at step 4.7.6. D23 Bus voltage and frequency were noted to lower following the RHR Pump start and then rise a few seconds later. D23 Bus voltage did not stabilize, it continued to rise to a value upscale of the meter. The D23 D/G Output Breaker was opened and the D23 Engine was secured per the RT.

1029	EPS	Fail to Load/Run			Test
44709		Fail to Start			
3/30/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

EDG 2A did not meet acceptance criteria for steady state frequency (59.9-60.5 HZ) following being placed into the emergency run mode per step 8.9.30 of procedure 73ST-9DG01 (ISG).

1064	EPS	Unavailable (T&M)			Non-Test Demand
44722		Fail to Start			
3/31/2008		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

While securing Keowee Unit 1 from commercial generation, ACB-1 did not trip when expected. The failure of ACB-1 to open caused KHU-1 to motor for a brief period (~7 minutes). Upon instruction from Keowee Supervision, KOPS activated the KHU-1 GATE SAFETY (key inhibit) switch in order to secure KHU-1 (emergency lockout). KHU-1 shutdown but ACB-1 still failed to open. With the emergency lockout activated and ACB-1 closed, the 86T (Main Step-Up Transformer lockout) actuated tripping PCB-8 and PCB-9. ACB-1 still did not open on the actuation of the 86T. Approximately 25 minutes later, with no Operator action or work being performed, ACB-1 tripped.
Upon visual inspection of the ACB-1 auxiliary contacts, Maintenance observed one of the sliding links, Terminal Strip D Link 8, to be in a middle position, i.e. between the open and closed position. This link provides the path to the trip coil for ACB-1. With the sliding link in the open position, ACB-1 would never trip from an external signal to the breaker.

Component Type GEN

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1121	EPS	Fail to Run			Test
45598		Fail to Start			
5/19/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

Following a monthly surveillance run of the Unit 2 Train B Emergency Diesel Generator (EDG) S22420MG003 on 5/19/08, two unexplained megawatt perturbations were noted during a post test data review. Data indicated that the MWs jumped from 4.6 to 4.8, then down to 4.4, then back to 4.6 over a five second period. Also, two minutes after the first perturbation, MWs jumped from 4.6 to 4.9, then down to 4.4, then back to 4.6 over a four second period. These two perturbations occurred about two minutes after the EDG achieved a full load condition.
On 5/25/08, following replacement of the mechanical governors, the EDG was tested with no abnormalities in output were noted. The governor actuator levers between the mechanical governors and the fuel racks were removed. The eight bearings in the governor actuator levers showed significant wear and internal corrosion. Subsequently, it was determined that one governor bearing on the 20 cylinder engine was stuck and had affected the smooth operation of the governor of this engine, thus in turn causing the noted fluctuation in the power output of the generator. Consequently, all eight governor actuator lever bearings were replaced along with both mechanical governors to rectify the observed condition.

1114	EPS	Fail to Run			Test
45773		Fail to Start			
6/30/2008		erratic output (MSPI-S)			
		(MSPI-S)	Y		

During Monthly SO-024-001 run of the C DG, load control became erratic with no control from the Control Room (CR). Load increased to a maximum of approximately 5560kW. The CR notifed the NPO to perform Emergency Stop of the C DG. After the C DG was shutdown, the NPO observed that the EGB50P governer had no oil in the sight glass and that the governor oil sprayed across the front of the C DG. Additionally, the NPO noted that the turbocharger sounded as if turbocharger speed was very high when the engine was running at max load.

1043	EPS	Fail to Run			Inspection
46955		Fail to Start			
11/21/2008		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	Y		

Jacket Water Low Pressure Trip Pressure Switch PS-01DG-2465B2V developed a jacket water leak quantified to be 13.9 ounces per minute. This exceeds the informally calculated operability limit (ref. AR 301077) of 4.8 ounces per minute; therefore, the B EDG was conservatively declared unavailable as of 0630 on 11/21/08, which is the time when the security guard discovered the significant leak at the pressure switch. The failure of the pressure switch is a MRFF since the B EDG could no longer perform its MR function for a mission time of 24 hours due to the significant leak rate.

Component Type *GEN*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1103	EPS	Fail to Load/Run			Test
27303		Unavailable (T&M)			
1/18/2003		edg tripped after warmup (>1hr.) (MSPI-R)			
		(MSPI-R)	N		
	A CARDOX EQUIPMENT FAILURE OCCCURED DURING A 24 HOUR ENDURANCE TEST RUN THE E-2 EMERGENCY DIESEL. AS A RESULT, THE DIESEL TRIPPED AND RESULTED IN AN UNPLANNED TSA DUE TO AN INOPERABLE EMERGENCY DIESEL. DURING PERFORMANCE OF "E-2 D/G 24 HOUR ENDURANCE TEST" , E2 DIESEL TRIPPED FROM FULL LOAD. CONDITIONS. ALL 4KV BUSSES REMAINED ENERGIZED. DIESEL HAD BEEN LOADED TO TEST CONDITIONS IAW ST AT 13:53. APPROX 9 MINUTES LATER AT 14:02, THE E2 DIESEL TRIPPED ON AN APPARENT CARDOX SYSTEM MALFUNCTION. CARDOX DID NOT INJECT AS IT WAS BLOCKED UNDER a CLEARANCE.				
1082	EPS	Fail to Load/Run			Test
28267		Unavailable (T&M)			
4/8/2003		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	
	EPIX coded this event as not an MSPI failure. The INL review believes that this event is an MSPI failure.				
1036	EPS	Fail to Load/Run			Test
27885		Unavailable (T&M)			
4/23/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	
	During the performance of the monthly surveillance instruction run, division 2 diesel generator did not develop output voltage. All indications are that the field flash contactor, K1 did not close, causing no field voltage and no output voltage.				

Component Type *GEN*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1121	EPS	Fail to Start			Test
28439		Unavailable (T&M)			
8/31/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

At approximately 0200, 2G002 was started in idle mode to support a monthly surveillance test. The engine seemed to be running at rated speed based on the sound of the engine, an extinguished green stop light (extinguishes above 97% of rated speed), and the control room frequency meter which read 59.1 hertz. Due to these abnormal indications, the engine was secured after approximately 20 minutes of operation. AR 030801530 was initiated. At approximately 1530, 2G002 was test started in Idle Mode in an attempt to recreate and troubleshoot the original problem. The engine cranked for ten seconds but failed to start. By design, if the engine does not reach 150 rpm within 10 seconds, the start is aborted and a Failure to Start alarm is initiated. Data shows the engine reached only about 100 rpm. At the beginning of the start, the hydraulic actuators on both engines went full open for about one second, then went full closed within the following second. The acutators are reverse acting such that 17 volts input = fuel rack fully closed, and 0 volts input = fuel rack fully open. During the start attempt, the output from the electronic governor remained constant at 17 volts, so the governor never tried to open the fuel racks. The governor has an air-boost system which forces the fuel rack wide open on initial start, until hydraulic pressure can be developed. Based on this, it was concluded that the air boost system opened the fuel racks as designed, but the electronic governor did not hold the rack open as it should have.

1082	EPS	Fail to Load/Run			Test
31008		Unavailable (T&M)			
4/11/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

EPIX coded this event as not an MSPI failure. The INL review believes that this event is an MSPI failure.

1096	EPS	Fail to Start			PMT
32132		Unavailable (T&M)			
9/30/2004		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

WHILE PERFORMING POST WORK TESTING ON #2 DIESEL, WITHIN THE FIRST SECOND OF STARTING THE ENGINE THERE WAS A SCREECHING NOISE FROM THE ENGINE DRIVEN FUEL OIL PUMP AND SPARKS FROM THE THE COUPLING WHERE THE KEY WAS. WHILE THE ENGINE WAS STILL ROTATING THE COUPLING WAS ROTATING AND THE PUMP SHAFT WAS SITTING STILL.
REQUIREMENT NOT MET: ENGINE DRIVEN FUEL OIL PUMP NOT ROTATING

Component Type *GEN*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1139	EPS	Fail to Start			Non-Test Demand
34472		Unavailable (T&M)			
11/7/2004		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

Start failure received when attempting to start #2 Emergency Diesel Generator in accordance with 2-OPT-EG-001. Moisture in the EDG starting air supply system caused corrosion to accumulate on the secondary seat (pilot valve) and pilot valve stem section of the air start valve (2-EG-44). The air start motor (2-EG-M-02) pinion experienced an abutment with the flywheel ring gear, which limited the flow rate of air to the control side of the air start valve. The increased pressure required to operate a corroded air start valve (CC1) combined with the reduced flow rate of control air prevented the air start valve from opening within the required start failure time out (3 seconds).

1076	EPS	Fail to Load/Run			Test
34300		Unavailable (T&M)			
2/14/2005		discovered to be unable to load (MSPI-L)			
		(MSPI-L)	N	PMT failure related to maintenance performed	

EPIX coded this event as not an MSPI failure. The INL review believes that this event is an MSPI failure.

2C Diesel generator, 2R43S001C, output breaker failed to close while attempting to tie 2C D/G per 34SV-R43-003-2.. Alternate supply ACB135584 closed and S/U AUX XFMR 2D 2S11S005 was deenergized prior to performing this surveillance.

1099	EPS	Fail to Run			Test
35313		Unavailable (T&M)			
4/11/2005		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the surveillance, two problems occurred. Engine 1 cylinder B4 exhaust temperature deviation alarmed (727 vs 915 average). The engineer reported this was likely an injector problem. The second problem was that crankcase pressure in Engine #2 experienced several stepwise increases during the 1 hour full load run, plateauing at 22", 25-29", 32" then in less than 1 minute increased to 48" and rising. Operations unloaded the diesel per procedure to 2000 KW, at which time crankcase pressure reduced to 10". The diesel was run at the low load for cooldown then shut down.
The high crankcase pressure also caused oil to spray from the shaft seals.
The root cause of the elevated crank case pressure is piston ring sticking at high operating loads caused by particles inside the piston ring groove. These particles reduce the tolerance between the piston ring and the piston ring groove. At higher loads, differential expansion at the top of the piston can decrease the ring groove clearance.

Component Type *GEN*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1145	EPS	Fail to Load/Run			Test
35769		Unavailable (T&M)			
6/16/2005		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the performance of SP-42-312A "Diesel Generator A Availability Test" step 6.24.9, Breaker 1-509 "DG A to Bus 5" failed to close. The synchroscope was rotating in the fast direction at approximately 5 rpm and the breaker control switch was placed in close at the 9 o'clock position (per procedure). A second attempt to close the breaker was also unsuccessful. Electricians and OCC were contacted. Electricians were not immediately able to determine a cause and requested to rack the breaker out for troubleshooting.

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1093	EPS	Fail to Run			PMT
37222		Unavailable (T&M)			
9/27/2005		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

ON 9/27/05 AS PART OF A PLANNED WORK EVOLUTION, THE ROCKER ARM LUBE OIL WAS DRAINED FROM THE ROCKER ARM LUBE OIL RESERVOIR, THE RESERVOIR WIPED CLEAN, LUBE OIL FILTER IN 3EGO*FLT2B WAS REPLACED AND FRESH OIL WAS ADDED TO THE RESERVOIR AND FILTER. APPROXIMATELY 47 ML OF FREESTANDING WATER WAS DRAINED FROM THE RESERVOIR DURING THIS WORK EVOLUTION.

THE MONTHLY OPERABILITY RUN FOLLOWED THIS WORK EVOLUTION. WHEN THE ROCKER ARM LUBE OIL WAS SAMPLED FOLLOWING THE OPERABILITY RUN, APPROXIMATELY 1 QUART OF FREESTANDING WATER WAS DRAINED FROM THE ROCKER ARM LUBE OIL RESERVOIR. ROCKER ARM COVERS ON FOUR CYLINDERS WERE REMOVED IN AN ATTEMPT TO DETERMINE THE SOURCE OF THE WATER. WATER WAS OBSERVED DRIPPING FROM AN EXHAUST VALVE CAGE ON THE NUMBER SEVEN CYLINDER HEAD.

THE LEAK RATE ON THIS CYLINDER HEAD APPEARS TO BE APPROXIMATELY 1 DROP PER 10 SECONDS. THIS IS SIGNIFICANT, AS NO WATER LEAKS HAD BEEN OBSERVED ON ANY OF THE CYLINDER HEADS DURING PREVIOUS INSPECTIONS. FURTHERMORE, SINCE THE ENGINE WAS NOT RUNNING AT THE TIME OF THIS DISCOVERY, THE ONLY PRESSURE IN THE SYSTEM IS THAT DUE TO HEAD PRESSURE OF THE JACKET WATER EXPANSION TANK. THE LEAK WILL BE GREATER WHEN THE ENGINE IS RUNNING.

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1085	EPS	Fail to Load/Run			Non-Test Demand
37363		Unavailable (T&M)			
11/8/2005		erratic output (MSPI-S)			
		(MSPI-S)	N	Risk-significant function did not fail	

The B train Emergency Diesel Generator (EDG) automatically started and loaded B train emergency bus T21A (one of two B train emergency buses). However, the trip was complicated in that the other B train emergency bus, T21B, failed to energize automatically on the start of the B train EDG. The A train emergency buses transferred to reserve feed as expected. The A train EDG was out of service for scheduled maintenance. An additional anomaly occurred at 0510 hours when the EDG output breaker supplying the T21A bus opened and re-closed after 23 seconds without manual action. The INL review believes that this event is an MSPI failure.

Component Type GEN

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1103	EPS	Fail to Run			Inspection
37468		Unavailable (T&M)			
12/27/2005		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

On 12/27/05, at approximately 2030 hours, while preparing for a test run of the E-2 EDG, an Equipment Operator identified approximately 10 gallons of water in the vicinity of the E-2 EDG cooling subsystem. The leakage was determined to be pump shaft packing leakage associated with the E-2 EDG Air Coolant Auxiliary Pump. The leak rate was later determined to be approximately 10 gallons per hour, but existed only when the E-2 EDG was operating. The leak rate resulted in the E-2 EDG being declared inoperable. It was later determined that the E-2 EDG had been inoperable dating back to 12/22/2005 when the PMT on the Air Coolant Auxiliary Pump was last performed and returned to service.

1024	EPS	Fail to Run			Test
37635		Unavailable (T&M)			
1/10/2006		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

While performing FNP-1-STP-80.1 (OTC# 07/08/01 22:46:16) on 1B D/G, the diesel was shut down due to an exhaust gasket failure. A maintenance mechanic was performing vibration measurements during this time.1B Diesel is being tagged out to repair the gasket.Does not meet reportability criteria of 10CFR50.72 or 50.73

Later investigations revealed that a section of the exhaust manifold itself blew out, rather than a gasket. The breach was initially patched, but later a weld repair was performed, both under WO# 1000526.

1031	EPS	Fail to Load/Run			Test
41921		Unavailable (T&M)			
5/15/2007		erratic output (MSPI-S)			
		(MSPI-S)	N	Risk-significant function did not fail	

On May 15, 2007, at approximately 0651 hours, and approximately 45 minutes into the 60 minute monthly operability loaded run, the A EDG unexpectedly experienced sudden increasing/decreasing power oscillations of approximately (+)/(-) 150 kW (300 kW total) about the 2600kW load setting.
Root Causes:

The stiff control linkage from the EGB through the output coil spring to the engine combined with a loose linkage allowed the fuel rack position to get out of synch with the demand from the EGA to EGB. The Root Cause for this inconsistent linkage performance was inadequate level of detail in the existing PM procedures

1085	EPS	Fail to Start			Test
43666		Unavailable (T&M)			
12/4/2007		edg did not reach rated rpm & v on manual start (MSPI-S)			
		(MSPI-S)	N	Risk-significant function did not fail	

EPIX coded this event as not an MSPI failure. The INL review believes that this event is an MSPI failure.

Component Type *GEN*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1096	EPS	Fail to Run			Test
45549		Unavailable (T&M)			
2/13/2008		edg tripped after warmup (>1hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

During performance of Surveillance Procedure 6.2DG.101, DIESEL GENERATOR 31 DAY OPERABILITY TEST (IST) (DIV 2), operator identified an oil leak from the welded joint at the discharge of the #2 DG main lube oil pump. Leak rate estimated to be approximately 1 pint/minute.
Unloaded and secured #2 DG per SP.

1081	EPS	Fail to Run			Non-Test Demand
45583		Unavailable (T&M)			
5/14/2008		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

At 1:15 on May 14, it was reported that the engine driven fuel pump (3Q151MPA0237) on SBDG #12 was leaking a quart every twenty minutes, while the engine was not running, at which time CR 08-8589 was initiated and the pump was declared inoperable under OAS 12741. The fuel pump was then replaced under WAN # 359527.

1071	EPS	Fail to Load/Run			Inspection
46464		Unavailable (T&M)			
8/19/2008		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	N	Failure immediately annunciated in control room	

3B Emergency Diesel Generator declared inoperable due to potential failure of control power to cabinet.

At 1805 on 08/19/08, the Control Room received Ann F 9/2 EDG B TROUBLE. The Red ready to start light & white normal control light were noticed to be out. ANPO was sent to investigate.

At 1813 on 08/19/2008, the ANPO reports no alarms on the 3B EDG RA-1 & RA-2 panels. The 3B EDG engine control panel has no power.

SNPO checked breaker 3D23A-28 (control panel dist breaker) and it was found to be on. 3B EDG inoperable due to no power to engine control panel. Entered 14 day Tech Spec 3.4.3 Action a for the 3B PZR Backup Heaters inoperable, 3.5.2 Action f for the 3B HHSI Pump not capable of being powered from its associated EDG, and 3.8.1.1 Action b for the 3B EDG inoperable. Also have 72 hours to complete actions of 3-OP-023, Sec. 7.7, Extending a Unit EDG Out of Service Time past 72 hours.

This fuse failure prevented the 3B EDG control cabinet 3C12B from performing the safety related control functions to run the EDG, making the EDG inoperable and unavailable.

Component Type *GEN*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1081	EPS	Fail to Start			Test
46714		Unavailable (T&M)			
9/11/2008		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

Emerg Pwr Generator 3Q151MDG0234-GEN unaffected by failure.
ENGINE SPEED MONITOR SPEED SWITCH B1DGSS5576A failed to change state upon demand.
Emerg Pwr Generator Output Cktbrk 3E241EPS0234B failed to operate on demand.

AS FOUND: DISCOVERED NO 24VDC PRESENT AT INPUT TO SS-5576A AND NO 24VDC OUT OF PS11 AT DC/DC CONVERTER BOX 3E241EPS0234B.

FAILURE DESCRIPTION: DISCOVERED B1DGSS5576A DID NOT HAVE 24 VDC POWER DUE TO A DEFECTIVE CAPACITOR (C11) IN DC/DC CONVERTER BOX 3E241EPS0234B. EVEN THOUGH THE SDG REMAINED OPERABLE, THIS IS STILL A MRFF SINCE THE FAULTY CAPACITOR CAUSED A HIGH GQA COMPONENT TO FAIL (B1DGSS5576A DIESEL GENERATOR #12 ENGINE SPEED MONITOR SPEED SWITCH).

REPLACED DEFECTIVE CAPACITOR C11 AND ALSO REPLACED CAPACITOR C10.

Component Type *HOV*

Component Type *HOV*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1042	AFW	Fail to Close			Test
46101		Unavailable (T&M)			
7/16/2008		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

The 'B' motor driven Aux Feedwater Pump was taken out of service to perform a scheduled pump run on 7/16/08. When the pump was started, the discharge valve (FCV-1425) went open but would not throttle or close in automatic or manual. FIC-1425 was removed from service and sent to the CRDF for repairs and failure analysis. The CRDF repaired the controller satisfactorily and sent it back to RNP, where it was installed and returned to service. The CRDFs investigation revealed that a filter capacitor on the Service Module circuit board had shorted and caused part of the power supply to stop functioning correctly, which caused the observed condition.

Component Type *MDP*

Component Type MDP

EPIX MSPI Failure Mode Fail to Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1036	SWN	Fail to Run <1H			Test
28992		Fail to Run			
9/1/2003		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

Emergency Service Water (ESW) A pump, 1P45C0001A, lost flow after 42 minutes of operation. Follow up investigation found no evidence of a pump or motor transient nor any sign of foreign material obstruction in the pump impellers. Disassembly of the pimp found the first line shaft coupling sleeve had failed and was found in two pieces inside the pump assembly. Visual inspection of wear marks on the broken coupling sleeve halves indicated the coupling was not centered between the two shafts. This left approximately one inch of the key extending above the coupling during operation.

Event captured by LER 4402003004.

1106	SWN	Fail to Run <1H			Non-Test Demand
39480		Fail to Run			
10/5/2003		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

After placing 16 Service Water Pump in service, it was noticed that the upper motor bearing temperature was 201 degrees. The pump was declared inoperable. Drain valve 16SW362 was opened and .other than liquid. material was flushed from the piping until all large particulates were removed. The motor bearing temperature stabilized at ~143 degrees and the pump was declared operable.

1036	SWN	Fail to Run <1H			Test
32268		Fail to Run			
5/21/2004		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

Flow total was normal, reading 11.93 K gpm. 2 minutes later (0150) received ESW A low flow and low discharge pressure alarms. Observed 0 gpm and 20 amps on the pump in the control room. Operator in the field reported that the pump was making an unusual vibration and there was an electrical burning smell. No smoke or fire observed. Pump was shutdown at 0159.

Event captured by LER 4402004001.

1106	SWS	Fail to Run <1H			PMT
35128		Fail to Run			
5/3/2005		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

On 5/3/05, 11 Service Water Pump Motor Bearing temperature increased to 190 degrees following the pump being placed in service. This caused the inoperability of the 11 SW Pump. Since 13 Service Water Pump was previously declared inoperable, 72 hour Tech Spec Action Statement 3.7.4.1 was entered.
Cooler outlet drain valve 11SW362 was opened in order to flush debris out of the cooler and/or check valve 11SW13. The flush was successful as the motor upper bearing temperature stabilized at 141 degrees after being placed back in service.

