Response to

Request for Additional Information No. 9, Revision 0

6/12/2008
U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 08.01 - Electric Power - Introduction
SRP Section: 08.02 - Offsite Power System
Application Section: FSAR Ch 8
EE Branch

Question 08.01-1:

Page 8.1-3 (8.1.3) of the FSAR states that "a COL applicant will identify site-specific loading differences that raise EDG [emergency diesel generator] or Class 1E battery loading, and demonstrate the electrical distribution system is adequately sized for the additional load." Regulatory Issue Summary (RIS)-2006-06 encourages the agency's design-centered review approach (DCRA) regarding DC and COL applications and describes the level of standardization of a particular design needed in order to make the DCRA effective. The RIS promotes the standardization of COL applications to facilitate the establishment of a predictable and consistent method for reviewing applications. The staff notes that only approximate sizing information for the main generator, EDG, and SBODG [station blackout diesel generator] is given. It appears that the exact size for the above equipment is left for the Combined Operating License (COL) applicants to decide based on site specific information. COL applicants proposing different sizes for electrical equipment will require additional time which will impact their review schedules. The staff believes that all sizing information for the US-EPR certified design (CD) should be standardized. The staff has reviewed other standardized FSARs and found all adhering to the DCRA concept. All electrical equipment (main generator, EDG, battery and SBODG) sizes should be specified in EPR DC documentation (FSAR) and the decision should not be left to the COL applicants. In addition, all statements including the phrase "a COL applicant will identify site-specific loading differences…." should be amended to reflect this approach. Please fully delineate Areva's position on the standardized equipment sizing issue.

Response to Question 08.01-1:

The electrical equipment sizes [main generator, emergency diesel generators (EDG), and station blackout diesel generators (SBODG)] were sized and analyzed using the electrical transient analyzer program (ETAP) to provide the safety-related standby power source function (for EDG) plus margin, alternate AC source function (for SBODG) plus margin, and plant output capacity (for main generator). The actual rated size of the main generator, EDG, and SBODG is dependent on which manufacturer is selected to provide the equipment and the nominal values of the associated equipment. The equipment sizes are indicated [e.g., "SBODG size of 3900 kW (or greater)" and "verify an EDG output of 9500 kW or greater"], to provide a minimum equipment size to satisfy the function of the equipment, plus margin, but allows for slight differences in the size of as-procured equipment. The COLA information item verifies that any additional site-specific EDG loads do not exceed the minimum required size for the EDG of 9500 kW plus the 10 percent margin stated in Regulatory Guide 1.9. The required size for the SBODG is 3900 kW and the EDG is 9500 kW. The final ratings of the equipment may be slightly higher as stated above. The main generator output is approximately 2000 MVA but actual nameplate values depend on which turbine-generator manufacturer is selected. The ETAP analysis used 2015 MVA for assumed main generator output and the main step up transformers are sized for 2130 MVA as described in FSAR Table 8.3-1—Onsite AC Power System Component Data Nominal Values.

The Class 1E battery size is listed in FSAR Table 8.3-11—Onsite DC Power System Component Data Nominal Values. The COLA item verifies that any additional site-specific Class 1E battery loads do not exceed the required size for the Class 1E batteries plus margin as defined in FSAR Table 8.3-11.

FSAR Impact:

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

Question 08.01-2:

As stated in RAI 8.1-1, RIS-2006-06 encourages the agency's design-centered review approach (DCRA) regarding DC and COL applications and describes the level of standardization of a particular design needed in order to make the DCRA effective. For evaluation of this standardization effort, provide the list of major electrical equipment and its pertinent electrical information (e.g., RCPs [reactor coolant pumps], main feedwater pumps, and condensate pumps; nominal ratings of output, load factor, efficiency, power factors, etc) that will be installed on the onsite electrical distribution system in US-EPR design. The above information is requested by the staff in fulfilling necessary interface review activities as identified by 10 CFR Part 52.47 (a) 24 and/or 25. Guidance for this information request (i.e., failure of non-safety-related electrical equipment that could directly affect safety-related equipment operation) can be found in Regulatory Guide C.I.8.3.1.1 where it states that "the applicant should describe the onsite ac power systems, emphasizing those portions that are that are safety-related. Those portions that are not related to safety should be described only in sufficient detail to permit an understanding of their interactions with the safety-related portions." The above design information is considered necessary to provide the staff with the understanding necessary to support their safety determination.

