PSE

NPS

SEVERITY LEVEL
A. ☐ 3 working days
B. ☐ 10 calendar days
C. ☐ 30 calendar days
D. ☐ Other

CONDITION REPORT

DUE: _____ Date

CR NO. 03-1330-1

PTN ☒ PSL ☐ JB ☐

PAGE 1 OF _____

CR Administrator

ORIGINATOR

1. SYSTEM #/NAME 041/RCS UNIT 09
COMPONENT ID 3/4P200A,B,C
COMPONENT NAME RCP Seal Injection/Cooling
LOCATION (BLDG/ELEV) Containment
DISCOVERY DATE/TIME 9/9/03 /0930
EVENT DATE/TIME 6/10/03 /1500
CR ORIGINATOR A. S. Dunstan
DEPT/PHONE Eng /6004

2. (ATTACH ADDITIONAL PAGES AS NECESSARY)

PROBLEM (WHAT HAPPENED, HOW WAS THE ISSUE DISCOVERED, WHAT ACTIVITIES, PROCESSES AND PROCEDURES WERE INVOLVED, PHYSICAL CONDITION EXISTING AT THE ISSUE LOCATION, WHY IS THIS ISSUE OR EVENT A CONCERN, HAVE YOU SEEN THIS ISSUE OCCUR BEFORE)

The original disposition indicated that a review of all fire areas would be performed for actions credited to establish RCP seal cooling. The review was to be performed in conjunction with the reviews prescribed via CR 03-1306. However, the portion of review associated with RCP seal cooling is completed and additional documentation is available that was not considered in the original disposition. Therefore, the purpose of this supplement is to document specific results of this review pertaining to RCP seal cooling.

ORIGINATOR

REGULATION OR REQUIREMENT IMPACTED

IMMEDIATE CORRECTIVE ACTION TAKEN, ADDITIONAL CORRECTIVE ACTIONS COMPLETED

NOTIFICATIONS

3. ORIGINATOR REQUESTS COPY OF CLOSED CONDITION REPORT ☐ YES ☐ NO

SUPERVISOR NOTIFICATION: _____ / _____ ☐ N/A
PRINT SIGNATURE

NPS

4. OPERABILITY/REPORTABILITY DETERMINATION:

OUTAGE RELATED? ☐ YES ☐ NO

MODE HOLD? ☐ YES ☐ NO

FOR ENTRY INTO MODE _____

☐ A. OPERABILITY ASSESSMENT REQUIRED (3 WORK DAYS)
☐ B. POTENTIALLY REPORTABLE (ATTACH ENS WORKSHEET, IF USED)
☐ C. NO OPERABILITY CONCERN/NOT REPORTABLE
☐ D. OTHER _____

COMMENTS: _____

NPS/VPNE _____ / _____ DATE/TIME _____ / _____
PRINT SIGNATURE

VICE PRES., NUCLEAR ENGINEERING

PGM

5. CONDITION REPORT ASSIGNED TO: _____

COMMENTS: _____

☐ Significance Level 1 - Root Cause Analysis
☐ Significance Level 2 - Apparent Cause
☐ Significance Level 3 - Correction Only
☐ PGM Closeout
☐ Trend Only
☐ Potential Human Performance Issue

Affected Dept. _____

DATE _____

CRs ARE QA RECORDS WHEN CLOSED. PLEASE ENSURE ALL RESPONSES AND ATTACHMENTS ARE LEGIBLE

CC-1

CONDITION REPORT # 03-1330-1 PAGE 2 OF _____

ENG/SCE

6. FUNCTIONAL FAILURE: ☐ YES ☒ NO BY: A. S. Dunstan / [signature] (PRINT / SIGNATURE) N/A

ASSIGNEE

7. INVESTIGATION: ANALYSIS, CORRECTIVE ACTIONS. GENERIC IMPLICATIONS. DISPOSITION DETAILS, WORK INSTRUCTIONS (ATTACH ADDITIONAL PAGES AS NECESSARY)

Disposition Page 19.