Component Type MDP

EPIX MSPI Failure Mode Fail to Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1072	HPI	Unavailable (T&M)			Test
37475		Fail to Run			
1/20/2006		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

On 1/20/2006, during the performance of In-Service Testing per procedure 0-OSP-062.2 (Safety Injection System In-Service Test), it was observed that there was an oil leak of approximately 10 to 15 drops per minute on the outboard bearing oiler of the 4B HHSI pump (4P215B). It was noted, prior to pump start, that there was no leakage from the oiler.

The leakage only began with pump operation. After securing the 4B HHSI pump, the oil leak stopped and only residual oil was noted. It was also reported that the oiler rotated freely on its threaded connection with the bearing housing piping nipple. Immediate discussions with Operations resulted in the determination that the oil leak was sufficient to declare the pump inoperable. The 4B HHSI pump was then taken OOS and the Trico oiler was replaced and tested SAT

1139	CCW	Unavailable (T&M)			PMT
39060		Fail to Run			
7/27/2006		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

At 19:46:59, the Unit 2 Charging Pump/SW Pump low discharge pressure annunciator, 2D-G5, was received while restoring 2-SW-E-1A to service IAW 2-MOP-8.22 following scheduled maintenance. The standby Charging CC Pump, 2-CC-P-2A automatically started, but no flow was observed locally or on the PCS.

The low Charging CC discharge pressure occurred while opening 2-CC-785, the 'A' ISC discharge isolation valve, to return the system to a normal lineup. The 'A' ISC and its associated piping had been vented through 2-CC-553 until the system was water solid prior to opening 2-CC-785. 2-CC-553 is on the inlet side to the cooler. There is no vent valve at the cooler discharge, only the drain valve, 2-CC-554.

1103	SWS	Unavailable (T&M)			Non-Test Demand
39694		Fail to Run			
9/17/2006		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

On 9/17/06 at approximately 20:00 hours, the 2B and 2D HPSW Pumps were started to support reactor cool down from Mode 3 following completion of nobel metals application. The initial equipment operator walk through of the Unit 2 HPSW Pump bay following start of the 2B and 2D HPSW Pumps identified water spray issuing from the 2B HPSW Pump motor oil cooler cooling water supply piping near HV-2-32-22223B. The equipment operator contacted the control room and the 2B HPSW pump was secured and declared inoperable pending investigation and repair. Inspection of the affected piping identified a through wall hole, approximately 3/16" in diameter on the bottom of the motor oil cooler cooling water supply pipe immediately downstream of the first 90 degree elbow from the pipe discharge column. The piping was temporarily repaired via application of a housekeeping clamp and the 2B HPSW pump was later returned to service to support shutdown cooling operation as "available". Replacement of the failed piping was completed during the "B" ECCS maintenance window later in P2R16 and the removed pipe section was retained for inspection and failure analysis.

Component Type *MDP*

EPIX MSPI Failure Mode Fail to Run

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1114	SWS	Fail to Start			Non-Test Demand
40497		Fail to Run			
12/21/2006		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

Control Room Operators started the "A" and "B" ESW pumps to support "E" DG testing, IAW OP-054-001. Approximately ten seconds after the "B" pump was started, it was noticed that Div 2 ESW pressure was decaying and then that the "B" ESW pump was shutdown. PICSY showed that the "B" pump current had increased to approximately 79 amps (starting current) and then lowered to zero after about four seconds. No alarms were received in the Control Room. The reactor building NPO and FUS were dispatched to the switchgear and reported no abnormal indications or relays tripped. The NPO at the pumps reported that the "B" pump motor was not hot and nothing abnormal was noted locally at the pumps.
The system engineer and electrician were called to the breaker and Ops attempted a second start of the "B" ESW pump at their request. The breaker attempted to close several times, but never did. The breaker was removed and placed on the test stand. The breaker would not close on the test stand. Subsequent dissassembly of the breaker revealed a retaining clip that had worked its way loose.

1043	HPI	Fail to Run <1H			Non-Test Demand
41401		Fail to Run			
3/23/2007		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

On 03/23/07 at 1032 started 'B' CSIP IAW OP-107, section 5.2. At 1037 RAB operator reports oil pressure fluctuations on the B' CSIP speed changer. The peak fluctuations are more erratic than we are used to seeing, varying from 0-5 psig with a mean value of 3 psig. Per RAB AO rounds guidance the min pressure is 3 psig and the max is 15 psig. Normal values are between 7-10 psig. We have dispatched the shift mechanic to investigate. We monitored all available B CSIP MCB, local & ERFIS parameters and they were normal based on normal operating parameters and oil pressure at the minimum value we did not declare the pump inoperable. At 1135 off shift mechanic, had been monitoring 'B' CSIP. He reports that the speed changer oil pressure is too low and the system relief valve (which controls operating pressure) needs to be adjusted. He recalls that when the system is setup up properly, the oil pressure on the speed changer is near 6 psig. After discussion with WWM and maint, at 1154 the B CSIP was secured. Plan to place the pump under clearance and replace the system relief valve
When mechanics took the relief valve off the B speed increaser and tested it they found that it was in proper working order. Later it was discovered that the operator had trouble with the gear pump oil standpipe as he was trying to check for prime. Pre-start checks were performed early morning, March 23rd, approximately 0200.
The operator indicated that the stand pipe threaded fitting that must be removed in order to check that the stand pipe is full of oil was difficult to remove. After this fact became known, the mechanic discovered that the stand pipe was cracked in the root of the threads which connected it to the oil system just upstream of the gear pump.
The stand pipe was replaced and the B CSIP was started without incident.

Component Type MDP

EPIX MSPI Failure Mode Fail to Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1025	SWS	Unavailable (T&M)			Non-Test Demand
42875		Fail to Run			
9/5/2007		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

On September 5, 2007, it was determined that the 2A SW Motor had an oil cooling coil leak causing oil to leak out of the motor.

Upon investigation, it was determined that the cooling coil had been in service in the 2A motor for only approximately 4 years. The coil was removed from the motor and taken to Alabama Electric for pressure testing. The pressure test revealed that a pinhole leak existed in the inside of the elbow on one of the fittings on the coil. These fittings are sweated on to the coils by our Electrical Maintenance personnel during installation of the cooling coils in the motors. The cooling coils are pressure tested following installation into a motor. This means that they are pressure tested after the 90 degree fittings are installed. When the motors are installed into the plant, swage-lock fittings are installed onto the coil piping and attached to the permanent cooling piping in the plant. Historically, internal erosion has been seen on the outer side of the elbow on the 90 degree fittings after at least 10 years of service.

1060	CVC	Unavailable (T&M)			Inspection
43507		Fail to Run			
12/31/2007		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

Rounds NLO reported from the field that 1B NV Pump Seal Balance Pressure D/P was greater than allowable value of 35 psid. It calculated to be 39 psid and stable. Engineering was contacted and viewed some data. OPS along with Engineering personel determined it would be best for Engineering to come in for a detailed look at data for determination of Operability. Engineering requested additional Maintenance support to obtain vibration data to aid in this determination. After Engineering arrival and examination of additional data, Engineering recommended that the 1B NV Pump be declared inoperable. 1B NV Pump was declared Inoperable at 01:30.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1121	SWS	Leak (External)			Inspection
27122		Fail to Start			
3/21/2003		external leakage (MSPI-D)			
		(MSPI-D)	Y		

Salt water cooling pump S21413MP307 has developed a leak through a small hole, less than 1/8", at the 6 o'clock position on the inside of the elbow of the discharge head, between the pump flange and the bellows. The propose of this activity is to perform the necessary weld repairs to the through wall leak and to any other identified corroded areas on the inside of the discharge head of the pump.

1121	AFW	Fail to Run			Inspection
27118		Fail to Start			
3/27/2003		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	Y		

On 3/27/03, at approximately 8:00 pm, during routine rounds, an operator noticed that the pump inboard appeared to have water in the oil. Visual observation of the bearing bulls eye showed that the liquid was very clear in color, the level was at the maximum level mark, and it had indications of very small bubbles. When the chicken feeder was removed, the oil in the base was cloudy and also had small bubbles. The pump was declared inoperable at 2220 hours (LCOAR L2-03-0247) The suspect liquid was drained per MO# 03032109 and approximately 300 mL of water was collected in addition to the oil that was in the bearing. The oil was changed with Mobil SHC 624, the pump was run and tested satisfactorily. It was declared operable on 3/30/03 at approximately 0530 hours.

1135	SWS	Unavailable (T&M)			Inspection
28973		Fail to Start			
5/20/2003		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

Engineering reported to the Control Room that Essential Service Water System pressure differential transmitter guage EFPDT0020 was reading less than zero with the 'B' ESW Pump in service. Normal reading would be 2-5 psid. 'B' ESW Pump was declared inoperable and Work Control began troubleshooting. G708282-014 was written to troubleshoot EFPDT0020. I&C Techs and Equipment Operators found the instrument lines to the dP transmitter had been reversed, such that the Hi Side instrument line was connected to the Low Side of the instrument and the Low Side instrument line was connected to the Hi Side of the instrument. The correct configuration requires the instrument lines to cross over each other behind the instrument support stantion where they are swagelocked to the dP instrument. EFPDT0020 was removed from service by I&C and EOs, the sensing lines were connected in the correct configuration and the instrument placed in service. EFPDT0020 was retested sat per instructions on G708282-014. 'B" ESW Pump was declared operable at 0915, 5/22/03.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1040	SWN	Unavailable (T&M)			Non-Test Demand
28053		Fail to Start			
5/21/2003		ran, but failed to develop adequate flow/pressure (MSPI-D)			
		(MSPI-D)	Y		

Three occurrences of Service Water Pump inoperability occurred between 9/20/02 and 10/3/02 due to excessive pressure differential across Service Water Pump discharge strainers. Corrective maintenance performed in each case found clogging of the strainers due to an accumulation of oyster shells.

1035	CCW	Unavailable (T&M)			Non-Test Demand
28279		Fail to Start			
5/28/2003		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

The 23 CCW pump was PM'd. The test required running the 23 CCW pump and shuting down the 22 CCW pump . When the 22 pump was stopped, 22 and 21 CCW pumps auto started due to low flow. The 22 CCW Pump Discharge Check Valve, 761B, appears to have stuck open.

5-29-03 - Opened valve. Engineer found wear in left side of body, recommends swapping shims on either side of pin to center disc. Package back to planning for disassembly of internals.

The CKV was not part of the PM and counts as a failure of that check valve.

1083	SWS	Fail to Run			Inspection
38218		Fail to Start			
7/7/2003		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	Y		

Water found in pump bearing due to cooler leak.
Work order A63050 identified the leak at the threaded connection between the nipple and elbow (inside the reservoir) for the cooling water return. Work order A63050 replaced both the return and supply nipples, and successfully pressure tested the assembly prior to reassembly and return to service.

1060	SWN	Unavailable (T&M)			Test
28773		Fail to Start			
7/31/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

While performing cal on 1RNLP7500 per WO 98548102 the pressure switch RNPS7500 would not work (IP/0/A/3112/002) hence the procedure could not show the system met the acceptance criteria. During trouble shooting of the switch using the Barton procedure, the switch was exercised and began working. The IP requires an Engineering evaluation since the acceptance criteria could not be met with the switch not working. This Pip has been written to confirm the conversation between the Shift Work Manager and the Engineer on 07/31/03 at 0430 that there are no operability concerns with the pressure switch. Engineering should document their concurrence.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1036	RHR	Unavailable (T&M)			Non-Test Demand
28951		Fail to Start			
8/14/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

At 1610 hrs. on August 14, 2003, the Perry Nuclear Power Plant (PNPP) experienced a "Loss of Offsite Power" (LOOP) event with a reactor SCRAM. Upon restoration of electrical power, the Low Pressure Core Spray (LPCS) and Residual Heat Removal Loop 'A' (RHR A) Systems' low discharge pressure alarms remained illuminated and the LPCS/RHR A Waterleg Pump (1E21C0002) failed to develop discharge pressure, even though it had other indications of proper operation.
As a result, LPCS, RHR A, and Division 1 Feed Water Leakage Control System (FWLCS) were not capable of functioning until the waterleg pump was vented, started, and the associated systems were vented. LPCS Fill and Vent per SOI-E12 was completed 8/15/2003 @0100 for a total of 8 hours 50 minutes of unavailability. RHR A was declared "available" by the Unit Supervisor 8/15/2003 @1408 hours for 21 hours 58 minutes of unavailability. FWLCS was unavailable for the time duration from the LOOP until venting/restart of the waterleg pump, for a total of 5 hours 25 minutes.

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1118	AFW	Fail to Run			Non-Test Demand
28816		Fail to Start			
8/14/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

The "B" MDAFW Pump overheated due to operating in a "dead headed" condition for approximately one hour. The "dead head" of the pump was caused by operation of the "A" &"B" MDAFW Pumps in parallel with the pump(s) discharge piping cross- tied (MOV-4000A and MOV-4000B open) with less than full pump flow (200 gpm/pump) required. The "stronger" "A" MDAFW Pump operating at an higher discharge pressure than the "B" MDAFW pump caused reverse flow in the "B" MDAFW Pump discharge line closing check valve V-4010 thus "dead heading" the "B" MDAFW Pump. Closing of the check valve due to reverse flow in the piping caused the pump to overheat due to less than adequate flow through the pump since the pump recirculation line is located downsteam of the check valve. The recirculation line was isolated when the check valve closed due to reverse flow in the "B" MDAFW discharge piping. FF BASIS: The pump started and achieved flow and throttled back properly. The pump was manually stopped prior to failure due to an observed overheating condition. Since the pump required repair prior to restoring it to service,this is considered a functional failure.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1094	CCW	Fail to Run			Non-Test Demand
29554		Fail to Start			
9/25/2003		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

On 9/25/03 at 17:00 with NMP Unit 1 at 100 percent power, 12 RBCLC pump tripped unexpectedly. Computer points E166, A069, and B110 were received along with Control Room annunciators H1-2-1, H1-4-1, and F2-1-1 due to the reduction in flow. The ARP actions were taken to start 13 RBCLC pump and thus restore system parameters. After 13 RBCLC pump start, the computer points and annunciators cleared. The operator at the scene noted that the motor for 12 RBCLC pump was hot and there was an acrid odor present. The operator went to the breaker which has no flags and noted nothing abnormal.
The motor was troubleshot under GAP-PSH-10, Trouble shooting and testing. The resistance to ground was below one Meg ohm and the phase to phase resistance variance was approximately 17% [less than 10% required]. An as found inspection of the motor was performed with out disassembly. There was one section of windings that was darker in color. There was also indication of movement on the ties on the end turns of the windings. The motor was sent to Schulz for rewind, where a more extensive failure analysis was performed. The magnet wire was noted to be loose in the slot from the manufacturing process. When the motor was made it was Vacuum Pressure Impregnated [VPI] with epoxy, this should have filled the voids in the slot and kept the magnet wire rigid. With out a proper VPI, it appears the magnet wire was allowed to move in the slot, which abraded the insulation and caused the motor to fail prematurely turn to turn or turn to ground.

1142	SWN	Fail to Stop			Inspection
35258		Fail to Start			
10/3/2003		failed to stop on demand (MSPI-D)			
		(MSPI-D)	Y		

FOUND CORROSION ON FUSE BLOCK CONTACTS AND ONE
CONTACT COMPRESSED. WORK PERFORMED: CLEANED FUSE STABS WITH SCOTCHBRITE
& REFORMED STABS TO ENSURE PROPER PRESSURE ON FUSE BLOCK CONTACTS.

1075	SWS	Fail to Run			Non-Test Demand
30884		Fail to Start			
11/19/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

1E11C001C RHR/SW pump was started, its discharge pressure was 290 psig with 4000 gpm flow. 4000 gpm was the highest flow that could be established. Previous CR's have been written to document this pumps poor flow performance. At present this pump would not meet IST reference discharge pressure of 360 psig.--and would appear to be in the required action range for the IST test.
DISASSEMBLED PUMP WE FOUND THE BEARING IN THE SEAL BOX HAD STUCK TO THE HEAD SHAFT & WAS TURNING IN THE SEAL BOX & THE HEAD SHAFT IS SCARED UP IN THIS AREA. NO OTHER DAMAGE FOUND WHILE DISASSEMBLING COLUMNS. WORK PERF PER 52PM-E11-002-0S. RANDY ROBERSON 11-23-03 RECEIVED TURNOVER FROM DAYSHIFT, MOVED THE NEW SUCTION HEAD TO THE INTAKE, CHECKED THE RUNOUT ON THE NEW LOWER HEAD SHAFT & MOVED IT TO THE INTAKE, IN A WOODEN BOX. DREW THE NEW STUFFING BOX, MECHANICAL SEAL, FOUR "0" RINGS FROM THE WHSE & CARRIED TO THE SHOP. MEASURED THE NEW STUFFING BOX PER PROC & PRESSED THE NEW BUSHINGS IN THE BOX, CARRIED TO INTAKE. MOVED THE THREE OLD SHAFTS TO THE SHOP & STARTED TO TAKE RUNOUT READINGS. ** SEE "COMMENTS" TAB FOR REMAINDER OF WORK PERFORMED.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1131	CVC	Unavailable (T&M)			Inspection
29736		Fail to Start			
11/20/2003		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

The 1B Centrifugal Charging Pump was tagged out of service when the 1B ERCW ESF Header was tagged. The Risk review of the schedule intended for the pump to remain available while the header was out of service. By tagging the CCP, U1 was placed in a white undefined condition for risk.

1071	SWN	Unavailable (T&M)			Non-Test Demand
29680		Fail to Start			
11/24/2003		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	Y		

While swapping the Unit 3 ICW pumps for the weekly rotation, the 3A ICW pump discharge check valve 3-50-311 failed to fully seat. The 3D 4kV bus is currently aligned to the 3B 4kV bus, which places the 3B and 3C ICW pump powered from the same train with 3A [ICW pump] out of service. This resulted in an unplanned 72-hour shutdown action statement.

Based on the results of the operability analysis, the backleakage observed on the 3A ICW pump discharge check valve would not have prevented the ICW system from removing required accident heat loads.

1121	SWS	Leak (External)			Inspection
31089		Fail to Start			
1/24/2004		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

THERE IS A LEAK ON THE DISCHARGE PIPING OF 2P307. THE RATE IS APPROX. 1 DROP EVERY 4 SECONDS. THE BIGGER ISSUE IS IT APPEARS THE LEAK IS COMING FROM A WELD ABOUT 7 INCHES ON THE PUMP SIDE OF THE FLANGE DIRECTLY ON THE BOTTOM OF THE PIPE. THE PUMP IS RUNNING AT THIS TIME. PLEASE INVESITIGATE AND REPAIR.

1025	AFW	Fail to Run			Test
30656		Fail to Start			
3/13/2004		external leakage (MSPI-D)			
		(MSPI-D)	Y		

Problem Statement Per CR 2004001041 the 2A MDAFWP was declared a MPFF. While the 2A MDAFWP was in service for surveillance testing, the pump's inboard bearing oil bubbler was found empty with oil on the floor. This resulted in entry into a MANDATORY LCO per Tech Spec 3.7.5 condition B. (2) Cause Determination Technique Used Event and Causal Factor (3) Summary The morning of 3/13/04 Unit 2 was in Mode 3 preparing for 2R16 the 2A MDAFWP was in service for surveillance testing. The pump's inboard bearing oil bubbler was found empty with oil on the floor. The oil appeared to be leaking from the fill cap and from TE-508. A mandatory LCO per Tech Spec 3.7.5 condition B was declared.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1136	SWN	Fail to Run			Inspection
30630		Fail to Start			
3/17/2004		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

Oil leak found on the lower motor bearing on 1-SW-P-1A . The cause of the leak was determined to be from an o-ring that shrunk. The shrinkage was due to long term exposure to the bearing oil. The o-ring material is rated for use in oil environments but has a limited life. The o-ring should have been changed out before exceeding the end of life. Analysis:In the morning of March 17, 2004, Electricians discovered an oil leak on 1-SW-P-1A-MOTOR that had not been in service for nearly three weeks. Disassembly of the motor later determined that an o-ring failed, leaving a 1/4" gap for the oil to leak by.

1075	SWN	Fail to Run <1H			Inspection
36060		Fail to Start			
5/5/2004		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

When checking for leaks on 1P41F208D. Upon entering the intake noticed unusual smell, (like something was getting hot). After checking for leaks on valve we investigated smell. Check motor and it was hot to the touch, checked other motors and they were about the same. Check oil levels found lower bearing oil level in normal range, also checked upper bearing oil level and found it to be at bottom of site glass. Checked temperature gage on side of motor and it was 80 deg. Heard a high pitch squealing noise and about the same time smoke started coming from the motor, had ops shut pump down.
This event is a functional failure. The event has been determined not to be maintenance preventable due to the oil levels being marked incorrectly during the motor manufacturing process.