Response to Question 08.01-2:

The major (13.8 kV and 6.9 kV) non-safety-related electrical equipment and its pertinent electrical information are included in Table 8.1-2-1—U.S. EPR Large Non-Safety-Related Load Information. The information was used in the electrical transient analyzer program (ETAP) analysis for the U.S. EPR electrical distribution system. The information is based upon system engineer's requirements, preliminary vendor data, ETAP library, and industry standards, as appropriate. Large motors or equipment have not yet been procured so vendor-specific data is not available. This is a reasonable representation of the expected system performance for loading analysis that will be combined with a protective relaying design to provide reliable performance of the safety systems when called upon to operate, even in the presence of potential faults on the non-safety portions of the system.

Table 8.1-2-1—U.S. EPR Large Non-Safety-Related Load Information

Equipment	Number of Pumps / Units	System Capacity Supplied (%)	Rated Voltage (kV)	Rated Power	η	pf	β	pf_{st}	LRC (%)
Main Feedwater Pumps	3	33	13.2 (2)	16000	0.90 3	0.90 3	0.95	0.10 (3)	500 (3)
Reactor Coolant Pumps	4	100	13.2 (2)	15000 (3)(6)	0.93 3	0.91 3	0.97 (3) (6)	0.18 (3)	533 (3)
Circulating Water Pumps (5)	4	25	13.2 (2)	11000	0.90 1	0.97 1	0.91	0.10 (1)	650 (1)
Auxiliary Boilers	2	100	13.8	14000 kW	n/a	1.0 4	n/a	n/a	n/a
Coolant Degas Heater Skid Package	1	100	13.8	2400 kW	n/a	0.8 4	n/a	n/a	n/a
Main Condensate Pumps	3	50	13.2 (2)	3000	0.94 1	0.93 1	0.97	0.11 (1)	650 (1)
Startup Feedwater Pump	1	100	13.2 (2)	3000	0.94 1	0.93 1	0.89	0.12 (1)	650 (1)
Cooling Tower Makeup Pumps	3	50	6.6 (2)	1500	0.97 1	0.90 1	1.00	0.16 (1)	650 (1)
Coolant Treatment System Heater Skid Package	1	100	6.9	1100 kW	n/a	0.8 4	n/a	n/a	n/a
Coolant Treatment Makeup Water Heater Skid Package	1	100	6.9	300 kW	n/a	0.8 4	n/a	n/a	n/a
Coolant Treatment Degas Heater Skid Package	1	100	6.9	282 kW	n/a	0.8 4	n/a	n/a	n/a
Operational Chilled Water Compressor Skid Packages	4	33	6.6 (2)	900	0.93 1	0.92 1	0.97	0.17 (1)	650 (1)
Condenser Hogging Pump	1	100	6.6 (2)	700	0.93 1	0.92 1	1.00	0.21 (1)	650 (1)

