RELEASE SEVERITY AND TIMING CLASSIFICATION SCHEME
(SEVERITY, TIMING)

Release Severity Source Term Release Fraction		Release Timing	
Classification Category	Cs Iodide % in Release	Classification Category	Time of Release[1] (noble gases or CsI)
High (H)	greater than 10	Late (L)	greater than 24 hours
Moderate (M)	1 to 10	Intermediate (I)	4 to 24 hours
Low (L)	0.1 to 1	Early (E)	less than 4 hours
Low-low (LL)	less than 0.1		
Negligible (OK)	<< 0.1		

Three timing classifications are used, as follows:

1. Early (E) — less than 4 hours after General Emergency Declaration
2. Intermediate (I) — greater than or equal to 4 hours, but less than 24 hours
3. Late (L) — greater than or equal to 24 hours after General Emergency declaration.

The definition of the categories is based upon past experience with offsite responses:

- 0-4 hours is conservatively assumed to include cases in which minimal offsite protective measures have been observed to be performed in non-nuclear accidents.
- 4-24 hours is a time frame in which much of the offsite nuclear plant protective measures can be assured to be accomplished.
- > 24 hours are times at which the offsite measures can be assumed to be fully effective.

There are four classes of Emergency Action Levels: Notification of Unusual Event, Alert, Site Emergency and General Emergency. The General Emergency action level is used in this analysis as the timing reference point as it is the level associated with the declaration of public evacuation.

[1] Time relative to declaration of General Emergency

A-1

Table 3.5-1 provides a summary of the estimated time to declare a General Emergency during the different accident scenarios. As can be seen from Table 3.5-1, the time to the declaration of a General Emergency is an hour or less for most accident types.

Using the information in Table 3.5-1 and CNS accident progression timings, Table 3.5-2 provides a useful summary of the release timing characteristic for the different plant damage states and various release modes. For example, a containment isolation failure release for a TQUV accident results in an Early release. As another example, a SBO accident with in-vessel recovery but no containment heat removal methods (and subsequent containment failure) results in a late release.

In the event of multiple containment release pathways (e.g., containment overtemperature failure and subsequent sump melt-through), the release timing is classified consistent with the earlier release mode (overtemperature failure in this example).

PROBABILISTIC SAFETY ASSESSMENT

COOPER NUCLEAR STATION

ENGINEERING STUDY

Risk Significance of SCR 2004-0077
Service Water Gland Water Valve Mis-positioning Event

PSA-ES062

Prepared: Glen A Seeman, Risk Management Date:

Reviewed: Steve K Nelson & George R Sawtelle, Risk Management Date:

Approved: Kent Sutton, Risk Management Supervisor Date:

Revisions:

Number	Description	Reviewed By	Date	Approved By	Date
0	Original Issue				

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AA-3

Problem Statement

On February 11, 2004, a Station Operator was validating a valve line-up on the Service Water (SW) Gland Water (GW) System to assess the cause of low gland water supply pressure. The Station Operator discovered SW-V-28 closed, SW-V-1479 open, and SW-V-1480 open which was not the expected configuration. The effect of this lineup was that SW GW Subsystem B was being supplied by SW Subsystem A. SW GW Subsystem B was in this configuration since maintenance was performed on the B Zurn Strainer on January 21, 2004.

In order to assist in a significance determination of these identified conditions, a risk assessment is provided. This risk assessment included evaluating this condition for exposure time and change in core damage frequency (CDF). The exposure time was multiplied by the change in CDF to determine the increased core damage probability (ΔCDP).

Assumptions

1) CNS On-line Maintenance Model results apply.

2) The condition evaluated is limited to the valve line-up described in the problem statement.

3) The SW pumps can run 30 minutes with no GW flow and complete the PRA mission time if GW is restored by the end of 30 minutes, Reference 1.

4) The average time to respond to the GW trouble alarm or SW pump bearing low flow alarm and restore valve line-up is 20 minutes, see discussion below.

Limitations of this Evaluation

This evaluation is applicable to the specific conditions being evaluated in this study. It does not address the risk significance of other plant issues or equipment unavailability, procedural or configuration changes or modifications.

Conclusion

This condition has been evaluated and is not risk significant. The affect on Core Damage Frequency due to the SW Gland Water valve mis-positioning was evaluated by adding a dependency on SW System A to the SW System B pumps and a recovery factor. The recovery factor was based on a time validation performed by Operations. The increased CDF was multiplied by the time the condition existed to estimate increased core damage probability (ΔCDP). The ΔCDP has been calculated as 3.85E-07. This increased CDP is less than 1.0E-06, therefore, this condition is not risk significant.

Evaluation

With the SW Gland Water Subsystem B in this configuration, a failure of both SW Subsystem A pumps would have resulted in the SW Subsystem B pumps running without GW flow. GW trouble is alarmed in the Control Room. Each SW Subsystem has a GW supply trouble alarm (B-3/E-6 for Subsystem B) and SW pump bearing low flow alarm (B-3/D-6 for Subsystem B). In the event of failure of both SW Subsystem A pumps, an Operator would have had 30 minutes to restore the GW line-up to prevent failure of the SW Subsystem B pumps, reference Assumption 3.

Time Required to Restore GW Valve Line-up

The Operations Supervisor validated the time required to restore the SW GW valve line-up using a newly qualified Non-Licensed Operator (~3 months), Reference 3. The simulated valve line-up was restored in 21 minutes. Twenty-one minutes is considered conservative due to the time added by the Operations Supervisor's interactions in the scenario. Given that a more experienced NLO would require less time, the time to restore the GW valve line-up is estimated at 20 minutes.