1074	RHR	Unavailable (T&M)			Test
31468		Fail to Start			
5/11/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

Using this conservative methodology we find that sufficient quantity of transportable material was left in containment to block the RHR sump screens beyond analyzed limits and may have prevented the RHA pumps from performing their safety-related function post-LOCA.
The miscellaneous pieces of metal identified on were reviewed and considered to have negligible impact on containment heat sink and hydrogen generation calculations and PCT calculations
CONSERVATISMS NOT INCLUDED IN EVALUATION
We did not factor into our evaluation the location of material in an attempt to determine if it would or wouldnt reach the sump screens. Instead we considered that all transportable debris would reach the containment floor and ultimately reach one of the four sumps. We assumed that this debris would rest flat and be distributed on the sump screen to obtain the maximum blockage area. Finally, based on test results provided in support of GSI-191, it is likely that some of the debris would have become lodged on obstructions on the way to the sum However, for this evaluation, all of the transportable material was assumed to reach the sump.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1074	RHR	Unavailable (T&M)			Test
31468		Fail to Start			
5/11/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

Using this conservative methodology we find that sufficient quantity of transportable material was left in containment to block the RHR sump screens beyond analyzed limits and may have prevented the RHA pumps from performing their safety-related function post-LOCA.
The miscellaneous pieces of metal identified on were reviewed and considered to have negligible impact on containment heat sink and hydrogen generation calculations and PCT calculations
CONSERVATISMS NOT INCLUDED IN EVALUATION
We did not factor into our evaluation the location of material in an attempt to determine if it would or wouldnt reach the sump screens. Instead we considered that all transportable debris would reach the containment floor and ultimately reach one of the four sumps. We assumed that this debris would rest flat and be distributed on the sump screen to obtain the maximum blockage area. Finally, based on test results provided in support of GSI-191, it is likely that some of the debris would have become lodged on obstructions on the way to the sum However, for this evaluation, all of the transportable material was assumed to reach the sump.

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1085	SWN	Unavailable (T&M)			Test
31530		Fail to Start			
5/11/2004		ran, but failed to develop adequate flow/pressure (MSPI-D)			
		(MSPI-D)	Y		

During performance of 02-OHP-5030-019-002W, "West Essential Service Water System Flow Test" on 5/11/2004, 2-PP-7W Unit 2 West Essential Service Water Pump was not able to produce adequate discharge pressure to pass the IST surveillance test. The action value is 64.2 psid, with an alert range value of 65.6. The pump produced only 63.5 psid. The IST program owner has verified these values. This failed surveillance led to pump being declared inoperable placing Unit 2 in the 72 hour action of TS 3.4.7.1.

After the pump was declared inoperable, a fault tree was started by a team consisting of members from System Engineering, Production Engineering, Operations, and Maintenance. One identified fault was "impeller rubbing induced by low flow". At this point the coupling gap adjustment was made and the pump then passed the operability test. Continuation of the fault tree analysis was stopped at this point, since the apparent fault was discovered and corrected.

Per the maintenance rule evaluation of this CR, this did not result in a functional failure for the ESW Essential Service Water system. This is based on the fact that the pump was still capable of performing its function (did not go below the minimum operability limit) and it would have been able to meet is mission time of 30 days.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1035	CCW	Fail to Run			Non-Test Demand
31235		Fail to Start			
5/17/2004		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

At 13:59 22 Component Cooling Water pump (22CCP) tripped on indication of over current (amber light). Multiple alarms on Control Room panel SG dealing with CCW flows and pressures momentarily annunciated and cleared. 21, and 22 CCWPs auto started. 480V motor trip alarm remained up.
The direct cause of the motor failure was a phase-to-ground fault from coil insulation breakdown. According to Schulz Report N-9059-2, stator damage evidence of a turn-to-turn short existed, creating excessive currents that lead to heating and breakdown of motor insulation. The apparent cause for motor failure was a personnel error.

1129	SWS	Unavailable (T&M)			Non-Test Demand
36541		Fail to Start			
6/21/2004		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

06/21/04, the 2A RHR HEX outlet valve failed to open as required with the A2 pump in service during performance of step 7.8.8 of 2-SI-4.5.C.1(3-COMP).
Cause Description: It was discovered that BKR 52 STA actuator arm set screw was loose. The set screw was tightened, breaker installed and closed and the problem was alleviated.

1085	SWN	Unavailable (T&M)			Inspection
31537		Fail to Start			
6/27/2004		ran, but failed to develop adequate flow/pressure (MSPI-D)			
		(MSPI-D)	Y		

Based on the fault tree/support refute and the inspection performed, the most likely cause (apparent cause) of the pump problem is that some foreign material was sucked up against the suction bell on the ESW pump causing the pump discharge pressure and flow to decrease. When the ESW pump was turned off to prepare for replacement, the foreign material on the suction of the pump was apparently pushed back into the forebay by the water draining back from the pump discharge strained. Based on flow patterns in the screen house forebay the foreign material has probably moved over towards the Unit 2 Circulating Water pumps and is in some low flow area in the forebay or it has been sucked up by the Unit 2 Circulating Water pumps and is not causing any problems.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1072	HPI	Unavailable (T&M)			Non-Test Demand
33759		Fail to Start			
8/3/2004		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

High-Press Inj Pump 4P215B/SISPUMP misalignment-human error.
4B HHSI Pump Outboard Bearing Oil Leak.
An oil leak in the outboard bearing housing would have caused the pump to lose sufficient amounts of oil during a 30 day mission time such that the pump would have eventually ceased to rotate.
The ongoing investigation identified during disassemble that evident damage to the thrust ring existed due to the anti-rotation pin not being properly aligned into the slot during the previous overhaul (workmanship, human performance error). In addition, the as-found gaskets from the inboard and outboard sides of the thrust bearing housing were sent to an outside lab for analysis. Also, new gaskets were sent for to the lab comparative analysis. The results indicate that the old gasket material was chemically different than the new gaskets. This seems to indicate that during the past overhaul incorrect gasket material was used. Although it is inconclusive as to when the material was added, what is known is that during the past overhaul in 1994 (ref. WO 94000737-01), there is no evidence that new gaskets were issued and used during the pump overhaul. This leads to two conclusions; one, that the old gaskets were reused and were incorrect, or two, that the gaskets were fabricated from incorrect material.

1057	RHR	Fail to Run			Non-Test Demand
32696		Fail to Start			
8/10/2004		external leakage (MSPI-D)			
		(MSPI-D)	Y		

Seal line on RHR pump 'A' has double ended shear and is leaking several gallons a minute. This was discovered while the pump was in service for shutdown cooling. On 8-10-2004, RHR Pump A was operating in Shutdown Cooling mode. As a result of increases in sump level activity, an Operator was dispatched to the Division 1 RHR Pump room. The Operator reported that the RHR Pump A seal line was "sheared" and is leaking several gallons a minute. Immediate Actions As stated in the CARD, the Operator had RHR Pump A shutdown and isolated the pump. When disassembling of the compression fitting at the pump discharge orifice, the tube appeared to be loose. When the tube was removed from the fitting, the ferrule was not on the tube but remained in the fitting. In the "Hot Shop," the compression fitting from which the tube pulled out of was disassembled, the ferrule was found in the fitting. Using a magnet, the compression fitting and ferrule were determined to be carbon steel. The tubing is stainless steel. Inspection of the tubing showed no indications that the ferrule ever swaged the tube. The soft carbon steel of the ferrule did not bite into the harder stainless steel tube.

1071	SWN	Unavailable (T&M)			Non-Test Demand
33803		Fail to Start			
10/2/2004		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	Y		

While swapping ICW Pp.s on Unit 3, the 3B ICW pump discharge valve (3-50-321) did not seat upon stopping the pump. The Intake operator reported the pump to be rotating backwards after the pump had been stopped.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1119	SWS	Unavailable (T&M)			Non-Test Demand
33047		Fail to Start			
12/13/2004		failed to start on demand (MSPI-D)			
		(MSPI-D)	Y		

While attempting to rack up the "C" SW Pump breaker (XSW1EB 02) to support tagging out the "B" SW Pump for scheduled maintenance, Operations personnel noted that the charging springs failed to charge when the breaker was racked up.

1135	CCW	Fail to Run			Inspection
34196		Fail to Start			
1/10/2005		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

At approximately 0050 on 1/10/05, the B CCW pump was secured. Grease was found coming from the coupling area of the pump. Per the SS turnonver, once the pump was secured, the grease was cleaned up.
An EFIN Engineer and the System Engineer walked down the pump at approximately 0715. Piles of greases were observed in the pump base and under the coupling guard (see atached photographs). Presumably, the piles slid off of the guard after the previous cleaning. However, not knowing the exact cause, the pump was placed in pull-to-lock and declared inoperable. While performing 05101114, Maintenance personnel could not determine if the gasket was between the coupling halves. They loosened the bolting enough to make the decision. They found the 3/8" coupling gap disk material had been installed such that it was smashed between the bolted coupling halves during performance of P718978 (see attached photographs). The gasket was torn with the excess material between the halves.

1084	CVC	Fail to Run			Non-Test Demand
33818		Fail to Start			
1/13/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

Condition report CR 05013003 was written on 1/13/2005 for abnormal flow rates and high motor amps on the Unit 1 West Centrifugal Charging pump, component number 1-PP-50W.

This condition was identified during normal operation of the pump. The pump was declared Inoperable because of the abnormal flow rates and high motor amps.

System conditions observed included increase of motor amps from normal values (~57 amps) to 75 amps with amperage swings of 6 to 8 amps. The level in the Pressurizer (component 1-OME-4) was noted to be lowering. Charging system flow rate was also noted to be lowering.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1035	HPI	Fail to Run			Inspection
34787		Fail to Start			
1/26/2005		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	Y		

On February 18, 2005, while in mode 1 at 100% power, engineering analysis determined that the 23 Safety Injection Pump had been inoperable for an indeterminate period between the successful pump surveillance on 12/24/04 and 01/27/05 when gas was vented from the 23 SI pump casing due to gas build-up within the casing.

1057	RHR	Fail to Run <1H			Non-Test Demand
34254		Fail to Start			
2/4/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

The EIT performed a Causal and Effects analysis and determined the Root Cause of the event to be air in the RHR piping. The cause of the pump trip was a pressure spike generated due to air in the RHR piping.
The air was introduced into the system on 1-25-2005 due to the mis-alignment of the Division 2 RHR pump suction valves during the fill and vent evolution per SOP 23.205.
Follow-up discussion with the NRC resulted in a request to address the potential that a pump runout condition can result in an overcurrent trip of the motor. In addition, air could have accumulated in the 18"diameter elbow located between the RHR header and valves E1150-F028A and E1150-F028B and was not vented. The NRC requested the impact this potential air void would have on the RHR piping system.
As a result of these questions, an analysis was performed, TMSA-05-0025, that evaluated the impact this potential air void could have during LPCI and Suppression Pool Cooling operations. The overall analysis concluded that both LPCI and Suppression Pool Cooling would have remained fully operational assuming either modes were initiated when air voids were present in the system.
The operability assessment was revised to address the NRC's concern about the potential trip of the motor during pump runout conditions. The assessment also included the potential air void in the 18" diameter elbow that was not vented.
Corrective actions, including both procedural and training enhancements, for the Human Performance issues that resulted in the air being admitted to the RHR system are being addressed in CARD 05-20760.

1035	SWN	Fail to Run			Non-Test Demand
36597		Fail to Start			
3/8/2005		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

On 3/8/2005, 22SWP failed after less than one year of operation due to noise and high vibration from the motor upper bearing.

The motor upper bearing failed due to brinnelling (spherical indentation) of the bearing rings by the ball bearings. The indentations inhibited bearing lubrication, preventing the smooth sliding contact of the rolling balls with the ring surfaces. The breakdown of this antifriction contact resulted in rapid bearing deterioration

---

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1097	RHR	Fail to Run			Non-Test Demand
34669		Fail to Start			
3/8/2005		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

During the isolation of 1-APR-0400262-E-0, at ~ 0454, 12 RHR pump tripped. #12 RHR Pump was in service for Shutdown Cooling. The following annunciators came in while the isolation was being hung: C03-A-01, C03-A-06, C03-B-23, C03B-50, C05-A-55, & C05-A-56. The duty CRS and non-duty SM were reviewing electrical prints to confirm that the alarms received were consistent with what was expected with the isolation evolution.

An isolation was being hung to support replacement of the Safety Relief Valve (SRV) solenoids. The isolation caused several unexpected alarms in the Control Room. It was decided by Shift Supervision to restore the isolation and re-evaluate the tagged components. When the isolation was restored the running pump logic sensed a loss of suction flow path because the position indication for the RHR pump shutdown cooling suction valves had been lost. The indicated loss of suction flow path caused the pump to trip. The station lost the in service SDC train.

1027	AFW	Fail to Run <1H			Test
34469		Fail to Start			
4/9/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

While performing 2106.006 Sup. 11, EFW Train 'A' Flow Path Verification From T-41B, (Q CST), the flow and discharge pressure were observed lowering.
After aligning the Q CST as the suction source for the 'B' Emergency Feedwater Pump (steps 2.2 and 2.3), the pump was started. With the recirc aligned to the flume (step 2.4), normal recirc flow was seen ~60 gpm. When we attempted to perform step 2.7 and raise flow to 540 gpm, flow went up to ~280gpm and then started to lower. Pump discharge pressure was seen lowering during this time (it went to ~5 psig and was not seen to fluctuate). The pump was immediately secured The Q CST suction line had been tagged and drained earlier in the outage for check valve (2CS-844/845) inspections. When the tags were cleared, the line was filled and vented using the vent that was tagged open on the tagout (2CS-5016), but not the suction line high point vents (2CS-1109/1097/1095). A procedure for performing this venting did not exist because this flow-path is not normally used. Even though the operators returning the Q CST suction line to service filled and vented the line, there was still air present in the line. When B EFW pump was being operated for surveillance testing IAW 2106.006 supp. 11 (EFW flow-path verification from Q CST), the operators noted indications of oscillating flow/pressure and immediately secured the pump. The pump had operated normally for~5 minutes on recirc flow (~30 gpm) and began oscillating as flow was raised to ~250 gpm for flow path testing. Because the pump was promptly secured when flow began to oscillate, no pump damage occurred. The B EFW pump was declared operable following EFW system venting and completion of surveillance testing.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1053	SWS	Fail to Run <1H			Non-Test Demand
35573		Fail to Start			
4/14/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

1D RHRSW Pump tripped after running 4 sec. Troubleshooting was performed under WO 793632. No equipment failure has been identified.
Statement of Cause:
The following is the write-up of the AT 324585-02 - Review conclusions of Troubleshooting pkg-WO 793632-01:
The purpose of this assignment is to document the engineering review of the troubleshooting performed under W0 793632-01 "Trip of the 1D RHR Service Water Pump on 04/14/05".
The Electrical Maintenance Department (EMs) performed troubleshooting at the 901-3 and 901-33 panels. Voltage measurements were taken at various points in the trip circuit, as defined in WO 793632-01. The test data did not indicate the suspected source of the trip. The 1D RHR Service Water Pump Motor was tested in accordance with MA-AA-723-330 "Electrical Testing of AC Motors Using Baker Instrument Advanced Winding Analyzer". Test results indicated no degradation to the motor. The protective relays were tested and had calibrations verified per WO 801430-01. No adverse conditions were identified while performing the calibration checks. While extensive tro

1113	SWS	Fail to Run			Inspection
34757		Fail to Start			
5/6/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

During shutdown of the "A" ESW Pump following TST-104, the assigned NPO noticed that the packing gland sleeve was intermittently rotating on the pump shaft. After discussions with PCE engineers it was determined that it was the packing sleeve that was intermittently rotating and that the sleeve was displaced above the pump gland. This condition was previously observed, documented , and evaluated in CR-JAF-2005-04625 in October, 2004. This previous CR documented that the shaft sleeve had risen approx. 2 inches above the pump packing gland. Today's observation determined that the sleeve had risen another 3 inches above the packing gland.

1029	CSR	Fail to Run <1H			Test
34880		Fail to Start			
5/10/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

On May 10, 2005, while operating on mini-flow recirculation for the performance of ECCS leakage surveillance testing per 40ST-9SI09, the Unit 2 Containment Spray Pump A (2MSIAP03) tripped on an 86 ground fault. During troubleshooting activities for the identified, faulted, pump motor cable under Work Order 2798843, it was noticed that the ground could be eliminated by wiggling the cable in the termination box. This indicated that the ground was near the end of the cable, possibly inside the Armored Terminator.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1082	CCW	Fail to Run <1H			Test
34939		Fail to Start			
6/30/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

CCW PUMP 2C TRIPPED WHILE THROTTLING FLOW DOWN TO 9000 GPM. THE PUMP BREAKER OPENED UNEXPECTEDLY DUE TO A SPURIOUS ACTUATION OF THE COMPONENT COOLING WATER PUMP 2C OVERCURRENT 50/51 RELAY TIME DEVICE. THE RELAY WAS REMOVED AND SENT TO THE VENDOR FOR A FAILURE ANALYSIS SINCE A SPECIFIC REPEATABLE FAILURE IN THE RELAY SUB-COMPONENT(S) COULD NOT BE IDENTIFIED. THIS IS A MRFF SINCE THIS CONDITION CAUSED A LOSS OF A GQA AND PSA HIGH RISK RANKED FUNCTION OF CIRCULATING COOLING WATER. HISTORY REVEALS NO OTHER SIMILIAR FAILURE HAS OCCURRED WITHIN THE LAST 2 YEARS.
CORRECTIVE ACTIONS: REPLACED RELAY AND CALIBRATED PER 0PMP05-ZE-0037.

1109	AFW	Fail to Run			Inspection
36449		Fail to Start			
8/27/2005		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

During operation rounds in August 2005, the operator noticed some oil underneath the Auxiliary Feedwater Pump (AFWP) 1-2. After implementing compensatory measure it was discovered the there was a crack in the pipe connecting the oilier to the bearing housing. Apparent cause of the crack on the Brass piping was stress corrosion cracking. Ammonia is one of three elements that would promote Stress corrosion cracking. Ammonia was introduced from cleaning products.

1129	SWS	Unavailable (T&M)			Non-Test Demand
36089		Fail to Start			
9/30/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

On 09/30/05 the 2A RHR HEX outlet valve, 2-FCV-23-34, failed to open when the A2 RHRSW pump was placed in service.

1126	SWN	Fail to Run <1H			PMT
36735		Fail to Start			
10/20/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

A fault in the C Phase power cable to the 1-01 SSW pump's motor caused the associated breaker to trip on overcurrent shortly after the pump was placed into operation.

Just prior to this, the motor had been removed and re-installed to facilitate SSW pump 1-01 replacement. The 1-02 SSW pump had just been taken out of service to commence a scheduled work window but was subsequently returned to service pending resolution of the cable problem on the 1-01 pump.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1129	SWS	Unavailable (T&M)			Non-Test Demand
36088		Fail to Start			
10/21/2005		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

On 10/20/2005 at 08:22, OPs placed Loop I of RHR in suppression pool cooling per 2-OI-74 section 8.5 with both 2A/2C RHR pumps and A2/C2 RHRSW pumps. It was noted that the 2A RHR HEX SW outlet valve (2-FCV-23-34) would not operate when given an open signal from the control room.

1109	SWN	Unavailable (T&M)			Inspection
38338		Fail to Start			
1/11/2006		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

Operator found no visible packing leakoff of ASW PP 1-1. The cause is that the packing is full of silt due to the rough seas we have had during the last month. Pump was repacked and declared operable.

DURING A ROUTINE OBSERVATION OF ASW PUMP 1-1, NO PACKING LEAKOFF WAS OBSERVED. MAINTENANCE AND ENGINEERING INSPECTED THE PUMP WHILE IT WAS IN SERVICE AND NOTED THAT THERE WAS NO VISIBLE PACKING LEAKOFF, AND THAT THE UPPER HALF OF THE STUFFING BOX WAS WARM, THE LOWER HALF WAS COOL, INDICATING THAT THERE WAS PACKING FLUSH GOING TO THE LOWER PACKING RINGS. BASED ON DISCUSSIONS AND PREVIOUS EXPERIENCE, IT WAS DECIDED THAT THE APPROPRIATE COURSE OF ACTION WOULD BE TO CLEAR THE PUMP AND REPACK IT. THIS WAS DONE AND THE PUMP WAS RETURNED TO SERVICE WITH ADEQUATE LEAKOFF.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1137	HPI	Unavailable (T&M)			Inspection
37904		Fail to Start			
1/11/2006		corrective maintenance prior to failure (MSPI-SD)			
		(MSPI-SD)	Y		

The high vibrations that were detected at the pump were actually caused by the speed increaser. The speed increaser had been rebuilt and placed in-service four days prior to the high vibrations being detected. Disassembly and inspection of the speed increaser have determined that the high speed gear and bearings were wearing excessively in the journal areas. Maintenance changes the oil in the speed increaser every three years. Procedure 0-MPM-0103-01 does not instruct the craft to drain the oil from the oil cooler. With the oil cooler being mounted lower than the speed increaser on the pump skid, draining the oil in the speed increaser does not drain the oil from the oil cooler. This allowed dirty oil to stay in the system. The oil system of the speed increaser is a closed system that holds approximately fifteen gallons of oil. The debris that was found in the oil strainer as described in PI #2006-0197 was most likely caused by wear materials from the bearings and shaft of the speed increaser. The relatively small quantity of oil in the closed loop system continuously cycled the debris through the system.
The new bearings installed in the speed increaser are typically field fitted (scraped) to ensure proper contact and clearances are obtained. The new bearings installed into the speed increaser were measured and blue checked and found to be in satisfactory condition for installation in accordance with the procedure as it was written. No scraping was done on the failed speed increaser bearings. Previous overhauls of other speed increasers have required several shifts needed to scrape the bearings to acceptable tolerance to pass a blue check. This may have led to tighter shaft clearances than is normal for the bearings. Debris in the old oil that was left in the oil cooler along with the tighter clearances associated with the new bearings appears to have caused the damage to the bearings and the shafts.

1093	CVC	Fail to Run <1H			Test
37833		Fail to Start			
1/24/2006		failed to start on demand (MSPI-D)			
		(MSPI-D)	Y		

The Unit 3 "B" charging pump was started on 1/24/06 for a surveillance run following maintenance activities. The pump ran for approximately 25 seconds before tripping on overcurrent. During the brief run, thrust bearing temperature spiked above 200 F, and steam or mist was observed coming from the pump inboard seal.
The pump's lube oil filter assembly was opened and some non-ferrous metal particles were evident. Further disassembly of the pump revealed thrust bearing damage and a sheared pump shaft.

