FENOC
FirstEnergy Nuclear Operating Company

Beaver Valley Power Station
P.O. Box 4
Shippingport, PA 15077-0004

L. William Pearce
Vice President

724-682-5234
Fax: 724-643-8069

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Beaver Valley Power Station, Unit No. 2
Docket No. 50-412 License No. NPF-73
LER 2005-001-00

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

In accordance with Appendix A, Beaver Valley Technical Specifications, the following Licensee Event Report is submitted:

LER 2005-001-00, 10 CFR 50.73(a)(2)(i)(B), "Containment Isolation Valve Relay Failure Unknowingly Leads to Technical Specification Noncompliance."

L. William Pearce

Attachment

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Sr. Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
INPO Records Center (via electronic image)
Mr. L. E. Ryan (BRP/DEP)

IE22

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hrs. 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 Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to Infocollects@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 reverse for required number of digits/characters for each block)

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4. TITLE

Containment Isolation Valve Relay Failure Unknowingly Leads to Technical Specification Noncompliance

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	DOCKET NUMBER
07	19	2005	2005	- 001	- 00	09	16	2005	None	
									FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

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

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
L. R. Freeland, Manager Regulatory Compliance	(724) 682-4284

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
X	JM	RLY	ASEA	Y					

14. SUPPLEMENTAL REPORT EXPECTED

☒ YES *(If yes, complete EXPECTED SUBMISSION DATE).* ☐ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
11	16	2005

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

On July 14, 2005, one of the two Main Steam System isolation valves (2MSS-SOV105C) on the steam supply line from 21C steam generator leading to the steam turbine-driven auxiliary feedwater pump (TDAFWP) unexpectedly opened at Beaver Valley Power Station (BVPS) Unit No. 2. The control room verified that no start signal to the TDAFWP existed or was necessary and that the redundant steam isolation valve (2MSS-SOV105F) on that steam line remained closed. 2MSS-SOV105C was declared inoperable. During follow-up investigation actions, it was determined that a sequence of three cascading component failures occurred, the third of which was a passive failure of an auxiliary control circuit relay (3D-SSRAB) in such a manner as to prevent it from being able to perform its intended automatic containment isolation signal transfer function. This passive failure was not discovered until July 19, 2005.

Since it was unknown on July 14, 2005 that Relay 3D-SSRAB failed making four containment isolation valves inoperable, the containment penetrations associated with these four valves were not isolated with a deactivated closed valve within four hours as required by Technical Specification 3.6.3.1 Action a. This is a condition prohibited by plant Technical Specification, and is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B). The plant risk associated with the BVPS Unit 2 event that occurred on July 14, 2005 is considered to be very low.

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

PLANT AND SYSTEM IDENTIFICATION

Westinghouse-Pressurized Water Reactor {PWR}
Containment Isolation System {JM}
Main Steam System {SB}

CONDITIONS PRIOR TO OCCURRENCE

Unit 2: Mode 1 at 100 percent power

There were no systems, structures, or components that were inoperable at the start of the event that contributed to the event other than as described below.

DESCRIPTION OF EVENT

On July 14, 2005, one of the two Main Steam System isolation valves (2MSS-SOV105C) on the steam supply line from 21C steam generator leading to the steam turbine-driven auxiliary feedwater pump (TDAFWP) unexpectedly opened at Beaver Valley Power Station (BVPS) Unit No. 2. The control room operators verified that no start signal to the TDAFWP existed or was necessary and that the redundant steam isolation valve (2MSS-SOV105F) on that steam line remained closed. 2MSS-SOV105C was declared inoperable. The TDAFWP remained operable via steam lines supplied from steam generators 21A and 21B.

During follow-up investigation actions on July 19, 2005, it was determined that solenoid operated valve (SOV) 2MSS-SOV105C, located in the Main Steam Valve Room, inappropriately opened due to a shorted coil in the SOV. This caused an associated control circuit relay (3-MSSCTX) located in the Emergency Switchgear Room to fail when it opened at an amperage beyond its design current interruption rating. This relay failed by melting its contacts in the solenoid operated valve (SOV) coil circuit. The molten metal from this relay's contact melted through the relay's outer clear plastic dust cover and fell on the relay located below it (3D-SSRAB). The molten material also melted a small hole through the outside plastic relay dust cover of 3D-SSRAB, which could potentially cause this relay to fail. A failure of relay 3D-SSRAB could inhibit the control signals going to containment isolation valves 2SSR-SOV-128A1/129A1/130A1 (sample valves) and 2PAS-SOV105A1 (post-accident sample valve), potentially preventing them from automatically closing during a Containment Isolation Phase A (CIA) signal.

