FPL

JUL 0 2 2003

L-2003-146
10 CFR § 50.73

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: Turkey Point Unit 3
Docket No. 50-250
Reportable Event: 2003-007-00
Date of Event: March 15, 2003
Containment Spray Pump Failed During Mode 5 Refueling Outage Testing

The attached Licensee Event Report 250/2003-007-00 is being submitted pursuant to the requirements of 10 CFR § 50.73(a)(2)(i)(B) to provide notification of the subject event.

Very truly yours,

Michael O Pearce / For T.O. Jones

Terry O. Jones
Vice President
Turkey Point Nuclear Plant

SM

Attachment

cc: Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, Turkey Point Nuclear Plant

IE22

NRC FORM 366 (7-2001)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104	EXPIRES 7-31-2004
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)		Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.	

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE
Containment Spray Pump Failed During Mode 5 Refueling Outage Testing

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
03	15	2003	2003	- 007 -	00			2003	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	3
10. POWER LEVEL	0

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more)

	20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)
	20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)
	20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)
	20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)
	20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		
	20.2203(a)(2)(v)	X	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)		
	20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)		
	20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)		

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Stavroula Mihalakea (Licensing Engineer)	(305) 246 - 6454

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
x	BE	P	G200	N	-	-	-	-	-

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

16. ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On March 15, 2003, Turkey Point Unit 3 was in Mode 5, returning to power following the planned reactor shutdown for the Cycle 20, refueling outage. During the Train B Engineered Safeguards Integrated Testing, when the 3B Containment Spray Pump (CSP) [BE:P] was started, the field Operator heard unusual noises emanating from the pump and detected an electrical odor around the motor. The 3B CSP was secured. Investigations to determine pump failure, discovered that the pump casing wear ring was fused to the impeller wear ring and that there was a discoloration on the wear rings indicating that they had overheated. The pump was overhauled successfully, tested and returned to service on March 20, 2003.

After event analysis on May 7, 2003, it was concluded that the 3B CSP was considered to have been inoperable since the last successful Inservice Testing (IST) performed in Mode 1 on February 6, 2003. Based on that conclusion, the failure of the 3B CSP is reportable under the requirements of 10CFR50.73 (a)(2)(i)(B) for operation or condition prohibited by Technical Specifications. The root cause for the 3B CSP failure was a loss of internal pump clearance, due to the large amount of diametrical clearance between the pullout assembly to pump casing rabbet fit. The pump was overhauled successfully, tested and returned to service on March 20, 2003. It was determined that the health and safety of the public were not affected by this event.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

EVENT DESCRIPTION

On March 15, 2003, Turkey Point Unit 3 was in Mode 5, returning to power following the planned reactor shutdown for the Cycle 20, Refueling Outage. On March 15, 2003 the Train B Engineered Safeguards Integrated Testing was performed. As part of this test, the 3B Containment Spray Pump (CSP) [BE:P] was started at 03:24 hours. The field Operator heard unusual noises emanating from the pump and detected an electrical odor around the motor. The 3B CSP was secured. FPL commenced investigations to determine pump failure. It was found that the pump casing wear ring was fused to the impeller wear ring and that there was a discoloration on the wear rings indicating that they had overheated. The pump was overhauled successfully, tested and returned to service on March 20, 2003.

The Technical Specifications require that, during Modes 1 through 4, two independent Containment Spray Systems shall be Operable with each Spray System capable of taking suction from the Refueling Water Storage Tank (RWST) [KC:TK] and manually transferring suction to the containment sump via the Residual Heat Removal (RHR) System [BP]. FPL evaluated the failure mechanism and it was determined on May 07, 2003, that while a test failure is typically assumed to occur at the time of the test, the 3B CSP failure mechanism may have existed since the last successful Inservice Testing (IST) on February 6, 2003, while the unit was at 100% power level, in Mode 1. Operability subsequent to that test cannot be verified by available data. Therefore, the 3B CSP was considered to have been inoperable following the February 6, 2003 IST. Based on that conclusion, the failure of the 3B CSP is considered reportable under the provisions of 10 CFR 50.73 (a)(2)(i)(B) for operation or condition prohibited by Technical Specifications.

BACKGROUND

The Design Basis for the Containment Spray system (CSS) serves to mitigate the effects of a loss of coolant accident (LOCA) or main steam line break (MSLB) inside containment. It includes components required to reduce containment temperature and pressure to acceptable levels. The system consists of two motor driven horizontal centrifugal pumps that each discharge through motor operated valves, two spray headers and a series of nozzles, the necessary piping and valves.

