UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-4005

RH-LB3

MEMORANDUM TO: Kriss M. Kennedy, Chief
Project Branch C

FROM: David P. Loveless
Senior Reactor Analyst

SUBJECT: EVALUATION FOR HAVING THE SERVICE WATER GLAND SEAL WATER CROSS TIED

I have reviewed the risk significance of the licensee performance deficiency that resulted in the Division II service water pumps relying on Division I pumps for gland seal water at Cooper Nuclear Station from . Based on the attached evaluation and in accordance with Inspection Manual Chapter 0609, this deficiency represents a finding preliminarily characterized as being of low to moderate risk significance (white).

Please let me know if you have any additional questions.

Attachment

Q-3

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DOCUMENT: S:\DRS\PRA_Plants_Cooper\Condition Assessment\Risk Assessment - Service Water Gland Seal Cross Tie.wpd

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PRELIMINARY SIGNIFICANCE DETERMINATION
Cooper Nuclear Station
Service Water Divisions' Gland Seal Water Cross Tied

I. Performance Deficiency:

Operators failed to restore the normal valve alignment for the Division II service water pump gland water supply following maintenance and prior to returning the system to service. This configuration resulted in the Division II service water gland sealing system being provided by the Division I service water pumps. In this configuration, a failure of the Division I pumps would result in loss of gland water to the Division II pumps.

II. Conclusion:

III. Background:

On Jan 21, the DIV service water discharge strainer was bypassed for routine maintenance (cleaning). Per procedure, the gland water supply for the Div 2 pumps was cross-connected with the Div 1 pumps so as not to introduce debris in the Div 2 pump glands. This also required declaring Div 2 inoperable. Following the maintenance, the discharge strainer was returned to service and Div 2 of SW was declared operable but the gland water supplies remained cross-connected. This rendered Div 2 of SW inoperable per TS since this created an interdependence between the two division (Div 2 required Div 1 to be operable in order to supply gland water).

On Feb 11, the licensee was conducting a valve line up verification due to several spurious gland water low pressure alarms on Div 2. The incorrect line up was discovered as a result. The licensee appropriately declared Div 2 of SW inoperable as well as EDG 2 and Div 2 of RHR (for SPC and SDC - LPCI function was not affected).

IV. Safety Impact:

This event was determined to be of ********** risk significance based on the change in core damage frequency documented in Section V.

V. Initial Characterization of Risk:

Minor Determination:

In accordance with NRC Inspection Manual Chapter 0612, Appendix B, "Issue Screening," the inspectors determined that the failure to properly realign the system was a licensee performance deficiency because the system was returned to service in a condition that failed to meet the operability requirements of Technical

Specification ********. This specification requires that both divisions of service water be operable. Additionally the failure to properly align the gland water system was fully within the licensee's abilities to control. The issue was more than minor because it was similar to Example 4.e in Manual Chapter 0612, Appendix E, "Examples of Minor Issues," and it met the "not minor if" criteria, in that the error resulted in improper valve manipulation (alignment).

Phase 1 Screening:

The inspectors evaluated the issue using the SDP Phase 1 Screening Worksheet for the Initiating Events, Mitigating Systems, and Barriers Cornerstones provided in Manual Chapter 0609, Appendix A, "Significance Determination of Reactor Inspection Findings for At-Power Situations." This issue caused an increase in the likelihood of an initiating event, namely loss of service water, as well as increasing the probability that the service water system would not be available to perform its mitigating systems function. Therefore, the issue was passed to Phase 2.

Phase 2 Estimation:

In accordance with Manual Chapter 0609, Appendix A, Attachment 1, "User Guidance for Significance Determination of Reactor Inspection Findings for At-Power Situations," the inspectors evaluated the subject finding using the Risk-Informed Inspection Notebook for Cooper Nuclear Station, Revision 1. The following assumptions were made:

- The configuration of the service water system increased the likelihood that all service water would be lost.

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- The initiating event likelihood credit for loss of service water system was increased from five to four by the senior reactor analyst in accordance with Usage Rule 1.2 in Manual Chapter 0609, Appendix A, Attachment 2, "Site Specific Risk-Informed Inspection Notebook Usage Rules." This change reflects the fact that the finding increased the likelihood of a loss of service water, a normally cross-tied support system.