CAUSE CODES: 1) J-1 2) _____ 3) _____ HU ERROR AFFECTS OTHER DEPT ☐ YES ☒ NO

AFFECTED DEPARTMENT _____

8. DOCUMENTATION INITIATED: (N/A if not applicable)

PWO N/A

PMAI N/A

RTS/PCR N/A

_____

EVALUATION REQUIRED FOR:

EQ	☐ YES	☒ NO
10CFR50.59	☐ YES	☒ NO
10CFR21	☐ YES	☒ NO
ASME SECTION XI	☐ YES	☒ NO

9. NONCONFORMING/DEGRADED PLANT CONDITION DISPOSITION: N/A ☒ REWORK ☐ REPAIR ☐ USE-AS-IS ☐ OTHER ☐ _____

REVIEW / APPROVAL

10. DISPOSITION SIGNATURES: (N/A if not applicable)

PREPARER A. S. Dunstan / [signature] / 6004 6004 (PRINT / SIGNATURE / DEPT. PHONE) DATE 11/17/03

OTHER DEPT. HEAD CONCUR See Page 22! / — (PRINT / SIGNATURE) DATE —

ANII/SEC XI REVIEWER N/A N/A / _____ (PRINT / SIGNATURE) DATE _____

PNSC/FRG REVIEW ☐ YES ☒ NO

FRG/PNSC REVIEW (If required in Block 10) MTG# N/A CHAIRMAN _____ DATE _____

NUCLEAR NETWORK ☐ YES ☒ NO MODE RESTRICTION RELEASED ☐ YES ☐ NO ☒ N/A

DEPARTMENT HEAD PSV J. A. DELGADO / JADelgado for SPC (PRINT / SIGNATURE) DATE 12/30/03

APPROVAL:

VP/PGM MGR [signature] DATE 12/31/03

REVIEW / APPROVAL

ADMIN

EVENT CODES: 1) _____ 2) _____ 3) _____ EXPLAIN OTHER: _____

ADMIN

CRs ARE QA RECORDS WHEN CLOSED. PLEASE ENSURE ALL RESPONSES AND ATTACHMENTS ARE LEGIBLE

CONDITION REPORT REVIEW CHECKLIST

This checklist is provided as an aid in dispositioning and reviewing Condition Reports. Personnel preparing the CR disposition should review the checklist to ensure that CR program requirements are met. Personnel performing the independent review shall verify that required CR disposition attributes have been addressed by completing the applicable portions of the checklist. CRs that have not addressed all program requirements shall be corrected prior to closeout.

ALL CONDITION REPORTS:			
ENSURE THAT:	YES	NO	N/A
All blocks and spaces are filled in	☒	☐	☐
All pages identify the CR and page number (consecutively)	☒	☐	☐
The disposition addresses the identified condition	☒	☐	☐
The disposition addresses requirements specified in Block 5	☐	☐	☒
Concurrence has been obtained by all affected departments (note: Planning concurrence required for open WO used to track corrective action)	☒	☐	☐
Cause codes are appropriate for Significance Level 1 and 2 CRs	☐	☐	☒
Open corrective actions are tracked by PMAI, RTS or WO and traceable to the CR	☐	☐	☒
Work Orders properly reference the CR and are attached	☐	☐	☒
50.59 screening has been completed for NCR use-as-is or repair dispositions	☐	☐	☒
ISI/IST/ANII review have been obtained if required	☐	☐	☒
Corrective Actions are timely based upon the significance of the event	☐	☐	☒

SIGNIFICANCE LEVEL 1 CONDITION REPORTS:			
ENSURE THAT:	YES	NO	N/A
Root Cause Analysis completed in accordance with procedure requirements	☐	☐	☒
If RCA not completed, then PMAI assigned for completion (example: a detailed metallurgical analysis is necessary to determine root cause)	☐	☐	☐
The problem is clearly stated (Problem Statement)	☐	☐	☐
The data and evidence considered is identified	☐	☐	☐
Industry Operating Experience is appropriately considered	☐	☐	☐
Potential failure modes are identified, if applicable	☐	☐	☐
Tools and techniques used are appropriately selected and identified	☐	☐	☐
Root cause and contributing causes are identified and appear appropriate	☐	☐	☐
Corrective actions address the root cause and contributing causes	☐	☐	☐
Corrective Action(s) to Prevent Recurrence (CAPRs) are clearly designated as such	☐	☐	☐
Corrective actions are timely AND COMPLETE	☐	☐	☐
Generic implications are addressed, and corrective actions assigned as appropriate	☐	☐	☐
Extent of Condition is addressed, and corrective actions assigned as appropriate	☐	☐	☐
Potential repeat occurrence is addressed, and corrective actions assigned for identified issues	☐	☐	☐
Monitoring and follow-up is addressed to ensure that corrective actions are effective	☐	☐	☐
Root cause analysis is performed by qualified individuals (Ref: RCA Training Matrix)	☐	☐	☐
For equipment failures, a review of PM's or run to failure is documented	☐	☐	☒

