R4-2A6

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 and 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% 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 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% 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 analyst calculated this value in the preliminary significance determination. However, the value was applied to both pumps in the preliminary. The NRC will apply this value only to the operating pump in the final significance determination.

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. 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 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 2.65×10^{-2}.

The NRC developed an event tree to better model the failure of the service water system without gland water available. The event tree reflected a holistic approach to determining the survivability of the service water system. 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 5.05×10^{-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 6.26×10^{-9}/hr.

The change in core damage frequency (ΔCDF) from the revised models was calculated as follows:

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

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

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

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.

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

II. External Initiators:

The NRC made no changes to the models, techniques, and assumptions used in evaluating the external initiators contribution to the ΔCDF 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, the only external initiator determined to affect the change in core damage frequency in the preliminary determination. The revised values are presented in Table II.

Table II Final Significance Determination External Initiators (Internal Fire) Results		
Fire Areas:	Fire Type	ΔCDF
Switchgear 1F	Shorts Bus	4.65×10^{-10}/hr
Service Water Pump Room	One Pump	1.45×10^{-15}/hr
	Both Pumps	1.04×10^{-14}/hr
ΔCDF for All Fires Affecting the Service Water System:		4.65×10^{-10}/hr
Exposure Time (21 days):		5.04×10^{2} hrs
Total External Events ΔCDF over the Exposure Period:		2.34×10^{-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 argued that the dominant sequences were not contributors to the LERF. Therefore, there was no change in LERF resulting from the subject performance deficiency. Their argument was based on the longer than usual core damage sequences, providing for 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.