1110	SWN	Unavailable (T&M)			Non-Test Demand
38333		Fail to Start			
3/7/2006		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

While performing the weekly ASW pump swap per operating procedure E-5:IV, it was discovered that the pump had no leakoff flow.
The packing rings removed from this pump were found to be saturated with silt and other fine mtl.
The pump was repacked and returned to service with adequate leakoff.

Component Type *MDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1032	CSR	Fail to Run <1H			Non-Test Demand
38098		Fail to Start			
3/29/2006		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		
	On 3/29/06, approximately 5 minutes after starting the 12 Containment Spray Pump IAW STP O-4B-1, Thrust Bearing temperature on computer point T4170, indicated rising above the critical high set point of 170 F and peaked at approximately 270 deg F. Local observations revealed a burning smell along with burning indications at 12 CS PP Thrust Bearing.				
1053	SWS	Fail to Run <1H			Non-Test Demand
38496		Fail to Start			
5/16/2006		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		
	After starting the 1C RHR Service Water Pump, the NLO notified the Control Room that the outboard high pressure seal was leaking approximately 2-3 gpm. MMD was contacted to look at the pump while it was still running to evaluate the seal condition. MMF reported that the seal was gone and the pump should not be run.				
1083	SWS	Unavailable (T&M)			Inspection
38493		Fail to Start			
5/26/2006		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		
	Motor upper bearing oil loss due to migration of oil out of cooling coil because of pinhole leak in cooling coil. Leak caused by accelerated erosion due to locaized turbulent flow inducd by mechanical damage in the coil (possible during fabrication./installation) coupled with relatively high flow rate. Coil replaced.				

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1145	SWN	Unavailable (T&M)			Non-Test Demand
38776		Fail to Start			
5/30/2006		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	Y		

On 05/30/06 @ 0934, while performing a Tagout of SW(T)-261Service Water Pumps Seal Water Regulator, SW-43B1 the Backup Seal Water Regulator for Service Water Pump B1 did not provide any Seal Water Flow or Pressure. Service Water Pump 1B1 and Service Water Train B was declared INOPERABLE. The cause of the failure was attributed to iron deposit buildup in the regulator and the regulator outlet piping, resulting in a failure of the regulator to supply flow as designed.

At 09:34 on 5/30/2006, with Kewaunee Power Station at 100 percent power, the backup safety-related bearing lube water supply to service water pump B1 was discovered to be inoperable, making both service water pump B1 and service water train B inoperable. Maintenance was performed, service water pump B1 was returned to service, and both the pump and train B were declared operable at 15:31 on 5/30/2006. The inoperability is assumed to have existed since the regulator was last demonstrated operable at 21:07 on 4/16/2006. During that 43.5 days of inoperability, the plant was at power twice (once for 10 days and once for 8 days). Also during that time, various Train A engineered safety features were concurrently inoperable. The direct cause of the safety-related bearing lube water flow disruption for service water pump B1 was the service water backup lube water supply pressure regulator stem sticking in the stem guide bushing as a result of contaminants from the plant equipment water lube supply adhering to the stem. Inspection of the plant equipment water system found the filter tanks and internal components severely corroded allowing water and contaminants to bypass the cartridge filters. This condition developed because the original plant equipment water cartridge filter retaining cup material was not suitable for the application and inadequate maintenance practices failed to identify and correct the issue.

1083	SWS	Fail to Run			Inspection
38643		Fail to Start			
6/29/2006		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

A similar event occurred approximately 1 month ago, when water was found in the upper sight glass of the 'D' RHRSW Pump Motor. Reference CAP042424 and ACE001627. A prompt Condition Evaluation needs to be performed to assess the potential for a common mode failure mechanism for the RHRSW pumps, taking into account that potentially 2 motor cooler tubing failures have occurred within 1 month of each other.

1139	CCW	Unavailable (T&M)			PMT
39059		Fail to Start			
7/27/2006		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	Y		

At 19:46:59, the Unit 2 Charging Pump/SW Pump low discharge pressure annunciator, 2D-G5, was received while restoring 2-SW-E-1A to service IAW 2-MOP-8.22 following scheduled maintenance. The standby Charging CC Pump, 2-CC-P-2A automatically started, but no flow was observed locally or on the PCS.

The low Charging CC discharge pressure occurred while opening 2-CC-785, the 'A' ISC discharge isolation valve, to return the system to a normal lineup. The 'A' ISC and its associated piping had been vented through 2-CC-553 until the system was water solid prior to opening 2-CC-785. 2-CC-553 is on the inlet side to the cooler. There is no vent valve at the cooler discharge, only the drain valve, 2-CC-554.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1109	SWN	Unavailable (T&M)			Non-Test Demand
39549		Fail to Start			
9/10/2006		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

Auxiliary Saltwater Pump (ASP) 1-2 was started at 0150 on 9/10/06 to support a surveillance test for the Component Cooling Water Pump (CCWP) 1-1. 24 seconds later the ASP 1-2 room fan E-101 tripped on thermal overload (TOL). ASP 1-2 is inoperable as this fan is part of its acceptance criteria.

The cause of E-101 fan failing on TOL was that the fan motor was found seized.

The room fan is outside the MDP boundary.

1100	SWS	Fail to Run			Non-Test Demand
40088		Fail to Start			
10/4/2006		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	Y		

AC-10C and AC-10D were the running raw water pumps. At 0025 on 10/4/06, in preparation for the B cell outage which would isolate AC-10B and AC-10C, raw water pump AC-10A was started and AC-10C was secured. There was no pre-job brief by the operating crew for the B cell outage and at the time of the pump rotation, the AON was not aware of why the pumps were being rotated. After sparging AC-10A in preparation to start it, the AON asked the control room operator why we were rotating pumps and was told it was in preparation for a B cell outage. He was aware that CW-14A and CW-14B were closed, but also knew that AC-10A had a good suction flow path through the cross-tie sluice gate CW-16A. After the pump rotation, he left the intake and continued his other duties.

1073	SWN	Fail to Run <1H			Test
39961		Fail to Start			
10/15/2006		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

2 minutes after Safety Injection was initiated IAW 14666-1, section 5.3, NSCW pump #1 tripped.

1068	SWS	Fail to Run			Inspection
40618		Fail to Start			
11/20/2006		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

WHILE OBTAINING ADDITIONAL DATA FOR RWP-2B (REF NCR 213857), ABNORMAL LOUD NOISE WAS HEARD AND ELEVATED VIBRATIONS (NO -ISI TESTING) WERE NOTED. BASED UPON THESE FINDINGS RWP-2B WAS DECLARED INOPERABLE.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1064	AFW	Fail to Run			Non-Test Demand
41123		Fail to Start			
2/16/2007		corrective maintenance prior to failure (MSPI-SD)			
		(MSPI-SD)	Y		

1A MDEFW Pump Outboard Bearing Temperature reads 360 Degrees on OAC point O1A1190 and 330 degrees locally. The cause of the bearing overheating was lack of lubrication. The lack of lubrication was the result of human error. The pump had been disassembled, inspected internally for wear, and reassembled in December of 2000 per Work Order 01546995. The outboard bearing housing was reassembled during that time with the oil ring out of position. Specifically, the outboard oil ring was not placed onto the oil ring sleeve as required by step 11.9.15 of Maintenance Procedure MP/1/A/1300/027, rev. 18.

1113	SWS	Fail to Run <1H			PMT
42502		Fail to Start			
5/4/2007		corrective maintenance prior to failure (MSPI-SD)			
		(MSPI-SD)	Y		

When RHR Service Water Pump 10P-1C was started, 10SOV-1C did not open when de-energized.
THIS RESULTED IN LACK OF COOLING FOR 10P-1C.

1065	HPI	Fail to Run <1H			Test
43324		Fail to Start			
8/26/2007		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

On 8/26/2007, during normal quarterly in-service test (PT/2/A/0202/011) of the 2A HPI pump and motor, it was noticed by operators present to administer the testing that a metallic burning smell was prevalent in the Unit 2 HPI pump room. Upon further inspection of the pumps in the area, it was discovered that the area on the 2A HPIP where the shaft enters the mechanical seal package was glowing red hot from intense heat. A request was submitted by the NEO to stop and secure the 2A HPI pump immediately. At approximately 13:06, the 2A HPI pump was secured and the 2B HPI pump was started. The total length of duration that the 2A HPI pump ran was 18 minutes.

The 2A HPI pump was declared inoperable at 13:06 on the 26th of August. Corrective actions to repair the 2A HPI pump led to safety system unavailability and a generation loss warranting a root cause evaluation. The scope of this evaluation is to determine the root cause of the pump and mechanical seal failure.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1145	SWN	Unavailable (T&M)			Non-Test Demand
43056		Fail to Start			
10/15/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

Problem Statement: Received annunciator 47052-P SER 241, Turbine Building Service Water Header B Air Accumulator Pressure Low. NAO reported that SV-33044 was rapidly venting air. Requested I&C investigate, SV-33044 was mechanically agitated by I&C technician and repositioned allowing SW-4B to close as designed. The SV-33044 is an ASCO model 8344 solenoid operated valve (SOV) which failed to properly close the service water valve, and was required to be mechanically agitated to perform its function. Closing the SW-4A/B valves is required to assure proper service water flow is maintained to critical equipment during emergency situations such Safety Injection coincident with low service water header pressure.

1112	SWS	Fail to Run			Non-Test Demand
43984		Fail to Start			
10/17/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

On 10/17/2007, Operator heard banging noise from lower area of 36 SWP. After a vibration survey determined that vibration readings were above acceptable levels, the pump was secured.
CR 2007-3966: During 10/20/07 disassembly of 36 SWP, bolt heads holding the locking collar halves to the impeller were found severely eroded. Bolt locking tabs were completely missing but sufficient thread engagement remained to hold the locking collars fast to the impeller.

1100	SWN	Leak (External)			Non-Test Demand
44362		Fail to Start			
10/22/2007		external leakage (MSPI-D)			
		(MSPI-D)	Y		

On 10/22/2007 21:20, The Control Room received the "Raw Water Pump Room Hi Level" alarm (A2, D-6U). Level is detected by LC-2825, located on the south end of the RW Pump Room, with the alarm setpoint of >2 inches of detected level. Observed leaking pump AC-10D is located on the north end.

1088	CCW	Fail to Run <1H			PMT
44749		Fail to Start			
1/30/2008		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

Following ACCW Pump 'B' start for retest following maintenance on 01/30/08, inboard and outboard bearing temperatures were noted to be rising rapidly. Temperatures noted were 252 degF on the inboard bearing and 271 degF on the outboard bearing. Normal ACCW pump bearing temperatures are 80-120 degF. Subsequent inspection revealed that both inboard and outboard ACCW B pump journal bearings were wiped but the thrust bearing was unaffected.

Component Type MDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1097	SWS	Fail to Run			Non-Test Demand
44314		Fail to Start			
2/4/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

P-109A (11 RHRSW Pump) was placed in service per isolation instructions in C/O 27330 for work on "B" RHRSW loop motor cooler supply check valve PM. Operator stationed at pump noted low flow from the pump motor cooling line. Flow was quantified at 0.5 liters per minute (approx 0.1 gpm). Minimum required motor cooling flow is 2 gpm (based on 90F river temperature). Operator noted that motor cooling solenoid valve
SV-4937A indicated open; when the manual bypass around SV-4937A was opened, motor cooling flow was more than adequate. Based on this, it appeared that flow blockage was located at SV-4937A.

The flow blockage at SV-4937A reduced the motor cooling flow to the P-109A motor to less than the required 2 gpm, rendering the pump inoperable. The reduction of cooling water flow was sufficient enough to negate the beneficial effects of winter river temperatures and require that the pump be considered inoperable.

1100	SWN	Leak (External)			Non-Test Demand
44364		Fail to Start			
3/1/2008		external leakage (MSPI-D)			
		(MSPI-D)	Y		

On 10/22/2007 21:20, The Control Room received the "Raw Water Pump Room Hi Level" alarm (A2, D-6U). Level is detected by LC-2825, located on the south end of the RW Pump Room, with the alarm setpoint of >2 inches of detected level. Observed leaking pump AC-10D is located on the north end.

Initially, at the time of the alarm, no Pump Room Level rise was observed on indicator LIC-2889 (CB-1,2,3). LIC-2889 did indicate a rising level after the AON called in the local report.

Reference ARP, Dispatched the AON to check locally. Approximately 3 inches of water observed on the floor and water coming out of the pump casing area (through the splash shield) of the running pump AC-10D. Approximately 40 gpm leakage.

1035	CCW	Fail to Run			Non-Test Demand
44843		Fail to Start			
4/16/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

System Engineering accompanied Operations to the 21CCP and it was discovered that the pump inboard seal was leaking from the gland to stuffing box joint. The gasket was observed to be blown out at the bottom. The NPO reported significant seal leakage started when 21CCP was placed in service and the discharge check valve from the secured pump slammed shut. It has previously been determined that the rapid closure of CCW Pump discharge check valves following pump shutdown results in a water hammer pressure spike in the common pump discharge header. Under conditions such as this, it is advisable to use thin, fibrous gasket material such as 1/16" thick Garlock Blueguard, or equivalent, rather than resilient gasket material like EPDM or Viton. The Maintenance Procedure should be revised accordingly

---

Component Type *MDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1133	HPI	Fail to Run			Inspection
45745		Fail to Start			
6/2/2008		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

On 6/2/08 at 23:08, Annunciator Window 167-D alarmed in the Main Control Room for TURB/AUX/RB BLDG FLOODED. The alarm was due to external leakage from a ruptured head gasket on Centrifugal Charging Pump (CCP) 1B lube oil cooler 1-CLR-62-104A-B. Component Cooling System (CCS) flow to this cooler was isolated to stop the leakage. No adverse trend in lube oil temperature for CCP 1B was observed while the CCS leak from 1-CLR-62-104A-B was occurring. Tech Spec 3.5.2 Condition A (72-hr LCO) was entered at 23:35 when CCP 1B was declared to be inoperable during isolation of the CCS leak from lube oil cooler 1-CLR-62-104A-B.
The ruptured gasket on cooler 1-CLR-62-104A-B was replaced, and the cooler was returned to service with no leaks.

1032	CCW	Fail to Stop			Test
46014		Fail to Start			
6/21/2008		failed to stop on demand (MSPI-D)			
		(MSPI-D)	Y		

On 6/21/08 while performing STP-O-73B 13 SRW PP was started and aligned to breaker 152-1111. When the hand switch 1HS-152-1572 was placed in the stop position the breaker in cubical 152-1111 failed to open, the hand switch was then placed in pull to lock position and the breaker still failed to open. Personnel were sent to investigate the problem and an acrid odor and haze were noticed coming from 152-1111 cubical. The breaker was manually tripped and 13 SRW PP was secured. When the breaker was removed a bolt was found lying in the bottom of the cubical. The smell and haze were from the trip coil which was severely damaged from overcurrent. The bolt found in the cubical was the trip armature adjustment bolt which is used to rotate the trip shaft when the trip coil is energized.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1121	SWS	Fail to Run			Inspection
29666		Unavailable (T&M)			
10/3/2003		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

UNABLE TO OBTAIN ANY FLOW FROM CYCLONE SEPARATOR EVEN AFTER REASONABLE AGITATION. CYCLONE SEPERATOR INOPERABLE IN CURRENT CONDITION. BACKFLUSHING PER THE OPS PROCEDURE ATTACHMENT CAN BE ATTEMPTED TO RESTORE FLOW THRU THE SEPERATOR, OTHERWISE DISASSEMBLY WILL BE REQUIRED.
2P307 INOPERABLE WITHOUT THE CYCLONE SEPERATOR BEING CAPABLE OF EMERGENCY SEAL WATER SUPPLY.

1122	SWS	Fail to Run			Test
29668		Unavailable (T&M)			
11/13/2003		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

DURING A ROUTINE I.S.T. SO23-3-3.60.4, ATTACHMENT 5 FOR SALT WATER COOLING PUMP3P307, THE FOLLOWING OCCURRED:
DURING STEP 2.6.7, FLOW DROPPED TO APX. 1.2 GPM, WHICH IS LESS THAN THE 2 GPM REQUIRED. FLOW WAS "SAT" ON PREVIOUS STEPS IN SECTION 2.5.
ALSO, AFTER MU033 WAS RE-CLOSED IN STEP 2.6.8.1, FLOW REMAINED LESS THAN 2 GPM, UNTIL NORMAL SERVICE WATER WAS ESTABLISHED. THE INITIAL, BEFORE TEST POSITION OF THE SERVICE WATER SUPPLY VALVE (S31416MU464) WAS "4" TURNS OPEN; HOWEVER IT WAS NECESSARY TO OPEN MU464 "7" TURNS OPEN TO REESTABLISH THE PROPER SEAL WATER FLOW.

1060	HPI	Fail to Start			Test
30143		Unavailable (T&M)			
12/3/2003		ran, but failed to develop adequate flow/pressure (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During NI/NV check valve testing, the 1B Safety Injection (NI) pump failed the acceptance criteria for flow to the cold legs. Data for the 1B NI pump indicated a slow deterioration in flow until it stabilized around 560 gpm. Further examination of the data indicated dP increased as flow decreased, indicating blockage. Subsequent testing/troubleshooting confirmed blockage, most likely at the NI throttle valves.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1145	HPI	Fail to Run			Inspection
36340		Unavailable (T&M)			
1/16/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 1/15/04, with the plant operating at 100% power, the discovery of significant biofouling (blockage by biological matter) of both trains of Safety Injection (SI) Pump lube oil coolers resulted in initiating a Technical Specifications (TS) forced shutdown of the Kewaunee Nuclear Power Plant (KNPP). KNPP was taken offline at approximately 0600 on Friday, 1/16/04. During maintenance and inspection activities on SI pump A on 1/15/04, the lube oil cooler was found to be biofouled. After the cooler was cleaned similar conditions were found in SI pump B. Visible flow was occurring in only 3 of the 20 tubes in the B cooler inlet pass. Even though the coolers were cleaned and operational, the decision was made to shut down the plant.

1145	HPI	Fail to Run			Inspection
36340		Unavailable (T&M)			
1/16/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 1/15/04, with the plant operating at 100% power, the discovery of significant biofouling (blockage by biological matter) of both trains of Safety Injection (SI) Pump lube oil coolers resulted in initiating a Technical Specifications (TS) forced shutdown of the Kewaunee Nuclear Power Plant (KNPP). KNPP was taken offline at approximately 0600 on Friday, 1/16/04. During maintenance and inspection activities on SI pump A on 1/15/04, the lube oil cooler was found to be biofouled. After the cooler was cleaned similar conditions were found in SI pump B. Visible flow was occurring in only 3 of the 20 tubes in the B cooler inlet pass. Even though the coolers were cleaned and operational, the decision was made to shut down the plant.

1121	SWS	Fail to Run			Inspection
31090		Unavailable (T&M)			
1/30/2004		external leakage (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

SWC PUMP S21413MP113 IS INOP DUE TO CLOGGED CYCLONE SEPARATOR.

1059	HPI	Fail to Start			Inspection
31112		Unavailable (T&M)			
2/2/2004		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the monthly performance of 3BVT01.11.04 Void Monitoring a void was discovered at points 22 and 22a. These points are located on the suction of the "C" charging pump. 2CHS-P21C was the spare charging pump at the time of discovery. The stand by pump 2CHS-P21B suction piping was verified to be void free.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1105	SWN	Fail to Run			Inspection
32847		Unavailable (T&M)			
9/18/2004		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

On 9/18/2004, notification 20204119 was initiated to document an excessive cyclic noise emanating from the 'B' Station Service Water Pump. Maintenance Technicians performed vibration collection on this pump two separate times and forwarded the results to the Main Control Room. The Vibration Program Manager was immediately contacted for data review and recommendations. Based on this data assessment, the recommendation was made to immediately remove the 'B' SSW pump from service for support of investigation and possible pump replacement. A 30-day action statement was entered IAW Hope Creek Station Technical Specification 4 / 3.7.1.2.
On 9/19/2004, the 'B' SSW bay received dewatering to facilitate a System Engineering inspection of the pump upper and lower seismic supports. This inspection identified two failed bolts on the lower seismic support, while the remaining two were in a loose condition. Seismic support repairs were complete and ultimately the 'B' pump and motor were replaced under work order 60038786 to return this subsystem back to a reliable and operable condition.

1024	CCW	Fail to Start			Non-Test Demand
37953		Unavailable (T&M)			
9/26/2004		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

When attempting to start the 1C CCW Pump from the MCB for planned train swap, the supply breaker DF-04 did not close. Visual inspection found no obvious problems. EM contacted to investigate. EM racked the breaker out and cycled on test stand satisfactorily and noted nothing abnormal. Breaker was racked back in and successfully closed from MCB. Determined problem to be in handswitch and replaced it.

1024	SWN	Fail to Start			Non-Test Demand
37641		Unavailable (T&M)			
10/20/2004		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Trip feature that is overridden in ESF actuation	

Attempted to start 1D Service Water Pump. Immediately received the SW Pump tripped annunciator. No local signs of damage seen at the pump.
No FF for breaker. Breaker was operated several times satisfactorily. Pump is operable and available. Problem was found to be high resistance on the handswitch contacts. The signal did not reach the breaker to close.
Although the breaker did not close, if there were truly an SI signal received, the SW pump 1D would have started automatically on demand. Which is supported by the satisfatory results of FNP-0-STP-40.2

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1025	SWN	Fail to Start			Non-Test Demand
36466		Unavailable (T&M)			
2/2/2005		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Trip feature that is overridden in ESF actuation	

While attempting to start the 2D SW pump, the amber breaker tripped flag lit and annunciator AE4 "SW PUMP TRIPPED" alarmed. The breaker never closed. Breaker was checked and there was no indication of any tripped relays. Please investigate.
Work Completed: Found breaker handswitch contacts very dirty, replaced contact blocks.