SIGNIFICANCE LEVEL 2 CONDITION REPORTS:			
ENSURE THAT:	YES	NO	N/A
The disposition addresses the problem identified in Block 2	☐	☐	☒
The apparent cause of the problem is clearly identified	☐	☐	☐
Corrective actions address the cause and minimize recurrence	☐	☐	☐
Extent of Condition is addressed, and corrective actions assigned as appropriate	☐	☐	☐
Potential repeat occurrence is addressed, and corrective actions assigned for identified issues	☐	☐	☐
For equipment failures, a review of PM's or run to failure is documented	☐	☐	☒

SIGNIFICANCE LEVEL 3 CONDITION REPORTS:			
ENSURE THAT:	YES	NO	N/A
Corrective actions adequately address the immediate concern	☐	☐	☒

Review performed by: Tim Johnson _____ Ext 6175 Date: 12/18/03
Print/Signature

Component/Zone	4	10	30	40	61	63	67	68	70	71	93	94	95	96
			X	X										
MOV-3-716A														X
MOV-3-716B	X	X				X			X				X	
MOV-4-716A												X		
MOV-4-716B		X			X		X				X			
MOV-3-626	X	X				X							X	
MOV-4-626		X			X						X			
CV-3-389														
CV-4-389														
MOV-3-6386														X
MOV-4-6386												X		
MOV-3-381						X							X	
MOV-4-381					X						X			

4, 10	Action to open breakers within 24 hours
30, 40	Caution statement only to trip RCPs immediately and restore cooling in 20 minutes
61, 63	De-energize in 3 minutes from Control Room and locally verify OPEN in P&V Room
67, 70	Open breaker at MCC/verify OPEN in P&V Room in 3 min. (20 min if RCPs stopped)
93, 94, 95, 96	Open breaker at load center in 15 minutes

CR # 03-1320-C PG 1 OF

Westinghouse Non-Proprietary Class 3

WCAP-15603
Revision 1

WOG 2000 Reactor Coolant Pump Seal Leakage Model for Westinghouse PWRs

Westinghouse Electric Company LLC

3.0 RCP SEAL LEAKAGE MODEL FOR PUMPS WITH HIGH TEMPERATURE O-RINGS

Westinghouse has produced a high temperature o-ring material that is designed to function at the temperatures expected in the RCP seal during a loss of seal cooling scenario. These o-rings are not susceptible to extrusion failures, unlike the "old" o-rings, which may extrude excessively upon a loss of RCP seal cooling event. In most Westinghouse RCPs, seal packages with the high temperature o-rings are already installed.

This section presents the *WOG2000* RCP seal leakage model for the RCPs with the seal assemblies containing the high temperature o-rings. The *WOG2000* model adopts the Brookhaven Model, with two modifications:

- The probability of popping-and-binding is reduced by a factor of 2 for seals with high temperature o-rings – see Section 3.1(a).
- The mean starting time of the time-independent seal face failures (popping-and-binding) is postulated to be 30 minutes after the loss of RCP seal cooling – see Section 3.2.

These assumptions are described in more detail in the following subsections, along with a basis for each. These assumptions address conservatisms in the Brookhaven Model but do not alter the failure modes or structure of the model as presented in the Brookhaven Report. They are made to make the model less conservative (i.e., more realistic); conservative modeling in PRA can distort the plant risk profile and mask the "real" risk contributors. Note that these modifications are kept simple to retain the simplicity of the model.

3.1 SEAL FAILURE PROBABILITIES

(a) Popping-and-Binding Failure Mode

The Brookhaven Model gives the following probabilities of opening of the face seals of each stage, due to the "popping-and-binding" failure mode:

$$P(PB1) = 0.025$$

$$P(PB2) = 0.20$$

$$P(PB3) = 0.54$$

where P(PBx) is the probability of popping-and-binding failure (PB) in the x^{th} seal stage.

The Brookhaven Model applies these same probabilities to both the old and the high temperature o-ring seals.

