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**Nuclear Business Unit**

**OCT 22 1999**

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U. S. Nuclear Regulatory Commission  
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Washington, DC 20555

LER 272/99-009-00  
SALEM GENERATING STATION – UNIT 1  
FACILITY OPERATING LICENSE NO. DPR-70  
DOCKET NO. 50-272

Gentlemen:

This Licensee Event Report (LER) entitled "Pressurizer PORV and Block Valves do not meet the Requirements of 10CFR50 Appendix R" is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(ii)(B), "...a condition that was outside the design basis of the plant," and Salem Unit 1 and 2 Technical Specification 6.9.3.

Sincerely,

A handwritten signature in black ink, appearing to read "M. B. Bezilla".

M. B. Bezilla  
Vice President – Operations

Attachment

BJT

C     Distribution  
      LER File 3.7

291022

**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.

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TITLE (4)

Pressurizer PORV and Block Valves Do Not Meet the Requirements of 10CFR50 Appendix R

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
10	08	99	99	-009	- 00	10	22	99	Salem Unit 2	05000311
									FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	POWER LEVEL (10)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.73(a)(2)(i)-(viii) (Check one or more) (11)								
6	-	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)					
		20.2203(a)(1)	20.2203(a)(3)(i)	X 50.73(a)(2)(ii)	50.73(a)(2)(x)					
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71					
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	X OTHER					
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A					
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)						

**LICENSEE CONTACT FOR THIS LER (12)**

NAME	TELEPHONE NUMBER (Include Area Code)
Brian J. Thomas, Licensing Engineer	(856) 339-2022

**COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)**

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

**SUPPLEMENTAL REPORT EXPECTED (14)**

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

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

During a review of the Salem Post-fire Safe Shutdown Analysis a concern was identified with the cable routing of the air operated pressurizer Power Operated Relief Valves (PORVs) and motor operated block valves. The cable for each PORV and associated block valve is routed in the same cable tray inside the containment. The pressurizer PORVs and block valves are considered a high/low pressure interface point for 10CFR50 Appendix R analysis. The PORVs and block valves provide isolation of the pressurizer [high pressure] from the pressurizer relief tank (PRT) [low pressure]. Therefore each PORV/block valve combination is considered as redundant components that require proper separation in accordance with Section III.G.2 and III.L.7 of 10 CFR Appendix R when evaluating the affects of hot shorts, open circuits, or shorts to ground from causing spurious operation of these valves.

The cause of occurrence is the failure to properly evaluate the high/low pressure interface function of the PORVs and block valves during the development of the Appendix R Safe Shutdown Analysis. Immediate and long-term corrective actions are described in detailed report.

This event is reportable in accordance with 10CFR50.73(a)(2)(ii)(B), "...a condition that was outside the design basis of the plant..." This LER also satisfies the special reporting requirements of the Salem Unit 1 and 2 Technical Specifications Section 6.9.3 and Salem Unit 2 License Condition 2.1.

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**PLANT AND SYSTEM IDENTIFICATION**

Westinghouse – Pressurized Water Reactor

Pressurizer Power Operated Relief Valves (PORVs) {/-}\*

\* Energy Industry Identification System {EIIIS} codes and component function identifier codes appear as (SS/CCC)

**CONDITIONS PRIOR TO OCCURRENCE**

At the time of discovery, Salem Unit 1 was in Mode 6. Unit 2 was in Mode 1 at approximately 100% power.

**DESCRIPTION OF OCCURRENCE**

During a review of the Salem Post-fire Safe Shutdown Analysis a concern was identified with the cable routing of the air operated pressurizer Power Operated Relief Valves (PORVs) and motor operated block valves. The cable for each PORV and associated block valve is routed in the same cable tray inside the containment. The pressurizer PORVs and block valves are considered a high/low pressure interface point for 10CFR50 Appendix R analysis. The PORVs and block valves provide isolation of the pressurizer [high pressure] from the pressurizer relief tank (PRT) [low pressure]. Therefore each PORV/block valve combination is considered as redundant components that require proper separation in accordance with Section III.G.2 and III.L.7 of 10 CFR Appendix R when evaluating the affects of hot shorts, open circuits, or shorts to ground from causing spurious operation of these valves.

In the event of a postulated fire inside containment a motor operated block valve could lose power. Since the normal position of this valve during operation is the open position, the valve would not be able to be closed. The fire could also cause a hot short to occur that would cause the associated air operated PORV to spuriously open. These two occurrences together would result in the loss of Reactor Coolant System (RCS) inventory control. This condition does not satisfy the 10CFR50 Appendix R performance goal of inventory control for post-fire Safe Shutdown (SSD).

