## ArevaEPRDCPEm Resource

**From:** Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
**Sent:** Monday, November 17, 2008 4:57 PM
**To:** Getachew Tesfaye; John Rycyna
**Cc:** NOXON David B (AREVA NP INC); WELLS Russell D (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); SLIVA Dana (EXT)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 97(1296,1357,1389), FSAR Ch. 19
**Attachments:** RAI 97 Response US EPR DC.pdf

**ADAMSAccessionNumber**ML083280067

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 97 Response US EPR DC.pdf" provides technically correct and complete responses to 10 of the 11 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 97 Questions 19-220, 19-224, 19-225 and 19-226.

The following table indicates the respective pages in the response document, "RAI 97 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 97 — 19-215 | 2 | 15 |
| RAI 97 — 19-217 | 16 | 16 |
| RAI 97 — 19-218 | 17 | 17 |
| RAI 97 — 19-219 | 18 | 18 |
| RAI 97 — 19-220 | 19 | 19 |
| RAI 97 — 19-221 | 20 | 20 |
| RAI 97 — 19-222 | 21 | 23 |
| RAI 97 — 19-223 | 24 | 24 |
| RAI 97 — 19-224 | 25 | 25 |
| RAI 97 — 19-225 | 26 | 26 |
| RAI 97 — 19-226 | 27 | 27 |

A complete answer is not provided for one of the 11 questions. The schedule for a technically correct and complete response to this question is provided below.

| Question # | Response Date |
|---|---|
| RAI 97 — 19-223 | December 12, 2008 |

Sincerely,

*Ronda Pederson*
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment

**AREVA NP Inc.**
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

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**From:** Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
**Sent:** Friday, October 17, 2008 2:25 PM
**To:** ZZ-DL-A-USEPR-DL
**Cc:** Hanh Phan; Theresa Clark; Edward Fuller; Lynn Mrowca; Joseph Colaccino; John Rycyna
**Subject:** U.S. EPR Design Certification Application RAI No. 97(1296,1357,1389), FSAR Ch. 19

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 6, 2008, and discussed with your staff on October 16, 2008. Draft RAI Question 19-216 was deleted and Draft RAI Questions 19-223 and 224 were modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

**Hearing Identifier:** AREVA_EPR_DC_RAIs
**Email Number:** 64

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**Subject:** Response to U.S. EPR Design Certification Application RAI No. 97(1296,1357,1389), FSAR Ch. 19
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**From:** Pederson Ronda M (AREVA NP INC)

**Created By:** Ronda.Pederson@areva.com

**Recipients:**
"NOXON David B (AREVA NP INC)" <David.Noxon@areva.com>
Tracking Status: None
"WELLS Russell D (AREVA NP INC)" <Russell.Wells@areva.com>
Tracking Status: None
"BENNETT Kathy A (OFR) (AREVA NP INC)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen V (AREVA NP INC)" <Karen.Delano@areva.com>
Tracking Status: None
"SLIVA Dana (EXT)" <Dana.Sliva.ext@areva.com>
Tracking Status: None
"Getachew Tesfaye" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None
"John Rycyna" <John.Rycyna@nrc.gov>
Tracking Status: None

**Post Office:** AUSLYNCMX02.adom.ad.corp

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**Response to**

**Request for Additional Information No. 97 (1296, 1357, 1389), Revision 0**

**10/17/2008**

**U. S. EPR Standard Design Certification**
**AREVA NP Inc.**
**Docket No. 52-020**
**SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation**
**Application Section: 19.1.5**

**QUESTIONS for PRA Licensing, Operations Support and Maintenance Branch 1 (AP1000/EPR Projects) (SPLA)**

**Question 19-215:**

FSAR Page 19.1-110 states that “Structures and other passive components not typically included in the internal events PRA were added to the SEL.” Please identify the added structures and passive components.

**Response to Question 19-215:**

In the Response to RAI 8, Supplement 1, Question 19.01-6, Table 19.01-6-1—U.S. EPR Safety-Related Structures Seismic Fragilities and Table 19.01-6-2—U.S. EPR Mechanical and Electrical Equipment Seismic Fragilities include “seismic fragilities of the safety-related buildings” and “seismic fragilities of the mechanical and electrical equipment.” Table 19.01-6-1 and Table 19.01-6-2 are consolidated versions of the seismic equipment list (SEL) used in the seismic margin assessment (SMA) and are added to the U.S. EPR FSAR as U.S. EPR FAR Tier 2, Table 19.1-106—Seismic Fragilities of Safety-Related Structures and Table 19.1-107—Seismic Fragilities of Mechanical and Electrical Equipment.

The full version of the structures included in the SEL is provided in Table 19-215-1—Summary of Seismic Capacity of Structures of U.S. EPR. The full version of the components included in the SEL is provided in Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR.

Table 19-215-1 and Table 19-215-2 demonstrate that the SEL includes structures and passive components (e.g., heat exchangers, piping, cable trays and tanks).

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Table 19-215-1—Summary of Seismic Capacity of Structures of U.S. EPR (2 Sheets)**

