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a joint venture of



Constellation  
Energy



CALVERT CLIFFS  
NUCLEAR POWER PLANT

July 17, 2013

U.S. Nuclear Regulatory Commission  
Washington, DC 20555

**ATTENTION:** Document Control Desk

**SUBJECT:** Calvert Cliffs Nuclear Power Plant  
Unit No. 2; Docket No. 50-318; License No. DPR 69  
Licensee Event Report 2013-004, Revision 00  
Manual Reactor Trip Due to 22 Steam Generator Feed Pump Trip

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

Should you have questions regarding this report, please contact Mr. Douglas E. Lauer at (410) 495-5219.

Very truly yours,

GHG/TJU/bjd

Attachment: As stated

cc: N. S. Morgan, NRC  
W. M. Dean, NRC

Resident Inspector, NRC  
S. Gray, DNR

IE22  
NR

<b>NRC FORM 366</b> (10-2010)	<b>U.S. NUCLEAR REGULATORY COMMISSION</b>	APPROVED BY OMB: NO. 3150-0104	EXPIRES: 10/31/2013
<b>LICENSEE EVENT REPORT (LER)</b>  (See reverse for required number of digits/characters for each block)		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 Records and FOIA/Privacy Section (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.	

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**4. TITLE**  
 Manual Reactor Trip Due to 22 Steam Generator Feed Pump 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	DOCKET NUMBER	
05	21	2013	2013	- 004 -	00	07	17	2013	05000	
									DOCKET NUMBER	
									05000	

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

**12. LICENSEE CONTACT FOR THIS LER**

<b>FACILITY NAME</b> T. J. Unkle, Engineering Analyst	<b>TELEPHONE NUMBER (Include Area Code)</b> 410-495-3698
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**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
B	SJ	P	B580	Y					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b> <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO	<b>15. EXPECTED SUBMISSION DATE</b> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>MONTH</th> <th>DAY</th> <th>YEAR</th> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </table>	MONTH	DAY	YEAR			
MONTH	DAY	YEAR					

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

On May 21, 2013 at 0533, Calvert Cliffs Nuclear Power Plant Unit 2 initiated a manual reactor trip from 99.5 percent power in response to a trip of 22 Steam Generator Feed Pump (SGFP). All post-trip actions were completed and the event terminated without complications. The cause of the initiating event was the failure of the 22 SGFP coupling that connects the pump to its steam turbine driver, such that the pump and steam turbine were effectively disconnected. Inspection of the pump end of the coupling assembly revealed mechanical damage and separation along a weld seam. Forensic analysis identified areas of incomplete weld fusion on the turbine end of the failed coupling dating to the original component manufacture, combined with stresses induced by high cycle stress as being the root cause of 22 SGFP coupling failure. Immediate corrective actions taken included the examination, inspection, and replacement of the 22 SGFP coupling.

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**I. DESCRIPTION OF EVENT:**

**A. PRE-EVENT PLANT CONDITIONS:**

Unit 2 was operating at 99.5 percent of rated thermal power on May 21, 2013.

**B. EVENT:**

On May 21, 2013 at 0533, Calvert Cliffs Nuclear Power Plant Unit 2 initiated a manual reactor trip from 99.5 percent power in response to a trip of 22 Steam Generator Feed Pump (SGFP). The cause of the initiating event was the failure of 22 SGFP coupling that connects the pump to its steam turbine driver, such that the pump and steam turbine were effectively disconnected.

All control element assemblies fully inserted as expected. Containment atmosphere parameters were unaffected by the trip. Radiation levels were not affected by the trip.

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

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

**D. DATES AND APPROXIMATE TIMES OF MAJOR OCCURRENCES:**

May 21, 2013 At 0520, SGFP status panel alarm received for supervisory instrument alarm.

May 21, 2013 At 0522, Dispatched Operations personnel to local vibration panel. Report was 22 SGFP alert vibration in alarm.

May 21, 2013 At 0533, Plant Operators initiated a manual reactor trip in response to the trip of 22 SGFP. Post-reactor trip actions were completed in accordance with station procedures with no additional complications.

May 21, 2013 Following manual reactor trip, investigation determined 22 SGFP coupling that connects the pump to its steam turbine driver had failed.

May 30, 2013 Completed 22 SGFP repair.

May 30, 2013 At 2255, Unit 2 returned to 99.5 percent power following completion of post-maintenance testing.