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**DESCRIPTION OF OCCURRENCE (cont'd)**

A second similar concern exists with the PORVs and block valves for Alternate Shutdown (ASD) capability. ASD is implemented in the event of a fire in the Control Room, Relay Room or the ceiling of the 460V Switchgear room. A fire in the above areas could lead to the spurious operation of the PORVs. Operators implement the ASD methodology in accordance with procedures S1(2).OP-AB.CR-0002, "Control Room Evacuation Due to Fire in Control Room, Relay Room, or Ceiling of the 460/230V Switchgear Room." Spurious operation of the PORV could occur prior to the operators reaching the step in the ASD to operate the transfer switch for the block valve, which separates the block valve controls for alternate shutdown from the control room, and close the block valve. In the current procedure, it may take 20 minutes to reach the step to operate the transfer switch for the block valve. Prior to closing the block valve, there could be a loss of RCS inventory control due to the spurious operation of the PORV.

The following immediate actions were taken:

- Established hourly fire watch of the Unit 1 & 2 Relay Rooms and 460/230V Switchgear Rooms in accordance with the fire protection program.
- Licensed operators were briefed on the potential for spurious PORV and block valve operation during postulated fire.
- Guidance was added to procedures S1(2).OP-AB.PZR-0001, "Pressurizer Pressure Malfunction", for opening the DC control power breaker for the PORVs if the associated block valve can not be closed.

This event is reportable in accordance with 10CFR50.73(a)(2)(ii)(B), "...a condition that was outside the design basis of the plant..."

**ANALYSIS OF OCCURRENCE**

Generic Letter 86-10, "Implementation of Fire Protection Requirements," dated April 24, 1986, states in response to question 5.3.1:

"Sections III.G.2 and III.L.7 of Appendix R design the circuit failure modes as hot shorts, open circuits, and shorts to ground. For consideration of spurious actuations, all possible functional failure states must be evaluated, that is, that component could be energized or de-energized by one or more of the above failure modes. Therefore, valves could fail open or closed; pumps could fail running or not running; electrical distribution breakers could fail open or closed. For three-phase AC circuits, the probability of getting a hot short on all three phases in the proper sequence to cause spurious operation of a motor is considered

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**ANALYSIS OF OCCURRENCE (cont'd)**

sufficiently low as to not require evaluation except for any cases involving Hi/Lo pressure interfaces. For ungrounded DC circuits, if it can be shown that only two hot shorts of the proper polarity without grounding could cause spurious operation, no further evaluation is necessary except for any cases involving Hi/Lo interfaces."

Since the PORVs and block valves are 'Hi/Lo' pressure interfaces, the above failures are required to be evaluated.

On July 15, 1988, PSE&G submitted "Revised Exemption Requests Fire Protection – 10 CFR Appendix R". PSE&G stated in support of Exemption No. 12 that redundant cabling and valves at the pressurizer are routed in opposite directions from the cable penetration areas in the containment until they approach the pressurizer cubicle. The exemption also stated that, "...at the pressurizer cubicle, complete separation of cabling and valves for the PORV, block valves, and pressurizer indication is not provided, However, no combustibles are located in this area."

The NRC approved this exemption on July 20, 1989, stating that, "...request for exemption from the requirements of Section III.G.2 for at least 20 feet separation between redundant shutdown systems at Panel 335 and at the pressurizer within containment is granted."

The statements provided above in the exemption request indicate that the high/low pressure interface functions of the PORV/block valve arrangement were not adequately evaluated for ensuring that RCS inventory control is maintained. The above evaluation assumes that redundant trains of the PORV/block valves are separated from the point the cables enter containment until they approach the pressurizer.

However, based on re-review of the PORV and block cable routings, the cables for each set of PORVs and block valves are in the same cable trays. To isolate the high/low pressure interface, either the PORV must be closed or the block valve must be closed and remain closed. With the cables running in the same cable tray, a fire could prevent closing of the block valve and cause spurious operation of the associated PORV, thus preventing the isolation of this Hi/Lo pressure interface. Also, a review of the cable runs identified that the cable trays for both sets of PORV and block valves are within 20 feet of each other.

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**CAUSE OF OCCURRENCE**

The cause of occurrence is the failure to properly evaluate the high/low pressure interface function of the PORVs and block valves during the development of the Appendix R Safe Shutdown Analysis.

**PRIOR SIMILAR OCCURRENCES**

A review of LERs for Salem Units 1 and 2 for the past two years identified one similar occurrence. LER 311/99-008-00 identified that the limit switch cables for both of the service water header valves (SW22) are routed through the same fire area. In the event of hot shorts, both of the header valves could go closed resulting in isolation of service water flow to both nuclear headers. A review of other limit switch cables for external hot shorts was performed and did not identify any other concerns beyond the service water valves. Although the corrective actions of this LER did not extend beyond verifying the impact of limit switch cables of motor operated valves (MOVs) used for safe shutdown, the problem with the PORV and block valve cable routing existed prior to submittal of the above LER on July 28, 1999. Therefore, actions from this LER would not have been able to prevent recurrence of this existing condition.

**SAFETY CONSEQUENCES AND IMPLICATIONS**

The inadvertent opening of the PORV and block valve would result in RCS depressurization. For the block valve and PORV to open the following needs to occur:

- An external or internal "hot short" of the PORV solenoid DC control circuitry which causes the energization of the solenoid, coincident with the complete loss of the power supply cable to the PORV block valve, which prevents remote operation (closure) of the block valve.
- The control cables have external insulation, with an armored shield, with multiple individual insulated conductors within the shield. In order for the internal hot short to occur, the external fire would have to burn through the cable external jacket, and shielding, and then selectively affect specific DC conductors within the cable to enable conductors of the correct polarity to come in contact in such a manner to energize the solenoid valve and open the PORV. The same external fire would also have to damage the power supply to the block valve to preclude operation.
- In order for the external hot short to occur, another cable in the same raceway system, which is also of shielded construction, would have to have one of its internal conductors affected by the external fire affect the conductors of the PORV control circuit, which is contained in its own shielded cable.

Although the above scenarios are highly unlikely, they are required to be postulated to meet the requirements of 10CFR50 Appendix R.

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**SAFETY CONSEQUENCES AND IMPLICATIONS**

The major sources of fire inside the containment consist of the Reactor Coolant Pump (RCP) lube oil system, charcoal filters for the Iodine Removal Units (IRUs), electrical cables and transient combustibles.

- The RCP motor is equipped with detection and suppression system. A lube oil collection system is provided in the event of leakage.
- The RCP lube oil level has a low-level alarm in the control room. Any inadvertent oil loss would be detected and corrected. This reduces the probability of fire due to oil leakage.
- The charcoal filters of the IRUs are equipped with detection and suppression.
- The introduction of transient combustible materials into the containment is extremely remote due to limited containment access during operation.
- The cables in the affected cable tray are made up of self-extinguishing IEEE-383 cable material. This will minimize fire propagation along the cables.

A preliminary PSA review of a self-ignited cable fire in the containment that leads to damage of the PORV and block valve cables was performed. The estimated core damage frequency (CDF) from this event is approximately 3.9E-7. In comparison, the total estimated Salem CDF is about 4.5E-5/yr. The estimated fire CDF in the Salem IPEEE is about 2.3E-5. Thus, the estimated CDF 3.9E-7/yr for this scenario would not numerically change the Salem CDF analysis results.

For the alternate shutdown concern, automatic detection and suppression exist for the Relay Rooms and the 460/230V switchgear rooms. The control room complex is equipped with area-wide detectors and provided with a hose station and fire extinguishers for manual fire fighting. The control room is also continuously manned such that a fire will be detected and suppressed. At the time of discovery of this issue, a fire watch was already stationed in the relay rooms.

PSE&G concludes that the existing condition has no significant impact on the health and safety of the public. The possibility of a fire induced loss of RCS inventory is highly unlikely. This assessment is based on the highly unlikely cable failure mode for the PORVs, and the fire protection defense in depth philosophy of detection, suppression, and manual fire fighting capability provided for the affected areas such that fires would not develop beyond the incipient stages.

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**CORRECTIVE ACTIONS**

1. Established hourly fire watch of the Unit 1 & 2 Relay Rooms and 460/230V Switchgear Rooms.
2. Licensed operators were briefed on the potential for spurious PORV and block valve operation during postulated fire.
3. Guidance was added to procedures S1(2).OP-AB.PZR-0001, "Pressurizer Pressure Malfunction", for opening the DC control power breaker for the PORVs if the associated block valve can not be closed.
4. Necessary corrective actions to resolve compliance with 10CFR50 Appendix R for the PORVs and block valves will be determined and implemented using PSE&G's corrective action program. (70001776 Act 0090)
5. A review of the Safe Shutdown Analysis is being performed as part of the Fire Wrap Project as committed in letter LR-N97357 dated June 6, 1997. The high/low pressure interface concerns are being re-evaluated as part of this review. (70001776 Act. 0100)