Table 8.1-2-1—U.S. EPR Large Non-Safety-Related Load Information

Equipment	Number of Pumps / Units	System Capacity Supplied (%)	Rated Voltage (kV)	Rated Power	η	pf	β	pf_{st}	LRC (%)
MSR Drain Pumps	1 per MSR train	100	6.6 (2)	300	0.93 1	0.92 1	0.89	0.22 (1)	650 (1)
Auxiliary Cooling Water Pumps	2	100	6.6 (2)	500	0.93 1	0.92 1	0.95	0.19 (1)	650 (1)
Closed Cooling Water Pumps	3	50	6.6 (2)	600	0.93 1	0.92 1	0.89	0.19 (1)	650 (1)
Low Pressure Heater Drain Pump	1	100	6.6 (2)	500	0.93 1	0.92 1	0.94	0.17 (1)	650 (1)
Radwaste Process Evaporator Heater Skid Package	1	100	6.9	600 kW	n/a	0.8 4	n/a	n/a	n/a
Rad Waste Building Solution Heater Skid Package	1	100	6.9	565 kW	n/a	0.8 4	n/a	n/a	n/a
Coolant Treatment Vapor Compressor Skid Packages	3	50	6.6 (2)	450	0.93 1	0.92 1	1.00	0.19 (1)	650 (1)
Liquid Waste Processing Vapor Compressor	1	100	6.6 (2)	400	0.93 1	0.92 1	0.99	0.19 (1)	650 (1)
Emergency Demineralized Water Pump	1	100	6.6 (2)	300	0.93 1	0.92 1	0.88	0.22 (1)	650 (1)
Liquid Waste Storage System Heater Skid Package	1	100	6.9	280 kW	n/a	0.8 4	n/a	n/a	n/a

Where:

η	=	Efficiency	pf	=	Power factor
β	=	Load factor (required power to rated power ratio)	pf_{st}	=	Starting power factor
			LRC	=	Locked rotor current

Table 8.1-2-1 Notes:

1. Value from ETAP library.
2. Industry Standard (e.g., NEMA MG 1-2006).
3. Value obtained from preliminary vendor data.
4. Engineering judgment.
5. For circulating water pumps, an assumed value is provided that represents the system. Actual pump arrangement (number and capacity) is site-specific.
6. Reactor coolant pump required horsepower requirements are based on cold shutdown coolant temperatures. The required horsepower requirements for the reactor coolant pump for normal operating reactor coolant temperatures is approximately 4000 horsepower less than the required horsepower for cold reactor coolant temperature conditions.

FSAR Impact:

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

Question 08.01-3:

Table 1.8-2 of the FSAR (Chapter 1) addresses information that is required to be submitted by COL applicants. In addition to the COL applicant's degraded grid set points (that will be determined by the detailed analysis performed in the U. S. EPR design certification (8.3.1.3.1)) and the expected worst grid voltages, site-specific degraded grid voltage set points for EPSS [emergency power supply system] (Class 1E 6.9 kV buses) are not reflected in the aforementioned table. Additionally, the two additional items identified in RAIs 08.02-3 and 4 are COL items and need to be reflected in the table. AREVA is expected to ensure that all such coordination points are included in Table 1.8-2 to ensure data integrity.

Response to Question 08.01-3:

U.S. EPR FSAR Table 1.8-2—U.S. EPR Combined License Information Items, item 8.2-4 indicates "A COL applicant that references the U.S. EPR design certification will provide a site-specific grid stability analysis." FSAR Tier 2 Section 8.2.2.4 as referenced in Table 1.8-2 indicates (in part) that the results of the grid stability analysis will demonstrate that the EPSS degraded grid protection is not activated for the listed conditions concerning single contingencies. Tier 2 Section 8.2.2.4 further indicates that the transmission system operating voltage of ± 10 percent will not actuate the degraded voltage protection devices.

The intent of COL information items is to succinctly identify areas within the U.S. EPR FSAR where additional information is necessary to be provided or supplemented by the applicant. COL items are located within the FSAR section where the information is to be provided or supplemented. However, the COL item descriptions are not intended to replicate or provide all the NRC guidance information from the SRP or RG 1.206 necessary for the applicant to satisfactorily address the COL item.

The current COL information item in FSAR Section 8.2.2.4, which is listed in Table 1.8-2, along with the guidance provided in RG 1.206, provides the necessary details to capture the applicant's responsibilities for satisfactorily addressing the COL item regarding grid stability information. No changes to Table 1.8-2 are provided. Additional information will not be included in the U.S. EPR FSAR as a result of RAIs 08.02-3 or 08.02-4. As indicated in Tier 2 Section 8.2.2.4, a COL applicant that references the U.S. EPR design certification will provide a site specific grid stability analysis.

