ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Thursday, February 17, 2011 1:22 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); HUDSON Greg (AREVA); WILLIFORD Dennis (AREVA); HALLINGER Pat (EXTERNAL AREVA); GARDNER Darrell (AREVA); BUDZIK Dennis (AREVA)
Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Questions 7.1-31, 7.3-33, 7.3-34, 7.9-62, 7.9-65, 7.9-66
Attachments: RAI 442 Response US EPR DC - DRAFT - six questions.pdf

Getachew,

To support the final response date of March 15, 2011, attached is a draft response for RAI 442 questions 7.1-31, 7.3-33, 7.3-34, 7.9-62, 7.9-65, 7.9-66. Please let me know if the staff has questions or if the responses can be sent as a final response.

Thanks,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Wednesday, February 09, 2011 5:07 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 2

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. To allow additional time to interact with the staff and to process the responses a revised schedule is provided below. It should be noted that the dates below may need to be adjusted following the February 15, 2011 public meeting between AREVA and the NRC on digital instrumentation and controls.

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-29	March 15, 2011
RAI 442 — 7.1-30	March 15, 2011

RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	March 15, 2011
RAI 442 — 7.3-32	March 15, 2011
RAI 442 — 7.3-33	March 15, 2011
RAI 442 — 7.3-34	March 15, 2011
RAI 442 — 7.9-61	March 15, 2011
RAI 442 — 7.9-62	March 15, 2011
RAI 442 — 7.9-63	March 15, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-65	March 15, 2011
RAI 442 — 7.9-66	March 15, 2011
RAI 442 — 7.9-67	March 15, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, January 07, 2011 11:15 AM
To: Tesfaye, Getachew
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 1

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. To allow additional time to interact with the staff a revised schedule is provided below for questions 7.1.29, 7.1.32, 7.9-65 and 7.9-67. The schedule for the other questions remains unchanged.

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

Question #	**Response Date**
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-29	**February 9, 2011**
RAI 442 — 7.1-30	February 9, 2011
RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	**February 9, 2011**
RAI 442 — 7.3-32	February 9, 2011
RAI 442 — 7.3-33	February 9, 2011
RAI 442 — 7.3-34	March 15, 2011

RAI 442 — 7.9-61	February 9, 2011
RAI 442 — 7.9-62	February 9, 2011
RAI 442 — 7.9-63	February 9, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-65	**March 15, 2011**
RAI 442 — 7.9-66	February 9, 2011
RAI 442 — 7.9-67	**February 9, 2011**

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, November 19, 2010 5:12 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 442 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 17 question (s) is not provided.

The following table indicates the respective pages in the response document, "RAI 442 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 442 — 7.1-26	2	2
RAI 442 — 7.1-27	3	3
RAI 442 — 7.1-28	4	4
RAI 442 — 7.1-29	5	5
RAI 442 — 7.1-30	6	6
RAI 442 — 7.1-31	7	8
RAI 442 — 7.1-32	9	9
RAI 442 — 7.3-32	10	10
RAI 442 — 7.3-33	11	11
RAI 442 — 7.3-34	12	12
RAI 442 — 7.9-61	13	13
RAI 442 — 7.9-62	14	14
RAI 442 — 7.9-63	15	15
RAI 442 — 7.9-64	16	16
RAI 442 — 7.9-65	17	17
RAI 442 — 7.9-66	18	18
RAI 442 — 7.9-67	19	19

A complete answer is not provided for the 17 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-29	January 7, 2011
RAI 442 — 7.1-30	February 9, 2011
RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	January 7, 2011
RAI 442 — 7.3-32	February 9, 2011
RAI 442 — 7.3-33	February 9, 2011
RAI 442 — 7.3-34	March 15, 2011
RAI 442 — 7.9-61	February 9, 2011
RAI 442 — 7.9-62	February 9, 2011
RAI 442 — 7.9-63	February 9, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-65	January 7, 2011
RAI 442 — 7.9-66	February 9, 2011
RAI 442 — 7.9-67	January 7, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, October 20, 2010 8:09 AM
To: ZZ-DL-A-USEPR-DL
Cc: Zhao, Jack; Morton, Wendell; Mott, Kenneth; Spaulding, Deirdre; Truong, Tung; Zhang, Deanna; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 442(4295,5076,5068,5067), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 10, 2010, and discussed with your staff on October 13, 2010. Drat RAI Questions 07.01-26 and 07.03-33 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: 2568

