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AREVA NP Inc.
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SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: 19
SPLA Branch

QUESTIONS

19-125

Provide the frequencies of each sequence leading to core damage in both the internal events and shutdown models (for example, by annotating the event trees in Appendices 19A and 19B). For the “significant” sequences (i.e., with a sequence frequency greater than 1 percent of internal events or shutdown core damage frequency (CDF) or those that have an aggregate contribution of 95 percent of CDF when ranked by frequency), describe the scenario that each sequence represents.

19-126

Further information is needed on significant equipment and operator actions for all elements of the U.S. EPR probabilistic risk assessment (PRA). Specifically:

1. The tables of importance measures in Chapter 19 of the Final Safety Analysis Report (FSAR) appear not to include all “significant” equipment failures and operator actions above the thresholds referred to on page 19.1-54 of the FSAR. For example, Table 19.1-8 includes several failures with a risk achievement worth (RAW) greater than two that are not included in Table 19.1-9. Amend all relevant tables to include all entries above these thresholds.
2. The tables appear to group components from multiple trains. Are the listed importance measures the highest of any component in the group? If asymmetric modeling results in significantly different importance measures for components within a group, present the components separately in the tables and discuss the assumptions that result in the difference.
3. The tables refer to components rather than basic events that represent specific failure modes. Discuss how the importance measures account for the contribution of all modeled failure modes of the components.

19-127

(Follow-up to Question 19-03) Discuss whether the maintenance assumptions outlined in the response to Question 19-03 were applied to all equipment modeled in the PRA. If maintenance was excluded or reduced for certain equipment, provide the associated assumptions and discuss how the assumed conditions will be maintained in the as-to-be-operated plant (e.g., by adding them to Table 19.1-102 of the FSAR).

19-128

(Follow-up to Question 19-10) Provide additional justification related to the statement in response to Question 19-10 that the change to medium dependence between post-maintenance testing and independent verification is “not significant (less than 5% impact on the total CDF).” The importance measure tables in Chapter 19 do not appear to include any specific maintenance-related pre-initiator human errors. Please list the basic events that were included in determining that the impact is not significant, and the Fussell-Vesely (FV) and risk achievement worth (RAW) importance measures for each. Provide the results of a sensitivity study in which complete dependence is assumed as suggested by the ASEP method. In addition, justify using a medium dependence derived from the Technique for Human Error Rate Prediction (THERP) human reliability analysis (HRA) method in an analysis based on the Accident Sequence Evaluation Program (ASEP) method.

19-129

(Follow-up to Question 19-04) The table provided in response to Question 19-04 includes a sump strainer plugging failure rate of 5E-7 per hour (/hr). NUREG/CR-6928 cites a strainer plugging failure rate of 7.8E-6/hr, more than an order of magnitude higher. Given the high importance of sump strainer common-cause failure (CCF) in the U.S. EPR design, justify this lower failure rate.

19-130

Discuss whether failure of digital instrumentation and control (I&C) equipment caused by a loss of cooling was modeled in the U.S. EPR PRA. If the digital I&C design can accommodate loss of cooling, this is a significant assumption about a design feature that should be preserved in the FSAR (e.g., by adding the assumption and its disposition to Table 19.1-102).

19-131

(Follow-up to Question 19-19) Provide additional information on how decay heat loads were calculated for each shutdown plant operating state (POS). The derivation described in response to Question 19-19 may be appropriate for determining initiating event frequencies for each POS. In a real outage, the time of entrance into a given POS may be earlier than the sum of the estimated POS durations, because the durations were extended based on multiple outage types and estimated plant availability. If decay heat loads were based on the POS duration, justify this treatment.

19-132

Justify the exclusion of inadvertent boron dilution as an initiating event in the shutdown PRA.