Degraded grid setpoints are provided in Tier 2 Chapter 16 Table 3.3.1-2. This information is not required of the COL applicant, and was therefore not included in Table 1.8-2 or as a COL information item. The following additional information will be added to FSAR Tier 2 Section 8.2.2.4 for clarification:

"Degraded grid setpoints are provided in Chapter 16 Table 3.3.1-2—Acquisition and Processing Unit Requirements Referenced from Table 3.3.1-1."

FSAR Impact:

FSAR, Tier 2, Section 8.2.2.4 will be revised as indicated in the response to the question and shown in the attached FSAR markup.

Question 08.01-4:

Page 8.1-5 (8.1.4.2) of the FSAR states that "Class 1E electrical isolation devices are provided where non-Class 1E circuits connect to Class 1E systems. The isolation devices prevent, to the extent practical, faults or other failures in the non-Class 1E circuits from degrading the Class 1E circuits below acceptable levels." RG 1.75 of IEEE Std 384-1992 requires that the isolation devices be properly coordinated and periodically tested to ensure the overall coordination remains. The FSAR is not clear that the isolation devices used will be periodically tested. Confirm whether periodic testing per RG 1.75 is to be performed for those isolation devices considered in EPR electrical design.

Response to Question 08.01-4:

In discussing non-Class 1E circuit separation from Class 1E circuits, FSAR Tier 2 Section 8.3.1.1.9, page 22, second paragraph, the last sentence indicates, "Circuit breakers or fuses that are automatically opened by fault current meet the guidelines provided in RG 1.75." This regulatory guidance indicates that (in addition to other guidance) regulatory position (1) subsection (b) "periodic testing of circuit breakers (visual inspection of fuses and fuse holders) during every refueling must demonstrate that the overall coordination scheme under multiple faults of non-safety-related loads remains within the limits specified in the design criteria for the nuclear power plant." Therefore, RG 1.75 is confirmed to be applicable and considered in the U.S. EPR electrical design.

FSAR Impact:

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

Question 08.02-1:

Page 8.2-2 (8.2.1.1) of the FSAR states that "The U.S. EPR does not use an automatic load dispatch system, which eliminates any interference with safety-related actions that may be required of the protection system described in Section 7.1.1.3.1." Explain whether the above sentence is relevant in this section or consider revising if necessary.

Response to Question 08.02-1:

SRP Section 8.2.III.9 indicates "the review of any automatic TSO action should ascertain that TSO actions (including normal and postulated failure modes of operation) will not interfere with safety actions that may be required of the reactor protection system. This system should also be reviewed to ensure that no failure mode of the TSO system will cause an incident at the generating station which would require protective action." Tier 2 Section 8.2.1.1 provides the description of the offsite power system and the plant interface with offsite power. This sentence indicates there is not an automatic TSO action that will interact with the reactor protection system.

FSAR Impact:

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

Question 08.02-2:

Page 8.2-6 (8.2.2.4) of the FSAR states that "the transmission system will not subject the reactor coolant pumps to a sustained frequency decay of greater than 3.5 Hz/sec as bounded by the decrease in reactor coolant system flow rate transient and accident analysis described in Section 15.3.2." The staff is familiar with frequency and voltage limits for RCP trip in the technical specification (TS). Explain the significance of RCP frequency decay rate (3.5 Hz/sec) protection scheme that is related to the transmission system operability and how this decay rate works with the RCP operation in Chapter 15.

