RISK CONSIDERATIONS ASSOCIATED WITH GSI-191,

"ASSESSMENT OF DEBRIS ACCUMULATION ON PWR SUMP PERFORMANCE"

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SCOPE OF WORK:

- -- CALCULATE THE DECREASE IN CORE DAMAGE FREQUENCY FROM FIXING THE SUMP-SCREEN CLOGGING PROBLEM
- -- CALCULATE THE MONETIZED BENEFITS FROM FIXING THE SUMP-SCREEN CLOGGING; BENEFITS CONSIST OF:
  - -- EXPECTED AVERTED POPULATION DOSE TO 50 MILES, MONETIZED AT $2000 PER PERSON-REM
  - -- EXPECTED AVERTED OFFSITE FINANCIAL COSTS
  - -- EXPECTED AVERTED ONSITE COSTS (CLEANUP AND DECONTAMINATION; REPLACEMENT POWER)
  - -- EXPECTED AVERTED ONSITE OCCUPATIONAL DOSE, MONETIZED AT $2000 PER PERSON-REM

The methodology and assumptions will be discussed today.

OUTLINE OF APPROACH FOR CORE DAMAGE FREQUENCY CONTRIBUTION

The core damage sequence associated with sump screen clogging is:

LOCA(n)*RECIRC*SUMP-CLOGS*NON-RECOVERY

Here the n indexes the various size LOCAs.

LOCA(1)= Large LOCA=A

LOCA(2)=Medium LOCA=S1

LOCA(3)=Small LOCA=S2

LOCA(4)=RCP Seal LOCA

RECIRC= Event that ECCS recirculation is required

SUMP-CLOGS= Event that the sump screen clogs to the point that ECCS recirculation fails

NON-RECOVERY= Event that recovery actions fails

INITIATING EVENT FREQUENCIES

-- **OBTAINED FROM NUREG/CR-5750 ("Rates of Initiating Events at U.S. Nuclear Power Plants: 1987-1995", February 1999)**

INITIATING EVENT FREQUENCIES

		+seismic
Large LOCA (> 6 inches)	7E-6/yr	1E-5/yr
Medium LOCA (2 to 6 inches)	4E-5/yr	8E-6/yr
Small LOCA (0.5 to 2 inches)	5E-4/yr	1.6E-5/yr
Very Small LOCA	6.2E-3/yr	
Stuck-Open Safety Relief Valve	5E-3/yr	
Reactor Coolant Pump Seal LOCA	2.5E-3/yr	

(Large LOCA frequency updated to take into account V.C. Summer event)

Seismic frequencies from NUREG-1150 study for Surry; Used old (1988) LLNL hazard curves

EVALUATION OF "RECIRC" AND "NON-RECOVERY"

- Three different types of plants considered:
  - Plants with large dry containments, emergency fan coolers, and large refueling water storage tanks (RWSTs)
  - Plants with sub-atmospheric containments
  - Plants with ice-condenser containments
- For medium LOCAs and large LOCAs, it was assumed that it was certain to need to go to sump recirculation, and no credit was given for recovery
- For very small break LOCAs it was assumed that the chance of needing to go to recirculation was negligible.
- For stuck-open pressurizer safety valves, the probability of sump clogging was considered to be so small that the sequences could be neglected.

EVALUATION OF "RECIRC" AND "NON-RECOVERY", continued

-- Therefore, the distinctions between the plant types only enter for small break LOCAs and RCP seal LOCAs.

-- RCP SEAL LOCAs:

  -- Plants with large dry containments or sub-atmospheric containments

    -- "RECIRC" PROBABILITY = 0.05 (REF: p. D-70 of NUREG/CR-4550, Vol. 5, Rev. 1, Part 2–for Sequoyah, cases where sprays are not actuated)

    -- "NON-RECOVERY" PROBABILITY = 0.1 (REF: COMANCHE PEAK IPE, P. 3-198)

EVALUATION OF "RECIRC" AND "NON-RECOVERY", continued

- -- Plants with ice condenser containments (RCP seal LOCA)

  - -- "RECIRC" PROBABILITY = 0.43 (40% of RCP seal LOCAs result in containment spray actuation, for the other 60% of RCP seal LOCAs 0.05 human error probability; from Sequoyah NUREG/CR-4550 reference given above.)

  - -- "NON-RECOVERY" PROBABILITY = 0.3 (from Sequoyah IPE, event HAMU3, Table 3.3.3-4 of the IPE)

EVALUATION OF "RECIRC" AND "NON-RECOVERY", continued

- Small-break LOCA
  - Plants with large dry containments
    - "RECIRC" PROBABILITY= 0.1
    - "NON-RECOVERY" PROBABILITY= 0.1 (Comanche Peak IPE)
  - Ice-condenser plants
    - "RECIRC" PROBABILITY=1.0, no chance of avoiding going to sump recirculation
    - "NON-RECOVERY" PROBABILITY=0.3

EVALUATION OF "RECIRC" AND "NON-RECOVERY", continued

- -- Sub-Atmospheric containment plants
  - -- "RECIRC" PROBABILITY=0.7 (If containment sprays are actuated, may fail RHR system, which is inside containment)
  - -- "NON-RECOVERY" PROBABILITY=0.3 (RHR may not be available)

PROBABILITY OF SUMP CLOGGING

This was treated by parametric variation. The following probabilities were assigned:

"very likely"	P=1
"likely"	P=0.6
"possible"	P=0.3
"unlikely"	P=0

Various combinations are considered, for the various size LOCAs.

MONETIZED BENEFITS FROM AVERTING ACCIDENTS ASSOCIATED WITH SUMP CLOGGING

Generally, NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook", was followed.

For the population dose, the data given for Zion in Table 5.3 of this reference was used; note that the actual population density around Zion is not used, but the population density corresponding to an 80th percentile population density was used. A small break LOCA sequence was considered. This is conservative in two ways: the Zion dominant small break LOCA sequence was failure in injection and not recirculation. This means the cavity under the reactor vessel was not flooded, which increases the population dose. Also, for the consequences, all LOCAs were assumed to be small break LOCAs. Small break LOCAs have a higher chance of failing containment, although the probability was estimated to be small, about 2%.

Results, for various combinations of the probabilities of sump clogging for the types of plants considered are being generated. The large dry containment type of plant may be optimistic for some plants with large dry containments, if they do not have large RWSTs and emergency fan coolers.