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December 20, 2011

L-11-392

10 CFR 50.73

ATTN: Document Control Desk  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555-0001SUBJECT:  
Beaver Valley Power Station, Unit No. 1  
Docket No. 50-334, License No. DPR-66  
LER 2011-001-00

Enclosed is Licensee Event Report (LER) 2011-001-00, "Use of Liquid Tight Flexible Conduits Installed In Fire Barrier Penetrations Results In Unanalyzed Configurations."  
This event is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(B).

There are no regulatory commitments contained in this submittal. Any actions discussed in this document that represent intended or planned actions are described for the NRC's information, and are not regulatory commitments.

If there are any questions or if additional information is required, please contact Mr. Darin M. Benyak, Manager, Regulatory Compliance at 724-682-4284.

Sincerely,



Paul A. Harden

Enclosure – BVPS Unit 1 LER 2011-001-00

- c: Mr. W. M. Dean, NRC Region I Administrator  
Mr. D. I. Spindler, NRC Senior Resident Inspector  
Ms. N. S. Morgan, NRR Project Manager  
INPO Records Center (via electronic image)  
Mr. L. E. Ryan (BRP/DEP)

IE22  
NRR

**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: 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 Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to [infocollects.resource@nrc.gov](mailto: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.

**1. FACILITY NAME**

Beaver Valley Power Station Unit Number 1

**2. DOCKET NUMBER**

05000334

**3. PAGE**

1 OF 4

**4. TITLE**

Use of Liquid Tight Flexible Conduits Installed In Fire Barrier Penetrations Results In Unanalyzed Configurations

**5. EVENT DATE**

MONTH

DAY

YEAR

11

02

2011

**6. LER NUMBER**

YEAR

SEQUENTIAL  
NUMBERREV  
NO

2011 - 001 - 00

**7. REPORT DATE**

MONTH

DAY

YEAR

12

20

2011

**8. OTHER FACILITIES INVOLVED**

FACILITY NAME

None

DOCKET NUMBER

FACILITY NAME

DOCKET NUMBER

**9. OPERATING MODE**

1

**11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)**☐ 20.2201(b)☐ 20.2203(a)(3)(i)☐ 50.73(a)(2)(i)(C)☐ 50.73(a)(2)(vii)☐ 20.2201(d)☐ 20.2203(a)(3)(ii)☐ 50.73(a)(2)(ii)(A)☐ 50.73(a)(2)(viii)(A)☐ 20.2203(a)(1)☐ 20.2203(a)(4)☒ 50.73(a)(2)(ii)(B)☐ 50.73(a)(2)(viii)(B)☐ 20.2203(a)(2)(i)☐ 50.36(c)(1)(i)(A)☐ 50.73(a)(2)(iii)☐ 50.73(a)(2)(ix)(A)☐ 20.2203(a)(2)(ii)☐ 50.36(c)(1)(ii)(A)☐ 50.73(a)(2)(iv)(A)☐ 50.73(a)(2)(x)☐ 20.2203(a)(2)(iii)☐ 50.36(c)(2)☐ 50.73(a)(2)(v)(A)☐ 73.71(a)(4)☐ 20.2203(a)(2)(iv)☐ 50.46(a)(3)(ii)☐ 50.73(a)(2)(v)(B)☐ 73.71(a)(5)☐ 20.2203(a)(2)(v)☐ 50.73(a)(2)(i)(A)☐ 50.73(a)(2)(v)(C)☐ OTHER☐ 20.2203(a)(2)(vi)☐ 50.73(a)(2)(i)(B)☐ 50.73(a)(2)(v)(D)Specify in Abstract below or in  
NRC Form 366A**12. LICENSEE CONTACT FOR THIS LER**

FACILITY NAME

Darin M. Benyak, Manager, Regulatory Compliance

TELEPHONE NUMBER (Include Area Code)

(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

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

MONTH

DAY

YEAR

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

On November 2, 2011, the Beaver Valley Power Station NFPA 805 transition team personnel identified that samples taken from the outer coating from certain liquid tight flexible conduits installed through fire barrier penetrations did not exhibit expected flame resistant characteristics and were not in conformance with documented previously tested fire barrier configurations at Beaver Valley Power Station Unit 1 (BVPS-1). The liquid tight flexible conduits installed through fire barrier penetrations are non-conforming with the provisions of NRC Branch Technical Position (BTP) APCSB 9.5-1. The BVPS-1 plant areas that require fire barriers for train separation for safe shutdown equipment are potentially affected, except for the reactor containment and the river water main intake structure. The concern is whether the liquid tight coating could ignite and spread the fire to the opposite side of the barrier. The apparent cause of this latent issue is inadequate review of the accumulative effects from all field changes. Specifically, subsequent installation of otherwise qualified fire seals did not consider potential compromise by the jacket material of the previously installed liquid tight flexible conduit acting as a penetrant.