1024	AFW	Fail to Start			Test
37956		Unavailable (T&M)			
2/12/2005		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During performance of FNP-1-STP-73.1 Appendix K, at step 5.2.4.2, did NOT receive closed indication on HSDP breaker position for the 1A MDAFW pump, as required. Took a time out and invoked P&L 4.4, S.S. directed we "exercise" the handswitch to clean supposedly dirty contacts. Cycled handswitch three additional times with no change at all in breaker status. Subsequently checked out breaker DF10 for spring charged, control power on, and no loose parts or other problems--SAT. Decided to complete section of Appendix K for the 1A MDAFP, NOT perform section for 1B MDAFP, and restore MCB switch positions to normal per steps5.3.6.6 and 5.3.6.7.

1144	HCS	Fail to Run			Inspection
34335		Unavailable (T&M)			
3/16/2005		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

HPCS was declared inoperable when severe cracking and degradation was found on the upper air deflector of the pump motor during a maintenance activity. The cause was critical dimensions were not maintained during the motor reassembly process in 1992.

1097	SWS	Fail to Run			Inspection
34848		Unavailable (T&M)			
6/14/2005		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the performance of rounds, a Turbine Building Operator identified 0 psig on the B RHRSW Motor Cooler Pressurizing Station. Shift Supervision was notified. Upon further investigation it was determined that sand had filled the motor cooling piping.
The cause of the loss of motor cooling to the B RHRSW pump motors is due to the plugging of the motor cooler piping due to sand build up from the keep fill system supplied by normal service water.
Repair was not required, flushing of the piping was performed to free the motor cooler lines of sand blockage.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1097	SWS	Fail to Run			Inspection
34848		Unavailable (T&M)			
6/14/2005		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the performance of rounds, a Turbine Building Operator identified 0 psig on the B RHRSW Motor Cooler Pressurizing Station. Shift Supervision was notified. Upon further investigation it was determined that sand had filled the motor cooling piping.
The cause of the loss of motor cooling to the B RHRSW pump motors is due to the plugging of the motor cooler piping due to sand build up from the keep fill system supplied by normal service water.
Repair was not required, flushing of the piping was performed to free the motor cooler lines of sand blockage.

1071	CCW	Fail to Start			Test
38770		Unavailable (T&M)			
4/3/2006		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

On April 3, 2006, 3C CCW pump (3P211C) breaker was removed and installed to support pump seal work. Operations N/A'd the work order breaker PMT (3AD04) that would close the breaker after performing the associated pump maintenance. Ref. CR 2006-10448. A pump demand was performed and the pump failed to start. This pump failure to start is a MSPI monitored component failure, since the failure was outside PMT testing space. Had the breaker problem been identified during a PMT, this failure would have been attributed directly to the work activity and post maintenance testing. Post maintenance testing MSPI monitored component failures that are directly connected to the work being performed are not counted as MSPI failures.

1145	AFW	Fail to Run <1H			Test
41185		Unavailable (T&M)			
10/21/2006		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

While stabilizing S/G Levels during the RCS heatup to between 380 and 400 degrees F Balance of Plant Operator was starting the AFW Pump B per N-FW-05B. AFW-2B was not closed as required by step 4.1.2.b. When the AFW Pump B switch was taken to start, it tripped on low discharge pressure. S/G B pressure at the time was 370 psig. AFW Pump B tripped at 1629 on 10/21/06.

1092	CCW	Fail to Run			Non-Test Demand
40934		Unavailable (T&M)			
10/30/2006		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

WHILE PERFORMING A SURVEILLANCE (2611E-2), TO MANUALLY STROKE THE C-RBCCW HX OUTLET VALVES, A PROCEDURE STEP WAS MISSED, WHICH RESULTED IN ALIGNING THE A-RB PP DISCHARGE TO BOTH THE A AND B RB HEADERS. THE MIS-ALIGNMENT CAUSED THE RB PP TO TRIP ON LOW SUCTION PRESSURE.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1117	SWN	Fail to Start			Non-Test Demand
42651		Unavailable (T&M)			
11/22/2006		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

Brief Description: As identified in CR 06-14861, on 11/20/06 during surveillance testing for SW-P-41A, Operators noted pump inop on the MPCS colorgraphics. Upon further investigation the NSO noted white light closing control operational on SW-P-41A breaker was not lit. Operations placed SW-P-41C back in service and secured SW-P-41A. When SW-P-41A breaker was opened the inop alarm cleared on the colorgraphics and the white light closing control operational lit. Troubleshooting performed under WO 0637944 determined the cause to be a failure of the blocking diode installed in the SW-P-41A breaker closing circuit.

1128	SWS	Fail to Run			Non-Test Demand
41463		Unavailable (T&M)			
2/11/2007		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

On 02/11/2007 at 06:45, OPS received an annunciator Motor Tripout or Overload. OPS noted that the A2 RHRSW pump motor tripped out. The A2 RHRSW pump was in service for Shutdown Cooling on Unit 1. OPS declared the A2 RRSW pump inoperable. The outside AUO reported that a 50G (ground overcurrent) relay picked up at the breaker for the A2 RHRSW pump.
Megger test was performed on 02/17/07 at Board, the C phase showed direct ground. VLF testing was performed on the A, D, and C phases and testing results showed the C phase was bad.

1145	SWS	Fail to Run			Inspection
41272		Unavailable (T&M)			
2/16/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 02/16/07 @ 0619, received annunciator 47053-P, SW PUMP BRG SEAL WTR FLOW LOW, SER 96, SW Pump A2 bearing seal water flow low. Operations referenced the Alarm Response Procedure (ARP) and dispatched the Nuclear Auxiliary Operator (NAO) to investigate.

The NAO reported that SW pump A2 seal water flow was at 0 gpm and seal water pressure was 0 psig with the CUNO filter DP greater than 60 psid. The NAO shifted the CUNO filter to the standby filter at 0622 and annunciator 47053-P cleared and normal gland water flows and pressures were verified. Review of this condition determined that even though gland water flow may have been zero for up to 3 minutes, there was no damage or degradation to the SW pump. Inspection of the CUNO filter that was in service during the time gland water flow went to zero, did not indicate any abnormal buildup or buildup of unexpected materials.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1071	SWN	Fail to Run			Non-Test Demand
41863		Unavailable (T&M)			
3/9/2007		misalignment-human error (MSPI-SD)			
		(MSPI-SD)	N	Failure immediately annunciated in control room	

During the performance of breaker inspection for 3AA13 on 3/9/07 at approximately 10:30 AM, a journeyman traveling through the switchgear room inadvertently bumped an isolation switch on cubicle door 3AA19, causing the breaker to trip, tripping the Safety Related 3A ICW Pump.

1042	AFW	Fail to Start			Non-Test Demand
41947		Unavailable (T&M)			
5/15/2007		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

The Train "A" motor-driven auxiliary feedwater (MDAFW) pump [P:BA] failed to start automatically, but it was started manually within about one minute after the reactor trip by an operator. The cause of the Train "A" MDAFW pump failure was subsequently determined to be a failure of the control switch [HS:BA], which prevented the automatic start signal.

1118	SWN	Fail to Start			PMT
42121		Unavailable (T&M)			
6/1/2007		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

ELECTRICIANS REQUESTED A BUMP FOR ROTATION CHECK OF THE B SERVICE WATER PUMP. WHEN THE OPERATOR ROTATED THE START SWITCH, HE RECEIVED A GREEN LIGHT FOLLOWED BY A WHITE LIGHT AND J-9 SAFEGUARD BREAKER TRIP. HE TOOK THE SWITCH TO THE STOP POSITION. THE PUMP DID ROTATE IN THE CORRECT DIRECTION AND NOTED APPROXIMATELY 50 AMP JUMP ON BUS 17
.
Although the B service water pump was out of service for maintenance, the failure of the breaker to close for the motor rotation check is a functional failure. Racking of the breaker did not initiate the failure mechanism. If the breaker had not failed to close during motor rotation check it would have eventually failed when the B SW pump was in service.

1118	SWN	Fail to Start			Test
42122		Unavailable (T&M)			
6/27/2007		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During restoration from maintenance of the B service water pump the breaker tripped immediately after being closed. When the main control board switch was taken to the CLOSE position a green light followed by a white discrepancy light and J-9, safeguards breaker trip, was received. The pump was observed to rotate a few turns.

Component Type *MDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1036	RHR	Fail to Run			Non-Test Demand
44283		Unavailable (T&M)			
7/11/2007		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

On July 11, 2007, at approximately 2313 hours, the Residual Heat Removal pump (RHR) B tripped off. At the time of the event, the plant was in Mode 4 (Cold Shutdown). With RHR B subsystem inoperable, an alternate method of decay heat removal for the RHR B subsystem could not be verified within one hour as required by Technical Specification Limiting Condition for Operation 3.4.10, Required Action A.1. Required Action A.1 was completed on July 12, 2007, at 0559 hours when the tripped RHR B pump was returned to standby.
The RHR B pump trip occurred when an Instrument and Control Technician performing Reactor Core Isolation Cooling (RCIC) surveillance testing unnecessarily loosened a wire connection from an electrical terminal, inducing a current from the RCIC circuitry into the electrically independent RHR B trip system. Modifications to separate the wiring and to install noise suppression diodes are being prepared for installation.

1024	HPI	Fail to Start			Test
43910		Unavailable (T&M)			
10/26/2007		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	PMT failure related to maintenance performed	

Attempted to start 1C Charging pump per FNP-1-STP-40.7. Breaker DG06 did not close.No light indications changed.The Rover reported that he heard a click from the breaker.No other noise was heard and no other indications of a failure. 1CB448 placed on 1C Chg pump handswitch.

The breakers required to auto cycle have been inspected. For the remaining breakers Maintenance is performing FNP-0-EMP-1313.19, Multi-Point Inspection, on all breakers prior to installation in the plant. The Latch Check Switch inspection is performed by this procedure and also as part of the vacuum breaker installation procedure FNP-0-EMP-0-1313.11.

1053	SWS	Fail to Run			Test
44700		Unavailable (T&M)			
1/11/2008		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During QCOS 6600-43 'Unit 1/2 Emergency Diesel Generator Load Test' step H.4.n.13 the 1/2 EDG tripped on High temp. The cooling water pump tripped causing the high temp condition. Control room indications show that the cooling water pump is running from Bus 18 on U1 and U2. Locally on the 2251-12 panel the pump indicates that the pump is running from Bus 28. At Bus 28 the breaker for the cooling water pump shows that the breaker is closed. The Breaker at Bus 18 is open. The EDG cooling water room cooler fans are running. The cooling water pp. was verified locally to be tripped. There was no report of any acrid or burnt smell. Received alarm 902-8 A2 '4kv Res Feed Breaker Trip', 901-8 C4 'Diesel Gen Fail to Start' and 901-8 A4 'Diesel Gen 1/2 Trouble. The Diesel was being loaded to 23-1 when the trip occurred. The EDG had just finished running fully loaded on 13-1 for 1.5 hours.

This record is of interest because the subcomponent (Cooling Water Pump) was coded as failed, but the supercomponent (EDG) was not.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1142	SWN	Fail to Run			Non-Test Demand
44506		Unavailable (T&M)			
2/2/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

The direct cause of the high vibrations in P-032e was a bend in the 3rd intermediate shaft. The total indicated run out (TIR) was found to be well in excess of acceptance criteria. This created a radial force that accelerated shaft wear, as evident by the non-concentric wear pattern noted on disassembly. The wear became evident in vibrations transmitted from the shaft to the motor frame.

The apparent cause for the bent shaft was determined to most likely be due to pump shaft installation and rigging practices.

This event captured by LER 2662008002.

1110	CVC	Fail to Run <1H			Test
44413		Unavailable (T&M)			
3/12/2008		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	N	PMT failure related to maintenance performed	

During the initial start of the Centrifugal Charging Pump (CCP) 2-2, the operators noted sparks being produced from the outboard mechanical seal. The pump was immediately shut down. Initial investigation indicates a seal rub between the disaster bushing and the shaft sleeve. Additional investigation by the system engineer, seal vendor, and pump vendor determined that the seal tolerances were acceptable and the there must have been something between the seal and the shaft. After further evaluation of the pump, seal, and affected parts by a Flowserve field service representative and evaluation by Flowserve nuclear engineering we can conclude that the most likely cause of this event is the presence of foreign material with the running clearance between the seals shaft sleeve and the disaster bushing. It is not possible to determine the source of the foreign material because it was destroyed before the pump was stopped.

1096	SWS	Fail to Start			Non-Test Demand
44832		Unavailable (T&M)			
3/17/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

The apparent cause of Service Water pump D high amps at start up was the design of the traveling water screens can not feasibly be made to prevent all river debris from entering the service water bay and possibly lodging between the impeller and bowl.
An attempt to turn the pump/motor shaft by hand was unsuccessful, therefore the pump was uncoupled from the motor. At this time, the motor shaft turned freely and did not indicate any roughness that would be indicative of a motor bearing problem. The pump shaft should have dropped down the amount of the pump lift setting, however it did not move when it was uncoupled. The pump shaft was then lifted and turned slightly and set back down. At this time, the pump shaft did drop down to the extent expected (pump lift setting). The most likely cause of this was debris wedged in between the impeller and the casing. By lifting the impeller up and rotating it, this debris was dislodged.

Component Type *MDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1097	SWS	Fail to Run			Non-Test Demand
46919		Unavailable (T&M)			
5/6/2008		design change to improve reliability/efficiency (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On May 6, 2008, during performance of procedure 0255-05-IA-1-2 (B RHRSW Quarterly Pump and Valve test) it was observed by out plant operators that there was little to no cooling flow available to 12 RHRSW pump motor. Upon further investigation, PI-7332 (motor cooling water pressure to 12 and 14 RHRSW pump motors) was observed to read 0 psig. Upon observing this, operations declared Loop B RHRSW inoperable and entered Tech Spec. 3.7.1. This was considered an unplanned LCO entry. The sand that was found to plug PCV-3005 was flushed from the keep-fill lines due to the specific valving steps in the procedure being perfromed.

The B Division of the RHRSW system was unable to perform its safety related maintenance rule function of removing the heat rejected by the RHR system. The A Division of RHRSW was able to perform its safety and non-safety related maintenance rule functions during this time. The quarterly surveillance procedure that flushed sand into the pressure control valve on the B side was not concurrently performed on the A side of the RHRSW system; thus the failure mode observed on May 6, 2008 on the B side was not introduced in the A side.

AR 1136919 was initiated and immediate action to correct the condition was planned. WO 361167 was performed to flush the motor cooling lines with PCV-3005 disassembled. The lines were flushed until clean, and the PMT was performed which verified adequate motor cooling flow rates with single and dual pump operation. An OPR approved by operations under AR01136919.

The B Loop of RHRSW pumps water from the Mississippi river to the B RHR heat exchanger, where it accepts the heat from the RHR system which is then cooling the suppression pool. The RHRSW then exits the heat exchanger and discharges back to the Mississippi river. The RHRSW loop B system was unable to perform this function of removing the heat rejected by the RHR system.

Component Type MDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1097	SWS	Fail to Run			Test
46919		Unavailable (T&M)			
5/6/2008		design change to improve reliability/efficiency (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On May 6, 2008, during performance of procedure 0255-05-IA-1-2 (B RHRSW Quarterly Pump and Valve test) it was observed by out plant operators that there was little to no cooling flow available to 12 RHRSW pump motor. Upon further investigation, PI-7332 (motor cooling water pressure to 12 and 14 RHRSW pump motors) was observed to read 0 psig. Upon observing this, operations declared Loop B RHRSW inoperable and entered Tech Spec. 3.7.1. This was considered an unplanned LCO entry. The sand that was found to plug PCV-3005 was flushed from the keep-fill lines due to the specific valving steps in the procedure being perfromed.

The B Division of the RHRSW system was unable to perform its safety related maintenance rule function of removing the heat rejected by the RHR system. The A Division of RHRSW was able to perform its safety and non-safety related maintenance rule functions during this time. The quarterly surveillance procedure that flushed sand into the pressure control valve on the B side was not concurrently performed on the A side of the RHRSW system; thus the failure mode observed on May 6, 2008 on the B side was not introduced in the A side.

AR 1136919 was initiated and immediate action to correct the condition was planned. WO 361167 was performed to flush the motor cooling lines with PCV-3005 disassembled. The lines were flushed until clean, and the PMT was performed which verified adequate motor cooling flow rates with single and dual pump operation. An OPR approved by operations under AR01136919.

The B Loop of RHRSW pumps water from the Mississippi river to the B RHR heat exchanger, where it accepts the heat from the RHR system which is then cooling the suppression pool. The RHRSW then exits the heat exchanger and discharges back to the Mississippi river. The RHRSW loop B system was unable to perform this function of removing the heat rejected by the RHR system.

1060	SWN	Fail to Run			Non-Test Demand
46159		Unavailable (T&M)			
7/12/2008		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

At 10:41 on 7/12/2008, while in two pump flush alignment for B train RN, the flow and discharge pressure associated with the 1B RN pump dropped off completely. The 2B RN pump aligned in parallel picked up the flow.
The Root Cause of this event was the use of the coupling sleeve manufactured from a deficiently formed alloy. Specifically, the 1B RN Pump failed due to the heterogeneity of the upper Johnston coupling material [RC-1] Heterogeneity caused this material to be highly susceptible to intergranular corrosion and cracking (IGSCC) as shown by an accumulation of fine sulfide stringer inclusions along the boundaries of the failed coupling

1112	CCW	Fail to Start			Test
46271		Unavailable (T&M)			
8/10/2008		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

32 Aux CCW Pump tripped on attempted start for scheduled PT. Saw red light illuminate for half a second before pump tripped. Left-most line fuse found bad

Component Type *MDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1114	RHR	Fail to Start			Non-Test Demand
46948		Unavailable (T&M)			
10/29/2008		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

COINCIDENT WITH THE SHUTDOWN OF THE 'D' ESW PUMP, THE UNIT 1 'D' RHR PUMP LOST INDICATION IN THE CONTROL ROOM.
The Unit 1 'D' RHR Pump Lost Indication In The Control Room. Investigation found the knife switch for the DC Trip & Control Power in the 4kv cubicle was not making good contact. The clips that contact the switch in the closed position were squeezed closer together with pliers to improve contact.

Component Type *MOV*

Component Type *MOV*

EPIX MSPI Failure Mode Fail on Demand

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1064	RHR	Unavailable (T&M)			Non-Test Demand
29585		Fail on Demand			
5/5/2003		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	Y		

A review of Modification ONOE-16912 (Circuit Modifications to address spurious hot shorts affecting 3LP-19 & 3LP-20) identified a vulnerability of the circuit during a postulated Control Room fire. Modification ONOE-16912 was initiated as a result of the problem documented in PIP O-02-1357. The proposed design has utilized a separate wire run for a critical conductor in the control circuit (the conductor that runs from the control switch in the Control Room to the MCC) from the MCC to a terminal strip inside the UB2 section of the Main Control Board. This separate wire run removed this critical conductor from the multi-conductor cable used to feed the other portions of the circuit. This successfully removed the potential of a hot short from occurring in the circuit from the MCC to the terminal strip. From the terminal strip to the control switch for one of the valves, the proposed design routed all of the circuit conductors for the valve (including the energized conductors for the indicating lights and the conductor running to the control switch) inside single flexible conduit. Since this design runs the conductor to the control switch inside the same conduit with energized conductors, this portion of the control circuit would still be susceptible to hot shorts causing a spurious actuation of the valve. The wiring from the terminal strip to the control switch for the other valve was to be left as originally installed, with no added protection for the wire from the control switch to the MCC. This also would still be susceptible to hot shorts causing a spurious actuation of the valve.
An Appendix R fire in the Main Control Room could cause LP-19 & LP-20 to spuriously operate. This could result in a transfer of BWST inventory to the corresponding units RB basement. Water level in the Reactor Building could be high enough to cause the corresponding SSF RC makeup pump to fail.

1064	RHR	Unavailable (T&M)			Inspection
29585		Fail on Demand			
5/5/2003		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	Y		

A review of Modification ONOE-16912 (Circuit Modifications to address spurious hot shorts affecting 3LP-19 & 3LP-20) identified a vulnerability of the circuit during a postulated Control Room fire. Modification ONOE-16912 was initiated as a result of the problem documented in PIP O-02-1357. The proposed design has utilized a separate wire run for a critical conductor in the control circuit (the conductor that runs from the control switch in the Control Room to the MCC) from the MCC to a terminal strip inside the UB2 section of the Main Control Board. This separate wire run removed this critical conductor from the multi-conductor cable used to feed the other portions of the circuit. This successfully removed the potential of a hot short from occurring in the circuit from the MCC to the terminal strip. From the terminal strip to the control switch for one of the valves, the proposed design routed all of the circuit conductors for the valve (including the energized conductors for the indicating lights and the conductor running to the control switch) inside single flexible conduit. Since this design runs the conductor to the control switch inside the same conduit with energized conductors, this portion of the control circuit would still be susceptible to hot shorts causing a spurious actuation of the valve. The wiring from the terminal strip to the control switch for the other valve was to be left as originally installed, with no added protection for the wire from the control switch to the MCC. This also would still be susceptible to hot shorts causing a spurious actuation of the valve.
An Appendix R fire in the Main Control Room could cause LP-19 & LP-20 to spuriously operate. This could result in a transfer of BWST inventory to the corresponding units RB basement. Water level in the Reactor Building could be high enough to cause the corresponding SSF RC makeup pump to fail.

