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10 CFR 50.73

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Calvert Cliffs Nuclear Power Plant, Unit No. 2
Renewed Facility Operating License No. DPR-69
NRC Docket No. 50-318

Subject: Licensee Event Report 2015-001, Revision 00
Manual Reactor Trip Due to Steam Generator Feed Pump 22 Trip

The attached report is being sent to you as required by 10 CFR 50.73.

There are no regulatory commitments contained in this correspondence.

Should you have questions regarding this report, please contact Mr. Larry D. Smith at (410) 495-5219.

Respectfully,

Mark D. Flaherty
Plant Manager

MDF/KLG/bjm

Attachment: As stated

cc: NRC Project Manager, Calvert Cliffs
NRC Regional Administrator, Region I
NRC Resident Inspector, Calvert Cliffs
S. Gray, MD-DNR

IE22
NRR

NRC FORM 366 (11-2015) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 | EXPIRES: 10/31/2018

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose 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.

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Calvert Cliffs Nuclear Power Plant, Unit 2	05000318	1 OF 5

4. TITLE

Manual Reactor Trip Due to Steam Generator Feed Pump 22 Trip

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	
12	01	2015	2015	- 001	00	01	27	2016	FACILITY NAME	

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*			
1	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
100	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER (Include Area Code)
Kenneth L. Greene, Regulatory Engineer	410 495-4385

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
A	SJ	P	B580	Y					

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

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

On December 1, 2015 at 1820, Unit 2 turbine driven Steam Generator Feed Pump (SGFP) 22 tripped. Operations attempted to reset SGFP 22 unsuccessfully. Facing lowering steam generator water level, Operations manually initiated a reactor trip. It was determined that SGFP 22 tripped due to a failed coupling. This occurred because excessive misalignment developed between the pump and turbine due to insufficient tensioning of the pump's casing to pedestal studs thus causing SGFP 22 coupling to fail. Investigation determined that the vender supplied stud tensioning values used in tensioning the hold down studs on both Unit 2 SGFPs during the 2015 refueling outage were incorrect and resulted in insufficient clamping force being applied to all the studs. The root cause of the failure was that Engineering personnel did not rigorously follow Engineering standards and applicable site processes. The coupling for SGFP 22 was replaced and SGFP 22 was realigned. Corrected tensioning values were then applied to all the hold down studs on SGFP 21 and 22. Corrective actions include implementing a process to conduct a critical parameter and scope review via an Engineering Evaluation when new tools/technology are introduced. Unit 2 was returned to Mode 1 operations at 1326 on December 6, 2015 and the unit reached 100 percent power at 0514 on December 7, 2015.

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LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Calvert Cliffs Nuclear Power Plant, Unit 2	05000 318	2015	-- 001 --	00

NARRATIVE

I. DESCRIPTION OF EVENT:

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

A. INITIAL CONDITIONS:

Unit 2 was operating at 100 percent power on December 1, 2015 prior to the event.

B. EVENT:

On December 1, 2015 at 1820, Unit 2 turbine driven Steam Generator Feed Pump [SJ] [P] (SGFP) 22 tripped. Operations attempt to reset SGFP 22, in accordance with the abnormal operating procedure, was unsuccessful. Facing lowering steam generator water level, Operations manually initiated a reactor trip. The unit experienced an uncomplicated trip as all systems operated as designed.

Following the reactor trip, the unit transitioned into an unscheduled outage. Upon inspection, SGFP 22 coupling was found failed. During disassembly, Maintenance discovered that one of the four pump casing hold-down nuts (southeast corner) had backed off from its bolting surface by 1-5/8 inches. Further investigation revealed that the vendor supplied stud tensioning values used in tensioning the hold down studs on both Unit 2 SGFPs during the March 2015 refueling outage were incorrect and resulted in insufficient clamping force being applied to all the studs. As a result, SGFP 22 pump became misaligned with the turbine to such an extent to exceed the maximum designed angular misalignment of its coupling and subsequently caused the coupling to fail. Although SGFP 21 also had insufficient tensioning applied during the refueling outage, it was found to still be within acceptable alignment. The root cause of the failure was that Engineering personnel did not rigorously follow Engineering standards and applicable site processes in evaluating the change that allowed the use of studs to hold down the SGFP pump casing to its pedestal. The investigation further determined that the southeast stud had been pulled out of perpendicular alignment to its base during the 2015 refueling outage due to the stud tensioner not having a flat surface to sit flush upon. This combined with the incorrect stud tensioning value used prevented sufficient clamping force to be applied and led to SGFP 22 failure.

The coupling on SGFP 22 was replaced and SGFP 22 was realigned. Corrected tensioning values were then applied to all the hold down studs on SGFP 21 and 22. To ensure proper clamping force had been applied, a hydraulic power high torqueing tool was subsequently used to verify required clamping force on both SGFP 21 and 22 studs had been achieved. In addition, anti-rotation nuts were installed as a measure to help ensure vibration will not cause the nuts to lose tension resulting in a loss of clamping force.

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Unit 2 was returned to Mode 1 operations at 1326 on December 6, 2015 and the unit reached 100 percent power at 0514 on December 7, 2015.

C. INOPERABLE STRUCTURES, COMPONENTS, OR SYSTEMS THAT CONTRIBUTED TO THE EVENT:

There were no structures, systems or components inoperable at the start of the event that contributed to the event.