| Building / Structures | Designation / Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF (g) |
|---|---|---|---|---|---|---|
| Containment & Annulus | 0UJA, 0UJB | Shear failure of containment wall | 8.9 | 0.25 | 0.41 | 3.0 |
| Containment penetrations (piping, hatches etc.) | 0UJA | -- | -- | -- | -- | 1.3 |
| Reactor Building internal structure | 0UJA | Shear failure of internal structure walls | 6.4 | 0.26 | 0.4 | 2.1 |
| IRWST | 0UJA | -- | 6.4 | 0.26 | 0.4 | 2.1 |
| Core Melt Retention Structure | 0UJA | -- | 6.4 | 0.26 | 0.4 | 2.1 |
| IRWST drain valve to core catcher | 0UJA | -- | | | | 1.3 |
| Combustible Gas Control | 0UJA | -- | | | | 1.3 |
| Reactor cavity, seal and pools | 0UJA | -- | 6.4 | 0.26 | 0.4 | 2.1 |
| Fuel transfer tube | 0UJA | -- | | | | 1.3 |
| Refuel gates | 0UJA | -- | 6.4 | 0.26 | 0.4 | 2.1 |
| Refuel machine | 0UJA | -- | | | | 1.3 |
| Polar crane | 0UJA | -- | | | | 1.3 |
| Safeguards Buildings 1 & 4 | 1/4UJH, 1/4UJK, 1/4UJE | Shear failure of concrete shear wall | 4.9 | 0.26 | 0.41 | 1.6 |
| Safeguards Buildings 2 & 3 | UJH,UJK, UJE | Shear failure of concrete shear wall | 5.8 | 0.26 | 0.4 | 1.9 |
| EFW pools (LAR10BB001) | UJH05030 | -- | 4.9 | 0.26 | 0.41 | 1.6 |
| CCW surge pools (KAA10BB001) | UJH31025 | -- | 4.9 | 0.26 | 0.41 | 1.6 |
| EBS boric acid pools | UFA06038 | -- | 5.8 | 0.26 | 0.41 | 1.9 |
| Control room & ceiling | 2UJK26030 | -- | 5.8 | 0.26 | 0.4 | 1.9 |
| Fuel Building | 0UFA | Shear failure of concrete shear wall | 5.8 | 0.26 | 0.4 | 1.9 |
| Spent fuel pool | UFA | -- | 5.8 | 0.26 | 0.41 | 1.9 |