Mail Envelope Properties (199EBB4D1CD9644D9472AA84D5D8EFA71FB6F4)

Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Questions 7.1-31, 7.3-33, 7.3-34, 7.9-62, 7.9-65, 7.9-66
Sent Date: 2/17/2011 1:22:11 PM
Received Date: 2/17/2011 1:22:16 PM
From: BRYAN Martin (EXTERNAL AREVA)

Created By: Martin.Bryan.ext@areva.com

Recipients:
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"HUDSON Greg (AREVA)" <Greg.Hudson@areva.com>
Tracking Status: None
"WILLIFORD Dennis (AREVA)" <Dennis.Williford@areva.com>
Tracking Status: None
"HALLINGER Pat (EXTERNAL AREVA)" <Pat.Hallinger.ext@areva.com>
Tracking Status: None
"GARDNER Darrell (AREVA)" <Darrell.Gardner@areva.com>
Tracking Status: None
"BUDZIK Dennis (AREVA)" <Dennis.Budzik@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	7979	2/17/2011 1:22:16 PM
RAI 442 Response US EPR DC - DRAFT - six questions.pdf	503121	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
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Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 442

10/20/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 07.01 - Instrumentation and Controls - Introduction
SRP Section: 07.03 - Engineered Safety Features Systems
SRP Section: 07.09 - Data Communication Systems

Application Section: FSAR Ch 7

QUESTIONS for Instrumentation, Controls and Electrical Engineering 1 (AP1000/EPR Projects) (ICE1)

Question 07.01-31:

Follow-up RAI 321, Question 07.01-19.

The staff requests that the following additional information be provided:

a. Information which adequately describes your commercial grade dedication program.

b. Information which adequately identifies the specific critical characteristics.

In the original question, the staff RAI requested the following:

> Describe the software development process (SDP) used for the video display that will be used in the safety information and control systems (SICS), particularly with respect to identification of aspects that differ from the SDP used for the TELEPERM XS.
>
> The applicant needs to provide a description of the differences in the SDP for the safety-related video display. The staff needs to be able to determine acceptability with regards to the quality requirements of 10 CFR 50.55a(a)(1); 10 CFR Part 50, Appendix A, General Design Criteria 1; 10 CFR Part 50, Appendix B; and 10 CFR 50.55a(h) are met.

In its response, AREVA NP indicated that: "QDS system software is commercial software. … qualify the QDS … through a commercial dedication process that conforms to the guidance of EPRI TR-106439, 'Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications.' … The QDS specific [development] tools [used to create the QDS application software] will be qualified as part of the commercial grade dedication process. …"

The NRC staff safety evaluation (SE) of TR-106439 stated that applicants referencing TR-106439 need to provide details regarding the dedication process. AREVA NP listed the following four (4) items as the process they would follow for commercial dedication.

1. Identification of the critical characteristics the system software must exhibit.
2. Definition of a combination of supplemental testing, supplier surveys, source verifications, or performance reviews, which demonstrate that the system software exhibits the critical characteristics.
3. Performance of the defined combination of supplemental testing, supplier surveys, source verifications, or performance reviews.
4. Creation of a dedication acceptance package that documents the results of activity 3 and provides evidence that the QDS system software exhibits the required critical characteristics.

The staff has determined that the four (4) items do not provide a detailed description of their dedication process. Additional information is requested which describes the detailed commercial dedication process that AREVA NP will follow, in conformance with EPRI TR-106439. Additionally, in its response, AREVA NP did not provide the specific critical characteristics. The NRC staff SE of TR-106439 stated that applicants referencing TR-106439 need to provide specific critical characteristics. Additional information is requested which provides the specific critical characteristics.

Response to Question 07.01-31:

This response discusses the four general activities cited in the question and describes the commercial dedication of the qualified display system (QDS) system software, the QDS application software programming tools, and the QDS hardware. In this response, AREVA NP refers to organizations in the United States, and AREVA SAS refers to organizations in France.