Following identification of this issue, compensatory actions were promptly implemented to provide an adequate level of protection for redundant equipment. These include a twice per twelve hour shift fire watch patrol in the affected plant areas, and the restrictions for performing hot work in the vicinity of the affected penetrations. In addition, transient combustible materials are prohibited in affected plant areas from being stored adjacent to electrical penetrations fire seals or adjacent to conduit within five feet of an electrical penetration fire seal as a compensatory action.

A fire has not occurred in the affected fire areas that has challenged these penetrations. The overall safety significance due to the impact of these potentially non-compliant flexible conduits being used in penetration fire barriers is considered to be low to moderate, based on the summation of all the analyzed individual fire compartment delta Core Damage Frequencies for the affected areas. Degraded fire barriers, such that the required degree of separation for redundant safe shutdown trains is lacking, is reportable as an unanalyzed condition that significantly degraded plant safety. Therefore, this report is being submitted pursuant to 10 CFR 50.73(a)(2)(ii)(B).

NRC FORM 366A (10-2010)		<b>LICENSEE EVENT REPORT (LER) CONTINUATION SHEET</b>		U.S. NUCLEAR REGULATORY COMMISSION	
1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Beaver Valley Power Station Unit Number 1	05000334	YEAR	SEQUENTIAL NUMBER	REV NO.	2 OF 4
		2011	- 001	- 00	
<b>NARRATIVE</b>  <p>Energy industry identification system (EIS) codes are identified in the text using the format [XX].</p> <p><b>CONDITIONS PRIOR TO OCCURRENCE</b></p> <p>Unit 1: Mode 1 at 100 percent power</p> <p>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.</p> <p><b>DESCRIPTION OF EVENT</b></p> <p>On November 2, 2011, the Beaver Valley Power Station National Fire Protection Association (NFPA) 805 transition project personnel identified that samples taken from the outer coating from certain liquid tight flexible conduits [CND] installed through fire barrier penetrations [PEN] did not exhibit expected flame resistant characteristics and were not in conformance with documented previously tested fire barrier configurations at Beaver Valley Power Station Unit 1 (BVPS-1). Liquid tight flexible conduit is typically made from a segmented steel material and coated with a thin layer of polymer material (typically poly vinyl chloride (PVC) material) which provides the liquid tight function. The polymer material and thickness used varies from each manufacturer and type specified. Since the BVPS-1 installed configurations may not conform to previously qualified fire barrier configurations, it was postulated that a fire in one fire area could eventually spread to another fire area by burning or melting of the outer polymer coating material which may allow hot gas or flame to breach the three hour rated fire seal. Ignition of polymer coating on the opposite side penetration from heat transfer might also be a possible fire spread mechanism.</p> <p>Following identification of this issue, compensatory actions were promptly implemented to provide an adequate level of protection for redundant equipment. These include a twice per twelve hour shift fire watch patrol in the affected plant areas, and the restrictions for performing hot work in the vicinity of the affected penetrations. In addition, transient combustible materials are prohibited in affected plant areas from being stored adjacent to electrical penetrations fire seals or adjacent to conduit within five feet of an electrical penetration fire seal as a compensatory action.</p> <p>Walkdowns performed at BVPS-1 have identified that approximately 924 of the 2843 electrical conduit fire barrier penetrations between separate fire areas contain liquid tight flexible conduit. Sixteen different types of coating material have been identified based on external characteristics such as manufacturer markings or color. Preliminary test results for eight of the 16 types indicate that the lowest auto-ignition temperature was 734 degrees Fahrenheit, which is greater than the 700 degrees Fahrenheit maximum acceptance temperature for the cold side of a rated fire penetration seal specified in IEEE 634 - 1978.</p> <p>No fire barrier penetrations containing liquid tight flexible conduit have been identified at Beaver Valley Power Station Unit 2 (BVPS-2) based on general area walkdowns. Furthermore, review of the BVPS-2 design specifications indicated that they prohibit use of PVC flexible conduit in BVPS-2 plant fire areas other than the Alternate Intake Structure. A fire in the Alternate Intake Structure does not affect post fire safe shutdown.</p>					