The installed pump is a Goulds Model 3736, Size 4 X 6-13DV pump [P:G200]. By design, the pump impeller and bearing housing constitute a pullout assembly, which has a stuffing box/flange adapter that mounts into the pump-casing flange. This stuffing box main flange centers the pump impeller into the pump casing bore by mating its male rabbet to the pump casing female rabbet. This fit up centers the impeller wear ring into the pump casing wear ring and restricts the pump impeller wear ring Outer Diameter (OD) to prevent internal interference. The installed pump has the normal discharge line (normally closed), a mini-recirculation line (always open except for testing) and a "full flow" test line utilized primarily for IST.

One main design feature of the pullout assembly is to rigidly fix the pullout assembly to the pump casing by having a tight rabbet fit. This allows for minimal movement between mating parts, while centering the impeller into the casing wear rings. Because of this design, it is critical that the pullout assembly and pump casing are precisely machined. This precise machining is part of the vendor fabrication process for new/spare pump casings or pullout assemblies. As such it is expected that all new/spare pumps and casings are fabricated within tolerances in order to achieve proper assembly. Because the mating interface area of the rabbet fit up for the pullout assembly and pump casing are stationary to each other, this fit is considered to be a non-wear area.

Due to the design and fabrication requirements stated above, there are no requirements in the vendor manual to measure the diametrical fit between the pump casing Inner Diameter (ID) to pullout assembly Outer Diameter (OD) rabbet fit. As such, by design, there should be no need to inspect this fit. Plant maintenance procedures are appropriate for this design and do not include an inspection for this fit.

EVENT ANALYSIS

The following 3B CSP failure analysis investigations assisted in the cause determination:

1. Visual inspections were performed during the disassembly overhaul and the reassembly of the pump/pullout assembly, to photograph the as-found conditions and to gather failure data.
2. Inservice Testing and Predictive Maintenance Vibration data was analyzed for evidence of degradation and possible failure mechanism determination.
3. Plant Procedures used to test/start the 3B CSP were reviewed for unusual, unexpected or unacceptable operating lineups or conditions.
4. Work history analysis was performed to determine potentials for pre-existing conditions or lack of proper Maintenance.
5. Expertise from a SULZER pump field service representative was utilized to aid in the overhaul of the new pullout assembly and required casing machining.
6. INPO Operating Experience feedback was used to identify industry reported CSP failures or any generic CSP problems.

The investigation determined the 3B CSP failure was due to loss of pump wear ring clearances due to a “shift” of the pullout assembly during startup. During the as-found pump disassembly, the pump wear rings were found to have been in contact with the pump casing. Since the pump casing and impeller wear rings are Stainless Steel (SS), galling and metal rolling caused the impellers to fuse after the pump was started. As-found field measurements of the spare pullout assembly, point to an excessive pump casing diametrical clearance. This excessive clearance allowed the pullout assembly to shift due to gravity and/or inrush torque developed during startup, and thus, caused a loss of pump impeller wear ring to pump casing wear ring clearance. After overhaul, installation, and IST of the spare pullout assembly/pump was successfully completed, the old pullout assembly rabbet outer diameter (OD) was measured. The results of those measurements identified that a pre-existing out-of-tolerance condition was also present with the original pullout assembly installed. The ability of the pump to absorb any transient movements at the impeller, whether through vibration, flow perturbations, thermal growth, or pullout assembly shifting, is directly related to the amount of as-left clearance within the impeller wear rings. Work order history indicates that wear ring clearance for this pump was slightly out-of-tolerance low. Vibration/flow perturbations (e.g., passing a void) have a higher potential of inducing the contact that led to failure under those circumstances. The clearances in the 3B CSP were such that sufficient movement could occur to result in wear ring contact. Evidence from other pumps suggests that, if a slightly out-of-tolerance fit up does exist within a CSP, it does not result in the loss of internal clearance.

Casing bolt relaxation was identified and contributed to the loss of internal clearance. The last documented overhaul was performed in September 1991. Therefore, there was sufficient time for the pump to be subjected to vibrational loading and excess clearances, for the casing bolts to relax. This active bolt relaxation phenomenon, which is time dependent, coupled with out-of-tolerance dimensions (e.g., casing to cover diametrical clearance, wear ring clearance, eccentricity between the pump casing wear ring and casing female rabbet fit), made the 3B CSP susceptible to failure. As the S. S. bolts started to relax, the corresponding clamping force reduced. The remaining force was still high enough to provide the residual gasket loading needed to seal, but eventually was not sufficient to provide the clamping force necessary to overcome the combined gasket seating load, pullout assembly weight and transient loads at startup.