The critical characteristics for the QDS hardware and system software will be provided in several engineering documents. The set of critical characteristics will be detailed and extensive. Therefore, it is unnecessary to include the critical characteristics in this response, or in the U.S. EPR FSAR. However, the descriptions in this response provide reasonable assurance that the critical characteristics will be adequately defined and verified appropriately in the dedication process. Additionally, U.S. EPR FSAR Tier 1, Section 2.4.2 contains specific acceptance criteria related to the definition of the critical characteristics.

QDS System Software and Application Software Programming Tools:

EPRI TR-106439 is a guideline as opposed to a requirement. Therefore, AREVA NP will determine which activities are appropriate or necessary based on the safety-related importance of equipment, and based on examples in EPRI TR-106439 showing how the guidance can be applied for dedicating equipment of various levels of complexity and safety significance. For the QDS, safety-related importance is a priority. As a result, applicable elements of the example process described in EPRI TR-106439, Section 6.4, "ESFAS Upgrade Using PLCs," will be used in the dedication process. AREVA NP chose the EPRI TR-106439, Section 6.4 example for its thoroughness. EPRI TR-106439, Section 6.4 describes more scrutiny during the commercial survey than the other three examples and adds a failure analysis task. The EPRI TR-106439, Section 6.4 process pertains to a PLC, and because the QDS is a video display system, example process elements inapplicable to a display system will not be included for the QDS. The four processes described in the EPRI TR do not discuss code examination, except for a thread audit during the commercial survey to verify that the vendor's software development processes and established coding practices were followed. The commercial dedication of software process does not require the dedicator's expertise in the vendor's target system or its associated software. Therefore, the dedicator is not required to perform code reviews other than the thread audit. A review of the software's architecture to check for determinism, simplicity, error handling capabilities, or effects of unneeded features limits abstraction.

AREVA SAS supplies most of the QDS software, and its software development program is equivalent to the process endorsed by the NRC for safety-related software. When compared to other commercial suppliers, the supplied development and verification and validation (V&V) processes will be more formalized, and the available documentation will be more extensive. This supports an engineering judgment on the software quality.

The QDS software commercial dedication will include the following activities:

1. Prepare a software dedication plan, or a Software Quality Assurance Plan (SQAP), which describes the process for qualifying software. This document will describe the qualification process, including an identification and description of the affected software programs and their safety significance, tasks and responsibilities by organization, documentation, reviews, configuration management program, tools, techniques and methodologies, code and medial

control, supplier control, records control, and training. The format will be in accordance with ANSI/IEEE, Std. 730-1989.

2. Prepare a V&V plan, outlining V&V activities that AREVA NP will perform for the QDS software. The V&V plan describes the types and formats of documents (described further in this response), which contain the software requirements, test requirements, test results, and describe the V&V activities, the process for handling discrepancies, and the current hardware/software configuration.

3. Define the critical characteristics of the software. This includes identifying the applicable specifications (QDS System Requirements Specification and Graphical Library Items Specification) from AREVA SAS and the U.S. EPR Functional Requirements Specification from AREVA NP. Other QDS software requirements sources, such as the QDS design tool manual and examining recent cyber security requirements, will also be considered. These critical requirements will be compiled into a Software Critical Functional Requirements document. Based on these requirements, a software requirements matrix (SRM) will be made, which contains the critical requirements, list their source(s), and describes how each requirement was or will be validated.

4. Prepare commercial survey plan of AREVA SAS related to the QDS software. The plan should include a review of the supplier's software development and quality assurance organizations, the software development and testing processes, training, software configuration management, and software maintenance practices, with examples showing how field problem reports were resolved. The field problems history should be reviewed to support engineering judgment regarding the reliability level of the current software, which is evidenced by a decreasing number of reported problems. Software coding thread audits will assess how accurately the developer followed accepted coding practices. The V&V documents will be examined to verify the types and adequacy of the V&V activities that were performed by the independent V&V organization, including documentation formality, the extent of software verification reviews, verification testing (e.g., module, line, or branch coverage), and validation testing (e.g., static, dynamic, random). Unlike previously developed software used in installed QDS units, the new (functional evolution) software will not have operating history data for reliability assessments, and will require more attention. New software quality is only demonstrated through the development and V&V processes used. The independent V&V performed for/by AREVA SAS will be sufficiently similar to the process described in IEEE-1012. The V&V will not require re-performance other than the guidelines described in EPRI TR-106439. A review should also be performed regarding software assessments that AREVA SAS conducted of the sub-supplier's commercial off-the-shelf (COTS) software, provided with the QDS display, such as the video driver.