3.2 SCENARIO STARTING TIMES

The Brookhaven Model assumes the following leakage start times for the high temperature o-rings:

- 21 gpm "normal" leakage starts at the beginning of the scenario (t = 0)
- Binding-and-popping failures, if they occur, start at the beginning of the scenario (t = 0)

WOG2000 Model uses the Brookhaven assumption that the "normal" 21 gpm leakage per pump would start at the beginning of the scenario. However, the *WOG2000* model uses the following modification for the starting time of the potential binding-and-popping failures.

The Brookhaven Report (Reference 1, page 24) notes only that the failure is expected sometime during the first hour:

> ".. the processes of binding and popping-open are not time-dependent, and the onset of the probability of opening of the face seals due to either process is assumed *during the first hour* of the LOSC event. For evaluating the probabilistic model, NUREG/CR-4906P does not state the specific time during the first hour of the LOSC event at which the face seals are assumed to fail; we interpret that NUREG/CR-4906P used time = 0, the onset of the LOSC event, as the time of possible failure."

The *WOG2000* model postulates that the binding-and-popping failures would occur at 30 minutes. This is based on analysis of the heatup rate as well as operating experience and expert judgment. There is no physical mechanism for such a failure before 15 minutes following loss of cooling since the seals would not yet experience out-of design basis temperatures.

This is consistent with Reference 2 (Section 10.1.1) which estimates it would take 30 minutes for the #1 seal to become thermally saturated.

Moreover, there is no evidence from operating experience of popping-and-binding failure with loss of seal cooling. Reference 2 (Section 2.4) presents the evidence of 24 RCPs that experienced loss of seal cooling but without popping-and-binding failure. In addition, in the more recent Sizewell loss of RCP seal cooling event (Reference 6), the seal material underwent a total loss of cooling for a 20-minutes period, without a popping-and-binding failure; then underwent further periods of the same conditions until seal cooling was permanently established. At the end of this unplanned "test" with periods of total loss of seal cooling, no binding-and-popping failure was observed.

Using 15 minutes and 60 minutes as the upper and lower bounds respectively, the following approach is used to estimate a reasonable mean time of occurrence of the binding-popping failure mode:

- The time of occurrence is assumed to obey the lognormal distribution (which is a commonly used assumption in PRAs);
- The 5th percentile of the distribution is at 15 minutes

- The 95th percentile of the distribution is at 60 minutes

This results in a mean time of occurrence of 33 minutes.

To see the sensitivity of this mean value to the postulated percentiles, the following scenario is also considered:

- The time of occurrence is again assumed to obey the lognormal distribution
- The 1st percentile of the distribution is at 15 minutes
- The 99th percentile of the distribution is at 60 minutes

This results in a mean time of occurrence of 32 minutes.

Thus, given the physical lower limit of 15 minutes and taking 60 minutes as the upper bound of the expert opinion, the mean time of 30 minutes for the occurrence of these failure modes is reasonable.

3.3 TREATMENT OF MULTIPLE RCPS

The Brookhaven Model postulates that if a leakage scenario occurs, all RCP pumps with the same seal material in a given unit would respond with the same leakage. However, it is not unreasonable to expect some degree of randomness in the failures. Thus, not all RCP seals in a plant would be expected with 100% certainty to undergo the same leakage failure. The current assumption – if one pump has a leakage at a certain rate, then all other pumps have leakages at the same rate – is likely to be conservative (i.e., likely to overstate the expected total leakage). On the other hand, addressing this assumption rigorously would make the model very complicated. In order to maintain the simplicity of the model, this treatment will be recognized as a potential conservatism but will not be addressed quantitatively in the *WOG2000* model.

3.4 LEAKAGE SCENARIOS

Using the above parameters, the RCP seal leakage scenarios can be defined with their probabilities, leakage rates, and times of progression. The results are summarized in Table 3.4-1 for the five scenarios for a single RCP pump. With the simplified treatment of multiple RCP pumps, this result also applies to 2, 3, or 4 pumps in the same unit; however, the total RCS leakage from multiple pumps must be calculated by multiplying the number of pumps with the leakage rate per pump. For example, for a 4-loop plant, the fifth leakage scenario in Table 3.4-1 would have a 1920 gpm (4 * 480) RCS leakage.

The RCP seal leakage scenarios for 2, 3, and 4 loop plants with high temperature o-rings following a total loss of RCP seal cooling with RCP pumps tripped are given in Table 3.4-2.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
18	**Check All RCP Number One Seal Leak-Off Flows On FR-4-154A – LESS THAN 6 GPM**	Perform the following: a. Manually trip the reactor AND perform 4-EOP-E-0, REACTOR TRIP OR SAFETY INJECTION, while continuing with this procedure. b. WHEN the reactor verified tripped, THEN stop the affected RCP(s) c. Close affected RCP Seal Leakoff valve(s) after the pump has stopped: * CV-4-303A for RCP A * CV-4-303B for RCP B * CV-4-303C for RCP C d. Monitor RCDT level for indication of number two seal failure. e. DO NOT restart the affected RCP until the cause of the seal malfunction has been determined AND corrected. f. Return to Step 3.
19	**Check All RCP Number One Seal Leak-Off Flows On FR-4-154A** a. RCP number one seal leak-off flow - LESS THAN OR EQUAL TO 5.5 GPM	a. Perform the following: 1) Commence unit shutdown using 4-ONOP-100, FAST LOAD REDUCTION. 2) WHEN turbine tripped, THEN trip the reactor. 3) WHEN the reactor is tripped, THEN stop affected RCP(s). 4) Go to Step 19c.
	b. Begin preparations to shutdown AND stop affected RCP using 4-GOP-103, POWER OPERATION TO HOT STANDBY	
	c. Contact Plant Management for further guidance	

CR# 03-1330-1 PG 12 OF

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
22	**Check RCP STANDPIPE HI LEVEL Alarm On Affected RCP - ON** • G 2/1 for RCP A • G 2/2 for RCP B • G 2/3 for RCP C	Perform the following: a. IF flow on FR-4-154B greater than 0.8 gpm, THEN operation of the RCP may continue. b. IF flow on FR-4-154B less than 0.8 gpm, AND Pump Bearing/Seal Inlet temperature and/or Number One Leak-off temperature on TR-420 increasing, THEN manually trip the reactor AND perform 4-EOP-E-0, REACTOR TRIP OR SAFETY INJECTION, while continuing with this procedure. 1) WHEN the reactor is verified tripped, THEN stop the affected RCP(s). 2) Close affected RCP Seal Leak-off valve(s) after the pump has stopped. • CV-4-303A for RCP A • CV-4-303B for RCP B • CV-4-303C for RCP C 3) Monitor RCDT level for indication of number two seal failure. 4) DO NOT restart the affected pump until cause of the seal malfunction has been determined AND corrected. 5) Return to Step 3. c. IF flow on FR-4-154B less than 0.8 gpm, AND Pump Bearing/Seal Inlet Temperature and/or Number One Leak-off temperatures are stable, THEN commence a shutdown using 4-GOP-103, POWER OPERATION TO HOT STANDBY. 1) Contact plant management for further guidance. 2) Return to Step 3.

CR# 03-1330-1 PG 13 OF

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

CAUTION

O-ring seals will deteriorate rapidly as number one seal leakoff temperature approaches 350°F.

35 **Establish Cooling To RCP Pump Bearings**

CR # 03-1330-1 PG 14 OF

a. Adjust seal injection flow to affected RCP(s) - 6 to 13 GPM

   * FI-4-130 for RCP A using valve 4-297A
   * FI-4-127 for RCP B using valve 4-297B
   * FI-4-124 for RCP C using valve 4-297C

b. Check number one seal leakoff flow on affected RCP(s), FR-4-154B - LESS THAN 1 GPM

   b. Return to Step 5.

c. Check RCS pressure - LESS THAN 1000 PSIG

   c. Return to Step 5.

d. Check the affected RCP Seal Leakoff Valve – OPEN

   * CV-4-303A for RCP A
   * CV-4-303B for RCP B
   * CV-4-303C for RCP C

   d. Perform the following:

   1) IF affected RCP Seal Leakoff valve was closed as result of number one seal failure, THEN return to Step 5.

   2) Open affected RCP Seal Leakoff valve.

