DRAFT

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QUESTIONS

19-193

Table 19.1-3 of the Final Safety Analysis Report (FSAR) indicates that very small loss-of-coolant accidents (LOCA) are not modeled because it is assumed that normal charging will maintain the reactor coolant system (RCS) inventory. However, this assumption is not included in the list of assumptions and insights in Table 19.1-102. Additionally, the components associated with charging injection may be inappropriately excluded from probabilistic risk assessment (PRA) input to other programs. Provide additional qualitative and quantitative justification for the exclusion of very small LOCAs, discuss the impact of the exclusion on the U.S. EPR risk profile and on input to other programs such as the reliability assurance program (RAP), and add assumptions and insights to the FSAR as appropriate.

19-194

Justify the exclusion of vessel rupture as an initiating event in the U.S. EPR PRA. Discuss the impact of the exclusion on the U.S. EPR risk profile and on input to other programs such as the reliability assurance program (RAP), and add assumptions and insights to the FSAR as appropriate.

19-195

(Follow-up to Question 19-66) The response to Question 19-66 discusses conservatism in the steam line break inside containment (SLBI) initiating event frequencies as a justification for not modeling feedwater line breaks inside containment (FLBI). However, SLBI represents an overcooling event and FLBI represents an overheating event. Discuss how the PRA model addresses the different mitigating strategies and consequences (e.g., possible lifting and sticking of pressurizer safety relief valves (PSRV)) of the two events.

19-196

To the discussion of system modeling in section 19.1.4.1.1.3 of the FSAR, add a description of the screening process used to exclude failure events or failure modes from the PRA model based on low probability or other considerations. Such screening is addressed by supporting requirement SY-A14 of the ASME

PRA standard (RA-Sb-2005), as endorsed by the U.S. Nuclear Regulatory Commission (NRC) staff in Regulatory Guide (RG) 1.200.

19-197

(Follow-up to Questions 19-70 and 19-5) The cutsets provided in Table 19.1-7 of the FSAR show the initiating event as one element of the cutset rather than including the individual failures that cause the initiating event. Clarify whether the initiating event fault trees are linked to the mitigating system fault trees during quantification, or whether the initiating event frequencies are assessed separately. In addition:

a. How do the cutset examination and sensitivity study presented in response to Question 19-70 address combinations of human errors among initiating events and mitigating systems?

b. How do the correlation classes presented in response to Question 19-5 address combinations of similar components among initiating events and mitigating systems?

19-198

(Follow-up to Question 19-126) The response to Question 19-126 states that the importance measures provided in Chapter 19 of the FSAR are grouped where appropriate, and that “the presented importance measures are always the highest of any component in the group.” Does this statement apply only to the risk achievement worth (RAW) importance measures? That is, does a group’s Fussell-Vesely (FV) importance measure represent the sum of the group’s FV measures, as was made clear for multiple failure modes of a single component?

19-199

(Follow-up to Question 19-127) Question 19-127 asked for the maintenance assumptions for all equipment modeled in the PRA, but the response appears to be limited to “mechanical equipment.” Clarify whether any components modeled in the PRA (e.g., batteries, inverters, buses) that may not be considered “mechanical equipment” have different maintenance assumptions from those stated. If so, these assumptions should be clearly stated in the appropriate location in the FSAR.

19-200

(Follow-up to Questions 19-133 and 19-143) Additional information is needed on the operator action timing assumptions in the U.S. EPR PRA. Specifically:

a. The response to Question 19-143 states that operator isolation of residual heat removal system (RHRS) flow diversions is not credited if less than 25 minutes is available. The response to Question 19-133 appears to credit human action in cases where 16, 27, or 28 minutes are available, but not when 15 minutes are available. Clarify the apparent discrepancy between these two approaches.

b. Page 19.1-42 of the FSAR indicates that the PRA is “not limited to the design philosophy expectation” that operator actions are not required within the first 30 minutes for control room actions or the first 60 minutes for local actions. So that the staff can understand the impact of this approach on the PRA, provide the results of a sensitivity study with no credit for operator actions with less than 30 or 60 minutes available, respectively.

c. Provide additional detail about the “engineering judgment” used to estimate a median time for diagnosis and the adjustment of action times “for actions that entail multiple steps or complexity,” both of which are mentioned on page 19.1-43 of the FSAR.

19-201

(Follow-up to Question 19-139) The response to Question 19-139 did not discuss how doors or removable barriers between fire areas will be controlled during shutdown. Address this aspect of the question, and provide a sensitivity study in which fire areas separated by a door or removable barrier are considered as a single fire area.