5. Prepare a test plan for functional black box testing of the critical software functions listed in the SRM. The test plan should be formatted in accordance with IEEE Std. 829-1983, endorsed by Regulatory Guide 1.170. The software will be integrated into the target QDS platform, which is interfaced to a Teleperm XS (TXS) function processor. The test plan should include provisions for testing under abnormal and faulted conditions, high communications throughput conditions, and using multiple values for each input and adjustable parameter.

6. Prepare a test procedure based on Activity 5. The test plan will now include physical specifics related to the test item and test equipment.

7. Perform the commercial survey described in Activity 4. This survey should begin early in the process so that any identified weaknesses can be corrected. However, it will not be

complete until after the V&V of the new software is complete, verifying that the survey accounts for each aspect.

8. Perform a failure analysis or review the failure modes and effects analysis (FMEA) prepared by AREVA SAS or AREVA GmbH.
9. Performance of functional black box testing described in Activities 5 and 6. This requires that a QDS display unit, with a TXS function processor as an interface, is available.
10. Prepare a test report that contains the test results, any test discrepancies, and their resolutions. This report will contain the elements described in IEEE 829-1998, Sections 8 through 11, although the format will not necessarily be identical to that standard.
11. Prepare a V&V Final Report that describes the V&V tasks performed and their results, the anomalies/discrepancies and their resolutions, and provides an assessment of the software quality based on the results of the V&V work.
12. Prepare a dedication acceptance package that documents the results of these activities and, as previously stated to the NRC, "provides evidence that the QDS system software exhibits the required critical characteristics."

The QDS software commercial dedication activities are simplified because they do not address the iterative nature of the V&V effort.

QDS Hardware:

The QDS hardware will be procured as commercial grade off the shelf (COTS) hardware, and the commercial grade dedication will be required. This dedication process will follow the guidance of EPRI TR-106439. As discussed in EPRI TR-106439, the hardware dedication is based on EPRI NP-5652 and EPRI TR-102260.

As discussed in the software dedication plan section, the QDS has both a high safety significance and a high level of complexity. As a result, applicable elements of the example process described in EPRI TR-106439, Section 6.4, "ESFAS Upgrade Using PLCs," will also be used in the hardware dedication process.

The hardware dedication process can be divided into three broad areas of activity:

- Commercial grade dedication activities relating to form, fit, and function.
- Seismic/environmental qualification.
- Electromagnetic compatibility (EMC)/event sequence diagram (ESD) testing.

Critical characteristics that fulfill the QDS safety-related functions exist in these three areas, and each area will be discussed in the following sections.

Because the QDS components are purchased as COTS items, the relatively rapid change in the computer industry, and the expected low hardware purchases for QDS relative to manufacturer capacities, a stable hardware configuration will not be maintained for long. For this reason, the QDS hardware will be procured in "batches." These batches will be homogenous as part of the dedication process. Based on testing a single set of QDS hardware for these stressors, the QDS hardware items that are not previously environmentally, seismically, or EMC tested are qualified for these conditions. The homogenous batches support this conclusion

Because these are digital, computer-based systems, hardware and software dedication can not be completely separated. For example, dependable operation predictions are based on proper operation of both hardware and software. Hardware dedication will require a full set of system software, and representative application software to be installed, for operation and functional testing. Overlap will exist between the software and hardware dedication activities. Where appropriate, the software dedication program will credit work that supports the verification of critical characteristics under the hardware dedication program.