**E. OTHER SYSTEMS OR SECONDARY FUNCTIONS AFFECTED:**

No other systems or secondary functions were affected.

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**F. METHOD OF DISCOVERY:**

The event was self-revealing.

**G. MAJOR OPERATOR ACTION:**

Operators initiated a manual reactor trip in response to the trip of 22 SGFP.

No additional mitigating operator actions were taken as a result of this event.

**H. SAFETY SYSTEM RESPONSES:**

The Reactor Protective System operated as required. There were no safety system functional failures.

**II. CAUSE OF EVENT:**

The Unit 2 manual reactor trip is documented in station condition report CR-2013-004520.

The Calvert Cliffs Unit 2 manual reactor trip was in response to the trip of 22 SGFP. The trip of 22 SGFP occurred due to a failed pump coupling that connects the pump to its steam turbine driver, such that the pump and steam turbine were effectively disconnected. Inspection of the pump end of the coupling assembly revealed mechanical damage and separation along a weld seam. Failure analysis identified areas of incomplete weld fusion on the turbine end of the coupling dating to the original component manufacture. These pre-existing manufacturing flaws combined with stresses induced by high cycle stress and SGFP start/stop cycles over the life of the coupling resulted in fatigue failure.

**III. ANALYSIS OF EVENT:**

The manual reactor trip resulted in a valid actuation of the Reactor Protective System. The actuation was not part of a pre-planned sequence during testing or reactor operation. Therefore, this event is reportable in accordance with 10 CFR 50.73(a)(2)(iv)(A). Immediate notification of this event (Event Number 49054) was made on May 21, 2013, in accordance with 10 CFR 50.72(b)(2)(iv)(B) and 10 CFR 50.72(b)(3)(iv)(A).

The Nuclear Regulatory Commission Performance Indicator for Unplanned Scrams per 7,000 Critical Hours is projected to rise to approximately 1.8 and remain green. No other performance indicators were impacted.

There were no actual nuclear safety consequences incurred from this event. The loss of feedwater event is analyzed in Section 14.6 of the Calvert Cliffs' Updated Final Safety Analysis Report. The analyses assumes the closure of the feedwater regulating valves, the loss of condensate or feedwater pumps, or a pipe break in the condensate or feedwater systems during steady-state operation results in a total loss of feedwater flow event. However, in this event,

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only one of the two feedwater pumps tripped. Therefore, this event is bounded by the Section 14.6 safety analysis.

An estimated conditional core damage probability of 1.55E-06 and an estimated conditional large early release probability of 8.00E-08 were calculated for this event.

**IV. CORRECTIVE ACTIONS:**

**A. ACTION TO RETURN AFFECTED SYSTEMS TO PRE-EVENT NORMAL STATUS:**

Immediate corrective actions taken included, replacement of the 22 SGFP coupling after completing non-destructive examination on welds to ensure integrity and repairs to the 22 SGFP.

**B. ACTION TAKEN OR PLANNED TO PREVENT RECURRENCE:**

1. Reviewed the performance of 11, 12, and 21 SGFPs to assess any performance anomalies.
2. Performed examination, including non-destructive examination on the replacement coupling to prevent another failure at this location.
3. Revise the inspection plan for SGFPs to require appropriate non-destructive examination of pump coupling welds.
4. Perform non-destructive examination of the critical welds for the pump couplings on 11, 12, and 21 SGFPs.
5. Develop and implement a preventive maintenance strategy for SGFP coupling assemblies.
6. Generate and plan work orders to inspect/replace couplings for 11, 12, and 21 SGFP's and place on Forced Outage Work List.

**V. ADDITIONAL INFORMATION:**

**A. FAILED COMPONENTS:**

Failed component is 22 SGFP, Manufacturer: Byron Jackson Pump Division-Borg Warner Corp., DVSR Pump IF-6225.

**B. PREVIOUS LERS ON SIMILAR EVENTS:**

At Calvert Cliffs, there have been no recent similar events involving a reactor trip caused by the failure of the SGFP coupling.

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C. THE ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) COMPONENT FUNCTION IDENTIFIER AND SYSTEM NAME OF EACH COMPONENT OR SYSTEM REFERRED TO IN THIS LER:

COMPONENT	IEEE 803 FUNCTION ID	IEEE 805 SYSTEM ID
2 PUMP FW22 (22 SGFP)	P	SJ

D. SPECIAL COMMENTS:

None