Component Type *MOV*

EPIX MSPI Failure Mode Fail on Demand

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1065	RHR	Unavailable (T&M)			Inspection
32318		Fail on Demand			
5/5/2003		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	Y		

A review of Modification ONOE-16912 (Circuit Modifications to address spurious hot shorts affecting 3LP-19 & 3LP-20) identified a vulnerability of the circuit during a postulated Control Room fire. Modification ONOE-16912 was initiated as a result of the problem documented in PIP O-02-1357. The proposed design has utilized a separate wire run for a critical conductor in the control circuit (the conductor that runs from the control switch in the Control Room to the MCC) from the MCC to a terminal strip inside the UB2 section of the Main Control Board. This separate wire run removed this critical conductor from the multi-conductor cable used to feed the other portions of the circuit. This successfully removed the potential of a hot short from occurring in the circuit from the MCC to the terminal strip. From the terminal strip to the control switch for one of the valves, the proposed design routed all of the circuit conductors for the valve (including the energized conductors for the indicating lights and the conductor running to the control switch) inside single flexible conduit. Since this design runs the conductor to the control switch inside the same conduit with energized conductors, this portion of the control circuit would still be susceptible to hot shorts causing a spurious actuation of the valve. The wiring from the terminal strip to the control switch for the other valve was to be left as originally installed, with no added protection for the wire from the control switch to the MCC. This also would still be susceptible to hot shorts causing a spurious actuation of the valve.
An Appendix R fire in the Main Control Room could cause LP-19 & LP-20 to spuriously operate. This could result in a transfer of BWST inventory to the corresponding units RB basement. Water level in the Reactor Building could be high enough to cause the corresponding SSF RC makeup pump to fail.

1065	RHR	Unavailable (T&M)			Inspection
32318		Fail on Demand			
5/5/2003		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	Y		

A review of Modification ONOE-16912 (Circuit Modifications to address spurious hot shorts affecting 3LP-19 & 3LP-20) identified a vulnerability of the circuit during a postulated Control Room fire. Modification ONOE-16912 was initiated as a result of the problem documented in PIP O-02-1357. The proposed design has utilized a separate wire run for a critical conductor in the control circuit (the conductor that runs from the control switch in the Control Room to the MCC) from the MCC to a terminal strip inside the UB2 section of the Main Control Board. This separate wire run removed this critical conductor from the multi-conductor cable used to feed the other portions of the circuit. This successfully removed the potential of a hot short from occurring in the circuit from the MCC to the terminal strip. From the terminal strip to the control switch for one of the valves, the proposed design routed all of the circuit conductors for the valve (including the energized conductors for the indicating lights and the conductor running to the control switch) inside single flexible conduit. Since this design runs the conductor to the control switch inside the same conduit with energized conductors, this portion of the control circuit would still be susceptible to hot shorts causing a spurious actuation of the valve. The wiring from the terminal strip to the control switch for the other valve was to be left as originally installed, with no added protection for the wire from the control switch to the MCC. This also would still be susceptible to hot shorts causing a spurious actuation of the valve.
An Appendix R fire in the Main Control Room could cause LP-19 & LP-20 to spuriously operate. This could result in a transfer of BWST inventory to the corresponding units RB basement. Water level in the Reactor Building could be high enough to cause the corresponding SSF RC makeup pump to fail.

Component Type *MOV*

EPIX MSPI Failure Mode Fail on Demand

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1076	RCI	Leak (Internal)			Inspection
28990		Fail on Demand			
9/24/2003		internal leakage when fully seated (MSPI-D)			
		(MSPI-D)	Y		

After disassembling 2E51-F045, it was found that steam cuts and draws had formed on the valve disk, allowing steam to leak past the seat through the turbine casing and into the exhaust line drain pot.

1040	RHR	Unavailable (T&M)			PMT
32443		Fail on Demand			
8/2/2004		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

While troubleshooting loss of open indication for 2-E11-F048A, the control power fuse was inadvertently blown resulting in loss of suppression pool cooling (SPC).
2.Problem Description / Investigation Summary
WO 597014 was initiated on 7/31/04 to troubleshoot the 2-E11-F048A red light (open) indicator which would not light. The valve was verified to be operable from the RTGB and full open per MCC indication. During trouble shooting on 8/3/04 the control power fuse was inadvertently blown which caused SPC to be inoperable.

1088	CCW	Unavailable (T&M)			Test
32459		Fail on Demand			
8/24/2004		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

During testing of ACC-110A per OP-903-118 Section 7.4.6 obtained a stroke closed time of 17.3 seconds which exceeded the maximum allowed stroke closed time of 16.8 seconds. ACC-110A was also timed in the open direction with a time of 12.3 seconds which is in the acceptable stroke time limits. ACC-110A was timed by the SNPO only on the first stroke test. A field operator was locally observing ACC-110A for the first stroke test and noted that the valve stroked smoothly and freely. ACCW Train A had 5200 GPM flow for performance of this section. A second stroke test of ACC-110A was conducted with the SNPO and the field operator both timing ACC-110A on the closed stroke. The field operator and SNPO received a time of 13.3 seconds. The field operator and SNPO also stroke timed ACC-110A in the open direction with the field operator getting a time of 13.4 seconds and the SNPO getting a time of 12.8 seconds. The field operator once again noted that ACC-110A stroked in both directions smoothly and freely.

1083	HCI	Leak (External)			Inspection
40577		Fail on Demand			
10/31/2006		external leakage (MSPI-D)			
		(MSPI-D)	Y		

On October 13, 2006 water started leaking from the packing of MO2405. Ops closed the valve leading to RCIC unplanned LCO and MPFF. This steam line should not have water present.

The Apparent Cause of this problem, is the leakage of condensate and steam past MO2404, which lead to trapped water and steam between MO2404 & MO2405. This resulted in leakage of the water out through the packing of MO2405.

Component Type *MOV*

EPIX MSPI Failure Mode Fail on Demand

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1074	AFW	Spurious Operation			Test
42335		Fail on Demand			
7/27/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

2HV5132 failed 14607-2 @ step 5.9: it failed to remain Closed in the Jog/Override position from 2HS5132A with an AFW actuation signal present. This condition report describes a condition where 2HV5132 failed remain Closed in the Jog/Override position from 2HS5132A with an AFW actuation signal present. This failure has been attributed to foreign material found inside the handswitch preventing one set of hand switch contacts to make up. The foreign material was likely from manufacturing based on the material, the color of the material, and the location of the material.

1027	HPI	Unavailable (T&M)			Non-Test Demand
45963		Fail on Demand			
7/8/2008		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

On 7-08-08, Unit 2 entered an unplanned Tech Spec due to 2CV-5103-1 (Red Train HPSI Thot Orifice Bypass Valve) being declutched during the performance of OP-1412.001 Supplement 2 (Non-Intrusive Preventative Maintenance of Limitorque).

Prior to work commencing, the Technician had a face to face with the CRSA about beginning a Supplement 2 on 2CV-5103-1. The technician asked if Operations would desire to stroke the valve following maintenance. The CRSA informed the technician that it should not be a problem to stroke the valve under current plant conditions, but it would ultimately be up to the U2 CRS.

Following the maintenance, the Technician inquired as to whether or not the Control Room wanted to stroke 2CV-5103-1. The Unit 2 CRS stated that due to the 'A' Spray pump being out of service for maintenance, he did not wish to manipulate HPSI components by stroking 2CV-5103-1. This information was then relayed to the craft. At that time the craft reported that the valve had been declutched. The U2 CRS was informed and 2CV-5103-1 was declared Inoperable.

Component Type MOV

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1085	CVC	Fail to Operate			Test
26835		Unavailable (T&M)			
4/8/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

During the performance of 2-OHP-4030-208-053A 2-QMO-225 failed to meet the tming requirements in the open and closed directions. During the close stroke 2-QMO-225 position indicating light did not come on until 12.41 seconds. This exceeds the limit open time (10 seconds) for 2-QMO-225. The open position indicating light came on about 4 seconds later. When attempting to reopen 2-QMO-225 the valve took 91.03 seconds to indicate open. The stroke open time also exceeded the limt stroke time (10 sewconds). During the completion of 2-OHP-4030-208-053A 2-QMO-225 was noted to be repositioning with no control switch manipulations. the contnous operation was stopped by open the power supply breaker.

2-QMO-225 not being able to successfully open or close as required to mitigate the consequences of an accident satisfies the above definition for a functional failure, therefore, 2-ECCS-Sub-A failed ECCS/RHR-02 for the injection phase and ECCS/RHR-03 for recirculation.

This failure is considered maintenance preventable, but not repetitive because no previous failure of a like component due to a similar cause has occurred within the previous 24 months.

1135	HPI	Fail to Open			Test
28974		Unavailable (T&M)			
5/27/2003		failed to control (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During the performance of OSP-EM-V001A SI Valve strokes valve EMHV8814A would not open after it was stroked closed. The breaker was checked and found to be closed.
@ 0334 EMHV8814A was declutched and manually opened.
*
This was not a MPFF as the actuator problem was not tied to improper alignment or maintenance issues. The failure occurred during regular surveillance testing. The following text is provided by W224916: HAD CONTROL ROOM STROKE VALVE CLOSE AND TRY OPEN. VALVE WOULD NOT OPEN WENT TO MCC NG01AER3 AND VERIFY VOLTAGE THRU 254 AT EMHV8814A AND THRU EXTERNAL LIMIT 333C AT EJHV8804B AND THRU 2513 AT EJHV8804A. DID CONTINUITY CHECK THRU ELECTRICAL INTERLOCK 42 C/B WITH BREAKER NG01AER3 TURNED OFF BY EO. HAD EO TURN BREAKER BACK ON TO VERIFY HANDSWITCH EMHIS8814A WORKS. HAD RO TRY TO STROKE VALVE OPEN AND IT WORKED. No problems have been discovered explaning the reason for the initial failure. A cause of the valve to fail to OPEN is still under investigation. WR W232260 has been initiated to replace EMHIS8814A, as these handswitches have been suspect to failure in the past (TSD 9/16/03)

Component Type MOV

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1057	HCI	Fail to Close			Non-Test Demand
34687		Unavailable (T&M)			
7/13/2003		partially closed on demand (not stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During performance of 24.202.01 (partial), HPCI Pump Time Response and Operability Test, after opening for stroke time (which was SAT), E4150F003 failed to fully close. Reopened E4150F003 to attempt to gather data and noted valve took about 2 seconds to indicate full open (normal stroke time is between 7.5 sec and 12.4 sec). Troubleshooting was performed on E4150F003 by Electrical Maintenance personnel in accordance with Priority 1 Work Request 000Z032836 on 7/14/2003. The following activities were performed as part of
troubleshooting:
* Electrical Maintenance (EM) verified that all connections were tight inside the motor control center (MCC),
* EM ensured that there was voltage at terminal 11 in the MCC which indicated that the normally closed (NC) portion of the open pushbutton was not the problem,
* Coordinated with the Control Room to cycle E4150F003 while monitoring with MPM by pressing and releasing the closed pushbutton (MOV moved closed momentarily),
* Coordinated with the Control Room to cycle E4150F003 while monitoring with MPM by pressing and holding in the closed pushbutton (MOV fully closed),
* Coordinated with the Control Room to cycle E4150F003 by pressing and holding in the closed pushbutton for approximately 5 seconds (MOV fully closed) [This indicated that there was a possible problem with the closed auxiliary seal in contact. The work request was revised to replace and test the auxiliary contact.]

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1086	RHR	Fail to Close			Inspection
30416		Unavailable (T&M)			
3/26/2004		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

IR 199068 was written because the breaker for 1E12F014A tripped. No valve manipulations were being performed. The unit was in Mode 1 performing soft shut down for C1R09. The operator investigated the condition and found the control power fuse blown. The fuse was replaced under the provisions of a one time fuse replacement.

The fuse was discarded and IR 199068 written for trending. The valve was declared Operable by Operations. Valve 1E12F014A is the RHR 'A' heat exchanger shutdown service water inlet. The impact of this condition caused an unexpected LCO entry, Unplanned Unavailability for RHR 'A' and a Maintenance Rule Functional Failure. The significance is minimal, the control power fuse was replaced and the component returned to operable status. This IR was written to document the Maintenance Rule FF. By program requirements an EACE is required on the blown fuse.

Component Type *MOV*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1057	HCI	Fail to Close			Test
31304		Unavailable (T&M)			
4/18/2004		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During 24.202.01, E4150-F003 was stroked open for stroke time (SAT). During the close stroke, the valve went dual and never closed. The valve was stroked open and closed earlier during the SOP run prior to the surveillance.
The seal-in contact of this contactor was found not properly seated. This caused a distortion of the aux contact block. Review of history shows that this aux contact block was installed by Electrical Maint under WR# 000Z032836 during 07/14/04. CARD 03-10957 addressed the failure of E4150-F003 to stroke and its root cause finding was determined to be the random failure of the closed seal-in aux contact due to poor contact surface material. WR# 000Z032836 replaced the faulty seal-in aux contact and in doing so Electrical Maint seems to have induced a second random failure mode due to the aux contact block misalignment (see Attachment Photos).
After discussion with craft personnel who removed the aux contact block under 000Z032836 it was determined that the replacement was performed with the main contactor covers and movable contacts in place. Aux contact replacement can be performed this way, however it does make replacement more difficult. Due to the size of the starter and orientation of the leads it was necessary to land the leads on the aux contact prior to installation.This added tension to the aux contact block from the wires pulling away from contactor. After aux contact block replacement was completed, PMT was performed satisfactorily.

1086	RCI	Fail to Close			Test
31608		Unavailable (T&M)			
4/26/2004		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

While performing a maintenance run of RCIC following a system outage, as the RCIC turbine was being brought up to 1500-2000 rpm, 1E51-F019 cycled at least 20 times and as many as 80 times, and eventually went full open. As flow was raised to 400 gpm (above the min flow closure set-point), 1E51-F019 failed to close. Flow was lowered to 130 gpm to raise RCIC discharge pressure to approximately 300 psig (above 125 psig valve opening criteria) and then raised flow to 340 gpm. RCIC Pump discharge pressure was approximately 180 psig at 340 gpm. 1E51-F019 again failed to close. Per shift management discretion, the 20-minute maintenance run was completed with 1E51-F019 open, since the flowrate is minimal with respect to the amount of water being pumped from the RCIC Storage Tank to the Suppression Pool.
Secured RCIC IAW 3310.01 step 8.2.1.8.10. Minimum Flow valve 1E51F019 failed to close as required when the RCIC Turbine was secured. The RCIC Pump Minimum Flow Recirc To Suppression Pool valve should automatically close if the RCIC Pump discharge flow is > 240 gpm or if either the RCIC Steam Supply Shutoff Valve (F045) or the RCIC Turbine Trip Throttle Valve (C002E) goes closed. Several attempts were made to close 1E51-F019 with the control switch in the MCR, and were unsuccessful.
To comply with ITS LCO 3.6.1.3 Action A.1, 1E51-F019 was manually closed and deactivated. WR 116656 has been written to address this deficiency.

Investigation and troubleshooting revealed the auxiliary contacts for 1E51-F019 were found to be damaged. Further attempts to open and close 1E51-F019 from the MCR have been unsuccessful. The excessive Min flow valve cycling could result from starting the turbine manually with the existing logic, where the limit switch arm remains in contact with the round bar on the stem when the handwheel is only turned approximately one turn.

Due to the min flow valve logic (as shown below), in conjunction with the fact that the turbine-pump rotation will pump sufficient flow to satisfy the 120 gpm and 125 psig criteria; and without the Stop Valve being open far enough to actuate the full closed limit switch, the valve logic causes it to continuously cycle back and forth.

Component Type MOV

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1029	HPI	Fail to Operate			Inspection
31387		Unavailable (T&M)			
6/2/2004		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

Unit 2 Control Room received a SEIS alarm on "A" train valve HPSI Hdr "A" to RC LOOPs Isol Vlv HV698 (window 13L). Investigation showed no control room indication at SIAHV698 handswitch. Also, there is no indication of position locally at breaker PHAM3708. This alarm seemed to coincide with the start of the "A" ESP pump. No indications of any other abnormalities were found at this time. Locally SIAHV698 position matches that of SIBHV699. ERFDADS position indication for SIAHV698 was checked and there was no change in state, i.e. indicates open.
Entered LCO 3.5.3 Condition "B" and declared HPSI "A" INOPERABLE due to the loss of control power to SIAHV698.
Background
CRDR 2713743 was written to document and address the receipt of a SEIS alarm on valve 2JSIAHV0698 (window 13L) which was also accompanied by a loss of control room indication at the valve handswitch. Local position indication was also lost. However, ERFDADS position
indication for 2JSIAHV0698 showed that the valve had not changed state (i.e. valve remained open). Troubleshooting was conducted under WO 2713742 and the only abnormality found was a defective 2.5 amp fuse in the associated Class 1E 480 VAC MCC, 2EPHAM3708. The fuse
was replaced and the valve was confirmed to stroke satisfactorily.

1129	SWN	Fail to Open			Non-Test Demand
36541		Unavailable (T&M)			
6/21/2004		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

06/21/04, the 2A RHR HEX outlet valve failed to open as required with the A2 pump in service during performance of step 7.8.8 of 2-SI-4.5.C.1(3-COMP).
Cause Description: It was discovered that BKR 52 STA actuator arm set screw was loose. The set screw was tightened, breaker installed and closed and the problem was alleviated.

1086	RHR	Fail to Open			Non-Test Demand
31559		Unavailable (T&M)			
6/30/2004		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 6/30/04 the control power fuse for 1AP76E-8A blew causing loss of power for 1E12F048B "RHR HX 1B SHELL SIDE BYPASS VALVE" and resultant unplanned LCO and functional failure. Subsequent investigation and troubleshooting revealed Agastat type GP relay 74X-E12FJB had sustained a coil circuit failure, which represents a typical end of life failure mode for this device. This relay was discovered to be approximately 15 years old, as part of the modifications for Division 2 remote shutdown capability installed in 1989 under WO 144215. Review also revealed that this relay is normally energized and does not have a periodic replacement PM, contrary to well established norms for this type device. Normally energized relays of this type should be replaced on a periodic basis generally not more than 10 to 12 years. This is a demonstrated effective technique to prevent or mitigate this failure mode, as these relays exhibit limited life in the normally energized state.

Component Type MOV

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1057	HCI	Fail to Close			Test
33746		Unavailable (T&M)			
8/12/2004		partially closed on demand (not stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During surveillance 24.202.05 step 5.1.18 the E4150F003 failed to complete its closing stroke. Stopped the stopwatch after 2 minutes and re-opened the valve. The valve indicated full open approximately 2 seconds after depressing the open pushbutton. Stroked the valve closed again to determine repeatability and the valve stroked closed and indicated full closed in 11.2 sec (9.1-12.2 second specification). This failure was identical in symptoms to two previous failures (CARD 03-10957: 7/13/03; CARD 04-21564: 4/8/04). The first failure was attributed to an intermittent aux contact failure. The contact was replaced. The second failure was attributed to misaligned aux contacts (those installed as corrective action for the previous failure). The contacts were again replaced and correct alignment verified. An EIT was formed immediately following the event. The team developed a fault tree, and from this developed a troubleshooting plan. The troubleshooting plan was implemented in accordance with Work Requests 000Z042333 (troubleshooting/inspection at the valve) and 000Z042337 (inspections and de-energized and energized checks from the MCC). Troubleshooting revealed no specific cause, but did indicate the problem was limited to the close seal-in portion of the control circuit. All active components in this portion of the circuit (close contactor, c/a relay, and open pushbutton) were replaced in accordance with Work Requests 000Z042337 (open pushbutton replacement) and 000Z973751 (bucket replacement), and the removed components quarantined for failure analysis. The likely cause of this failure was the close seal-in contact on the open pushbutton not being electrically closed at the time of the first attempted closure. When the open PB was depressed it would have cycled that N.C. contact and restored it to its closed condition. That allowed the subsequent closing stroke attempt to be successful. The entire contact block on the open pushbutton was replaced as corrective action.

1130	SWN	Fail to Close			Test
32904		Unavailable (T&M)			
9/21/2004		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

rhr 3-FCV-023-0034 failed to close on demand (stuck open).

1027	RHR	Fail to Close			Test
34408		Unavailable (T&M)			
3/4/2005		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

While performing 2104.005 Supplement 3B, "QUARTERLY GREEN TRAIN SPRAY & SUMP VALVE STROKE TEST", Containment Sump Isolation Valve 2CV-5650-2 exhibited abnormal behavior. 2CV-5650-2 stroked to the full open position from the normally closed position within the acceptable normal band. However, when the valve was taken to the closed position, the valve only travelled about 1% closed before it stopped travel. With Operators stationed locally at the valve, the handswitch for 2CV-5650-2 was taken to the open position. The valve travelled open and indicated fully open in the Control Room. 2CV-5650-2 does not have a local position indicator. On the next attempt to close 2CV-5650-2, the valve smoothly travelled fully closed and indicated fully closed in the Control Room. No abnormal valve movement was observed locally while opening and closing the valve.

Component Type *MOV*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1040	HCI	Fail to Close			Test
35342		Unavailable (T&M)			
4/7/2005		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

Operations attempted to stroke 1-E41-F001 in the closed direction during the performance of PT 9.2.4. The valve went to dual indication, i.e., mid-position, but did not fully close. The R.O. attempted to complete the close stroke multiple times by engaging the control switch, but was unsuccessful in completing the stroke. The valve was taken to the open direction, and it quickly indicated "full open." A subsequent attempt to electrically close the valve was successful.

Maintenance and Engineering personnel reviewed the Control Wiring Diagram (CWD) and determined the most likely cause of the problem to be a failure of the closed seal-in contactor to remain "closed" when Operations electrically cycled the valve. A troubleshooting plan was developed to monitor the contactor, along with actuation of the closed limit switch and the closed torque switch. I&C technicians opened the MCC compartment door to attach run current and voltage monitoring equipment. When the door was opened, it was noted that a single wire, which was part of a bundle of wires in the compartment, was looped out of the bundle and was resting against the closed auxiliary seal-in contact. The wire was moved aside. Subsequently, Operations stroked the valve open and back closed. The valve operated properly and the stroke time was normal.