19-202

Provide additional information on the emergency feedwater system (EFWS) success criteria in the at-power internal events PRA. Specifically:

a. How many trains of the emergency feedwater system (EFWS) are required for success in various scenarios in the at-power internal events PRA? Provide a summary of the calculations that support these success criteria.

b. Discuss whether the water in EFWS pools is expected to be exhausted in any scenario, and how the refill operation is modeled in the PRA.

c. If EFWS success depends on tripping the reactor coolant pumps (RCP), clarify which scenarios require an RCP trip, discuss how the operator action to trip the RCPs is modeled in the PRA, and document any related assumptions.

19-203

Page 19.1-19 of the FSAR indicates that, as part of the initiating events assessment, a failure modes and effects (FMEA) approach was taken to identify system failures that could affect plant operation. Did this evaluation include (a) spurious actuation of automatic signals and (b) human errors (such as during maintenance)? If so, provide the results of the analysis and discuss how they were incorporated in the PRA. If not, justify the exclusion or amend the PRA and FSAR to include these initiating events.

19-204

Please describe how dependencies between automatic and manual actions (e.g., following a signal failure) have been addressed in the U.S. EPR PRA.

19-205

Please discuss how dependencies between pre-initiator human errors have been addressed in the U.S. EPR PRA.

19-206

(Follow-up to Question 19-56) The response to Question 19-56 indicates that the standstill seal system (SSSS) failure probability of 1.0E-3 is based on engineering judgment. The SSSS design information provided in the FSAR is not sufficient to determine whether this failure probability is appropriate. Provide the following additional information on the SSSS:

a. Discussion of the required support systems (e.g., nitrogen supply, power).

b. Simplified piping and instrumentation diagram (P&ID) that shows the components (e.g, valves, accumulators) needed for system function.

c. Actuation logic for the SSSS and instrumentation and control (I&C) platform used, with supporting diagrams as appropriate (note that if this actuation signal fits into any of the categories described in Chapter 7 of the FSAR, the FSAR should be revised to include it).

19-207

(Follow-up to Question 19-36) The response to Question 19-36 states that "simultaneous loss of AC/DC divisions is very unlikely without a significant spatial impact which is analyzed for the internal hazards." Provide a quantitative justification for this statement, including a discussion of common-cause failure (CCF) of the electrical buses, considering both active and passive components. Also, discuss how bus failures resulting in fire or explosion can affect other electrical buses in the same fire area.

19-208

After a loss of main feedwater, the startup and shutdown feedwater system (SSS) is credited as a mitigating system. Given that certain failures could disable both main feedwater and the SSS, discuss how dependencies between the two systems are modeled in the U.S. EPR PRA. Support the discussion with relevant operating experience and generic data.

19-209

(Follow-up to Question 19-58) The response to Question 19-58 presents the differences between the various loss of component cooling water system (CCWS) and essential service water system (ESWS) initiating events. However, the success criteria and event tree provided in Appendix 19A of the FSAR treats loss of CCWS or ESWS as a single initiating event. So that the staff can clearly understand the impact of these initiators, amend Appendix 19A to specify the success criteria for each sub-initiator (e.g., in some cases, only two trains may be available; in others, the function may be guaranteed to fail). A single event tree is appropriate if the success criteria tables make clear which top events are applicable for each sub-initiator.

19-210

FSAR Chapter 19 indicates that the safety injection system (SIS) common injection check valves are extremely important following a LOCA, given that CCF of these valves disables all safety injection. However, CCF of these valves also inhibits use of the RHRS to reach cold shutdown following a general transient or planned shutdown. Therefore, additional information on this failure is needed, specifically:

a. Describe how the PRA models CCF of the SIS common injection check valves in non-LOCA sequences.

b. Define the “safe, stable state” success criterion for this scenario, including how long-term core cooling is provided.

c. Provide the results of supporting thermal-hydraulic analyses demonstrating that this “safe, stable state” can be reached.

19-211

Table 19.1-88 of the FSAR indicates that a generic small LOCA frequency was used to develop the shutdown LOCA initiating event frequency. Provide the source and value of this generic small LOCA frequency. Discuss how this frequency was combined with flow diversions and fault tree analysis to develop the initiating event frequencies presented in Table 19.1-90 of the FSAR.

19-212

(Follow-up to Question 19-143) The response to Question 19-143 lists several valves that, if opened, would allow draining of the RCS to the in-containment refueling water storage tank (IRWST). Discuss how inadvertent opening of these valves by the operators is modeled in the PRA. If such errors are not included in the PRA, justify their exclusion. Describe how the U.S. EPR human factors program (including procedures and training) accounts for the risk associated with inadvertently opening these valves.