- The configuration of the service water system did not increase the probability that the system function would be lost by an order of magnitude because both pumps in Division I would have to be lost before the condition would affect Division II. Therefore, the order of magnitude assumption was that the service water system would continue to be a multi-train system.

- Because both divisions of service water continued to run and would have been available without an independent loss of Division I, this condition increased the reliability of the system, but not the function. Therefore, sequences with loss of the service water mitigating function were not included in the analysis.

This deviation from the risk-informed notebook represents a Phase 3 analysis in accordance with Manual Chapter 0609, Appendix A, Attachment 1, in the section entitled: "Phase 3 - Risk Significance Estimation Using Any Risk Basis That Departs from the Phase 1 or 2 Process."

Table 2 of the risk-informed notebook requires that all initiating event scenarios be evaluated when a performance deficiency affects the service water system. However, given that the service water system function was not degraded, only the sequences with the special initiator for Loss of Service Water (TSW) and the sequences related to a Loss of A/C are applicable to this evaluation. The sequences from the notebook are as follows:

Initiating Event	Sequence	Mitigating Functions	Results
Loss of Service Water	1	RECSW24-LI	6
Loss of Service Water	2	RCIC-LI	6
Loss of Service Water	3	RCIC-HPCI	6

Using the counting rule worksheet, this finding is estimated to be YELLOW. However, because several assumptions made during the Phase 2 process were overly conservative, a Phase 3 evaluation is required.

Phase 3 Evaluation:

Internal Events

As stated above, the analyst modified the Phase 2 estimation by not including the sequences from initiating events other than a loss of service water. This change alone represents a Phase 3 analysis.

However, the results from the modified notebook estimation were compared with an evaluation developed using a Standardized Plant Analysis Risk (SPAR) model simulation of the cross tied service water divisions, as well as an assessment of the licensee's evaluation provided by the licensee's probabilistic risk assessment staff (Glen A. Seeman). The SPAR runs were based on the following analyst assumptions:

- The Cooper SPAR model was revised to better reflect the failure logic for the service water system. This model, including the component test and maintenance basic events, represents an appropriate tool for evaluation of the subject finding.

- NUREG/CR-5496, "Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1980 - 1996," contains the NRC's current best estimate of both the likelihood of each of the LOOP classes (i.e., plant-centered, grid related, and severe weather) and their recovery probabilities.

- The service water pumps at Cooper will fail to run if gland water is lost for 30 minutes or more. If gland water is recovered within 30 minutes of loss, the pumps will continue to run for their mission time, given their nominal failure rates.

- The nominal likelihood for a loss of service water, $IEL_{(TSW)}$, at the Cooper Nuclear Station is as stated in NUREG/CR-5750, "Rates of Initiating Events at Nuclear Power Plants: 1987 - 1995," Section 4.4.8, "Loss of Safety-Related Cooling Water System." This reference documents a total loss of service water frequency at [ ] Ex 5

- The nominal likelihood for a partial loss of service water, $IEL_{(PTSW)}$, at the Cooper Nuclear Station is as stated in NUREG/CR-5750, "Rates of Initiating Events at Nuclear Power Plants: 1987 - 1995," Section 4.4.8, "Loss of Safety-Related Cooling Water System." This reference documents a partial loss of service water frequency at 8.92×10^{-3} per critical year.

- [ ] Ex5

- The SPAR HRA method used by Idaho National Engineering and Environmental Laboratories during the development of the SPAR models and published in Draft NUREG/CR-xxxxx, INEEL/EXT-02-10307, "SPAR-H Method," is an appropriate tool for evaluating the probability of operators recovering from a loss of Division I service water.

- The probability of operators failing to properly diagnose the need to restore Division II service water gland water upon a loss of Division I service water is 0.4. This assumed the nominal diagnosis failure rate of 0.01 multiplied by the following performance shaping factors:

  - Available Time: 10

    The available time was barely adequate to complete the diagnosis. The analyst assumed that the diagnosis portion of this condition included all activities to identify the mispositioned valves. A licensee operator took 21 minutes to complete the steps. The analyst noted that this walk through was conducted in a vacuum. During a real incident, operators would have to prioritize many different annunciators. Additionally, operations personnel had been briefed on the finding at a time prior to the walk through, so they were more knowledgable of the potential problem than they would have been prior to the identification of the finding.