1129	SWN	Fail to Open			Non-Test Demand
36089		Unavailable (T&M)			
9/30/2005		discovered to be unable to open (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

On 09/30/05 the 2A RHR HEX outlet valve, 2-FCV-23-34, failed to open when the A2 RHRSW pump was placed in service.

1135	HPI	Fail to Open			Test
38985		Unavailable (T&M)			
5/22/2006		failed to open on demand (stuck closed) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During performance of OSP-EM-V001A SI valve strokes, EMHV8814A would not open after it was stroked closed.

Investigated per job 06116807 and found the aux contact on the close coil to be sticking.

Component Type *MOV*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1102	RHR	Fail to Close			Non-Test Demand
39335		Unavailable (T&M)			
6/20/2006		failed to close on demand (stuck open) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

While attempting to secure from Suppression Pool Cooling per S51.8.A, HV-051-2F024A failed to stroke closed from the MCR handswitch. SSVN informed and attempted to close HV-051-2F024A with an EO observing breaker operation. When handswitch taken to close observed no contactor movement at the breaker (D214-R-G-35). Thermal overloads were not tripped. 2A LPCI mode was declared inoperable. TRT 06-115 was performed to test the contacts of the control switch. The results of the TRT proved that the handswitch contacts are operating properly. PM is to be pulled up and worked to correct issue (See W/O R0850177). It was discovered that aux. contacts on the open contactor had failed and prevented the closing circuit from engaging. The failed aux. contacts were replaces, as detailed in the W/O CREM. The remainder of the bucket PM was performed and PMT valve strokes were performed SAT.

1080	RHR	Fail to Close			Non-Test Demand
39417		Unavailable (T&M)			
7/24/2006		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

E12-MOVFO68A (RHR A Service Water Return valve) exhibited flow indication and substantial flow noise after the valve had been taken to the close position.

1. After the valve was taken to the close position with the control switch indication was given that the valve was not fully closing (flow was indicated on E12-R602A RHR A Service Water Flow meter on H13-P601) even though the valve showed single light indication.
2. Control switch was then taken to close again but no change in flow indication.
3. An operator was then sent to the valve and verified substantial flow noise after the valve had been taken to the close position.
4. The valve was then opened successfully under flow conditions.

Component Type *MOV*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1123	RHR	Fail to Open			Test
41400		Unavailable (T&M)			
3/23/2007		failed to open on demand (stuck closed) (MSPI-D)			
		(MSPI-D)	N	Trip feature that is overridden in ESF actuation	

While performing 06-OP-1P75-R-0004, during step 5.8.27i. the following was observed:
1E12-F048B was fully closed by holding the handswitch.
When 1E12-F048B reached full closed and while still holding the handswitch,
breaker 152-163103 tripped to the "trip free" position.
Breaker 152-163103 was reset and reclosed prior to the 10 minute limit and 1E12F048B stroked fully open when the handswitch was released.
The actual cause of the reported condition is not known at this time. The 1E12F048B valve appeared to operate properly before the power supply breaker tripped and after the power supply breaker had been reset. The condition reported by the referenced CR is to be resolved at a later date by completion of WO No. 106059. Until this WO is completed, the actual cause of the reported event may not be knowm. Thus, at this time, the reported event is consertatively considered to be a loss of Maintenance Rule Program Function M-E12-15, "OPEN RHR HEAT EXCHANGER BYPASS VALVE F048A/B". Since the F048B valve could not be immediately opened remotely, this function was apparently impacted by the reported event. After the referenced WO is completed, it would seem prudent to review the actual cause of the reported event to determine if the ability to CLOSE the F048B valve was impacted by the reported event

1130	SWN	Fail to Close			Non-Test Demand
42397		Unavailable (T&M)			
7/5/2007		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 07/05/07, 3-FCV-023-0034 was found inoperable (Failed to close) during an attempt to isolate RHRSW flow to the 3A RHR HEX.

The valve was failed open and cooling water was provided. The
problem occurred on the closure of the valve. The valve was manually closed to provide isolation.

1074	SWN	Fail to Open			PMT
43589		Unavailable (T&M)			
8/23/2007		discovered to be unable to open (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

NSCW valve lost auto open function during instrument maintenance.

During performance of MWO 106189301 (Correct MWO is 1061895301 - R1X by AFS 10/23/07) for (24229-1), removal of NSCW 'A' Train Tower Control Valve, it was determined that the removal of the loop 1-T1668 for calibration resulted in TS 3.7.9 Contion A. entry. This work was planned and scheduled in the POD.

Component Type MOV

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1073	SWN	Fail to Open			PMT
43575		Unavailable (T&M)			
10/12/2007		discovered to be unable to open (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During performance of MWO 106189301 (Correct MWO is 1061895301 - R1X by AFS 10/23/07) for (24229-1), removal of NSCW 'A' Train Tower Control Valve, it was determined that the removal of the loop 1-T1668 for calibration resulted in TS 3.7.9 Contion A. entry. This work was planned and scheduled in the POD.

Not an actual failure,NSCW valve lost auto open function during maintenance on instrumentation.

1057	RCI	Fail to Open			PMT
43353		Unavailable (T&M)			
11/10/2007		failed to open on demand (stuck closed) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

RCIC PUMP SPLY TO FEEDWATER HEADER ISO VLV did not stroke from the control room during the performance of 24.206.02. The valve also made an abnormal noise during stroke attempts.
RCIC was already in an inoperable status. The testing was being performed for PMT following scheduled preventive maintenance on the MOV.

1121	AFW	Fail to Close			PMT
44790		Unavailable (T&M)			
1/16/2008		discovered to be unable to close (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

On 16 Jan 08 after overspeed trip testing activities for 2P140, Steam Driven Auxiliary Feedwater Pump, the actuator for MOV 2HV4716, Aux Feedwater Turbine Steam Inlet Valve, failed to stroke to the closed position.

Troubleshooting found two sets components were identified as possible causes for the problem.
The limit switch (LS-5) was reported as failed, but subsequent bench testing induced recovery. The normally closed contacts from the Opening Coil (42 OC) were found open when they should have been closed, and this was a verifiable cause for the failure, singly or in combination of the suspect limit switch.

1041	SWN	Fail to Open			Inspection
45766		Unavailable (T&M)			
3/19/2008		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

The 1-SW-V105 valve is a safety-related motor-operated butterfly valve that acts to provide a flow path for service water from the U1 Nuclear Service Water (NSW) header to the 1B and 1D RHRSW Booster Pumps. Failure/loss of the disc pins for the 1-SW-V105 introduces three concerns: (1) the loss of both pins would result in disc/stem separation that would allow the butterfly to close when the operator is in the OPEN position, (2) a closed valve would not respond to an OPEN signal, and (3) the loss of either disc pin introduces foreign material that has the potential to damage the downstream RHRSW Booster Pumps.

Component Type *TDP*

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Run

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1042	AFW	Fail to Run <1H			Test
26697		Fail to Run			
1/27/2003		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

1.Event Description: On 1/27/03, while performing the quarterly surveillance test OST-202, Steam Driven Auxiliary Feedwater Component Test, operators noticed the Steam Driven Auxiliary Feedwater pump (SDAFW-PMP) was operating with high lube oil inlet (178 F) and outlet (170 F) temperatures. The OST requires that the pump be stopped if the lube oil cooler inlet temperature exceeds 155 degrees. 2.Investigation Results Executive Summary: The root cause of the overheating of the SDAFW-PMP was insufficient self-cooling water flow due to inadequate delta P

1031	HCI	Fail to Run <1H			Test
29260		Fail to Run			
8/29/2003		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

On August 29, 2003 at 13:15 the HPCI turbine was started to perform quarterly full flow testing. After approximately 25 minutes of HPCI operation in full flow test mode, a HPCI turbine trip annunciator was received in the control room. Traces of the event (Figure 1) show turbine speed coasted down due to the trip, then subsequently increased when the trip automatically reset. Shortly after the reset, a second trip and automatic reset occurred. Operator actions were then taken to manually trip the turbine and end the event.
Trip #Speed when TrippedTime to Reset*
14000 RPM steady state15 seconds
22200 RPM10 seconds
33250 tripped by the OperatorNA
* Time from stop valve closure signal to stop valve open signal
Field investigations found the stem of the stop valve to be sheared at the coupling threads. The valve was in the open position with the actuator in the closed position.
This root cause analysis focuses on the cause of the turbine trip(s). The root cause of the HPCI surveillance run failure was determined to be that the overspeed (O/S) trip reset spring was found to have a reset value set to trip at a value less then the desired 2-5 lbs.

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Run

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1042	AFW	Fail to Start			Test
33188		Fail to Run			
5/25/2004		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

During performance of OST-202 on 5/25/04, the SDAFW pump began to emit sparks from the pump deflector inspection port. The pump was secured after 10 -15 seconds, and an inspection was performed to determine if foreign material had entered the gap between the deflector and diaphragm. No obvious foreign material was revealed. Subsequent pump starts on the same day (2258 hrs. and 2324 hrs.) produced similar results. During the 2258 start, sparks were emitted immediately, died out, and then re-appeared. The pump was tripped after 30 -40 seconds. During the 2324 start, sparks were emitted immediately and more severe than previous starts. The pump was tripped after 20 30 seconds.
2. Problem Description
A normal SDAFW-PMP start would be smooth with no interferences such as visible sparks and metal-to-metal rubbing noise. Sufficient disassembly of the pump to reveal the face of the deflector revealed rolled or deposited metal on the deflector face and adjoining diaphragm face. The gap between the two parts had closed causing interference between the deflector and the diaphragm.

1098	AFW	Fail to Run <1H			PMT
38569		Fail to Run			
6/6/2006		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	Y		

At approximately 1811 CDT on June 6, 2006, the 11 TDAFW Pump was shut down during performance of a flow test due to turbine outboard (governor end) bearing temperature exceeding the limit in a surveillance procedure. Upon disassembly, it was found that the inboard bearing was damaged and the outboard bearing was worn. The 11 TDAFW Pump was reassembled with new inboard and outboard bearings, tested, and declared operable on June 8, 2006 at approximately 1940 CDT.

1113	HCI	Fail to Run <1H			PMT
40404		Fail to Run			
11/4/2006		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	Y		

Changed the FM. During the 1000 # run of HPCI, severe flow and speed oscillations occurred, and were accompanied by exhaust check valve slamming. The HPCI turbine was run for approximately one minute, and was manually tripped by the Operator (at 18:10:26 on 11/4/06) when system conditions did not improve.

Component Type TDP

EPIX MSPI Failure Mode Fail to Start

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1102	HCI	Fail to Run			Test
32151		Fail to Start			
3/22/2003		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

Unplanned RCIC inoperability during the performance of ST-2-055-601-1 (ECCS - CONDENSATE STORAGE TANK LEVEL - LOW, DIV 2 (HPCI)FUNCTIONAL TEST (LIS-55-1N661B)). The inoperability occurred when the HPCI suction swapped which caused a pressure change on the CST supply line to both HPCI and RCIC. This change in pressure caused the "RCIC pump suction low pressure" (116 RCIC window B1) and the "RCIC pump suction high pressure" (116 RCIC window B2)alarms to annunciate. The pump suction low pressure caused a RCIC turbine trip. The ST states that the following in the "shift permission to test section":
- Due to the change in head pressure when HPCI valve line-up changes from CST to Suppression Pool, performance of this test may affect the following RCIC alarms/indications, which may be reset as necessary. 1. Annunciator 116 RCIC-A1 (10C848-1), RCIC OUT OF SERVICE. 2. GROSS FAIL Indication on FIS-49-1N651, (RCIC PUMP DISCHARGE). 3. GROSS FAIL Indication on FS-49-1N659, (RCIC PUMP DISCHARGE). 4. Status Light DS18 at RCIC Panel 10C648, (DIVISION 1); "RCIC T/U IN CAL OR GROSS FAIL" RCIC turbine trip was reset using S49.1.C and operability restored to RCIC at 02:51.

1076	HCI	Unavailable (T&M)			PMT
27957		Fail to Start			
3/29/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

On 3/29/03 at 245 EST, Unit 2 was in the Startup mode with the reactor critical at a power level of approximately 1% CMWT and reactor pressure of approximately 165 psig. Major maintenance was performed on the High Pressure Coolant Injection (HPCI) system during the refueling outage. Surveillance procedure 34SV-E41-005-2, "HPCI Pump Operability 165 PSIG Test" was being performed when it was determined that the control valve, 2E41-F3052, went to the fully open position and the flow controller, 2E41-R612, showed a system flow in excess of 5200 GPM.
Investigation uncovered the fact that the gap between the toothed sensing gear and the magnetic speed pickup sensor was greater than the .008" required by procedure. This caused the governor system to incorrectly sense a zero speed condition and attempt to increase the turbine speed to correspond to the speed demand signal from the flow controller. Once the flow controller sensed that flow was increasing past the flow controller setpoint of 4250 GPM, the speed demand from the flow controller was automatically decreased to try to bring the flow back to the controller's setpoint. This demand was decreased until the low speed signal of 4 ma was reached (which corresponds to approximately 850 RPM). Since the governor system was still seeing zero speed, the governor system still tried to reach 850 RPM by continually opening the control valve until it was fully open. Since reactor pressure was low, there was not sufficient motive force to drive the turbine to an overspeed condition(reference CR 2003004227). Briefly, the magnetic speed pick-up that supplies the speed feedback signal to the governor system was incorrectly set-up. Subsequently, the magnetic speed pick up was adjusted and the HPCI surveillance test was successfully completed and the HPCI system was declared operable at 1215 EST.

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1113	RCI	Fail to Run <1H			Test
32153		Fail to Start			
6/10/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

While performing step 8.3.14 of ST-24J, RCIC Flow Indicating Controller 13FIC-91 failed to begin restoring system flow to setpoint until approximately 5 minutes after the flow loop offset was created. The SNO operating the RCIC turbine throttled 13MOV-30 in the close direction in order to raise RCIC pump/system pressure. The valve manipulation caused total system flow to lower, thus establishing an offset of approximately 60 gpm between actual system flow and controller setpoint (350 gpm vs. 410 gpm setpoint). The output of the controller was noted to be 60% of span and not increasing. After approximately 5 minutes, the controller output began to increase, system flow approached setpoint and balance was achieved. Subsequent changes in system flowrate were controlled as expected by 13FIC-91, both in the automatic and manual flow control mode.

1071	AFW	Fail to Run <1H			Test
36411		Fail to Start			
8/18/2003		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

"B" AFWP LUBE OIL FOOT VALVE FAILURE CAUSING SUBSEQUENT PUMP FAILURE. FOOT VALVE NOT RELIABLE. NEED ADDITIONAL SOURCE OF OIL TO PRIME MAIN OIL PUMP. THIS IS A REPEAT PROBLEM.

Component Type TDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1043	AFW	Fail to Run <1H			Test
29204		Fail to Start			
11/3/2003		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

With the TDAFW discharge FCV shut and recirculation flow path aligned, the TDAFW pump was started by opening 1MS-72. Within approximately 15 seconds the trip and throttle valve tripped closed due to mechanical overspeed. The turbine casing relief was observed to lift. It was noted locally that the governor did not appear to respond to control speed, as expected, during the start. ERFIS and OSI-PI captured a peak speed of 4863 rpm which is in excess of the normal maximum control band speed of 4100 rpm. EIR 20030783 and WR# 120370 initiated. Request: Perform Maintenance Rule Review Response: The TDAFW pump trip on mechanical overspeed that occurred on 11/03/03 at 14:28 was a Maintenance Rule functional failure, for further information see maintenance rule entry. Maintenance Rule Entry: The TDAFW pump tripped on mechanical overspeed shortly after start in support of OST-1411. Investigation determined that electronic problem existed with the dropping resistor that supplied power to electronic governor and the ramp generator. The dropping resistor is replaced periodically (PMID# 23341-01 = 728 days). The ramp generator is replaced when the component can not be successfully calibrated. The last functional failure for the TDAFW pump was recorded on 8/26/97 due to excessive vibration on the inboard bearing of the TDAFW pump. This TDAFW pump performance monitoring group consists of the turbine driven AFW pump, turbine, turbine controls, and all of the turbine train piping and valves (open position) between the pump suction and the steam generator nozzles. This group also includes the ability of components in the turbine steam supply lines to open or remain open and to adequately remove condensate. Components in the flow paths to the individual steam generators are included with this performance group since the turbine speed control system is sensitive to changes in the flow configuration. A value of 144 unavailability hours per 18 month period (1.1 %) was chosen to accommodate planned train outages with a provision for unplanned down time. A reliability performance criteria of one FF per two operating cycles was also selected based upon historical system performance. This criteria was evaluated as part of the integrated PSA review of all system unavailability (NF-96A-0190) and determined to be acceptable. Event Description WITH THE TDAFW DISCHARGE FCV SHUT AND RECIRC. FLOWPATH TDAFW PUMP WAS STARTED BY OPENING 1MS-72. WITHIN ~ 15 SECS. THE T&T TRIPPED CLOSED DUE TO MECHANICAL OVERSPEED. THE TURBINE CASING RELIEF WAS OBSERVED TO LIFT. IT WAS NOTED LOCALLY THAT THE GOVERNOR DID NOT APPEAR TO RESPOND TO CONTROL SPEED, AS EXPECTED, DURING THE START. ERFIS AND OSI PI CAPTURED A PEAK SPEED OF 4863 RPM WHICH IS IN EXCESS OF THE NORMAL MAXIMUM CONTROL BAND SPEED OF 4100 RPM. EIR 20030783 AND WR 120370 INITIATED. 2.Problem Description / Investigation Summary TDAFW pump tripped on over speed during OST-1411 and caused the plant to enter a 72 hour unplanned LCO. WO 480783-01 was initiated to repair this condition. Investigation revealed that R5, a 200 ohm voltage dropping resistor, had failed. The RGSC, ramp generator signal converter, was also found defective and was replaced.

1070	AFW	Fail to Run <1H			Non-Test Demand
31142		Fail to Start			
12/20/2003		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

REVIEW OF AUTO RPS RX TRIP AT 0949 ON 12/20/03 IDd AN OVERSPEED TRIP OF AUX FEED PP 2C OCCURRED. SUBSEQUENT TROUBLESHOOTING HAS REPLICATED AN OVERSPEED CONDITION FOLLOWING THE OPENINGO F THE SECOND STEAM ADMISSION VALVE.
Modify Procedure IMP-09.01, "2C Auxiliary Feedwater Pump governor Oil Change Instruction," to clearly delineate the method and criteria for setting the governor compensating needle to ensure the optimum stability setting is established.

Component Type TDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1101	HCI	Unavailable (T&M)			Test
32150		Fail to Start			
3/18/2004		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	Y		

Unplanned RCIC inoperability during the performance of ST-2-055-601-1 (ECCS - CONDENSATE STORAGE TANK LEVEL - LOW, DIV 2 (HPCI)FUNCTIONAL TEST (LIS-55-1N661B)). The inoperability occurred when the HPCI suction swapped which caused a pressure change on the CST supply line to both HPCI and RCIC. This change in pressure caused the "RCIC pump suction low pressure" (116 RCIC window B1) and the "RCIC pump suction high pressure" (116 RCIC window B2)alarms to annunciate. The pump suction low pressure caused a RCIC turbine trip. The ST states that the following in the "shift permission to test section":

1103	HCI	Fail to Run			Non-Test Demand
32024		Fail to Start			
5/15/2004		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

During a Unit 2 HPCI run, the MCR received a low oil pressure alarm. Anequipment operator stationed in the Unit 2 HPCI room notified the ShiftManager that the local pressure indicator for the HPCI governor oilpressure indicated 0 psig. The Shift Manager directed the U/2 HPCIturbine to be tripped. With the aux oil pump still in service, the otherHPCI oil pressures were checked and confirmed to be in spec.Additionally, a hand valve that supplies oil to the journal bearing wasfound to be out-of-adjustment..The consequence of this hand valve failing to supply sufficient oil to thejournal bearing led to the wiping of the journal bearing and the scoringof the main HPCI turbine shaft..Statement of Cause:.The cause is determined to be insufficient oil to the journal bearing dueto a bumped or jarred hand valve in the oil supply line. It is believedthat this hand valve was bumped or jarred sometime after the successfulcompletion of the pump valve and flow. Interviews of the individuals who performed work during this timeframe could not identify any actions takenwhich resulted in the valve being bumped or jarred.

1063	AFW	Fail to Run <1H			Test
35567		Fail to Start			
4/9/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

On April 9, 2005, the Unit 2 Turbine-Driven Auxiliary Feedwater (CA) Pump (TDCAP) was being run by OPS Test Group in support of its required surveillance (within 24 hours of reaching 900 psig Main Steam pressure) per PT/2/A/4252/007. Following the first TDCAP start, the turbine tripped within one minute of reaching full speed of 3500 rpm. The TDCAP tripped due to activation of the trip/throttle valve (2SA-3) latching mechanism (turbine overspeed trip mechanism was not tripped). Approximately 5 hours prior to this trip, 2SA-48ABC was inadvertently opened, allowing the turbine to start. The turbine reached operating speed and ran at operating speed for 50 seconds before 2SA-48ABC was reclosed, and the turbine began coasting down.
Maintenance inspected the trip/throttle valve latching mechanism and found no problems. 2SA-3 was then reset. Testing per the PT continued with 4 start-run-stop evolutions completed successfully. On the next turbine start, 2SA-3 again tripped closed within one minute of the turbine reaching full speed. The Unit 2 TDCAP was declared inoperable, and a Unit Threat Team was assembled.
The most probable cause of 2SA-3 trip/throttle valve unlatching is high vibration of the valve due to flow induced vibration. The specific phenomenon causing this vibration is not known, but is thought to be related to possible excessive condensate induction exciting the internals of valve 2SA-3.