Response to Question 08.02-2:

In Tier 2 Section 15.3.2 of the U.S. EPR FSAR, a "Complete Loss of Forced Reactor Coolant Flow" is analyzed. The analysis assumes the initiating event is a loss of offsite power (LOOP) that is simulated by tripping the four reactor coolant pumps (RCP) and isolating main feedwater (MFW). In this scenario, the RCPs are in free coastdown mode. An electrical transient associated with the RCP buses could also cause a forced reduction in reactor coolant flow due to a decrease in bus system frequency or voltage. An electrical system frequency decay rate effectively applies an electrical braking action to the RCP and results in a corresponding reduction in reactor coolant flow. The forced reduction in reactor coolant flow from an electrical transient could be more limiting than the free coastdown of the RCPs during a LOOP. The RCP coastdown rate which determines the rate of reactor coolant flow decrease is influenced by the frequency decay rate associated with the electrical transient. In U.S. EPR FSAR Tier 2 Section 15.3.2.2 "Method of Analysis and Assumptions", the "Complete Loss of Forced Reactor Coolant Flow" due to an electrical transient is bounded by the free coastdown of the RCPs analysis as long as the sustained RCP bus frequency decay rate is less than or equal to 3.5 Hz/s.

The maximum credible frequency decay rates associated with the RCP buses are determined by grid stability studies. The COLA information item to verify that the maximum credible sustained frequency decay rate is less than or equal to 3.5 Hz/s verifies that the bounding assumption in the safety analysis is valid for the particular site and local grid conditions.

The U.S. EPR uses an RCP speed reactor trip setpoint in a similar manner that other pressurized water reactors use RCP bus voltage and frequency as an input for a reactor trip. Additionally, the RCP speed reactor trip is credited in the safety analysis instead of low RCS flow rate due to the slower response time of a low RCS flow rate initiated reactor trip. The reactor trip on low RCP speed and maximum frequency decay rate of 3.5 Hz/s are key RCP parameters that provide protection against violating the departure from nucleate boiling ratio limit during a loss of flow event which could originate from an electrical transient. A discussion on the RCP speed reactor trip and setpoint is found in U.S. EPR FSAR Tier 2 Chapter 3 Table 3.10-1—List of Seismically and Dynamically Qualified Mechanical and Electrical Equipment, Tier 2 Chapter 7.2.1.2.7 and Tier 2 Chapter 16 Section 3.3.

FSAR Impact:

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

Question 08.02-3:

If COL applicant plans to add as a new EPR unit at the existing site, the SRP section 8.2 states that the COL applicants should discuss the past grid availability history, including the frequency, duration, and causes of outages over the past 20 years for both the transmission system accepting the unit's output and the transmission system providing the preferred power for the unit's loads. Revise the EPR FSAR to include a requirement for the above information.

Response to Question 08.02-3:

The intent of COL information items is to succinctly identify areas within the U.S. EPR FSAR where additional information is necessary to be provided or supplemented by the applicant. COL information items are located within the FSAR section where the information is to be provided or supplemented. However, the COL item descriptions are not intended to replicate or provide all the NRC guidance information from the SRP or RG 1.206 necessary for the applicant to satisfactorily address the COL item.

The current COL item in FSAR Section 8.2.2.4, which is listed in Table 1.8-2, along with the guidance provided in RG 1.206, provides the necessary details to capture the applicant's responsibilities for satisfactorily addressing the COL item regarding grid stability information. As indicated in Tier 2 Section 8.2.2.4, a COL applicant that references the U.S. EPR design certification will provide a site specific grid stability analysis.

FSAR Impact:

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

Question 08.02-4:

Section C.I.8.2.2 (Analysis) of RG 1.206 states that "for all designs, the COL applicant should provide an analysis of the stability of the grid. This analysis should include the worst-case disturbances for which the grid has been analyzed and considered to remain stable and should describe how the stability of the grid is continuously studied as the loads grow and more transmission lines and generators are added. It should also provide the assumptions and conclusions that demonstrate that the applicant has addressed the acceptance criteria required for the continued safe operation of the nuclear unit and the stability of the grid." Revise Section 8.2 of EPR FSAR so that the COL applicant is required to address the above RG guidance information.

Response to Question 08.02-4:

The intent of COL information items is to succinctly identify areas within the U.S. EPR FSAR where additional information is necessary to be provided or supplemented by the applicant. COL items are located within the FSAR section where the information is to be provided or supplemented. However, the COL item descriptions are not intended to replicate or provide all the NRC guidance information from the SRP or RG 1.206 necessary for the applicant to satisfactorily address the COL item.