**Table 19-215-1—Summary of Seismic Capacity of Structures of U.S. EPR (2 Sheets)**

| Building / Structures | Designation / Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF (g) |
|---|---|---|---|---|---|---|
| Diesel Buildings | 1/2/3/4UBP | Shear failure of concrete shear wall | 5.6 | 0.26 | 0.41 | 1.8 |
| Ultimate Heat Sink building | 1/2/3/4URB | Shear failure of concrete shear wall | 5.6 | 0.26 | 0.41 | 1.8 |
| Cable duct & shaft | UBZ, UBS | -- | -- | -- | -- | 1.3 |
| Nuclear Auxiliary Building | 0UKA | -- | -- | -- | -- | 1.3 |
| Access Building | 0UKE | -- | -- | -- | -- | 1.3 |
| Turbine Building | 0UMA | -- | -- | -- | -- | 1.3 |
| Vent Stack | 0UKH | -- | -- | -- | -- | 1.3 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| **Reactor Coolant System, Control Rods & Reactor Internals** | | | | | | |
| Reactor vessel & supports | UJA | Structural failure of supports | 5.2 | 0.26 | 0.39 | 1.8 |
| Reactor internals (do not prevent rod drop) | UJA | Structural failure | 4.7 | 0.41 | 0.31 | 1.4 |
| Core assemblies (do not prevent rod drop) | UJA | Structural failure | 4.7 | 0.41 | 0.31 | 1.4 |
| Control rod drives, guide tubes etc | UJA | Functional failure | 6.5 | 0.41 | 0.31 | 2.0 |
| Steam generators & supports | UJA | Structural failure of supports | 6.5 | 0.41 | 0.31 | 2.0 |
| Reactor coolant pumps & supports | UJA | Structural failure of supports | 6.5 | 0.41 | 0.31 | 2.0 |
| Pressurizer & supports | UJA | Structural failure of supports | 6.5 | 0.41 | 0.31 | 2.0 |
| Pressurizer relief valves (JEF10AA191 including SOV JEF10AA717) | UJA34019 | Loss of function | 9.9 | 0.37 | 0.49 | 2.4 |
| Dedicated relief valves MOV (JEF10AA004, 005, 006, 007) | UJA34019 | Loss of function | 9.9 | 0.37 | 0.49 | 2.4 |
| Pressurizer vent MOVs (JEF10AA501 and 502) | UJA34019 | Loss of function | 9.9 | 0.37 | 0.49 | 2.4 |
| Piping, manual valves, check valves | UJA, UJH, UJE | Support failure | 7.9 | 0.34 | 0.43 | 2.2 |
| Steam Generator Tubes including tube to tube sheet weld | UJA | Not credible | -- | -- | -- | 4.0 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| **Secondary Coolant System** | | | | | | |
| Feedwater piping upstream of FWIV | UJA, UJE28001 | Support failure | 7.9 | 0.34 | 0.43 | 2.2 |
| Main steam piping upstream of MSIV | UJA, UJE29002 | Support failure | 7.9 | 0.34 | 0.43 | 2.2 |
| MSIVs Oleo pneumatic (LBA10AA002 and SOVs LBA10AA712) | UJE29002, UJE34002 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| FWIVs MOVs (LAB60AA002) | UJE28001 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| FWIVs Full and Low Load Oleo pneumatic (LAB60AA001, LAB64AA102, and their associated SOVs | UJE28001 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| MSRVs Control MOV (LBA13AA101) | UJE29002 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| MSRIVs steam operated (LBA13AA001 and SOVs LBA13AA712 and 722 typical of 16 SOVs) | UJE29002 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| MSSVs (LBA11AA191) | UJE | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Turbine stop & control valves | UMA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| **Emergency Feedwater System** | | | | | | |
| Pumps (LAS11AP001) | 31UJH01024 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Isolation MOVs (LAR11AA006) | 31UJH10004, 32UJH10002 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Flow control valves (LAR11AA105) | 31UJH01024 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Limitation control valves (LAR11AA103) | 31UJH01024 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| Piping, manual valves, check valves | UJH, UJA | Support failure | 7.9 | 0.34 | 0.43 | 2.2 |
| **Medium Head Safety Injection** | | | | | | |
| Pumps (JND10AP001) | 31UJH01002, 33UJH01007 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| MOVs (JND10AA002/004/ 005) | UJH. UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, manual valves, check valves, motor operated check valve | UJH, UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| **SI Accumulators** | | | | | | |
| Accumulator (JNG13BB001) | UJA | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| Piping, MOV, manual valves, check valves | UJA | Support failure | 7.9 | 0.34 | 0.43 | 2.2 |
| **Low Head Safety Injection/RHR** | | | | | | |
| Pumps (JNG10AP001) | 31UJH01006, 32UJH01009 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Heat Exchangers (JNG10AC001) | 31UJH05005, 32UJH05006 | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| CCWS pneumatic valve (KAA12AA005) | 31UJH10004, 32UJH10002 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| MOVs (i.e. JNG, JNA10AA001, JNA10AA003, JNA10AA101) | 31UJH05004, UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, safety, manual & check valves, motor operated check valve | UJH, UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| **Severe Accident Containment Heat Removal** | | | | | | |
| Pumps (JMQ10AP001) | 31UJH01008 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Heat Exchangers (JMQ10AC001) | 31UJH05012 | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| Dedicated CCWS Pump (KAA50AP001) | 31UJH01027 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Dedicated CCWS HX (KAA50AP001) | 31UJH10026 | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| Dedicated ESWS Pump (PEB50AP001) | 31UQB01001 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| MOVs | UJH | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, manual valves, check valves | UJH, UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| **Extra Borating System (EBS)** | | | | | | |
| Pumps (JDH10AP001 and JDH40AP001) | UFA01038, UFA01088 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| MOVs (i.e. JDH10AA006/008/015) | UJA11003, 01038, UFA10045 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, safety, manual & check valves | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Building Ventilation (fans, dampers, ducts, coolers, filters etc.) | UFA01088, 01038 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| **RCP Seal Integrity** | | | | | | |
| RCP shaft, seals and Standstill seal (RCP JEB10AP001) | UJA23002, 005, 006, 009 to UJA18002, 005, 006, 009 | | 6.5 | 0.41 | 0.31 | 2.0 |
| RCP breaker (JEB) | | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| SSSS N2 supply SOV (JEB10AA018) | UJA15002, 005, 006, 009 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| SSSS N2 discharge MOV (JEB10AA020) | UJA15002, 005, 006, 009 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Seal 1 SOV (JEB10AA009) | UJA18002, 005, 006, 009 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Seal 2 MOV (JEB10AA010) | UJA18002, 005, 006, 009 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| Seal 3 MOV (JEB10AA017) | UJA15013, 014, 015, 016 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Thermal barrier SOV (JEB10AA003) | UJA15002, 005, 006, 009 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Pneumatic valves (TB and Leak off) | -- | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, safety (TB), manual & check valves | UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| **Component Cooling Water** | | | | | | |
| Pumps (KAA10AP001) | 31UJH01026, 32UJH01020 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Heat Exchangers (KAA10AC001) | 31UJH10026, 32UJH10020 | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| MOVs (i.e KAA10AA112, KAA12AA005/013) | UJH | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Pneumatic Valves (i.e. KAA10AA006/010/032/033) | UJH | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, safety, manual & check valves | UJH, UJA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| **Essential Service Water** | | | | | | |
| ESWS Pumps (PEB10AP001) | 31UQB01001 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| MOVs (PEB10AA005.) | UQB, UJH | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Cooling Tower Fans & Equipment | -- | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Piping, manual valves, check valves, filters and strainers | UQB, UJH | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Building Ventilation (fans, dampers, ducts, coolers, filters etc.) | UQB | Functional | 5.2 | 0.20 | 0.40 | 1.9 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| **Emergency Diesels** | | | | | | |
| Diesel generator and controls (XJA10) | UBP | Functional | | | | 1.3 |
| Fuel oil day tanks | UBP | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| Fuel oil storage tanks | UBP | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| Air start compressors (XJX10AN001) | 31UBP10003, | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Air start receivers | UBP | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| Diesel heat exchangers (air cooled) | UBP | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| Building Ventilation (fans, dampers, ducts, coolers, filters etc.) | UBP | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| **Safeguards Bldg Ventilation** | | | | | | |
| Supply fans (SAC01AN001, SAC02AN001) | 31UJK22056, 32UJK31007 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Exhaust fans (SAC31AN001, SAC32AN001) | 31UJK22039, 32UJK31032 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Chillers (QKA10AH112, QKA20AH112) | 31UJK22028, 32UJH10020 | Functional | 5.2 | 0.30 | 0.35 | 1.8 |
| Pumps (QKA10AP107, QKA20AP107) | 31UJK22028, 32UJH05020 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Motor operated dampers (SAC31AA002 etc) | 31UJK22026 | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, ducting, manual and check dampers (valves QKA) | UJH, UJK | Functional | 7.9 | 0.34 | 0.43 | 2.2 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| EFW Ventilation Chiller (SAC01AH001) | 31UJK22026 | Functional | 5.2 | 0.30 | 0.35 | 1.8 |
| **Control Room Emergency Ventilation** | | | | | | |
| Pre, HEPA, Carbon filters SAB11AT001, 2, 3, 4 | 32UJK31034 | Functional | 5.2 | 0.30 | 0.35 | 1.8 |
| Fan (SAB11AN001) | 32/33UJK3103 4/35 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Chiller Cooling coil (SAB01AC001) | | Functional | 5.2 | 0.30 | 0.35 | 1.8 |
| Fan (SAB01AN001) | 32UJK31034 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| HEPA Filter (SAB01AT005) | | Functional | 5.2 | 0.30 | 0.35 | 1.8 |
| **Fuel Pool Cooling** | | | | | | |
| Pumps (FAK11AP001, FAK12AP001, FAK21AP001, FAK22AP001) | 30UFA01026 and 01027, 30UFA01076 and 01077 | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| Heat Exchangers (FAK10AC001, FAK20AC001) | UFA01026, UFA01076 | Anchorage failure | 5.2 | 0.30 | 0.35 | 1.8 |
| MOVs (FAK10AA601, FAK10AA001) | UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Piping, manual valves, check valves | UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Building Ventilation (fans, dampers, ducts, coolers, filters etc.) | UFA | Functional | 5.2 | 0.20 | 0.40 | 1.9 |
| **Emergency AC & DC** | | | | | | |
| 6.9 kV switchgear (31BDA, BDB) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Transformers (31BMT01, 03) | UJK | Functional | 6.2 | 0.25 | 0.37 | 2.2 |
| Transformer, Voltage Regulated (31BNT04) | UJK | Functional | 6.2 | 0.25 | 0.37 | 2.2 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| 480 V load center (31BMA, C) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| 480 V MCC (31BNA02, 03, BNC01, BNC02, BND, BNE) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| 480 V Uninterruptible MCC (31BRA, BRC) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| 480 V MCC (31BNA01, BHZ01, BRB) | UBP | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Electrical Panel Boards (e.g., 120V AC) | | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Batteries & racks (31BTD01) | 31UJK, 32UJK | Functional | 7.0 | 0.25 | 0.37 | 2.5 |
| Batteries & racks (31BTD05 and 34BTD05) | UJK | Functional | 7.0 | 0.25 | 0.37 | 2.5 |
| Chargers (31BTP01, BTP02) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Chargers (31BTP05 and 34BTD05) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Inverters with electronic bypass switch in same cabinet (31BRU01) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Inverters (31BRU05 and 34BRU05) (seismic category II) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| AC/DC Converters & DC power supplies (BRV, BRW) | UJK, UBP | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| EDG breaker (qualified as part of cabinet) | UBP, UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| SBO diesel breaker (qualified as part of cabinet) | UBP and UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Cable trays | UJK, UBP, UBZ, etc | Support failure | 7.9 | 0.34 | 0.43 | 2.2 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| **I&C / Relays / Sensor & transmitters in the field (input signals to TXS etc.)** | | | | | | |
| Low frequency at 13.8 kV | UBP | Functional | -- | -- | -- | 1.3 |
| Low voltage at 13.8 kV | UBP | Functional | -- | -- | -- | 1.3 |
| SG level (JEA10CL809,810,811,812) | UJA Service Area | Functional | -- | -- | -- | 1.3 |
| SG pressure (LBA10CP811, 821, 831, 841) | UJE | Functional | -- | -- | -- | 1.3 |
| Pressurizer pressure (JEF10CP801, 803, 805, 807) | UJA Service Area | Functional | -- | -- | -- | 1.3 |
| Pressurizer level (JEF10CL802, 804, 806, 808) | UJA Service Area | Functional | -- | -- | -- | 1.3 |
| Activity sensor | UJE | Functional | -- | -- | -- | 1.3 |
| EFW pump Flow (LAR11CF801) | UJH01024 | Functional | -- | -- | -- | 1.3 |
| RCP Speed | UJA | Functional | -- | -- | -- | 1.3 |
| Cold leg temperature elements (JEB10CT811) | UJA | Functional | -- | -- | -- | 1.3 |
| Hot leg temperature elements (JEB10CT805) | UJA | Functional | -- | -- | -- | 1.3 |
| RCS loop level | UJA | Functional | | | | 1.3 |
| Self powered neutron sensor | UJA | Functional | | | | 1.3 |
| RCCA rod position Reactor trip check back (CRDM) | UJA | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Reactor Protection Cabinets, Racks, Modules, Fiber Optics (TXS) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Reactor trip cabinets (breakers, contactors) (TXS) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| PACS cabinets (ESF, priority module actuators, solid state modules) (TXS) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| SAS cabinets (EFW, RHR controls) (TXS) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| RCSL cabinets (reactor control) (TXS) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| PAS cabinets (non-safety) (T3000) | UJK | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| PICS cabinets (operator displays, digital control and screens)(T3000) | 32UJK26030 | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| SICS (backup to PICS – solid state display) (TXS) | 32UJK26030 | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Incore Instrumentation and Cabinets (TXS) | -- | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Excore Instrumentation and Cabinets (TXS) | -- | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Rodpilot Cabinets (TXS) | -- | Functional | 4.3 | 0.26 | 0.39 | 1.5 |
| Radiation Monitoring sensors, skids, cabinets (TXS, T3000) | | Functional | -- | -- | -- | 1.3 |
| Instrumentation (operator support other than above sensors) | | Functional | -- | -- | -- | 1.3 |
| LHSI HX temperature (JNG10CT001 and 002) | | Functional | -- | -- | -- | 1.3 |
| ESWS Flow Rate (PEB10CF001) | UQB | Functional | -- | -- | -- | 1.3 |

**Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR (11 Sheets)**

| Component | Location | Failure Mode | Am (g, spectral accel.) | $\beta_R$ | $\beta_U$ | HCLPF, g |
|---|---|---|---|---|---|---|
| CCWS Flow Rate (KAA10CF023) | UJH | Functional | -- | -- | -- | 1.3 |
| CCWS temperature (KAA10CT092 and 093) | UJH | Functional | -- | -- | -- | 1.3 |
| CCWS/ESWS Start (KAA10EC001) | UJH | Functional | -- | -- | -- | 1.3 |
| EFW Flow to SG (LAR11CF802) | UJH01024 | Functional | -- | -- | -- | 1.3 |
| EFW Pool Level (LAR10CL001) | UJH10024 | Functional | -- | -- | -- | 1.3 |
| **Containment Isolation** | | | | | | |
| Ventilation (KLA10AA001, 003 etc including SOVs) | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Gaseous Waste (KPL84AA003 and 003 etc) | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Reactor Bldg Primary Drain (KTA10AA017 and 018 etc) | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Containment area sump, floor drain (KTC10AA005 and 006 etc) | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Leakage Monitoring (JMM10AA006 and 007 etc) | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Letdown isolation valves (KBA14AA002 and 003 etc) | UJA, UFA | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| SG Blowdown (LCQ10AA003, LCQ51AA002 and 003, LCQ52AA001 and 002) | UJA, UJE, UJH | Functional | 7.9 | 0.34 | 0.43 | 2.2 |
| Loss of Offsite Power | -- | Functional | 0.8 | 0.40 | 0.38 | 0.2 |

**Question 19-217:**

FSAR Page 19.1-112 states that “since the HCLPF for the SLOCA initiating event is much higher than that for LOOP,” please provide the SLOCA HCLPF and its basis.