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1144	RCI	Fail to Run <1H			Non-Test Demand
35540		Fail to Start			
6/23/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

The RCIC turbine (RCIC-DT-1) has tripped during its initial ramp on several electronic initiations using the control room pushbutton. The Reactor Operator has stated that RCIC was successfully started and run by manually ramping up the flow demand signal in the control room. On the initial start of RCIC from the control room pushbutton, the RCIC system ramped up to rated flow properly and controlled level as designed. After RX water had been restored to an acceptable level, the RCIC turbine was tripped by closing the switch for RCIC-V-1 in the control room. After restoring RCIC-V-45 to its standby position, the Reactor Operator was unable to reset the trip on RCIC-V-1 in the control room. The trip was reset locally at the turbine. A short time later, the Reactor Operator depressed the initiation pushbutton to start RCIC. The RCIC turbine ramped up properly, then at maximum flow a trip occurred. The total time from initiation to trip was approximately 18 seconds. The RCIC valve lineup was again restored, and a subsequent initiation produced another similar trip. On a final attempt, the Reactor Operator placed the RCIC flow controller in manual mode and brought the RCIC system up to rated flow in a controlled manner. The RCIC system was run successfully for an extended period with no subsequent trip. A review of startup/run data and the RCIC initiation logic diagrams indicates the most likely cause as a problem with either the Low Pump Suction Pressure Switch or the High Turbine Exhaust Pressure Switch.
RCIC was not able to perform its design function due to a latent flaw in the original design of the system.

1069	AFW	Fail to Run <1H			Test
37774		Fail to Start			
1/5/2006		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

On January 5, 2006, during performance of a surveillance run of the 1C AFW pump in accordance with procedure 1-0700050, Data Sheet C, the mechanical overspeed actuated and tripped the turbine. The pump had been running for several minutes with speed stable at the rated speed of 3600 rpm. Alarm G-46 came in several seconds prior to the actual turbine trip. The electrical overspeed trip coil was not heard to actuate. Based on local observation, pump speed did not increase prior to the trip. The mechanical trip tappet nut was observed to be in the tripped position. This information indicated a potential problem with the mechanical overspeed trip mechanism.
The Root Cause Analysis determined that prior to this event a latent procedural weakness existed because proper latch validation of the 1C AFW turbine overspeed mechanism was not clearly incorporated into the plant operating procedures. As a result, operating crews did not have clear direction on the method of relatching the turbine and what method to use to confirm that the turbine was properly latched. Prior to the event, the 1C AFW turbine was last re-latched after performance of procedure 1-0700050, Appendix A, on December 16, 2005. At that time, the head lever and emergency trip rod had not been retracted sufficiently for the tappet to drop to the fully seated position. Binding of the tappet nut in the head bracket with side load from the head lever was also determined to be a root cause since it enabled the overspeed mechanism to appear latched when it was not. This condition remained unnoticed until the unexpected trip.

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1081	AFW	Fail to Run <1H			Test
40620		Fail to Start			
12/12/2006		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

THE FAILURE OF AFWP #14 TO START IS LESS THAN ADEQUATE LEVEL OF DETAIL IN THE ASSOCIATED WORK INSTRUCTIONS, RESULTING IN THE IMPROPER ADJUSTMENT OF THE TRIP LATCH LINKAGE AND THE REQUIRED IMPACT SPACE. IN ADDITION TO THE IMPROPER IMPACT SPACE, DISCOVERED EXCESSIVE GREASE APPLIED TO THE TRIP HOOK / LATCH-UP MATING SURFACES. ADJUSTMENT TO THE IMPACT SPACE AND REPLACEMENT OF THE OVERSPEED TRIP LINKAGE ROD END ASSSEMBLY WAS PERFORMED. SUBSEQUENT TESTING DEMONSTRATED REPEATABLE SATISFACTORY PERFORMANCE.

1033	AFW	Fail to Run			PMT
41346		Fail to Start			
3/31/2007		unaffected by failure (MSPI-SD)			
		(MSPI-SD)	Y		

The AFW pump was tripped two hours into a test run due to foaming of the bearing lube oil and increasing bearing temperature.

The forced oil modification (ES200100565) was installed on the 22 Auxiliary Feedwater (AFW) Pump Turbine during the 2007 Refueling Outage (RFO). Foaming/ air entrainment occurred during Post Modification testing on March 17.

1102	HCI	Fail to Run			Non-Test Demand
41641		Fail to Start			
4/24/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

Following an automatic unplanned Unit 2 reactor SCRAM on April 24, 2007, the High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) systems automatically started, as expected, but experienced full-scale flow oscillations, which is the subject of this root cause analysis. The subsequent investigation determined that the Unit 2 Main Control Room (MCR) HPCI and RCIC flow controllers had the tunable parameters of gain and reset set considerably different than the same controllers on Unit 1 and considerably different than the as-left Unit 2 startup testing settings. While the Unit 2 HPCI and RCIC control systems were sufficiently tuned to ensure stable operation in full flow test mode, the as-found flow controller tunable parameters resulted in unstable operation during vessel injection mode, which is not routinely tested. The unacceptable setting adjustments were performed in May of 1999 and rendered both systems inoperable. The root cause of this problem is a less than adequate maintenance procedure, and contributing causes stem from a less than adequate training lesson plan. In addition to correcting the associated procedure and training, improvements are planned for the operating experience assessment program, flow controller configuration controls, and maintenance record keeping.

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1102	RCI	Fail to Run			Non-Test Demand
41642		Fail to Start			
4/24/2007		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		

On December 21, 2002, PBAPS Unit 2 experienced a RCIC flow oscillations event similar to the one experienced on April 24, 2007 at LGS Unit 2 (this event). The oscillations were 500 gpm, and determined to be caused by the controller gain setting being too high. The LGS HPCI System Manager was directly involved in the prompt response to this event, supplementing the PBAPS on-site staff. Refer to Issue Report 00137771. The Licensee Event Report (LER) submitted to the NRC for the transient addressed the RCIC flow oscillations and stated that the condition rendered RCIC inoperable since May of 1994. An INPO Operating Experience Report (NNOE) was issued on February 24, 2003 for the RCIC flow oscillations, but no Exelon Nuclear Event Report (NER) was issued because the INPO report was issued, which meets the same objective of communicating the event to Exelon stations. Corporate Engineering recommended that no Exelon Fleet-wide actions be required because only PBAPS had done a design change to replace their HPCI or RCIC flow controller. Therefore, a Yellow or Red NER was not issued.

The NNOE implies that "sluggish" control in the test mode is sufficient to assure stable operation in the RPV injection mode. The NNOE stated that plants that have replaced their analog flow controller should evaluate their system's ability to inject into the RPV without flow oscillations. LGS had not replaced their flow controllers and still has the original flow controllers. The PBAPS event was due to the gain setting being increased during a design change acceptance test (replaced flow controllers with different manufacturer's controller). The gain at PBAPS had been raised from 0.14 to 0.35, which was determined to be the cause of the flow oscillations. It appears that LGS took no actions in response to this event.

1076	HCI	Fail to Run			Inspection
42043		Fail to Start			
5/18/2007		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	Y		

At 21:00 on May 17, 2007, Maintenance personnel discovered oil accumulating on the HPCI Turbine Skid. They began investigating the source of the oil leak with WO 2071170501. At 15:45 on May 18, 2007, they reported that the HPCI lube oil reservoir had water in it. The water intrusion was attributed to a clogged bracket drain valve, 2E41FD103. CR 2007105300 stated that 2E41FD103 was partially unclogged during performance of WO 2071170502, and the seal cavity was then able to drain. This clogged drain valve caused water to accumulate in the mechanical seal cavity. This water came from a small leak in the mechanical seal, and it apparently entered the oil system by flowing past the thrust bearing oil deflector. The deflector forms one of the seal cavity walls and is not designed to keep standing water out of the bearing housing.

Component Type TDP

EPIX MSPI Failure Mode Fail to Start

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1076	HCI	Fail to Run <1H			Test
42242		Fail to Start			
5/25/2007		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

During the performance of 34SV-E41-002-2, High Pressure Coolant Injection (HPCI) Time Response Testing, following the Unit 2 HPCI System Outage, the system tripped after reaching rated speed, flow, and pressure. The system subsequently reset and restarted, returning to rated speed, flow, and pressure for completion of 34SV-E41-002-2.
The reset spring setting was discovered to be low. The as-found trip reset spring setting was 1.0 lbf. This is below the procedure criteria of 2.0 - 5.0 lbf. The spring was adjusted to 4.0 lbf, and the system was retested. Since the trip reset spring setting was not optimal, the spring did not perform its function of holding the trip tappet in place. Therefore, the tappet was released causing the spurious turbine overspeed trip.

1042	AFW	Fail to Run <1H			Test
42847		Fail to Start			
8/12/2007		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

The SDAFW Pump was started IAW OST-206 for a PMT of MS-V1-8A following a breaker PM. Approximately 15 seconds after opening V1-8A and starting the SDAFW Pump, APP-007-F5 (SD AFW PMP LO DISCH PRESS TRIP) was received. V1-8A closed and the SDAFW Pump tripped.
The troubleshooting data obtained concluded the Woodward Governor air supply solenoid valve was most likely not re-positioning in a timely manner (sticking). This would not allow the SDAFW Pump to come up to speed prior to the discharge pressure timer relay activation.

1040	HCI	Unavailable (T&M)			Test
43099		Fail to Start			
10/10/2007		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		

From LER record:

On October 10, 2007, at 2245 hours Eastern Daylight Time (EDT), during performance of the High Pressure Coolant Injection (HPCI) system operability test, the HPCI system was declared inoperable due to a leak on the main pump turbine side seal. The approximate five gallon per minute leak was isolated by securing the pump and isolating the keep-fill. No automatic system isolations or actuations occurred. All Emergency Core Cooling Systems (ECCS) and the Reactor Core Isolation Cooling (RCIC) system were operable.

The safety significance of this event is considered minimal because HPCI was still available for injection, though in a degraded condition, and adequate core cooling was ensured by the operability of the redundant low pressure ECCS injection subsystems in conjunction with the Automatic Depressurization System (ADS). The RCIC system would also automatically provide makeup water at high reactor operating pressures.

Component Type *TDP*

EPIX MSPI Failure Mode Fail to Start

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1137	MFW	Fail to Run <1H			Non-Test Demand
43489		Fail to Start			
12/25/2007		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	Y		
	All Engineered Safety Feature equipment responded as designed with the exception of the steam driven auxiliary feedwater pump which tripped due to actuation of the over-speed trip valve and was manually reset and subsequently placed in service. The emergency trip tappet failed due to worn parts.				
1049	HCI	Fail to Run			Non-Test Demand
44972		Fail to Start			
4/15/2008		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	Y		
	HPCI FIC Observed to be in auto with about 60% open demand and no observable setpoint. MGU not at the High speed stop				
1036	RCI	Fail to Run			Non-Test Demand
45115		Fail to Start			
4/24/2008		failed to start on demand (MSPI-D)			
		(MSPI-D)	Y		
	Shortly after turnover on 4/24/08, the RCIC controller output signal dropped and needed adjustment. This was complete. After about another hour, the controller needed another adjustment. Within 30 min of this adjustment, the controller dropped to < 99.5% open and RCIC was declared inoperable.				

Component Type *TDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1096	RCI	Fail to Start			Inspection
30214		Unavailable (T&M)			
11/24/2003		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On November 24, 2003, RCIC-IVTR-1A shut down causing RCIC-FIC-91 to lose power and demand no flow. RCIC was declared inoperable and the inverter was replaced. The inverter failure is considered a maintenance rule functional failure since RCIC was incapable of supplying required flow. This evaluation will determine the apparent cause of the RCIC inverter failure and review the current PMs and industry operating experience for applicability as required per CNS Procedure 0.27.
Evaluation:
The RCIC inverter (CNS-1-RCIC-IVTR-1A) converts 125 Vdc power to a 60 Hz, 120 Vac power for the RCIC flow controller (CNS-1-RCIC-FIC-91), the RCIC square rooter (RCIC-SQRT-99) and the RCIC test mode power supply (CNS-1-RCIC-ES-100).

1119	AFW	Fail to Run <1H			Test
29705		Unavailable (T&M)			
12/8/2003		operated, but not within specified parameters (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 12/8/04 during performance of STP0220.002, the TDEF on initial start increased in speed to 4170 RPM, which was within the required speed range. However, the speed began to increase and when it was attempted to adjust speed for IST data collection, speed could not be reduced. The turbine speed continued to increase slowly and when speed exceeded 4400 RPM, it was decided to trip the TDEFP. It was initially believed that the speed knob had loosened, but it was found to be secure. Upon further investigation, it was determined that the governor valve linkage was binding and the governor valve was not traveling to the full closed position. Because of a potential concern with over adjusting the valve in the closed position to the point where it would not go full open, it was decided to maintain valve travel at it's existing setting without adjusting it to travel more in the closed position. The procedures for linkage adjustment were not clear and a vendor rep was en route to the plant for assistance, if needed. The governor valve linkage was lubricated and readjusted and the surveillance test was completed satifactorily prior to vendor arrival. However, using the governor speed knob the turbine could only be reduced to about 3700 RPM, but normal speed and the IST data collection speed were achieved.

1106	AFW	Fail to Run			Test
31847		Unavailable (T&M)			
5/20/2004		tripped/stopped after warmup (>1 hr.) (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	

Changed the FM. Isolation valve associated with TDP opened as it should, but the limit switch did not indicate that the valve had opened.

Component Type *TDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1030	AFW	Fail to Start			Inspection
31412		Unavailable (T&M)			
7/5/2004		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On July 5, 2004 at 10:15 'A' Train AF SEIS alarms were received; AUX FW SG1 and AUX FW SG2. The Alarm Response Procedure indicates that AUX FW PMP TURB SYSTEM TRBL may be caused by loss of power to the governor control circuit. This condition was confirmed by verifying that the 'EGM POWER ON' light was not illuminated. The 'A' AF pump was declared INOPERABLE and has been quarantined. There were no maintenance activities on-going at the time of the SEIS Alarms. This is similiar to the event that occurred in Unit 2 in May 2004; ref CRDR 2709451.
MRFF Review
The Unit 3 Turbine Driven Auxiliary Feedwater Pump spontaneously lost governor control power.

1096	RCI	Fail to Start			Inspection
32130		Unavailable (T&M)			
9/30/2004		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

RCIC-FIC-91 CONTROLLER OUTPUT HAS FAILED DOWNSCALE TO 0. NORMAL THE OUTPUT IS 100.

REQUIREMENT NOT MET: NO CONTROL OF RCIC FLOW

METHOD OF DISCOVERY: PANEL WALKDOWN
IMMEDIATE ACTIONS TAKEN: CHECKED RCIC INVERTER (RCIC-IVTR-1) AND IT APPEARS TO BE NOT WORKING SO THERE IS NO POWER TO THE CONTROLLER

1076	RCI	Fail to Run <1H			PMT
34287		Unavailable (T&M)			
3/13/2005		tripped/stopped during warmup (<1 hr.) (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

After RCIC tripped on " RCIC Pump Exhaust Pressure High " SOs were sent to verify the normal position (open) of the 2E51-F001 valve (Exhaust Line Stop Check Valve) as a possible cause of high exhaust pressure. The SOs reported back to me that the valve was open. As a result of this report, RCIC was started up a second time and subsequently tripped again on " RCIC Pump Exhaust Pressure High " . The 2E51-F001 was checked again as a possible cause of high exhaust pressure and this time the valve was unlocked and found to be CLOSED. RCIC Operability
CAP
This CR identifies a valve found out of its required position. The valve has been restored to its required position.

Component Type TDP

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1029	AFW	Fail to Start			Inspection
34007		Unavailable (T&M)			
3/19/2005		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

(U-3) FAILURE OF THE AFA-P01 GOVERNOR CONTROL CIRCUIT HAS RESULTED IN THE AF PUMP BEING DECLARED INOPERABLE.
On July 5, 2004 at 10:15 'A' Train AF SEIS alarms were received; AUX FW SG1 and AUX FW SG2. The Alarm Response Procedure indicates that AUX FW PMP TURB SYSTEM TRBL may be caused by loss of power to the governor control circuit. This condition was confirmed by verifying that the 'EGM POWER ON' light was not illuminated. The 'A' AF pump was declared INOPERABLE and has been quarantined. There were no maintenance activities on-going at the time of the SEIS Alarms. This is similiar to the event that occurred in Unit 2 in May 2004; ref CRDR 2709451.

WE HAVE LOST DC CONTROL POWER TO THE "A" AUX. FEED WATER PUMP GOVERNOR CONTROL CIRCUIT, BASED ON THE EGM POWER ON LIGHT BEING OFF.THE PUMP IS INOPERABLE. TROUBLESHOOT THE LOSS OF EMERGENCY GOVERNOR CONTORL POWER TO AFA-P01 IN ACCORDANCE WITH THE ENGINEERING GAME PLAN. REPLACE WOODWARD GOVERNOR DROPPING RESISTOR PER WSL 281406 AND CALIBRATE SPEED LOOP PER WSL 259028.

1144	RCI	Fail to Start			Non-Test Demand
35603		Unavailable (T&M)			
6/27/2005		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

In response to the reactor scram on 06/23/05, the RCIC system was initiated to restore reactor vessel level. The system operated per design and was manually shutdown by the control room RO by closing the trip and throttle valve (RCIC-V-1). Upon subsequent lineup restoration, the RO could not remotely re-open RCIC-V-1. Equipment Operators dispatched to investigate the cause found that the overspeed trip lever had disengaged from the overspeed trip tappet. The trip linkage was reset by the EO and RCIC-V-1 was remotely reset and opened from the control room.

1036	RCI	Fail to Start			PMT
42773		Unavailable (T&M)			
1/20/2006		ran, but failed to develop adequate flow/pressure (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	

During Post Maintenance Testing (PMT) on 1/21/06, Reactor Core Isolation Cooling (RCIC) pump (1E51C0001) flow/turbine (1E51C0002) speed drifted down unexpectedly when system flow controller (1E51R0600) was switched from Manual to Automatic.

Initial troubleshooting per NOP-ER-3001 isolated the RCIC system flow controller (1E51R0600) output drift as the likely cause of the unexpected decrease in RCIC pump (1E51C0001) flow/turbine (1E51C0002) speed with the flow controller in Automatic. The flow controller (1E51R0600) was replaced with a calibrated replacement flow controller.

Component Type *TDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID / FailureID / Event Date	System	FMEPIXCheck / EPIX MSPI Failure Mode / DeviceFailureMode / MSPIFM	IsMspiFailure	MspiExclusion	Detection
1080	RCI	Fail to Start			Test
38009		Unavailable (T&M)			
2/12/2006		failed to start on demand (MSPI-D)			
		(MSPI-D)	N	Risk-significant function did not fail	
	During STP-051-4224, the relay E51A-K60 has high contact resistance between M1-T1, this relay feeds RCIC initiation signal from Vessel Low water - reference 828E539AA sht-4, Work request # 70273 written for electrical to clean/replace relay as needed Relay E51-K60 replaced per WO#81860. Retest all SAT. No additional actions required and this CR may be closed.				
1073	AFW	Fail to Start			Inspection
44020		Unavailable (T&M)			
5/13/2007		discovered to be unable to start (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	
	This condition report documents the power supply for the driver failed, disallowing operation of the driver. With the driver unable to operate, there was no speed control available for the terry turbine. If the terry turbine had started, the turbine would have tripped on overspeed.				
1143	AFW	Fail to Run			Test
45091		Unavailable (T&M)			
11/13/2007		discovered to be unable to run for mission time (MSPI-R)			
		(MSPI-R)	N	Risk-significant function did not fail	
	Oil samples collected from the 2P-029-T Aux Feed Turbine OB bearing contained visible water.The sample had a significant level of cloud with free water sitting in the bottom of the sample container. Actual measured water levels in the oil are not available until external lab sample analysis is complete These results should be available on Friday 11/2/2007. The sample was collected under WO 347138-04 after the OI 62B Cold start of the turbine/pump Sample collected from the IB bearing of the turbine had no indication of water Samples collected prior to the operation of the turbine under OI 62 had no visible indication of water in either the IB or OB bearings Today's run indicated visible steam vapor in the area of the OB bearing steam gland during the first 20 minutes of operation After the visible steam had disappeared at approximately 25 minutes after start up a hand placed near the gland area would feel wet. After 30 minutes of operation no external indication of a steam leak was present All areas around the OB gland were dry.				
1024	AFW	Fail to Start			Inspection
46150		Unavailable (T&M)			
6/10/2008		unavailable, not failed (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	
	The Unit 1 Turbine Driven Auxiliary Feed Water Uninterruptible Power Supply (TDAFWP UPS) failed, resulting in a 72-hour Mandatory LCO.				

Component Type *TDP*

EPIX MSPI Failure Mode Unavailable (T&M)

Loc ID FailureID Event Date	System	FMEPIXCheck EPIX MSPI Failure Mode DeviceFailureMode MSPIFM	IsMspiFailure	MspiExclusion	Detection
1068	AFW	Fail to Start			Non-Test Demand
46280		Unavailable (T&M)			
7/11/2008		found unavailable during nondemand observation (MSPI-SD)			
		(MSPI-SD)	N	Risk-significant function did not fail	

On 7/11/08, EP2022 EFIC EFV-11 started coming into a level 4 alarm and clearing in a very rapid manner. A Primary Plant Operator was dispatched to investigate. The PPO manipulated the wires going into EFV-11 and the alarm stopped coming in. A few minutes later EFV-11 stroked closed with no operator action. EFV-11 was selected to open and the valve opened. When the annunciator alarm for the EFV-11 valve not being fully open cleared, the valve immediately started to close. EFV-11 was left in the closed position. WR 00342097 written on 7/11/08 to repair.
FIN Team actioned WR 00342097 to WO 01382773 on 7/11/08 and found that the K2 solid state relay off the vector module had failed. The K2 relay was replaced and the applicable sections of SP-146A were performed under Task 2 of WO 01382773.