Upon learning of this information on July 19, 2005, the control room operators conservatively declared the four containment isolation valves affected by relay 3D-SSRAB inoperable, deactivating these valves closed in accordance with BVPS Unit 2 Technical

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DESCRIPTION OF EVENT (Continued)

Specification 3.6.3.1, Action a. This action to declare these four containment isolation valves inoperable was conservatively taken even though the initial visual inspection indicated that relay 3D-SSRAB may still have adequately functioned.
Relay 3D-SSRAB was replaced. Subsequent bench testing of the original relay 3D-SSRAB indicated that this relay would not pick up when its coil was energized with 125 VDC and would not have functioned to transfer the CIA closure signal from the protection system to the four applicable containment isolation valves between the time when relay 3-MSSCTX failed on July 14, 2005 and when these four valves were deactivated closed on July 19, 2005.

REPORTABILITY

BVPS Unit 2 Technical Specification 3.6.3.1 requires that the each containment isolation valve be operable. When it was first discovered on July 19, 2005 that Relay 3D-SSRAB was potentially degraded, the four containment isolation valves potentially adversely affected by Relay 3D-SSRAB were de-energized closed in accordance with Technical Specification 3.6.3.1 Action a. Subsequent testing showed Relay 3D-SSRAB was not operable due to the molten metal that dripped from relay 3-MSSCTX on July 14, 2005. Action a requires "With one or more penetration flow paths with one containment isolation valve inoperable, isolate the affected penetration flow path within 4 hours by use of at least one closed and deactivated automatic valve." Since this was unknown on July 14, 2005 that Relay 3D-SSRAB failed making containment isolation valves 2SSR-SOV-128A1/129A1/130A1 and 2PAS-SOV105A1 inoperable, the containment penetrations associated with these four valves were not isolated with a deactivated closed valve within four hours as required by Technical Specification Action a. This is a condition prohibited by plant Technical Specification, and is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B). A Licensee Event Report is required to be issued within 60 days of July 19, 2005, when the degraded Relay 3D-SSRAB condition was discovered.

CAUSE OF EVENT

The direct cause of this event was that the failure of 3D-SSRAB was a passive failure from unexpected collateral damage at a location remote from the SOV failure. This relay failure presented no immediately recognizable indications. This resulted in not meeting the 4 hour requirement of Tech. Spec. 3.6.3.1 Action a. Operator actions at the time of discovery of the potential failure of 3D-SSRAB were appropriate and timely.

Additional cause analysis is ongoing and additional information will be provided in a supplement when completed.

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EVENT ANALYSIS

Relay 3-MSSCTX failed due to 2MSS-SOV105C failing. Beta Laboratory analysis determined that the coil of 2MSS-SOV105C failed due to a poorly crimped connection in the SOV coil made by the manufacturer, which led to the connection heating. This heating ultimately led to insulation failure, resulting in the coil shorting. Field measurements of the SOV coil resistance indicated that the resistance of the failed coil was approximately 4.5 ohms compared with the approximate 90-102 ohms for a good coil. With this greatly reduced resistance, the current in the circuit to 2MSS-SOV105C was much higher than normal. When the SOV opened, its Position Switch PS2 opened, deenergizing relay 3-MSSCTX, which opened contacts 113-114 to break the SOV circuit which was carrying a current estimated at approximately 10 amps due to the reduced coil resistance. This 10 amps was well beyond the contact's break rating of 5 amps, but remained below its overcurrent device setting. This melted contacts 113-114 of relay 3-MSSCTX. The molten material from contacts of the 3-MSSCTX relay melted through its relay outer plastic dust cover and fell on to the 3D-SSRAB relay below it, melting a small hole through the outer plastic dust cover of 3D-SSRAB. The material that melted its way into relay 3D-SSRAB came to rest in contact with the moving and fixed portions of the relay contact block. The material cooled, adhering to these surfaces such that the relay contacts would not move when 125 volts DC was applied. Since relay 3D-SSRAB remained in its normal arrangement and was not called upon to operate from July 14, 2005 until it was found damaged on July 19, 2005, there was no indication that relay 3D-SSRAB would not operate.