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<b>1. FACILITY NAME</b>	<b>2. DOCKET</b>	<b>6. LER NUMBER</b>			<b>3. PAGE</b>
Beaver Valley Power Station Unit Number 1	05000334	YEAR	SEQUENTIAL NUMBER	REV NO.	3 OF 4
		2011	- 001	- 00	
<b>NARRATIVE</b>					
<p><b>CAUSE OF EVENT</b></p> <p>A significant number of BVPS-1 fire barrier penetrations contain liquid tight flexible conduit (excluding the reactor containment and the river water main intake structure) with a polymer jacket material typically made of PVC. The liquid tight flexible conduits were installed during initial plant construction in accordance with plant design specifications in effect at the time. Qualified fire seals were subsequently installed in the penetrations where these liquid tight flexible conduits passed through. However, no documentation has been found to show that this type of configuration meets NRC Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1 requirements for a three hour fire barrier.</p> <p>The apparent cause of this latent issue is inadequate review of accumulative effects to all field changes. Specifically, the subsequent installation of otherwise qualified fire seals did not consider potential compromise by the jacket material of the previously installed liquid tight flexible conduit acting as a penetrant.</p> <p>The inadequate design of the BVPS-1 fire barrier penetrations was due to a lack of knowledge on the part of the installation vendor at the time the fire seal program was initially implemented (approximately in the late 1970's). The liquid tight flexible conduit was installed during initial plant construction to a 1973 design specification that specifically called out the use of PVC jackets due to its temperature rating and moisture resistance qualities.</p> <p>The 1973 design specification was developed prior to subsequent requirements (which derived from BTP APCS 9.5-1 in 1976) that the penetrations through walls be sealed with material equivalent to the barrier rating. When BVPS-1 committed to sealing in accordance with the BTP in the late 1970's, it appears attention was focused on the type and depth of sealant to meet the existing tested configurations, without recognizing that the installation also depended upon the conduit sheathing against which the seal was being applied.</p> <p><b>ANALYSIS OF EVENT</b></p> <p>BVPS-1 fire barriers containing liquid tight flexible conduit are non-conforming with the provisions of NRC BTP APCS 9.5-1, as documentation of a three hour barrier for this type of configuration was not found and some of the outer coatings did not exhibit expected flame resistant characteristics. Approximately 924 of 2843 electrical conduit fire barrier penetrations at BVPS-1 are currently known to be potentially affected (i.e., contain liquid tight flexible conduits). The BVPS-1 plant areas that require fire barriers for train separation for safe shutdown equipment are potentially affected, except for the reactor containment and the river water main intake structure. Following identification of the issue, compensatory actions including fire watch patrols and restrictions for performing hot work, and storage of transient combustible material near the affected penetrations were promptly implemented. Existing plant fire suppression and detection equipment and pre-planned fire response strategies along with the compensatory actions implemented provides for an adequate level of protection for redundant equipment.</p> <p>A risk assessment was performed that evaluated the significance of multi-compartment fires generated from the BVPS-1 fire compartments that may contain liquid tight flexible conduits installed in fire barrier penetrations. This assessment was based on the fire scenarios developed for NFPA 805 using the BVPS-1 Probabilistic Risk Assessment (PRA) model, which were modified to determine the change in core damage frequency (CDF) due to a fire propagating through the analyzed fire barrier penetrations.</p>					

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<b>1. FACILITY NAME</b>		<b>2. DOCKET</b>	<b>6. LER NUMBER</b>			<b>3. PAGE</b>
Beaver Valley Power Station Unit Number 1		05000334	YEAR	SEQUENTIAL NUMBER	REV NO.	4 OF 4
			2011	-	001	
<p><b>NARRATIVE</b></p> <p>Based on the results of the risk evaluation described above, the overall safety significance due to the impact of these non-compliant liquid tight flexible conduits being used in penetration fire barriers is considered to be low to moderate, based on the summation of the analyzed individual fire compartment delta CDFs for the affected areas.</p> <p>Since no documentation to prove qualification of the fire barrier penetrations containing liquid tight flexible conduits has been located, a conservative assumption was made that their function of preventing a fire from affecting redundant trains of safe shutdown systems for the required three hours could not be assured. NRC guidance on reportability, NUREG-1022, Event Reporting Guidelines for 10 CFR 50.72 and 50.73, Revision 2, states that if fire barriers are missing, such that the required degree of separation for redundant safe shutdown trains is lacking, the issue is reportable as an unanalyzed condition that significantly degraded plant safety. Therefore, this report is being submitted pursuant to 10 CFR 50.73(a)(2)(ii)(B). This event was previously reported as an unanalyzed condition that significantly degrades plant safety pursuant to 10 CFR 50.72(b)(3)(ii)(B) at 2041 hours on November 2, 2011 (Event Notification No. 47403).</p> <p><b>CORRECTIVE ACTIONS</b></p> <ol style="list-style-type: none"> <li>1. Samples of liquid tight flexible conduit jacketing obtained from the non-conforming fire barrier penetrations at BVPS-1 will be tested for auto-ignition temperature and flame resistance at an accredited laboratory in order to determine their ability to withstand the effects of postulated fires.</li> <li>2. The existing penetration fire seal configurations with polymer conduit jackets identified as non-conforming will be evaluated in accordance with NRC Generic Letter (GL) 86-10 to determine their acceptability considering the results of testing. Modifications to the polymer jacketed conduit may also be performed on a case-by-case basis to restore compliance.</li> <li>3. If any of the non-conforming penetration fire seal configurations being evaluated under NRC GL 86-10 are unable to be accepted with existing testing information, a specific penetration test utilizing an appropriate testing configuration will be performed at an accredited testing facility to qualify the configuration. The non-conforming fire barriers may be modified to restore compliance on a case-by-case basis in lieu of the specific penetration testing.</li> </ol> <p>Completion of the above and other corrective actions are being tracked through the BVPS corrective action program.</p> <p><b>PREVIOUS SIMILAR EVENTS</b></p> <p>A review found no prior BVPS-1 or BVPS-2 Licensee Event Reports within the past five years for an event involving non-conforming fire barrier penetrations.</p>						

CR 2011-04769