Additional discussions with the Operations Supervisor indicated that, due to previous problems with the SW GW system, Operations has been sensitized to GW problems and their effect on the operability of the SW pumps. Therefore, SW GW alarms would be investigated.

Human Error Probability to Restore GW Valve Line-up

The human error probability (HEP) to restore the GW valve line-up will be estimated using the method described in Reference 2 for post-accident human reliability analysis (HRA). For the estimation of post-accident HEP, the most important factors are: 1) time available; 2) availability of relevant procedures and training; and 3) the degree to which operators become burdened by multiple tasks or conflicting demands. These terms are defined as:

1) time available: given that 30 minutes is available to restore GW flow to the SW pumps and maintain their availability and 20 minutes is required to restore the GW valve line-up after receipt of the SW GW alarms, 10 minutes is available for diagnosis.
2) Availability of relevant procedures and training – the Alarm Procedures 2.3_B-3 and 2.3_SW-GLND-B and the System Operating Procedure 2.2.71 provide the required instructions to realign the SW GW valves.
3) Degree to which operators become burdened by multiple tasks or conflicting demands – it will be assumed that the operators have to deal with more than one event. The operators could be dealing with a range of conditions from a single event (failure of the SW System A pumps), to plant transients which cause failure of the SW System A pumps, eg. LOSP and failure of DG1.

Using the above information, the HEP Estimate Table for More Than One Abnormal Event with procedures is entered from Reference 2. For 10 minutes, the mean probability of error is 9.2E-2. For this evaluation, an HEP of 0.1 will be assumed.

Increase in Core Damage Frequency

To assess the increase in core damage frequency (CDF), gates were added to the Division II SW pumps which would result in failure if both Division I SW pumps do not operate. An example of the modifications is displayed in Figures 1 and 2 of Attachment 1. The added gate is G059, DIV II on DIV I GW WITH RECOVERY, as shown on the lower right of Figure 1 and in Figure 2 of Attachment 1. The inputs into this gate are failures of both SW System A pumps including support system failures and the recovery event with a probability of 0.1 as described above.

1.74×10^{-8}

The PRA model with the changes described above was then re-solved and the resulting CDF was 1.20E-05/yr. The base CDF with zero test and maintenance terms, 7.80E-06/yr [Reference 4], was subtracted from the resulting CDF to identify the change in CDF (= 4.20E-06/yr).

The applicable time frame for this condition is 21 days as described in the Problem Statement – January 21 to February 11. The increased core damage probability is calculated as

$$\Delta CDP = 4.20E\text{-}06/yr * 21 \text{ days} / 365 \text{ days/yr} = 2.42E\text{-}07.$$

Since the zero test and maintenance model was used, the maintenance schedule was reviewed to determine maintenance outages for equipment which significantly effects CDF. The following maintenance configurations were identified and evaluated for increased core damage probability (including the evaluated condition):

1) For 13 hours the following equipment was out of service (OOS) DG-2, CW-Pmp-B, IAS-Dryer-A, IAS-Comp-B with a resulting ΔCDP of 7.97E-08.
2) For 17 hours RCIC, CW-Pmp-B and CW-Pmp-D were OOS with a resulting ΔCDP of 4.30E-08.
3) For 20 hours HPCI, CW-Pmp-B and CW-Pmp-C were OOS with a resulting ΔCDP of 2.90E-08.
4) For 2.5 hours DG-1 and CW-Pmp-B were OOS with a resulting ΔCDP of 1.39E-08

Since these maintenance configurations lasted 52.5 hours, two days will be subtracted from the condition ΔCDP or

ΔCDP =4.20E-06/yr * 19 days / 365 days/yr = 2.19E-07.

The maintenance configuration CDP increases were added to the ΔCDP for the condition:

ΔCDP =2.19E-07+7.97E-08+4.30E-08+2.90E-08+1.39E-08=3.85E-07

This ΔCDP is less than 1.0E-06, therefore, this condition is not risk significant.

Additional recoveries were investigated including:

1) Recovery of certain long term core damage sequences due to loss of containment heat removal using EOPs, 5.2SW, and 5.2REC to make a CRD pump available for injection.
2) Recovery of NBI-LIS72s failures including mis-calibrations using EOP directions to start RPV injection.
3) More accurate HEP to initiate alternate quad cooling to Core Spray quads given realistic time available to initiate alternate cooling.

These recoveries would have reduced the increased core damage probability but were not included in the calculated results.

References

1) Memo from Gerald D. Harrelson, Johnston Pump Company, to Dwight Vorphal, Service Water System Engineer, dated January 15, 2003

2) PAG-006: Project Analysis Guideline for the Cooper Nuclear Station Probabilistic Risk Assessment Human Reliability Analysis Task

3) Time Validation of Loss of 125VDC A from 100% Power with SWGW Cross-tied, Email from Mike Tackett, Operation Supervisor dated March 1, 2004.

4) ORAM-Sentinel On-Line Risk Model

Attachments

Initials	Printed Name	Initials	Printed Name	Initials	Printed Name
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Operations Supervisor or Designee Review: ______________________ Date: ________

RECORDS

Entire procedure is sent to Operations Clerk (quality record upon review signature).

ATTACHMENT 9 SIGN-OFF AND REVIEW SHEET

Initial/date by each discrepancy or resolution listed.

#	DISCREPANCIES	#	RESOLUTIONS