



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION IV  
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March 31, 2005

EA-04-131

Randall K. Edington, Vice  
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**SUBJECT: COOPER NUCLEAR STATION - NRC INSPECTION REPORT  
05000298/2004014 - FINAL SIGNIFICANCE DETERMINATION FOR A  
PRELIMINARY GREATER THAN GREEN FINDING**

Dear Mr. Edington:

The purpose of this letter is to provide you the final results of our significance determination of the preliminary Greater than Green finding identified in the subject inspection report dated August 12, 2004. The finding involved the failure to restore the Cooper Nuclear Station Division 2 service water gland seal water supply to a normal alignment following maintenance on the discharge strainer. This error, which occurred on January 21, 2004, resulted in Division 2 of the service water system and Emergency Diesel Generator 2 being inoperable for 21 days. The finding was documented in NRC Inspection Report 05000298/2004014.

In the cover letter of the subject report we informed Nebraska Public Power District (NPPD) of the NRC's preliminary conclusion and provided NPPD an opportunity to request a regulatory conference on this matter. On September 27, 2004, a regulatory conference was conducted at the NRC Region IV office in Arlington, Texas. During this meeting NPPD described their assessment of the findings, including a detailed discussion of a service water pump test that determined the impact of running the pump without gland seal water. Additionally, NPPD stated they agreed with the apparent violation related to this finding and described the corrective actions taken for the underlying performance deficiency.

The NRC has considered the information developed during the inspection, the additional information you provided in your letter dated August 9, 2004, the information you provided at the Regulatory Conference, and the information you provided in your October 7, 2004, letter following the conference. After evaluating this information, the NRC concluded that a more realistic failure probability for the service water system should be used. This new probability reflected the results of your testing, as well as the inherent capabilities of the system.

Additionally, the NRC reviewed information you provided regarding the change in large early release frequency (LERF) that resulted from the performance deficiency. NRC Inspection Manual Chapter 0609, Appendix H, defines LERF as "The frequency of those accidents leading

to a significant, unmitigated release from containment in a time frame prior to effective evacuation of the close-in population such that there is a potential for early health effects.” NPPD provided information asserting that effective evacuation of the close-in population could be achieved prior to a release of radioactivity during the dominant accident sequences. After review of accident progression timing, the staff determined that the dominant sequences affected by this finding were not LERF contributors.

On the basis of this information, the NRC has concluded that the inspection finding is of very low safety significance (Green). The final significance determination is attached as an enclosure to this letter. The NRC has also determined that a violation was associated with this issue involving the failure of Clearance Order SWB-1-4324147 SW-STNR-B to provide adequate instructions to restore the service water system to an operable configuration following completion of maintenance activities on January 21, 2004. This violation is being treated as a noncited violation, consistent with Section VI.A of the Enforcement Policy.

If you contest the violation or its significance, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with copies to the Regional Administrator, U.S. Nuclear Regulatory Commission, Region IV, 611 Ryan Plaza Drive, Suite 400, Arlington, Texas 76011-4005; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at the Cooper Nuclear Station facility.

In accordance with 10 CFR 2.390 of the NRC’s “Rules of Practice,” a copy of this letter and its enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC’s document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

***/RA/ by AVegel for***

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## Enclosure

### Final Significance Determination Cooper Nuclear Station Service Water Gland Seal Water Configuration Deficiency

The NRC reviewed the information provided by the licensee in their analysis, PSA-ES63, Revision 0, "Temporary Alignment of Service Water Division I Gland Water Supply to SW Pumps in Both Divisions," dated August 9, 2004, plus additional information provided in a letter dated August 9, 2004, and presented during the Regulatory Conference held on September 27, 2004. Using the additional data provided by the licensee, as well as evaluations and input from the NRC staff, a final significance determination was performed by modifying the preliminary evaluation, as appropriate. The documentation that follows is not a stand-alone evaluation. The reader must also be familiar with the preliminary significance determination documented in NRC Special Inspection Report 05000298/2004014, Section 1R04.b(3), "Analysis."