   3) Return to Step 35a.

e. Open RCP Seal Bypass valve, CV-4-307

f. Return to Step 5

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

October 6, 2003

CR# 03-13301 PG 15 OF

NRC INFORMATION NOTICE 2003-19: UNANALYZED CONDITION OF REACTOR COOLANT PUMP SEAL LEAKOFF LINE DURING POSTULATED FIRE SCENARIOS OR STATION BLACKOUT

Addressees

All holders of operating licenses or construction permits for pressurized water reactors (PWRs).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to the recent identification of an unanalyzed condition involving the design of the reactor coolant pump (RCP) seal leakoff line. The NRC anticipates that recipients will review the information for applicability to their facilities and consider taking appropriate actions. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On January 13, 2003 the Millstone Unit 3 licensee identified that an over-pressurization of RCP seal leakoff lines could result from an extended loss of seal cooling following station blackout (SBO) scenarios or postulated fires in specific plant areas coincident with a loss of offsite power. Specifically, the licensee relies on operators to isolate the low pressure portion of the seal leakoff to prevent the line from over-pressurizing. The licensee determined this expectation may not be achievable because the valve used to isolate the low pressure portion of the seal leakoff line is an air-operated valve. This valve is designed to fail open upon loss of electrical power or instrument air, either of which could occur during a SBO or a loss of offsite power coincident with a postulated fire event.

The seal return line for RCPs is designed to recover leakoff volume, at low pressure and temperature, and return it to the volume control tank or charging pump suction. In the event of a fire in the cable spreading area, main control room, or instrument rack rooms, coincident with a loss of offsite power, a loss of RCP seal cooling could result. This situation can lead to a significant increase in RCP seal leakage which would increase the pressure and fluid temperature in the seal return line. This over pressurization could result in a pressure boundary failure of the seal return line, further increasing the RCP seal leakage beyond that assumed in the safe shutdown analysis.

ML032760027

The resulting rupture would divert more of the credited boric acid storage tank (BAST) volume than was assumed in the development of the licensee's fire safe-shutdown strategies. Therefore, the strategies may not be adequate to achieve safe-shutdown.

Discussion

The licensee identified this issue while reviewing a Westinghouse (W) document on RCP seal performance during loss of RCP seal cooling events, OG-00-009, "Transmittal of RCP Operation During Loss of Seal Cooling (MUHP-1063)," dated February 11, 2000. The W document states that up to 21 gallons per minute (gpm) leakoff from each RCP could occur for loss of seal cooling events following postulated fire or Station Blackout (SBO) events, which exceeds the 3 gpm assumed in the Millstone Unit 3 fire safe shutdown analysis. Therefore, the licensee concluded that the fire safe shutdown analysis was invalid, but the SBO analysis, which assumes 25 gpm leakoff, was valid.

Upon further investigation, the licensee determined that a loss of seal cooling event could not be mitigated successfully because the seal leakoff line could not be isolated by the air-operated valves (AOVs) located in the RCP seal return piping. These AOVs cannot be credited to close because they are not fed by a safety-related air system, and they are designed to fail open. As a result of the loss of seal cooling and fire scenarios described above, pressures in the seal leakoff line would reach approximately 800 to 2000 psig. Since the piping segment downstream of each AOV and upstream of the flow restriction orifice is designed 150 psig, this portion of the leakoff line could rupture, inducing leakoff flow rates in excess of the 21 gpm identified in the W document. These flow rates severely challenge the credited contents of the BAST and the requirements for achieving and maintaining safe shutdown in accordance with the applicable licensing basis.

The licensee had been aware of the potential for over pressurization of the seal leakoff line from a 1992 Westinghouse Technical Bulletin, NSD-TB-91-07-R1, "Over pressurization of RCP #1 Seal Leakoff Line." However, while the licensee had implemented specific recommendations contained in the bulletin, the licensee had not considered the potential for the AOVs in the seal leakoff line to be open. Therefore, the licensee did not consider a potential pressure boundary failure in the leakoff line that would divert the BAST contents credited for achieving and maintaining safe shutdown.

To mitigate and resolve the events described in this IN the licensee has: (1) instituted compensatory measures for the degraded condition, including continuous fire watches, placement of additional fire extinguishers in the three affected plant areas, and administratively controlling transient combustibles; (2) initiated plant design changes involving the RCP seal leak-off lines to preclude the possibility of rupture during loss-of-all-seal cooling events, i.e., replacement of susceptible valves and flanges; (3) performed engineering analyses regarding the event's impact on charging pumps and pressurizer level during the event; and (4) revised fire shutdown strategies to effectively mitigate the event.

CR # 03-1330-1 PG 17 OF

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/RA/
William D. Beckner, Chief
Reactor Operations Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

Technical Contacts: Paul Cataldo, Region I
(860) 701-3470
E-mail: pcc1@nrc.gov

Warren Lyon, NRR
(301) 415-2897
E-mail: wcl@nrc.gov

Phil Qualls, NRR
(301) 415-1849
E-mail: pmq@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

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OFFICE	OES:RORP:DRIP	Tech Editor	RGN:I	SPLB:DSSA
NAME	CPetrone*	Pkleene*	PCCataldo (per email)	JHannon*
DATE	06 /19 /2003	02 /24 /2003	07/14 /2003	09/30 /2003

OFFICE	SRXB:DSSA	SRXB:DSSA	EMEB/DE	SC:OES:DRIP	PD:RORP:DRIP
NAME	JUhle*	JRWermiel*	Elmbro*	TReis* ejb for	WDBeckner
DATE	09/02/2003	09/05 /2003	06/20 /2003	10/02/2003	10/06/2003

OFFICIAL RECORD COPY

CR# 03-1330-1 PG 18 OF

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
2003-18	General Electric Type SBM Control Switches With Defective Cam Followers	09/26/2003	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2003-17	Reduced Service Life of Automatic Switch Company (ASCO) Solenoid Valves With Buna-N Material	09/29/2003	All holders of operating licenses for nuclear power reactors.
2003-16	Icing Conditions Between Bottom of Dry Storage System and Storage Pad	Pending	All 10 CFR Part 72 licensees and certificate holders.
2003-15	Importance of Followup Activities in Resolving Maintenance Issues	09/05/2003	All holders of operating licenses for nuclear power reactors except those who have permanently ceased operation and have certified that fuel has been permanently removed from the reactor vessel.
2003-14	Potential Vulnerability of Plant Computer Network to Worm Infection	08/29/2003	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Note: NRC generic communications may be received in electronic format shortly after they are issued by subscribing to the NRC listserver as follows:

To subscribe send an e-mail to <listproc@nrc.gov>, no subject, and the following command in the message portion:

subscribe gc-nrr firstname lastname

OL = Operating License
CP = Construction Permit

Problem Statement:

The original disposition indicated that a review of all fire areas would be performed for actions credited to establish RCP seal cooling. The review was to be performed in conjunction with the reviews prescribed via CR 03-1306. However, the review associated with RCP seal cooling is completed and additional documentation is available that was not considered in the original disposition. In addition, NRC IN2003-19 was issued during the PTN review process. Therefore, the purpose of this supplement is to document specific results of this review pertaining to RCP seal cooling and address the NRC information notice (Pages 15 through 18).

Analysis:

The capability to achieve and maintain a safe shutdown condition under postulated Appendix R fire scenarios is a quality-related function. No safety-related functions are affected. Therefore, consistent with the original disposition, this ***CR is classified as QR***.

Procedures 0-ONOP-016.10 and 0-ONOP-105 were searched to identify fire zones for which actions are prescribed to establish or assure RCP cooling. Initial results presented on Page 4 herein for the 0-ONOP-016.10 review are superseded by the attached fire area analysis. Actions in 0-ONOP-016.10 regarding RCP seal cooling invoke the respective off-normal procedures, 3/4-ONOP-041.1. For 0-ONOP-105, only notes are included indicating that thermal barrier cooling should be restored if seal injection is not available for greater than 20 minutes and Procedures 3/4-ONOP-041.1 are only included by reference. These timeframes are consistent with original Appendix R safe shutdown analysis assumptions but not those assumed in the coping analysis for Station Blackout.

[redacted] However, WCAP-15603 (excerpt Pages 7 through 10) indicates that high-temperature O-rings are not susceptible to the extrusion failures experienced with earlier seal designs. The failure mode of the No. 1 seal with the high-temperature design is to "pop" open but failure is not expected to occur before 30 minutes into the event. [redacted] All PTN RCP seals have been upgraded with the high-temperature O-ring seals qualified to the criteria described in WCAP-10541. Therefore, requirements to confirm RCP seal cooling in 20 minutes are acceptable.

As indicated above, Procedures 3/4-ONOP-041.1 are invoked presuming RCP operation without seal cooling; hence, prescribed RCP trip in 3 minutes. These procedures (excerpt Pages 12, 13 and 14) require closing affected RCP Seal Leakoff Valves CV-3/4-303A/B/C after the RCP is stopped and if there is insufficient seal leak-off flow, then reopening them when seal injection flow is restored. This preserves inventory by preventing downstream relief valve lift and discharge to the PRT and presumes that thermal barrier cooling is available.