Dedication of QDS hardware will include the following activities:

1. Prepare a hardware commercial grade dedication plan. This high-level document defines and captures the hardware critical characteristics to be verified during the commercial grade dedication process. Critical characteristics contained in the applicable specifications will be included in the plan. This includes QDS System Requirements Specification from AREVA SAS, the U.S. EPR Functional Requirements Specification from the U.S. EPR FSAR design, and other QDS system requirements sources. This dedication plan will also specify seismic, environmental, EMC, and ESD requirements as critical characteristics to be met. However, the levels will be provided as part of the test plan prepared for those test programs.

   The plan will specify which EPRI NP-5652 method(s) will be used in the critical characteristics verification. These methods include:

   - Method 1 – Special tests and inspections.
   - Method 2 – Commercial grade survey of supplier.
   - Method 3 – Source verification.
   - Method 4 – Acceptable supplier/item performance.

   The hardware commercial grade dedication plan will also describe the method(s) used to verify lot homogeneity of the QDS hardware.

2. Prepare a detailed seismic and environmental qualification test plan, which will specify the seismic and environmental test levels, the specific items to be tested, baseline and functional test requirements, the required performance extremes, operating and surge voltages, monitoring requirements during seismic and environmental testing, and acceptance criteria.

3. Perform seismic/environmental qualification testing. QDS hardware qualification must be performed in accordance with IEEE Standard 323, as endorsed by Regulatory Guide 1.209. This qualification program is required to consider the normal, abnormal, and accident conditions that the equipment will be exposed to during its service life. A required qualification conditions determination will be made before qualification testing is started, and the conditions will be included in the qualification test plan.

   A test specimen will be randomly taken from the QDS the homogenous lot hardware, which will be used in the seismic and environmental qualification test program. Unless otherwise noted, the complete seismic/environmental test program will be completed with the same test specimen.

   The following test sequence from IEEE Standard 323-2003, as endorsed by Regulatory Guide 1.209, involves the following:

- Inspection of the test specimen.
- Baseline/functional tests under normal conditions.
- Operation of the test specimen to extremes of performance, operating, surge voltages, and electrical characteristics.
- Age conditioning to the end of qualified life, as required.
- Exposure to non-seismic mechanical vibration.
- Simulated operating basis earthquake (OBE) and safe shutdown earthquake (SSE) level seismic vibration.
- Simulated accident conditions (design basis event (DBE)).
- Final functional tests/post-test inspection.

Some of these test steps are not required. For example, QDS installation in a harsh environment is not anticipated. In this instance, age conditioning and simulated accident conditions testing will not be required.

Because the QDS hardware is procured on a homogeneous lot basis, the qualification testing applicability is confined to that lot. Seismic and environmental qualification testing will be required for each hardware lot.

4. Prepare a seismic/environmental qualification test report that contains the test results, any test anomalies with their resolutions, the levels achieved in the testing, and conclusions regarding QDS system performance during the test.
5. Prepare a detailed EMC and ESD qualification test plan, which will specify the test levels, the specific items to be tested, the monitoring requirements during testing, and the acceptance criteria.
6. Perform EMC and ESD qualification testing. To meet requirements for EMC testing, RG 1.209, Regulatory Position C (3), endorses both EPRI TR-102323-R1, and Regulatory Guide 1.180, Revision 1. EMC testing will be performed in accordance with Regulatory Guide 1.180, and will use the MIL-STD 461E protocol, as opposed to the IEC 61000 series protocol. Radiated emissions testing will be conducted up to 10 times the highest intentionally generated frequency, and radiated susceptibility tests will be conducted up to 10 GHz, as required in Regulatory Guide 1.180, Revision 1, Regulatory Position C (6).

   Regulatory Guide 1.180, Revision 1 does not require ESD testing, but EPRI TR-102323-R1 requires a contact discharge level of ±8 kV, and an air discharge level of ±15 kV. These are considered target levels, with a contact discharge level of ±6 kV and an air discharge level of ±8 kV as a minimum value.
7. Prepare an EMC and ESD test report that contains the test results, any test anomalies with their resolutions, the levels achieved in the testing, and the conclusions regarding QDS system performance during the test.

FSAR Impact:

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

Question 07.03-33:

Incorporate the response to the 4th RAI to Topical Report ANP-12081P, "U.S. EPR Digital Protection System Topical Report" and Attachment B to the 2nd RAI into the U.S. EPR, Tier 2, FSAR or Technical Report ANP-10309P, "U.S. EPR Digital Protection System Technical Report" to demonstrate conformance to IEEE Std. 603-1998, Clause 4.10.