#### I. Internal Events:

The NRC reviewed the testing data and other pertinent information provided by the licensee. The following characterizes each of the changes made to the assumptions in the NRC's preliminary significance determination:

- a. The service water pumps at Cooper will fail to run 50 percent of the time 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 NRC determined that the test conducted by NPPD on a representative pump indicated that service water pumps, when run without gland water, would not always fail as originally assumed. However, uncertainties in the data and differences identified between the test configuration and the actual plant indicated that a significant potential remained that a pump would fail if gland water were lost for greater than 30 minutes. Therefore, a bounding value of 50 percent was used.

- b. Vital battery depletion is best represented as occurring at 8 hours following a station blackout rather than at 4 hours as modeled in the Standardized Plant Analysis Risk (SPAR) Model for Cooper. This assumption was based on resident inspector review of the licensee's calculation provided following the regulatory conference.
- c. The probability of operators failing to properly diagnose the need to restore Division II service water gland water to the running pump upon a loss of Division I service water is 0.4. The NRC calculated this value in the preliminary significance determination. However, the value was applied to both pumps in the preliminary significance determination. The NRC applied this value only to the operating pump in the final significance determination because there would have been additional time to recover gland water for the standby pump.

- d. The probability of operators failing to properly diagnose the need to restore Division II service water gland water to the standby pump upon failure of the running pump is 0.05. This results in a conditional probability of recovering gland water to the standby pump, given a failure to recover gland water to the running pump, of 0.125.

For this calculation, the NRC used the same performance shaping factors used in the case of the running pump with the following exceptions: the available time was changed from barely adequate to extra time (0.1) because the time to perform this action was now greater than 60 minutes, and Odd's ratio<sup>1</sup> was applied to better quantify the multiple performance shaping factors.

- e. The conditional probability that Division II service water fails to survive upon demand given that Division I fails is  $2.65 \times 10^{-2}$ .

The NRC developed an event tree to better model the failure of the service water system without gland water available. This model indicated that, upon a failure of the running pump, the availability and reliability of the standby pump should be evaluated. Additionally, the degradation of the test pump observed during the licensee's testing was assumed to reduce the capability of the pumps to fulfill their mission after running without gland water for any period longer than 30 minutes. The event tree also included a small probability that the pumps would continue to run for 24 hours without any gland seal water as indicated by the licensee's testing. The NRC then quantified this event tree to obtain the probability.

The NRC used Assumption b to adjust the baseline SPAR model. The resulting baseline core damage frequency,  $CDF_{base}$ , was  $5.05 \times 10^{-9}/hr$ .

The NRC changed the modified SPAR model discussed in the preliminary significance determination to account for all changes in assumption discussed above. The NRC changed the recovery action value from the preliminary determination to the conditional probability that Division II service water fails to survive upon demand given that Division I fails provided in Assumption e. The modified SPAR model was requantified with the resulting current case conditional core damage frequency,  $CDF_{case}$ , of  $6.26 \times 10^{-9}/hr$ .

The change in core damage frequency ( $\Delta CDF$ ) from the revised models was calculated as follows:

$$\Delta CDF = CDF_{case} - CDF_{base} = 6.26 \times 10^{-9} - 5.05 \times 10^{-9} = 1.21 \times 10^{-9}/hr.$$

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<sup>1</sup>Odd's ratio is a method of accounting for the number of successes as well as failures when calculating a condition human error probability. This method of accounting for uncertainties associated with individual performance shaping factors is described in draft NUREG-CR-XXXXX (INEEL/EXT-02-10309), "SPAR-H METHOD," and tends to provide a less conservative result.

Therefore, the total change in core damage frequency over the exposure time that was related to this finding was calculated as:

$$\Delta\text{CDF} = 1.21 \times 10^{-9}/\text{hr} * 24 \text{ hr/day} * 21 \text{ days} = 6.10 \times 10^{-7} \text{ for 21 days}$$

The final risk significance of this finding is presented in the following table. The dominant cutsets from the internal risk model were essentially the same as provided in the preliminary significance determination.