[redacted]

[redacted] Per NUREG/CR-6834, it was observed that spurious actuation signals occurred during the first half-hour of the Browns Ferry fire. Also, there is a general opinion that hot shorts eventually become open-circuit faults due to continued degeneration of cable insulation and that the transition time from hot short to open circuit is normally distributed with 5th and 95th percentile of 5 and 35 minutes, respectively. [redacted]

Whether likely or not, it is postulated that seal cooling is lost. The potential results of spurious valve closures are addressed in detail in the attached analysis. As to potential consequences, there can be operational and hardware aspects. Operationally, Procedure 0-ONOP-016.10 indicates restoring seal cooling even after 20 minutes. This is contrary to EOP requirements (e.g., LOOP, station blackout) to which Operators are trained. Given the context that Procedure 0-ONOP-016.10 provides guidance and basically subserviant to the EOPs, the Operator would be expected to respond as trained and not re-establish seal cooling if found not functional after an extended period. Therefore, it is considered unlikely that operator response would exacerbate this condition.

In terms of hardware, Procedure 0-ONOP-016.10 invokes Procedures 3/4-ONOP-041.1 for RCP trip criteria but independently prescribes manual actions to prevent seal damage. If thermal barrier cooling is not available, then it is desirable to continue seal injection even if flow is diverted to the PRT upon spurious closure of a valve. The air-operated leak-off valves are designed to fail open upon loss of power or instrument air; however, spurious closure could block seal leakoff flow on one RCP and result in RCS fluid spillage to the pump bowl and floor. There is no Appendix R safe shutdown mitigative action taken for leak-off valve miss-operation. Instead, the thermal barrier cooling is established via manual action, if required.

Based on the preceding, there are no immediate hardware or operational concerns with Appendix R safe shutdown capability concerning RCP seal cooling. Even so, Procedures 0-ONOP-016.10 and 0-ONOP-105 should be revised to prohibit re-establishing seal cooling if neither thermal barrier nor seal injection flow has been available for more than a short time (not more than 10 minutes), as identified in Evaluation PTN-ENG-SEMS-03-045.

Apparent Cause:

This disposition is a continuation of the original CR to address prescribed action item and does not change the determination made in the original disposition that the apparent cause is a self-identified deficiency in analysis scope.

Extent of Condition:

The scope of the action prescribed by the original CR disposition was limited to Appendix R safe shutdown. Reference to 3/4-ONOP-041.1 by 0-ONOP-016.10 for RCP trip criteria does not conflict with 3/4-ONOP-041.1 use in non-Appendix R scenarios. No change in procedural objectives, methods or limiting conditions has been identified and no new issues have been identified in the context of NRC IN2003-19. Therefore, the extent of condition remains limited to the context of Appendix R safe shutdown capability.

Nonconformance Evaluation:

The Safe Shutdown Analysis (5610-M-722) and implementing procedures (0-ONOP-105 and 0-ONOP-016.10) are consistent in requiring that RCPs be tripped immediately (within 3 minutes) upon loss of cooling indication (see RCP trip criteria per 3/4-ONOP-041.1) and to restore seal cooling in 20 minutes. This is consistent with design and design basis requirements. [redacted] It is also determined that the guidance provided by Procedures 0-ONOP-016.10 and 0-ONOP-105 would not pre-empt EOP restrictions on re-establishing seal cooling. Therefore, there is no change to the original ***no nonconformance or operability concern*** determination.

Potential Repeat Occurrence/Event Review:

There remains no repeat condition associated with the condition identified in this CR.

Human Performance Review:

There are no human adverse performance issues associated with this CR.

Corrective Action(s):

The corrective action prescribed in the original CR disposition is completed by issue of this supplement. The activity was performed as part of the action items assigned via CR 03-1306 and was not tracked by a separate PMAI. As the results of this supplement are bounded by the scope and corrective actions defined in Evaluation PTN-ENG-SEMS-03-045 (tracked by PM03-07-162), which will prohibit re-establishing seal cooling after an extended period as well as other recommended procedure changes, **no new PMAI is required.**

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FIRE AREA ANALYSIS

RCP SEAL INJECTION

&

THERMAL BARRIER COOLING

COMPONENTS

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