19-133

Describe the sequence of events that must occur to use emergency feedwater (EFW) and main steam relief for secondary cooling after loss of the residual heat removal system (RHRS), either as an initiating event or following a loss-of-coolant accident (LOCA) or uncontrolled level drop. Page 19.1-162 states that automatic reset of the P13 permissive is needed for automatic emergency feedwater (EFW) operation in POS C. How long will the required temperature and pressure increase take after a loss of RHR? Can the EFW system and main steam relief be actuated manually before P13 resets? If so, is this manual action modeled in the PRA? If not, discuss the impact of the time delay, temperature and pressure increase, and any associated mode changes on subsequent plant response. Provide the input parameters (including temperature, pressure, and decay heat load) used to calculate operator action timing after the various losses of RHRS in all POS.

19-134

Discuss the differences in modeling, assumptions, and equipment and operator dependencies that result in the different significance of heating, ventilation, and air conditioning (HVAC) failures to the shutdown PRA compared to the at-power PRA. Specifically, the operator action to align a maintenance train (OPF-SAC-1H) is far more significant at shutdown (RAW of 96.6 compared to 3.4) and all other HVAC-related failures are much less significant at shutdown.

19-135

Provide an assessment of the impact on the shutdown PRA results of the HVAC modeling uncertainty case, as described in FSAR Section 19.1.4.1.2.7.

19-136

Provide a more detailed discussion of why the assumption on unavailability of the ultimate heat sink (UHS) in station blackout (SBO) conditions has a more significant impact on the shutdown CDF than on the at-power CDF. The FSAR states that the impact could be explained by a high loss-of-offsite-power (LOOP) contribution to shutdown CDF, but LOOP contributes 37 percent of shutdown risk (page 19.1-164), compared to nearly 50 percent at power (page 19.1-51).

19-137

Discuss why failure of an EFW storage tank, which is an important contributor to at-power CDF because it disables all EFW, is not a significant contributor to shutdown risk (i.e., is not included in the tables of important equipment).

19-138

(Follow-up to Question 19-20) Section 19.1.5.2.2.5 of the FSAR states that the essential service water system (ESWS) and demineralized water system (DWS) are automatically isolated if the safeguard or fuel building sumps detect a large flooding event. Are these sensors and isolation signals assumed operable during shutdown? If so, discuss the administrative controls that ensure that the automatic isolation occurs following a flood during shutdown.

19-139

(Follow-up to Question 19-20) The response to Question 19-20 states that, for certain areas, there are “a limited number or points where separation between two areas could be jeopardized and for these areas … the impact on the PRA mitigating systems is very similar." To what specific fire areas does this statement refer? Provide further justification for the statement that the impact is similar. If there are doors or other removable fire barriers between these fire areas, discuss how these barriers will be controlled during shutdown.

19-140

Discuss the analysis of the operator action to align a standby RHRS train in all applicable POS. How does the assessment account for the different actions needed to align a standby train initially in low head safety injection (LHSI) mode versus residual heat removal (RHR) mode? How is the operator action timing derived in each POS?

19-141

Describe how pre-initiator human errors are modeled in the shutdown PRA.

19-142

Provide a more detailed discussion of accident sequences initiated by an uncontrolled level drop in various POS. Specifically, how is spurious opening of the low-pressure reducing station motor-operated valves (MOV) while in mid-loop (i.e., failure to maintain water level) treated differently from failures to stop a controlled drain to mid-loop (i.e., overdrain)? How is the OPF-ULD basic event different from the OPF-ISOCSLPRS basic event?

19-143

Define which failures (e.g., spurious operation of particular valves) are included in the assessment of RHRS flow diversions at shutdown. If any failures are screened out, justify their exclusion. How much time does the operator have to isolate flow diversions in each POS?

19-144

Explain the meaning of the "SA-ESWS UHS4 SBO" basic event listed on page 19.1-396. Does this basic event represent a loss of the entire dedicated severe accident ESWS train? How was the failure probability derived, and what assumptions were made in the derivation?

19-145

Several equipment and operator failures in Tables 19.1-93 and 19.1-95 have RAW values of "1E-NA." Discuss the meaning of this indication. If any of the failure events do have finite RAW values, amend the tables as needed.