ROOT CAUSE

The root cause for the 3B CSP failure is a loss of internal pump clearance due to the large amount of diametrical clearance between the pullout assembly OD to pump casing ID rabbet fit. Additionally, the out-of specification concentricity between the pump casing wear ring bore and pump casing rabbet ID further reduced the available impeller wear ring clearance, thus leaving limited clearance to allow for expected transient impeller movements during startup. These factors caused the SS impeller and casing wear rings to contact during startup, which led to galling and failure of the 3B Containment Spray Pump.

The pullout assembly main flange bolts relaxed over time due to normal vibration, and were a contributing factor that permitted the pullout assembly to physically shift during startup. As the bolts relaxed, the corresponding clamping force reduced. This force was still high enough to provide the residual gasket loading needed to seal, but eventually was not sufficient to overcome gasket seating load, pullout assembly weight and motor torque surge at startup.

GENERIC IMPLICATIONS

FPL reviewed available work history and performed field inspections of the 3A, 4A, 4B CSPs to verify pump operability. No evidence of pump failure was found. Data from the CSPs and Root Cause yields several conclusions. First, bolt relaxation is an active phenomenon on all pumps and must be addressed via planned maintenance. Second, it was determined from CSP historical work records that active bolt relaxation is not sufficient to induce pump failure by itself; excessive fit up clearance must also exist. Third, the slightly out-of-tolerance fit up did not result in loss of internal clearance prior to evidencing bolt relaxation. Finally, evidence of an out-of-tolerance fit up indicates a need to verify fit up in all CSPs. It is concluded that, in order to initiate the type of pump failure seen on the CSP, three independent conditions must be present:

1. An out-of-tolerance diametrical fit between the pump casing ID to pullout assembly OD rabbet must exist,
2. An active bolt relaxation phenomenon must also exist, and
3. The pump must be oriented in a horizontal plane to allow for assembly weight to facilitate component shifting during startup.

If one of these conditions does not exist, then pump failure resulting from a loss of pump wear ring clearances due to a "shift" of the pullout assembly during startup should not occur.

A review of Condition Report Database, Condition Report History Database and work requests did not identify any pump failures, which were initiated by loss of internal pump clearances due to bolt relaxation and/or an out-of tolerance condition. The conclusion is that, although there is a potential for this condition to occur, it is remote and is highly dependent on the three independent variables discussed above. As such, there are no generic implications.

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SAFETY SIGNIFICANCE

For accident analyses, adequate containment heat removal capability is provided by two separate, engineered safety feature systems: the Containment Spray System and the Emergency Containment Cooling and filtering system. Operation of CSS and Emergency Containment Cooling System will ensure that containment pressure does not exceed its design value, which is 55 psig at 283 deg F. For the containment pressure calculation the minimum safeguards are employed in all calculations consistent with the loss of diesel generator e.g. one of two spray pumps and one of two-auto start emergency fan coolers.

For this event where the 3B CSP was inoperable for nearly 24 days, the 3A CSP remained operable to fulfill the accident analysis requirements. As such, the core damage frequency (CDF) for the plant configuration with the 3B Containment Spray Pump out of service is 9.497E-06 per year. This is an increase of 2.3E-08 per year, or 0.24%, above the normal, baseline CDF of 9.474E-06 per year. The CDF for this configuration is well below the "Potentially Risk-Significant" On-Line Risk Monitor (OLRM) threshold for CDF of 5E-04 per year. The large early release frequency (LERF) increase is less than 1% of the CDF increase, i.e., less than 2.3E-10 per year, and is not risk significant. The core damage probability (CDP) for the 24-day period the pump was out of service (2/6/03 to 3/1/03) is 1.53E-09, well below the "Potentially Risk-Significant" OLRM threshold for CDP of 1E-06. The large early release probability (LERP) for the 24-day period is less than 2.3E-11 and is not risk significant.

During the 24 days that the 3B CSP was inoperable, the 3A emergency diesel generator (EDG) was declared out of service for its monthly surveillance on February 11, 2003. The surveillance lasted approximately 3 hours and 15 minutes. However, the 3A EDG remained available at all times to provide power to the 3A train in the event of a Loss of Offsite Power. It can be concluded that the 3A CSP remained available to fulfill the accident analysis required function at all times during this 24-day period. Accordingly, the health and safety of the public were not affected by this event.

CORRECTIVE ACTIONS

1. Maintenance will check the torque on the 4A, 4B and 3A CSP pullout assembly to pump case main flange.

2. Predictive Maintenance will revise associated 6 month CSP PM's to verify main casing torque.

3. Maintenance will incorporate the as-found, as-left diameter measurements and a minimum casing bolt torque requirement in CSP Maintenance overhaul procedure 0-CMM-068.2 "Containment Spray Pump Disassembly, Repair and Assembly".

ADDITIONAL INFORMATION

None.

EIIS Codes are shown in the format [EIIS SYSTEM: IEEE component function identifier, second component function identifier (if appropriate)].