The current COL item in FSAR Section 8.2.2.4, which is listed in Table 1.8-2, along with the guidance provided in RG 1.206, provides the necessary details to capture the applicant's responsibilities for satisfactorily addressing the COL item regarding grid stability information. As indicated in Tier 2 Section 8.2.2.4, a COL applicant that references the U.S. EPR design certification will provide a site specific grid stability analysis.

FSAR Impact:

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

Question 08.02-5:

FSAR Item 20 of Table 8.2-3 states that “respective division EDG will start but will not energize the faulted bus due to the EDG output breaker lock out.” Describe how the EDG output breaker lock out scheme will prevent energizing the faulted bus.

Response to Question 08.02-5:

Contacts from the medium voltage bus lockout relay (86 device) are placed in the trip and close circuits of each associated EDG output source breaker as well as the other associated source breakers to the medium voltage bus. These contacts will trip open a closed EDG output breaker and prevent an EDG output breaker from closing until the lockout signal is manually reset.

FSAR Impact:

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

Question 08.02-6:

EPR is designed to accept a 100% load rejection without a turbine trip and continue to supply plant loads without interruption. The initial test program (test #109) described in Chapter 14 (14.2.12.10.2) appears to be demonstrating that the unit main power system (i.e., main generator) can supply power to designated house loads. Confirm whether this test is the load rejection test from full power. In addition, the staff is concerned that the transient voltage spike during the above test could trip the onsite safety-related equipment including battery charges and UPS system. Include in EPR FSAR that the COL applicant should provide the transient load-flow analysis that simulates the above test and demonstrates that transient voltage spike causes no problem to plant safety system.

Response to Question 08.02-6:

A response to this question will be provided by October 1, 2008.

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- The PPS is not degraded below a level that will activate EPSS degraded grid protection actions after any of the following single contingencies:
  - U.S. EPR turbine--generator trip.
  - Loss of the largest unit supplying the grid.
  - Loss of the largest transmission circuit or inter-tie.
  - Loss of the largest load on the grid.
- The transmission system will not subject the reactor coolant pumps to a sustained frequency decay of greater than 3.5 Hz/s as bounded by the decrease in reactor coolant system flow rate transient and accident analysis described in Section 15.3.2.

8.1-3

The U.S. EPR is designed to operate within a transmission system operating voltage of ± ten10 percent and not initiate the degraded voltage protection actions as described in Section 8.3.1.1.3. Degraded grid setpoints are provided in Chapter 16, Tech Spec 3.3.1, Table 3.3.1-2—Acquisition and Processing Unit Requirements, referenced from Tech Spec 3.3.1, Table 3.3.1-1. Regulation of the transmission system by the transmission system operator within these limits during normal operation and single contingencies provides sufficient voltage to safety-related loads during design basis events.

The PPS provides two circuits from the transmission system to the Class 1E distribution system through the station switchyard that are sized to supply the maximum expected coincident safety-related and non-safety-related loads during normal and abnormal operations as indicated in IEEE Std 308-2001 (Reference 2) and endorsed by RG 1.32.

8.2.2.5 Compliance with GDC 18

Offsite power complies with GDC 18. The offsite power system is designed to permit periodic testing and inspection of the system and components to assess itstheir performance. A COL applicant that references the U.S. EPR design certification will provide site-specific information for the station switchyard equipment inspection and testing plan.

Surge arresters and the lightning protection system are capable of periodic inspection and testing as described in RG 1.204, Section C.2.

8.2.2.6 Compliance with GDC 33, GDC 34, GDC 35, GDC 38, GDC 41, and GDC 44

Compliance with the design requirements of GDC 33, GDC 34, GDC 35, GDC 38, GDC 41 and GDC 44, are satisfied as they relate to the operation of the offsite power system through compliance with GDC 17, as described in Section 8.2.2.4.