**Response to Question 19-217:**

The loss of offsite power (LOOP) and seismic-induced small loss of coolant accident (SLOCA) are modeled as seismic initiating events. The seismic margins or high confidence, low probability of failure (HCLPF) capacities of components appearing in the accident sequences initiated by these events are calculated and shown to be higher than the review level earthquake (RLE) (1.67 times the certified seismic design response spectra (CSDRS)). These initiating events are postulated and the seismic margin assessment is carried out to assess if the seismic margins of these accident sequences exceed the RLE

The HCLPF capacity for LOOP is based on the performance of switchyards and electrical substations in real earthquakes and is less than the RLE. However, the significant seismic failures following the LOOP (and assumed SLOCA) are shown to have seismic HCLPF capacities larger than the RLE. Following the “min-max” approach, the HCLPF capacity of the plant against LOOP-initiated accident sequences is larger than the RLE.

Seismic failures leading to SLOCA are steam generator tube rupture (SGTR), smaller primary system line break (resulting from failures of a small nozzle or branch in the primary piping system or on the pressurizer), and rupture of a number of impulse (i.e., instrument) lines. The HCLPF for SGTR is higher than 0.5g peak ground acceleration (PGA) (4.0g average spectral acceleration according to Table 19-215-2—Summary of Seismic Capacity of Equipment of U.S. EPR provided in the Response to Question 19-215). Similarly, the piping is designed for the safe shutdown earthquake (SSE) of 0.30g PGA, resulting in a HCLPF of 2.2g average spectral acceleration (or 0.94g PGA) for a smaller primary system line break, as shown in Table 19-215-2. The impulse lines will be designed and installed so there are no seismically-induced spatial interactions resulting in the rupture of a sufficient number of lines to add up to a SLOCA size. Further, the adequacy of installation will be verified during the confirmatory walkdown per COL Item 19.1-9. Therefore, SLOCA HCLPF could be larger than 0.5g PGA. Because the significant seismic failures following SLOCA are the same as those following a LOOP, the seismic margins of SLOCA initiated accident sequences exceed the RLE.

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 19-218:**

FSAR Page 19.1-113 states that "Since seismic failures leading to ATWS have capacities greater than the RLE, these are not discussed further." Please provide the calculated HCLPF value and its basis for a seismically induced ATWS event. Additionally, justify why seismically induced binding of the control rods and channel deformation are not a concern for EPR design.

**Response to Question 19-218:**

The calculated high confidence, low probability of failure (HCLPF) values and basis requested are provided in the Response to Question 19-215. Specifically, the following structures systems and components (SSC) and HCLPFs are reported:

- Reactor Vessel and Supports 1.8g
- Reactor Internals (do not prevent rod drop) 1.4g
- Core Assemblies (fuel – do not prevent rod drop) 1.4g
- Control Rod Drives, Guide Tubes, etc. 2.0g
- Reactor Protection Cabinets, Racks, Modules, and Fiber Optics (TXS) 1.5g
- Reactor Trip Cabinets (breakers, contactors) (TXS) 1.5g

Therefore, there is a HCLPF probability of control rods and channel deformation.

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 19-219:**

Please identify the safety-related SSCs with HCLPF values less than 0.5g PGA, if there are any.

**Response to Question 19-219:**

There are no safety-related structures systems and components (SSC) with high confidence low probability of failure (HCLPF) values less than 0.5g peak ground acceleration (PGA).

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 19-220:**

According to NUREG-1407 and ANSI/ANS-58.21-2007, the effects of seismically induced fires and the impact of inadvertent actuation of fire protection systems on safety systems should be addressed during a plant walkdown. In addition, the effects of seismically induced external flooding and internal flooding on plant safety should also be addressed during a plant walkdown. Please ensure that these assessments will be addressed in COL action item 19.1-9.

**Response to Question 19-220:**

The probabilistic risk assessment (PRA)-based seismic margin assessment (SMA) assumes that equipment will be installed as designed and that there are no potential spatial interaction concerns in the as-built configuration (e.g., adjacent cabinets are bolted together, collapse of non-seismically designed equipment or masonry wall onto safety-related equipment is precluded, and no likelihood of seismically-induced fire or flood impacting safety-related equipment). This assumption will be added to U.S. EPR FSAR Tier 2, Table 19.1-109—U.S. EPR PRA General Assumptions.

U.S. EPR FSAR Tier 2, Section 19.1.2.2, COL Item 19.1-9 requires a review of as-designed and as-built information in order to confirm that the assumptions used in the PRA remain valid. A revision of U.S. EPR FSAR Tier 2, Section 19.1.2.2, COL Item 19.1-9 to specifically address changes or departures from the assumptions associated with the PRA-based seismic margins assessment is not necessary.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Table 19.1-109 will be revised as described in the response and indicated on the enclosed markup.

**Question 19-221:**

According to FSAR Figure 19.1-10, Sequence 30, why isn't main steam relief (MSR) included in Table 19.1-37?

**Response to Question 19-221:**

Failure of the main steam relief (MSR) functional event is included in Table 19.1-37—Summary of Cutsets for Seismic Sequences with LOOP and in combination with a reactor coolant pump seal related loss of coolant accident (LOCA). However, it is not included as a single-failure cutset.

Failure of the MSR functional event requires the failure of the main steam relief valves (MSRVs) and the main steam safety valves (MSSVs). Seismic failures are only included for MSRVs, leaving MSSVs to fail randomly and unrelated to the seismic event. Because the probability of random failures is low, MSR failure probability is low and its status as a single-failure cutset is not identified.

Seismic failures are not applied to both MSRVs and MSSVs because it is excessively conservative to assume that an earthquake would fail both for all steam generators (SGs). MSRVs and MSSVs have a high confidence, low probability of failure (HCLPF) of 2.2g.