Clause 4.10 of IEEE Std. 603-1998 requires, as a part of the design basis, identification of the critical points in time or the plant conditions, after the onset of a design basis event. In Section 4.3 of the SER for Topical Report EMF-2110(NP)(A), the staff stated that the TXS system architecture and the system response time test methodology, as discussed in the topical report, demonstrated that the TXS system design is consistent with BTP HICB-21 (Note: BTP-21 provides updated guidance to BTP HICB-21). It is, therefore, acceptable. However, the staff included plant-specific action item (PSAI) 11 in the SER for licensees who reference this topical report to perform protection system response time tests in accordance with plant technical specification requirements. PSAI 11 required licensees to evaluate plant-specific accident analysis to confirm that a TXS reactor trip system includes the provision to detect accident conditions and anticipated operational occurrences in order to initiate reactor shutdown (safety analysis confirmation for accuracy and time response) consistent with accident analysis presented in Chapter 15 of the plant safety analysis report. To address this PSAI, the staff requested the applicant to demonstrate how the guidance of BTP 7-21 is addressed in the design of the protection system to meet IEEE Std. 603-1998, Clause 4.10. This request was documented in the 4th RAI for Topical Report ANP-10281P, "U.S. EPR Digital Protection System Topical Report." In response to the RAI, the applicant stated that the methodology used to estimate the response time of the computerized portion of the PS establishes a theoretical bounding response time for the typical types of functions performed by the PS. The final response time of the PS will be verified to be within the bounding time limits established for the PS. The applicant provided an analysis of the allocation of time delays to the computerized portion of the PS in Attachment B of the 2nd RAI for the U.S. Digital Protection Topical Report.

The staff requests the above identified and described response information be incorporated into the U.S. EPR, Tier 2, FSAR or Technical Report ANP-10309P to demonstrate conformance to IEEE Std. 603-1998, Clause 4.10.

Response to Question 07.03-33:

Technical Report ANP-10309P will be revised to add an appendix describing the methodology used to calculate the bounding response time of the protection system (PS) computerized portion.

To support submittal of complete and consistent information, and considering multiple RAI responses and design changes communicated to the NRC staff, the Technical Report ANP-10309P revisions described in this response will be submitted with the Response to RAI 442, Question 07.01-27.

FSAR Impact:

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

Question 07.03-34:

Provide more information on the self-diagnostic features of the PACS. U.S. EPR FSAR, Tier 2, Revision 1, Section 7.1.2.6.21 states the following: "The PACS contains self-diagnostic test features to alert plant personnel of a fault within one of the PACS components.

Currently, Chapter 7 of the U.S. EPR FSAR does not provide any specific details on the PACS modules self-testing abilities. There is also no information in Chapter 7 where status indication, especially in terms of alarms, is displayed in the Main Control Room. ANP-10310P, "Methodology for 100% Combinatorial Testing of the U.S. EPR Priority Module Technical Report" provides details on the PACS. However it does not provide enough detail for the staff to make a finding. The applicant does not consider the PACS a part of the Protection System (PS), so the inherent self-testing features will be evaluated individually by the staff as well. The staff created this RAI question in order the get further information on the PACS self-diagnostic/monitoring abilities in order to gain a greater understanding of all self-testing features of the entire platform. Standard Review Plan Section 7.1-C and BTP 7-17 were used as guidance.

1. Provide more detailed information on the PACS self-testing features, in terms of coverage capabilities, types of failures they can detect, and how they meet IEEE Std. 603 -1998, Clauses 5.7 and 5.8.
2. Where do alarms and any other equipment status details from the PACS display? PICS or SICS, both or another display entirely
3. Provide more detail on how the PACS self diagnostic features addresses guidance from BTP 7-17, "Guidance on Self-test and Surveillance Test Provisions". Section 3 of BTP 7-17 states that, "Self-test functions should be verified during periodic functional tests."
4. Does the applicant intend to provide an ITAAC to verify the self-testing functions of the PACS and what will be the acceptance criteria for this ITAAC?