The failure analysis performed by Beta Laboratory determined that the failure of 2MSS-SOV105C was due to a poor internal crimped connection that attaches one of the two external leads to the coil windings which shorted to the coil windings through the fiber tape. The report indicated that the SOV was in good condition with the exception of localized heating in the area of the crimped connection. The coil in 2MSS-SOV105C failed after only 6 months of service. The most likely reason for the failure is a poor electrical connection inside the crimped connection that led to overheating at the connection and eventually shorting to the coil windings. Based on the lack of a similar failure history in both the BVPS and the vendor's records, the vendor testing of supplied coils, the Beta Laboratory failure analysis, the BVPS extent of condition review for similar failures in the industry, and on a visual evaluation of the crimped connection, it was concluded that this poor connection is an isolated case.

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SAFETY IMPLICATIONS

The four containment isolation valves (CIVs) adversely affected by the 2MSS-SOV105C controlling relay (3-MSSCTX) melting event on July 14, 2005 were:

- 2PAS-SOV105A1, inside CIV for post accident containment atmosphere sample, is normally closed and fails closed.
- 2SSR-SOV128A1, inside CIV for primary coolant hot leg sample, is normally closed and fails closed.
- 2SSR-SOV129A1, inside CIV for containment sump and Residual Heat Removal System liquid sample, is normally closed and fails closed.
- 2SSR-SOV130A1, inside CIV for pressurizer relief tank gas sample, is normally open and fails closed. It is normally isolated upstream by 2SSR-SOV125A, 125B, 140, 141, and 2SSR-AOV119A, all of which are normally closed and fail closed.

2SSR-SOV128A1, 2SSR-SOV129A1 and 2PAS-SOV105A1 are normally closed and remained closed from July 14 through July 19, 2005. Thus, these valves would have already been closed in their safety position if a condition causing a CIA condition would have occurred. However, 2SSR-SOV130A1 would not have been closed since it is normally open. However, there are other valves in this sample line which would have been closed preventing any direct path out of containment. In addition, 2SSR-SOV130A1 remained capable of remote manual operation from the control room and could have been manually operated closed as directed by the Emergency Operating Procedures.

The plant risk associated with the BVPS Unit 2 event that occurred on July 14, 2005, due to the failure of controlling relay (3-MSSCTX) and the subsequent failures of the containment isolation valves is considered to be very low. This is based on the very low risk impact of having 1 out of 3 main steam lines to the TDAFWP being isolated and the negligible risk impact from the affected containment isolation valves. These affected containment isolation valves are currently screened from the PRA containment isolation model due to their very low risk of contributing to a radioactive release.

Based on the above, the safety significance of the event that occurred on July 14, 2005, was very low.

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CORRECTIVE ACTIONS

1. Based on the lack of a failure history in both BVPS and the vendor's records, the vendor's testing of supplied coils, the Beta laboratory failure analysis, the BVPS extent of condition review for similar failures in the industry, and on a visual evaluation of the crimped connection, it was concluded that this poor connection was an isolated case and the hardware issue has been dispositioned by replacement of the coil and the damaged relays.

2. A design change will be initiated to provide a barrier to prevent a physical failure of one relay from cascading to nearby relays, where relays associated with the seal-in function of the 2MSS-SOV105A through F control circuits are located in close proximity.

3. An operating experience report has been issued on the subject providing the details of the event and component failures.

Completion of the above and other corrective actions are being tracked through the BVPS corrective action program.

PREVIOUS SIMILAR EVENTS

A review found one potential prior BVPS Unit No. 1 and one potential BVPS Unit No. 2 Licensee Event Report within the last five years involving either relay or containment isolation valve discrepancies.

BVPS Unit 1 LER 2000-007, "Technical Specification Non-Compliance Due to Misinterpretation of Containment Isolation Valve Requirements for GDC 57 Penetrations."
BVPS Unit 2 LER 2001-003, "Condition Inadvertently Exceeds Technical Specification Allowed Outage Time."

BVPS Unit 1 LER 2000-007 is not similar to this LER because it involved the human error of not complying with the containment isolation valve Technical Specification as written and misapplied previous NRC correspondence. BVPS Unit 2 LER 2001-003 is not similar to this LER because it involved a human error in not declaring an undervoltage relay inoperable due to not recognizing the importance of unexpected status light indications which signaled a failed solid state input/ protection channel.

COMMITMENTS

There are no new commitments made by FirstEnergy Nuclear Operating Company (FENOC) for BVPS Unit No. 2 in this document.