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 19-222:**

Please provide the HCLPF values for all events and cutsets identified in FSAR Table 19.1-37. Additionally, also provide the HCLPF values for medium head safety injection (MHSI) and low head safety injection (LHSI).

**Response to Question 19-222:**

Table 19-222-1—Seismic LOOP Accident Sequence Cutset Results Summary is a modification of U.S. EPR FSAR Tier 2, Table 19.1-37—Summary of Cutsets for Seismic Sequences with LOOP. The high confidence, low probability of failure (HCLPF) value for each element is provided in parenthesis and is derived from the Response to RAI 8, Supplement 1, Question 19.01-6 and the Response to Question 19-215. The HCLPF for a cutset is the highest HCLPF of each element in the cutset. All of these structures systems and components (SSC) have HCLPFs at or above 1.3g; therefore, each cutset has a HCLPF at or above 1.3g.

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Table 19-222-1—Seismic LOOP Accident Sequence Cutset Results Summary (2 Sheets)**

| Seismic Failures (1) | Non-Seismic Failures of Equipment | Human Failure Events (HFE) | Description |
|---|---|---|---|
| AC (1.5g – Switchgear) | — | — | Total loss of AC power, leading to loss of secondary cooling and failure of feed-and-bleed cooling. |
| I&C (1.3g – Instrumentation Rack) | — | — | No auto actuation or instrumentation for operators. |
| EDG (1.3g – Engine Generator) | — | — | Total loss of AC power, leading to loss of secondary cooling and failure of feed-and-bleed cooling. |
| BAT (2.5g – Battery or 1.5g – DC Switchgear) | — | — | Failure of DC power, causing unavailability of diesel-generators, and total loss of AC power. |
| ESWS (1.9g – Pump or Fan) | — | — | Failure of ESW causing unavailability of diesel-generators, and total loss of AC power. |
| SAC (1.8g – Chiller) | — | — | Failure of room cooling, leading to total loss of AC power and failure of I&C. |
| EFW (1.9g – Pump or Fan) | — | OPE-FB-90M | Failure of secondary cooling due to seismic failure of EFW, and failure of operators to effect feed-and-bleed cooling. |
| CCWS (1.8g – Heat Exchanger) | PROB SEAL LOCA (2.0g – RCP and Support) | — | Seismic failure of CCWS causes loss of cooling for RCP seals, and a seal LOCA results. Unavailability of CCWS precludes cooling of IRWST. |
| SEAL LOCA and MHSI (1.9g – Pump) | — | OPE-FCD-40M | Seismically induced seal LOCA and failure of MHSI, with failure of the operators to perform a fast cooldown to permit use of LHSI. |
| SEAL LOCA and (MSRT (2.2g – Valve) or EFW (1.9g – Pump)) | — | OPE-FB-40M | Seismically induced seal LOCA and failure of secondary cooling, with failure of the operators to effect feed-and-bleed cooling. |
| EFW | EDG1or EDG2 or EDG3 or EDG4 | OPF-XTDIV-NSC | Seismic failure of EFW and failure of an emergency diesel generator with failure of operator action to cross-tie AC division. Battery depleting causes loss of DC power at 2 hours, leading to closure of a PSV and failure of feed-and-bleed cooling. |

**Table 19-222-1—Seismic LOOP Accident Sequence Cutset Results Summary (2 Sheets)**

| Seismic Failures (1) | Non-Seismic Failures of Equipment | Human Failure Events (HFE) | Description |
|---|---|---|---|
| EFW | CCWS/ESWS PM2 or<br>CCWS/ESWS PM3 | OPF-XTDIV-NSC | Seismic failure of EFW and failure of cooling for emergency diesel-generator with failure of operator action to cross-tie AC division. Battery depletion causes loss of DC power at 2 hr, leading to closure of a PSV and failure of feed-and-bleed cooling. Note that CCWS/ESWS Divisions 1 and 4 have the same non-seismic failure impact as Divisions 2 and 3, but do not show up because they are assumed to be normally running in the model (no maintenance, PM). |
| EFW | SAC PM1 or SAC PM2 or SAC PM3 or SAC PM4 | OPF-SAC-2H | Seismic failure of EFW and failure of room cooling, leading to loss of DC power at 2 hr, which causes the PSV to close, resulting in failure of feed-and-bleed cooling. |

Notes for Table 19-222-1:

1) Where HCLPF are not listed, they are provided in other cells of the table. There are no HCLPF for human factors engineering (HFEs) because no credit for human action is taken.
2) The HCLPF values for the medium head safety injection (MHSI) and low head safety injection (LHSI) are provided by the Response to Question 19-215.

**Question 19-223:**

EPR FSAR Page 19.1-134 indicates that RES/OERAB/S02-01 was referenced as the basis for developing the fire ignition frequencies.

However, the estimated fire frequencies in this referenced report are based upon data solely from 1993 to 1999. Frequencies based only upon this data are much too limited since more years have passed than corresponds to the 1993 to 1999 period to which this data set pertains.

Frequencies developed from the state of art PRA methodology documented in NUREG/CR-6850 use a much more extensive fire event database, and supersede those from other sources. Only fire event data which have the potential to cause damage constitute fire frequencies in this methodology. In addition, the staff noted (Page 19.1-134) that the method described in NUREG/CR-6850, which is a preferable approach, was used for three PRA fire areas (PFAs), i.e., transformer yard, MS/MFW valve room, and containment pressurizer area. Sources of information for identifying the fire sources within these fire areas included: a) plant-specific spatial database, b) general arrangement drawings, and c) fire hazard analysis.

Accordingly, the staff has determined that fire frequencies developed from RES/OERAB/S02-01 are inappropriate for this application. Please explain why using RES/OERAB/S02-01 is appropriate for developing EPR fire ignition frequencies, especially since a plant-specific spatial database, general arrangement drawings, and fire hazard analyses were used in the development of fire ignition frequencies for some of the PFAs.

**Response to Question 19-223:**

A response to this question will be provided by December 12, 2008.

**Question 19-224:**

FSAR Page 19.1-139, Section 19.1.5.3.2.4, first sentence should be changed to "…important contributors to the internal fire CDF."

**Response to Question 19-224:**

The U.S. EPR FSAR Tier 2, Section 19.1.5.3.2.4 will be revised to include the phrase "fire CDF."

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 19.1.5.3.2.4 will be revised as described in the response and indicated on the enclosed markup.

**Question 19-225:**

FSAR Page 1.8-44, Table 1.8-2 and Page 19.1-151, Section 19.1.5.4 state that “A COL applicant that references the U.S. EPR design certification will perform the site-specific external event screening analysis for external events applicable to their site.” This COL action item should not be limited to the screening analysis to be performed by the applicant for external events. Where applicable to the site, COL applicant should perform a site-specific external events risk analysis to search for site-specific vulnerabilities. Please modify this COL action item to address this concern.

**Response to Question 19-225:**

U.S. EPR FSAR Tier 2, Table 1.8-2—U.S. EPR Combined License Information Items and Section 19.1.5.4, COL Item 19.1-7 will be revised as follows:

> “A COL applicant that references the U.S. EPR design certification will perform the site-specific screening analysis and the site specific risk analysis for external events applicable to their site.”

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Table 1.8-2 and Section 19.1.5.4, COL Item 19.1-7 will be revised as described in the response and indicated on the enclosed markup.

**Question 19-226:**

FSAR Page 19.1-152, second bullet, should “Safeguards Building” be changed to “all Safeguard Buildings”, since they house safety-related equipment and should be designated as seismic Category 1?

**Response to Question 19-226:**

U.S. EPR FSAR Tier 2, Section 19.1.4.5.1 will be revised to read “Safeguard Buildings (SBs).”

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 19.1.4.5.1 will be revised as described in the response and indicated on the enclosed markup.

# U.S. EPR Final Safety Analysis Report Markups

**Table 1.8-2—U.S. EPR Combined License Information Items**
**Sheet 42 of 42**

| Item No. | Description | Section | Action Required by COL Applicant | Action Required by COL Holder |
|---|---|---|---|---|
| 19.1-7 | A COL applicant that references the U.S. EPR design certification will perform the site-specific ~~external event~~ screening analysis and the site-specific risk analysis for external events applicable to their site. | 19.1.5.4 | Y | |
| 19.1-8 | A COL applicant that references the U.S. EPR design certification will describe the uses of PRA in support of site-specific design programs and processes during the design phase. | 19.1.1.1 | Y | |
| 19.1-9 | A COL applicant that references the U.S. EPR design certification will review as-designed and as-built information and conduct walk-downs as necessary to confirm that the assumptions used in the PRA (including PRA inputs to RAP and SAMDA) remain valid with respect to internal events, internal flood and fire events (routings and locations of pipe, cable and conduit), and HRA analyses (development of operating procedures, emergency operating procedures and severe accident management guidelines and training), external events including PRA-based seismic margins HCLPF fragilities, and LPSD procedures. | 19.1.2.2 | | Y |

19-225

Next File

### 19.1.5.3.2.4 Significant, SSC, Operator Actions and Common Cause Events

Table 19.1-67 through Table 19.1-73 show the important contributors to the internal
19-224 fire CDF. Importance is based on the FV importance measure (FV ≥0.005), or the RAW importance measure (RAW ≥2).

Table 19.1-67—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 1 Fire Events shows the top risk-significant ~~SSCs~~SSC based on the FV importance measure. The EDG trains, the cooling tower fan trains, and the air-cooled SCWS chiller trains have the highest FV. The presence of EDG trains highlights the importance of consequential LOOP events following a fire. The cooling tower fan trains are needed for long term cooling in seal LOCA sequences, which represent a large part of the fire risk. The air-cooled SCWS chillers importance reflects the importance of ventilation dependencies.

Table 19.1-68—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 1 Fire Events shows the top risk-significant ~~SSCs~~SSC based on the RAW importance measure. The most important components are 6.9kV divisional switchgears, 480V load centers, 24V DC I&C Power Rack, and 480V MCCs. This dominance of electrical and I&C components is partly due to the fact that the scenario which dominates the fire risk (i.e., fire in the switchgear room of SB 1 or SB 4) directly results in the failure of all buses for one division. Failure of buses in another division could have a significant impact on the mitigating systems like the MSRTs that require a specific combination of two divisions to perform their function.

Table 19.1-69—U.S. EPR Risk-Significant Human Actions based on FV Importance – Level 1 Fire Events shows the risk-significant human actions based on the FV importance measure. The most important operator actions are operator failure to recover room cooling locally, failure to initiate RHR cooling in four hours and failure to transfer to the RSS following an MCR fire. The first action reflects the importance of ventilation dependencies in the plant risk in general. The second and third actions are required in order to mitigate the two most important fire sequences (i.e., a fire in the ~~MSS/MFWS~~MFW/MS valve room with MSIVs failure to isolate and a fire in the MCR).

Table 19.1-70—U.S. EPR Risk-Significant Human Actions based on RAW Importance – Level 1 Fire Events shows the risk-significant human actions based on the RAW importance measure. Only four operator actions are considered important based on their RAW value: transfer to the RSS following an MCR fire, operator failure to initiate RHR cooling in four hours, operator failure to recover room cooling locally, and operator failure to initiate a feed and bleed for transient events. The very high RAW of the failure to transfer to the RSS can be explained by the fact that this event is assumed to lead directly to core damage.

#### 19.1.5.3.3.7 Fire Events Level 2 PRA Insights

In the absence of the specific challenges and bypasses of containment seen in the internal events analysis, the results for LRF for fire events are dominated by severe accident phenomenological issues. The specific issue for fires is the possibility of an accelerated flame arising from hydrogen combustion in the lower or middle equipment rooms during the in-vessel phase of a high pressure core melt. Further background discussion on the analysis of this issue is provided in Section 19.1.4.2.2.4.

As also discussed in Section 19.1.4.2.2.4 for internal events, sequences involving containment failure due to loads from an accelerated flame originating in the lower, middle or upper equipment rooms prior to vessel failure are visible contributors to LRF. The key features and assumptions of the analysis of accelerated flames are discussed in Section 19.1.4.2.2.4 and not repeated here.

The phenomena of thermally-induced steam generator tube rupture, which was assessed as having a large probability for equivalent two-inch seal LOCAs ~~(seal or otherwise)~~ in conjunction with a depressurized secondary side and an absence of feedwater to the SGs, also features in the results (i.e., 13 percent contribution to LRF). Seal LOCAs are a contributor to the fire CDF, ~~The contribution of this phenomenon is~~as discussed in ~~Section 19.1.5.2.2.3~~Section 19.1.5.3.2.3. Sensitivity studies show~~ed~~ that LRF did not significantly increase due to this phenomenon even in the bounding case of assumed concurrent unavailability of feedwater and depressurization functions.

Despite the dominance of a single phenomenological issue for LRF, it is noted that LRF is only approximately two percent of the CDF for fire events.

Other phenomenological challenges were not identified as leading to significant probabilities of large release.

### 19.1.5.4 Other Externals Risk Evaluation

The design certification scope of external event screening includes an assessment of high winds and tornadoes and external flooding as described below.

A COL applicant that references the U.S. EPR design certification will perform the
19-225 site-specific ~~external event~~ screening analysis and the site-specific risk analysis for external events applicable to their site.

#### 19.1.5.4.1 High Winds and Tornado Risk Evaluation

All U.S. EPR Seismic Category I structures are designed to meet the following standards for high winds and tornadoes.

### High Winds

The U.S. EPR Seismic Category I structures are designed to withstand high wind load characteristics as specified in NUREG-0800, Section 3.1.1. The EPR Seismic Category I structures are specifically designed for a basic wind speed of 145 mph. This value bounds all locations within the U.S. except the extreme southern tips of Louisiana and Florida (SEI/ASCE 7-05).

### Tornado Wind Loads

The U.S. EPR Seismic Category I structures are designed to meet the design-basis tornado wind characteristics of Tornado Intensity Region 1 as specified in NUREG-0800, Section 3.3.2. Tornado Intensity Region 1 is characterized by a maximum tornado wind speed of 230 mph (184 mph maximum rotational speed, 46 mph maximum translational speed). These design-basis tornado wind characteristics are bounding for all U.S. regions within the contiguous 48 states.

### Tornado Missiles

The U.S. EPR Seismic Category I structures are designed to the design-basis tornado missile characteristics of Region 1 (most limiting U.S. region) as specified in NUREG-0800, Section 3.5.1.4. The design basis missiles include (1) a massive high-kinetic-energy missile that deforms on impact, (2) a rigid missile that tests penetration, and (3) a small rigid missile of a size sufficient to pass through any opening in protective barriers.

U.S. EPR Seismic Category I structures include:

- Reactor Building (RB) and Reactor Building annulus.
- 19-226 Safeguard~~s~~ Buildings (SBs).
- Emergency Power Generating Buildings (EPGB).
- Essential service water (ESW) Pump Structures.
- ESW Cooling Water Structures.
- Fuel Building (FB).

Based on the U.S. EPR design, a tornado or high wind event will not have a significant impact on safety-related equipment. The most limiting impact from a tornado or high wind would likely be a LOOP.

The U.S. EPR has a robust design to cope with a LOOP event. Four independent EDGs (protected within the EPGB) are available to provide power to the safety buses. Although not specifically protected from high winds and tornado, two SBO diesels,

**Table 19.1-109—U.S. EPR PRA General Assumptions
Sheet 14 of 14**

| No. | Category[1] | PRA General Assumptions[2] |
|---|---|---|
| 78 | Fire | The entire Transformer Yard is considered a single fire area and is physically separated from other plant structures. Separation will be assured by non-rated exterior barriers and distance. These factors will prevent a fire in the Transformer Yard from propagating to other plant structures. In the fire risk evaluation, it is also assumed that fire protection features will be designed to prevent fire propagation between transformers. |
| 79 | Seismic | When equipment is not seismically qualified by analysis or testing or anchorage design is not complete, the seismic analysis is based on the seismic design criteria and qualification methods normally followed in the nuclear industry. |
| 80 | Seismic<br>19-220 | Seismic-induced LOOP, LOCA and ATWS events are assumed to dominate all potential initiating events. Equipment and structures that are not seismically qualified are not credited in the model.<br>The key assumptions regarding system availability and operator response are given below:<br>• Seismic-induced LOOP is assumed not to be recoverable.<br>• Station Blackout (SBO) Diesels are assumed to fail as a result of a SSE.<br>• All systems that depend on normal AC power such as main feedwater, main condenser, Startup and Shutdown System (SSS) pump, and their support systems are assumed to fail as a result of a SSE.<br>• Operator actions in response to seismic events are not credited.<br>• RCP seal injection with CVCS is assumed to be lost due to a seismic event.<br>• CVCS makeup to the Reactor Pressure Vessel (RPV) and auxiliary pressurizer spray are assumed to fail as a result of a SSE.<br>• Dedicated Relief Valves (DRV) are assumed to fail as a result of a SSE.<br>• Severe Accident Heat Removal (SAHR) is assumed to fail as a result of a SSE. |
| 81 | Seismic | The PRA-based seismic margin assessment assumes that equipment will be installed as designed and that there are no potential spatial interaction concerns in the as-built configuration (e.g., adjacent cabinets are bolted together, collapse of non-seismically designed equipment or masonry wall onto safety-related equipment is precluded, and no likelihood of seismically-induced fire or flood impacting safety-related equipment). |

**Notes:**

1. | Category | Description |
|---|---|
| Model | Modeling Assumption |
| IE | Initiating Event |
| CC | Common Cause |
| PM | Preventive Maintenance |
| HRA | Human Reliability Analysis |
| SYS | System Modeling |