Response to Question 07.03-34:

The priority modules in the PACS do not contain self-testing features. The statement regarding self-diagnostic features of the priority and actuator control system (PACS) was removed from the U.S. EPR FSAR in markups provided to the NRC by letter dated November 24, 2009. U.S. EPR FSAR Tier 2, Revision 2, Section 7.1.2.6.21 does not contain this information.

To meet IEEE Std. 603-1998, Clause 5.7 requirements, the PACS functionality required for performing engineered safety feature actuation system (ESFAS) functions is periodically tested through plant technical specification, actuating device operational tests (ADOT). U.S. EPR FSAR Tier 2, Chapter 16, Technical Specification 1.1 discusses ADOT.

To meet IEEE Std. 603-1998, Clause 5.8 requirements, U.S. EPR FSAR Tier 2, Section 7.1.2.6.19 describes how bypassed or inoperable status indications of the safety-related systems are provided to the operator on the process information and control system (PICS).

Because the priority module does not contain self-test features, the self-test guidance in BTP 7-17 is inapplicable to the priority module, and ITAAC regarding self-test features is not needed.

FSAR Impact:

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

Question 07.09-62:

Follow-up to RAI 286, Question 7.09-49.

Incorporate the response to RAI 286, Question 7.09-49 into the U.S. EPR, Tier 2 FSAR.

10 CFR Part 50, Appendix A, General Design Criteria 13, requires, in part, instrumentation be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety. The NRC issued Information Notice: 2007-15, "Effects of Ethernet-Based, Non-Safety Related Controls on the Safe and Continued Operation of Nuclear Power Stations," (ADAMS Accession No. ML071510428), describing operational experience on the effects of a data storm on non-safety control networks. The staff issued RAI 286, Question 7.09-49 to request the applicant to demonstrate how operating experience insights regarding the effects of data storms on non-safety data communications networks are addressed for the plant data network, which provides important to safety functions such as alarms, indications, and controls for all operational conditions. In response, the applicant states that sound engineering and design practices will be applied to development of the U.S. EPR plant data network and the instrumentation and controls (I&C) systems connected to the network. The plant data network will be designed to withstand data traffic, and the interfacing I&C systems will be designed with thresholds for network traffic that are consistent with maximum data rates of the network. Specific design details regarding preclusion of data storm events on a non-safety-related network will be developed later in the design process, and are thus not planned for inclusion in the application for design certification. However, the design features of the safety-related I&C systems that protect the safety-related functions will protect against loss of safety functions in case of data storm events on the non-safety-related plant data network. The staff finds this response acceptable. However, the staff requests the applicant to incorporate this response into the U.S. EPR, Tier 2, FSAR.

Response to Question 07.09-62:

U.S. EPR FSAR Tier 2, Section 7.1 will be revised to include the following information:

> "Sound engineering and design practices will be applied to the development of the U.S. EPR plant data network and the instrumentation and controls (I&C) systems connected to the network. The plant data network will be designed to withstand data traffic, and the interfacing I&C systems will be designed with thresholds for network traffic that are consistent with maximum data rates of the network. Specific design details regarding preclusion of data storm events on a non-safety-related network will depend on the specific technology chosen for these non-safety-related networks, and they are not included in the U.S. EPR FSAR. However, design features of the safety-related I&C systems protect against loss of safety function in case of data storm events on the non-safety-related plant data network. Specifically, the monitoring service interface (MSI) acts as a qualified communication barrier with the non-safety-related systems. It only accepts and transmits one set of messages each cycle, using the same deterministic processing cycle. This protects the safety-related function processors from communication events outside of their safety-related system. Loss of communication between the MSI and either the service unit (SU) or gateway does not impair performance of the safety-related functions."

To support submittal of complete and consistent information, and considering multiple RAI responses and design changes communicated to the NRC staff, the U.S. EPR FSAR Tier 2, Section 7.1 revisions described in this response will be submitted with the Response to RAI 442, Question 07.01-26.

FSAR Impact:

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

Question 07.09-65:

Incorporate the response to RAI 24 and 38 for Topical Report ANP-10281P into the U.S. EPR, Tier 2, FSAR or its referenced documents, to demonstrate independence when the ring network topology is used in the Protection System.