D. DATES AND APPROXIMATE TIMES OF MAJOR OCCURRENCES:

December 1, 2015 1820 – Unit 2 manual reactor trip following trip of SGFP 22.

December 1, 2015 1830 – All EOP -0 (Post Trip Immediate Actions) completed. Entered EOP-1 (Reactor Trip) to perform post-trip recovery actions.

December 1, 2015 1840 – All EOP -1 Safety Functions completed satisfactorily.

December 6, 2015 1326 – Unit 2 returned to Mode 1.

December 7, 2015 0514 – Unit 2 reached 100 percent power.

E. FAILURE MODES:

The cause of SGFP 22 trip was a coupling failure due to excessive pump to turbine misalignment caused by inadequate torque force having been applied to SGFP 22 hold-down nuts. The root cause for the failure was that Engineering personnel did not rigorously follow Engineering standards and applicable site processes in evaluating the change that allowed the use of studs to hold down the SGFP pump casing to its pedestal.

F. METHOD OF DISCOVERY:

The failure of SGFP 22 was self-revealing. This event is documented in the site's Corrective Action Program under IR 02594406.

II. CAUSE OF EVENT

A switch to use stud tensioning technology on the SGFPs was first made during Unit 1 2014 refueling outage, however it was only used on SGFP 12. During the Unit 2 2015 refueling outage, the same stud tensioning technology was used on both SGFPs. Prior to the original use of this technology, Engineering performed an equivalency evaluation that allowed use of studs to hold down the SGFP pump casing to its pedestal in place of previously used

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capscrews. However because the evaluation did not rigorously follow Engineering standards and applicable processes, the evaluation justified the use of the stud tensioning technology with insufficient technical basis. As a result, an opportunity to identify the vendor's incorrect hydraulic pressure values was missed. Additionally, the Engineering evaluation failed to ensure formal, systematic notification was made to Maintenance concerning the change. This resulted in a missed opportunity to incorporate Electric Power Research Institute bolted joint guidance into the applicable maintenance work practice that would have helped identify critical parameters that must be obtained or followed by Maintenance to ensure proper stud tensioning is applied.

A. SAFETY CONSEQUENCES:

The reactor protection system [JD] was manually initiated in response to SGFP 22 trip. No other safety systems were initiated following the trip.

The safety consequence of SGFP 22 trip was insufficient main feedwater flow to the steam generators. Facing decreasing water levels in the steam generators, Operations manually tripped the reactor prior to water levels reaching the low level setpoint for automatic reactor trip.

The subject condition satisfies the criteria in NUREG-1022, Revision 3, for an event that results in the actuation of the reactor protection system when the reactor is critical. Therefore, this event is reportable pursuant to 10 CFR 50.73(a)(2)(iv)(A). An immediate event notification report (51577) was also made pursuant to 10 CFR 50.72(b)(2)(iv)(B).

This event was reviewed for potential probabilistic risk assessment impact. The probabilistic risk assessment calculated a conditional Core Damage Frequency of less than 1E-7 and a Conditional Large Early Release Frequency of less than 1 E-8. Both these values result in this event as being of very low safety significance (Green) under the Nuclear Regulatory Commission's Significance Determination Process.

B. CORRECTIVE ACTIONS:

Following SGFP 22 failure, its coupling was replaced and SGFP 22 was realigned. Corrected tensioning values were then applied to all the hold down studs on SGFP 21 and 22. To ensure proper clamping force had been applied, a hydraulic power high torqueing tool was subsequently used to verify required clamping force on both SGFP 21 and 22 studs had been achieved. Additionally, anti-rotation nuts were installed as a precautionary measure to ensure the nuts do not lose tension during subsequent operation.

Although SGFP 12 used the same stud tensioning technology and tensioning values as used on Unit 2 SGFPs, SGFP 12 has exhibited normal operating parameters since the 2014 refueling outage. A determination was made to continue operation of SGFP 12 until its February 2016

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NARRATIVE

refueling outage at which time correct tensioning values will be applied. A robust adverse condition monitoring plan was developed for SGFPs 12, 21, and 22 to include the monitoring and recording of pump and turbine shaft and casing vibration, and the monitoring of thrust bearing temperatures.

Corrective actions to be taken include:

- Implement a process for when new tools/technology are introduced to single point vulnerable components for a critical parameter and scope review to be performed via an Engineering Evaluation
- Conduct critical parameters and rigor training
- Ensure proper barriers are in place to ensure tensioner seating surfaces are flat (perpendicular to stud) on all components where stud tensioning technology is used

III. PREVIOUS SIMILAR EVENTS:

On May 21, 2013, Calvert Cliffs Unit 2 initiated a manual reactor trip following the trip of SGFP 22. The failure of SGFP 22 was due to the failure of its coupling. However, in this event, the coupling failure was subsequently determined to be due to areas of incomplete weld fusion on the turbine end of the coupling that occurred during initial component manufacture. This event was described in Calvert Cliffs Licensee Event Report 2013-004-00.

A. COMPONENT INFORMATION:

COMPONENT	IEEE 803 FUNCTION ID	IEEE 805 SYSTEM ID
Pump, Steam Generator Feed, (SGFP 22)	P	SJ

SGFP 22 Pump is manufactured by Byron Jackson Pump Division – Borg Warner Corp. (Model DVSR).