<b>Table I</b> <b>Final Significance Determination</b> <b>Evaluation Model Results</b>		
Model	Result	Core Damage Frequency
SPAR 3.03, Revised (and modified for final determination)	Baseline: Internal Risk	$5.1 \times 10^{-9}/\text{hr}$
	Internal Events Risk	$6.3 \times 10^{-9}/\text{hr}$
	TOTAL Internal Risk ( $\Delta\text{CDF}$ )	$6.1 \times 10^{-7}$
	TOTAL External Risk ( $\Delta\text{CDF}$ )	$2.3 \times 10^{-7}$
	TOTAL Internal and External Change ( $\Delta\text{CDF}$ )	$8.4 \times 10^{-7}$

**II. External Initiators:**

The NRC made no changes to the models, techniques, and assumptions used in evaluating the external initiators contribution to the  $\Delta\text{CDF}$  from those presented in the preliminary significance determination. However, the NRC used the changes in assumption to the internal events evaluation and the revised SPAR model to requantify the core damage frequency related to internal fires. Internal fire was the only external initiator determined to affect the  $\Delta\text{CDF}$  in the preliminary significance determination. The revised values are presented in Table II.

<b>Table II</b> <b>Final Significance Determination</b> <b>External Initiators (Internal Fire) Results</b>		
Fire Areas:	Fire Type	$\Delta$ CDF
Switchgear 1F	Shorts Bus	$4.65 \times 10^{-10}/\text{hr}$
Service Water Pump Room	One Pump	$1.45 \times 10^{-15}/\text{hr}$
	Both Pumps	$1.04 \times 10^{-14}/\text{hr}$
$\Delta$ CDF for All Fires Affecting the Service Water System:		$4.65 \times 10^{-10}/\text{hr}$
Exposure Time (21 days):		$5.04 \times 10^2 \text{ hrs}$
Total External Events $\Delta$ CDF over the Exposure Period:		$2.34 \times 10^{-7}$

**III. Large Early Release Frequency (LERF):**

The NRC reevaluated the portions of the preliminary significance determination related to the change in LERF. In the regulatory conference, the licensee stated that the dominant sequences were not contributors to the LERF. Therefore, there was no change in LERF resulting from the subject performance deficiency. The licensee indicated that the postulated core damage sequence took more time than the average to progress to core damage. This provided additional time to core damage and the relatively short time estimated to evacuate the close-in population surrounding Cooper Nuclear Station.

LERF is defined in NRC Inspection Manual Chapter 0609, Appendix H, "Containment Integrity Significance Determination Process" as: "the frequency of those accidents leading to significant, unmitigated release from containment in a time frame prior to the effective evacuation of the close-in population such that there is a potential for early health effect." The NRC noted that the dominant core damage sequences documented in the preliminary significance determination were long sequences that took greater than 12 hours to proceed to reactor pressure vessel breach. The shortest calculated interval from the time reactor conditions would have met the requirements for entry into a general emergency (requiring the evacuation) until the time of postulated containment rupture was 3.5 hours. The licensee stated that the average evacuation time for Cooper from the declaration of a General Emergency was 62 minutes.

The NRC determined that, based on a 62-minute average evacuation time, effective evacuation of the close-in population could be achieved within 3.5 hours. Therefore, the dominant core damage sequences affected by the subject performance deficiency were not LERF contributors. As such, the NRC's best estimate determination of the change in LERF resulting from the performance deficiency was zero.

#### **IV. Conclusion:**

Based on reanalysis of the preliminary significance determination, the NRC concluded that the subject inspection finding was of very low safety significance (Green). This result was based on a more realistic failure probability for the service water system derived using the results of the licensee's testing program, as well as the inherent capabilities of the system. The total change in CDF, after adjusting for this revised system failure probability, was estimated to be  $8.4 \times 10^{-7}$ . Additionally, the NRC determined that there was no change in LERF because, during the dominant accident sequences, effective evacuation of the close-in population could be achieved prior to the release.