10 CFR Part 50, Appendix A, GDC 23, "Protection System Failure Modes," requires the protection system to be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced. NUREG/CR-6082, "Data Communications," provides additional discussion of independence and failure modes. In response to RAI 24, the applicant described the network failure modes and how these failures are bounded. In RAI 38 of the "Third Request for Additional for Information" for Topical Report ANP-10281P, the staff requested the applicant to describe the failure modes of the ring network employed in the U.S. EPR digital PS used to provide SPND measurements to the RAU and certain APUs, as required by GDC 23 of Appendix A to 10 CFR Part 50. The applicant provided in "Response to Third Request for Additional Information" for the Topical Report ANP-10281P, a description of how data messages are interpreted for validity and different types of message failures. The response also described how the APU will process each type of failure mode. In addition, the applicant provided in "U.S. EPR Digital Protection System Topical Report, Supplemental Information" a table detailing postulated communications failures within the TXS communications system. The staff requests the applicant to incorporate these responses from RAI 24 and RAI 38 for Topical Report ANP-10281P and the information in "U.S. EPR Digital Protection System Topical Report, Supplemental Information" into the U.S. EPR, Tier 2 FSAR or Technical Report ANP-10309P to demonstrate compliance to GDC 23.

Response to Question 07.09-65:

As discussed in public meetings with NRC staff on February 15, 2011, the ring networks connecting the four divisions of the remote acquisition units (RAU) to each division of the acquisition and processing units (APUs) will be removed from the U.S. EPR protection system (PS) design.

U.S. EPR FSAR Tier 2, Section 7.1 and Section 7.2, and Technical Report ANP-10309P will be revised to reflect the design change.

To support submittal of complete and consistent information, and considering multiple RAI responses and design changes communicated to the NRC staff, U.S. EPR FSAR Tier 2, Section 7.1 revisions described in this response will be submitted with the Response to RAI 442, Question 07.01-26. The U.S. EPR FSAR Tier 2, Section 7.2 and Technical Report ANP-10309 revisions described in this response will be submitted with the Response to RAI 442, Question 07.01-27.

FSAR Impact:

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

Question 07.09-66:

Follow-up to RAI 286, Question 7.9-52.

Incorporate the response to RAI 286, Question 7.9-52 regarding the quality of the plant data network to demonstrate compliance to 10 CFR Part 50 General Design Criterion (GDC) 1.

GDC 1 requires structures, systems, and components important to safety to be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. The Processing Information and Control System (PICS) is used to operate the plant during normal and accident conditions. This operation is achieved using the plant data network. In RAI 286, Question 7.9-52, the staff requested the applicant to demonstrate the quality and network capacity of the plant data network to support PICS functions. In response, the applicant stated that the normal control systems that will be utilized in the U.S. EPR must have adequate bandwidth to reliably operate and maneuver all the other systems in the reactor plant needed for plant operation and also to keep the plant reliably online. These I&C systems will be specified and procured consistent with the application of digital control technology currently in use in other power generation facilities. The staff requests the applicant to include the commitment to have adequate bandwidth to reliably operate and maneuver all systems in the reactor plant needed for plant operation and to keep the plant reliably online in the U.S. EPR, Tier 2, FSAR to demonstrate compliance to GDC 1. In addition, clarify whether the plant data network and terminal data network are classified as part of the PICS.

Response to Question 07.09-66:

U.S. EPR FSAR Tier 2, Section 7.1 will be revised to include the following information regarding quality and network capacity of the plant data network:

> "The control systems that will be utilized in the U.S. EPR must have adequate bandwidth to reliably operate and maneuver the process systems in the reactor plant needed for plant operation and to keep the plant reliably online."

U.S. EPR FSAR Tier 2, Section 7.1 will be revised to clarify that the plant data network and terminal data network are classified as part of the process information and control system (PICS).

To support submittal of complete and consistent information, and considering multiple RAI responses and design changes communicated to the NRC staff, the U.S. EPR FSAR Tier 2, Section 7.1 revisions described in this response will be submitted with the Response to RAI 442, Question 07.01-26.

FSAR Impact:

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