  - Stress: 2

Stress under the conditions postulated would be high. Multiple alarms would be initiated including a loss of the Division I service water and the loss of gland water to Division II. Additionally, assuming that indications of gland water failure were believed, the operators would understand that the consequences of their actions would represent a threat to plant safety.

- Complexity: 2

The complexity of the tasks necessary to properly diagnose this condition was determined to be moderately complex. The analyst determined that there was some ambiguity in the diagnosis of this condition. The following factors were considered:

- Division I would be lost and may be prioritized above Division II.
- The diagnosis takes place at both the main control room and the auxiliary panel in the service water structure and requires interaction between at least two operators.
- There have previously been alarms on gland water annunciators when swapping Divisions. Therefore, operators may hesitate to take action on Division II given problems with Division I.
- Previous heat exchanger clogging events may mislead the operators during their diagnosis.

Initiating Event Calc

The analyst calculated the new initiating event likelihood, $IEL_{(TSW\text{-}case)}$, as follows:

$$IEL_{(TSW\text{-}case)} = IEL_{(TSW)} + [\ ½ * \ IEL_{(PTSW)}\ ] =$$

$$9.72 \times 10^{-4} + [\ 0.5 * 8.92 \times 10^{-3}\ ] =$$

$$5.43 \times 10^{-3}/\text{ yr} \div 8760 \text{ hrs/yr}$$

$$6.20 \times 10^{-7}/\text{hr}.$$

SPAR Baseline Result: 4.82×10^{-9} /hr
SPAR Case Result: 1.74×10^{-8} /hr

The change in core damage frequency (ΔCDF) from the model was 1.26×10^{-8} /hr. Therefore, the change related to this finding was calculated as:

$\Delta CDF = 1.26 \times 10^{-8}$ /hr * 24 hr/day * 21 days = 6.35×10^{-6} for 21 days

The analyst utilized the SPAR model for evaluation of this condition[ ] Ex 5

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All other initiating events were left at their nominal values in the model logic.

This results in a corroboration of the result from the risk-informed notebook.

External Events

In accordance with Manual Chapter 0609, Appendix A, Attachment 1, Step 2.5, "Screening for the Potential Risk Contribution Due to External Initiating Events," the analyst assessed the impact of external initiators because the Phase 2 SDP result provided a Risk Significance Estimation of 7 or greater.

The analyst concluded that most external initiators were not major contributors to the increased risk caused by this finding. All four service water pumps are located in the same room at the same elevation. Both primary switchgear are at the same elevation and in adjacent rooms. Therefore, the analyst assumed that high winds, internal and external flooding events, and transportation accidents would impact the equipment equally. Therefore, any failures of the service water system caused by these initiators would be baseline risk.

However, the analyst concluded that internal fires had the potential to affect the change in core damage frequency. The major contributors were various fires in the pump room and a fire in Switchgear 1F. The following analysis was conducted:

Large Early Release Frequency (LERF)

In accordance with Manual Chapter 0609, Appendix A, Attachment 1, Step 2.6, "Screening for the Potential Risk Contribution Due to LERF," the analyst assessed the impact of large early release frequency because the Phase 2 SDP result provided a risk significance estimation of 7. A loss of service water is a special initiator for a transient. Step 2.6 requires a LERF evaluation for all reactor types if the risk significance estimation is 7 or less and transient sequences are involved.

In accordance with Manual Chapter 0609, Appendix H, "Containment Integrity SDP," the analyst determined that this was a Type A finding, because the finding affected the plant core damage frequency.

[ ] Ex 5

Evaluation of the Licensee's Analysis

[ ] Ex 5

VI. References:

- INEEL Standardized Plant Analysis Risk Model for Cooper, Revision 3.01
- Risk-Informed Inspection Notebook for Cooper Nuclear Station, Revision 1
- Manual Chapter 0609, Appendix A, "Significance Determination of Reactor Inspection Findings for At-Power Situations"
- Inspection Manual Chapter 0609, Appendix H, "Containment Integrity SDP"
- Telecon with Nebraska Public Power District, 4/26/2004
- Licensee Analysis PSA-ES062, "Risk Significance of SCR 2004-0077, Service Water Gland Water Valve Mis-positioning Event."
- Email from Steve Cochrum dated
- Email from Scott Schwind dated
- Email from Glen Seeman dated
- Email from Kent Sutton dated

VII. Participation:

Lead Inspector: Scott Schwind
Analyst: David Loveless
Peer Reviewer: