ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Wednesday, May 06, 2009 5:01 PM
To: Getachew Tesfaye
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); WELLS Russell D (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No.96, FSAR Ch. 3, Supplement 1
Attachments: RAI 96 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided technically correct and complete responses to all 4 questions of RAI No. 96 on November 14, 2008. In an e-mail dated November 14, 2008, NRC requested that AREVA NP modify the response to RAI 96, Question 03.11-1 and the U.S. EPR FSAR "to reflect the change from IEEE Std 323-2003 to IEEE Std 323-1974." Based on a conference call between AREVA NP and the NRC on February 6, 2009, AREVA NP is providing a revised response to Question 03.11-1 to change IEEE Std 323-2003 to IEEE Std 323-1974 with the exception where IEEE Std 323-2003 is referenced for safety-related computer-based instrumentation and controls (I&C) systems located in a mild environment as addressed in RG 1.209. This revised response is provided in the attached file, “RAI 96 Supplement 1 Response US EPR DC.pdf.”

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 96 Question 03.11-1.

The following table indicates the respective page in the response document, “RAI 96 Supplement 1 Response US EPR DC.pdf,” that contains AREVA NP’s response to the subject question.

Question #	Start Page	End Page
RAI 96 — 03.11-1	2	2

This concludes the formal AREVA NP response to RAI 96, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson

ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, November 14, 2008 5:59 PM
To: Pederson Ronda M (AREVA NP INC)
Cc: John Rycyna; Michael Miernicki; Joseph Colaccino
Subject: FW: Response to U.S. EPR Design Certification Application RAI No.96(991,1025,,1209), FSAR Ch. 3

Ronda,
Staff feedback on your RAI response. If you need to setup a phone call to discuss this further, John will help you next week.
Getachew

From: Paul Shemanski
Sent: Friday, November 14, 2008 5:55 PM
To: Getachew Tesfaye
Cc: Ronaldo Jenkins; Robert Buhowski; Amar Pal; Peter Kang
Subject: RE: Response to U.S. EPR Design Certification Application RAI No. 96(991,1025,,1209), FSAR Ch. 3

Getachew,

I reviewed the response from AREVA on RAI-SRP 3.11-EEB-01 and find it unacceptable. I explained to AREVA during our telecon that NRC has not endorsed IEEE Std 323-2003 and IEEE Std 323-1974 is the record of standard to be used for compliance with 10 CFR 50.49 based on my discussions with OGC. As such, this will be treated as an open item until the U.S. EPR FSAR is modified to reflect the change from IEEE Std 323-2003 to IEEE Std 323-1974. Unless AREVA modifies the FSAR to use IEEE 323-1974, EEB cannot make the finding that their EQ program is is compliance with 10 CFR 50.49.

Paul,

From: Getachew Tesfaye
Sent: Friday, November 14, 2008 5:05 PM
To: Paul Shemanski; Ronaldo Jenkins; Sara Bernal; Jean-Claude Dehmel; James Strnisha; David Terao; Michael Miernicki; Joseph Colaccino; John Rycyna; Tarun Roy
Subject: FW: Response to U.S. EPR Design Certification Application RAI No. 96(991,1025,,1209), FSAR Ch. 3

From: Pederson Ronda M (AREVA NP INC) [mailto:Ronda.Pederson@areva.com]
Sent: Friday, November 14, 2008 5:04 PM
To: Getachew Tesfaye
Cc: WELLS Russell D (AREVA NP INC); OWEN Dennis E (EXT); SLIVA Dana (EXT); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 96(991,1025,,1209), FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 96 Response US EPR DC.pdf" provides technically correct and complete responses to all 4 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 96 Question 03.11-2.

The following table indicates the respective pages in the response document, "RAI 96 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 96 — 03.11-1	2	3

RAI 96 — 03.11-2	4	5
RAI 96 — 03.11-3	6	7
RAI 96 — 03.11-4	8	10

This concludes the formal AREVA NP response to RAI 96, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson

ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
AREVA NP Inc.
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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, October 17, 2008 11:10 AM
To: ZZ-DL-A-USEPR-DL
Cc: Paul Shemanski; Ronaldo Jenkins; Sara Bernal; Jean-Claude Dehmel; James Strnisha; David Terao; Michael Miernicki; Joseph Colaccino; John Rycyna; Tarun Roy
Subject: U.S. EPR Design Certification Application RAI No. 96(991,1025,,1209), FSAR Ch. 3

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 15, 2008. Draft RAI Question 03.11-2(i) was modified and Draft RAI Question 03.11-3(ii) was deleted 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: 454

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D31E3870E)

Subject: Response to U.S. EPR Design Certification Application RAI No.96, FSAR Ch. 3, Supplement 1
Sent Date: 5/6/2009 5:01:25 PM
Received Date: 5/6/2009 5:01:26 PM
From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

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MESSAGE	6331	5/6/2009 5:01:26 PM
RAI 96 Supplement 1 Response US EPR DC.pdf		119502

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

Response to

Request for Additional Information No. 96, Supplement 1, Revision 0

10/17/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.11 - Environmental Qualification of Mechanical and Electrical Equipment

Application Section: FSAR Ch. 3

QUESTIONS for EEB, CHPB, and CIB1 Branches

Question 03.11-1:

RAI-SRP 3.11-EEB-01

In FSAR Tier 2, Revision 0, Section 3.11.2.1 it is stated that electrical equipment identified to be in a harsh location, as described in Section 3.11.1.1, will be environmentally qualified by type testing or type testing and analysis using the guidance of IEEE Std 323-2003 and related standards in Table 3.11-4. However, NRC has not endorsed the 2003 version of IEEE Std 323 for environmental qualification of electrical equipment in the harsh environment with the exception of safety-related computer-based I&C systems located in a mild environment as addressed in Regulatory Guide 1.209, March 2007. Since IEEE Std 323-1974 remains the current standard of record and is endorsed by Regulatory Guide 1.89 for environmental qualification, Section 3.11 of the FSAR Tier 2, Revision 0 needs to be modified to reflect the change from IEEE Std 323-2003 to IEEE Std 323-1974.

Response to Question 03.11-1:

Based on a conference call with the NRC on February 6, 2009, AREVA NP will revise the U.S. EPR FSAR to change IEEE Std 323-2003 to IEEE Std 323-1974 with the exception where IEEE Std 323-2003 is referenced for safety-related computer-based instrumentation and controls (I&C) systems located in a mild environment as addressed in RG 1.209.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.11 and Appendix 3D will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Electrical equipment identified to be in a harsh location, as described in Section 3.11.1.1, will be environmentally qualified by type testing or type testing and analysis using the guidance of IEEE Std 323-~~2003~~1974~~[1]~~ and related standards shown in Table 3.11-4—Summary Comparison of IEEE Endorsed Standards versus Latest IEEE Standards (References 4 through 14) and Table 3.11-5—Summary of IEEE Non-Endorsed Standards (References 2, 3, and 15 through 22)[1]. These related standards address other equipment specific IEEE qualification standards, such as IEEE Std 317 (electrical penetrations), IEEE Std 334 (motors), IEEE Std 344 (seismic), IEEE Std 382 (actuators), IEEE Std 383 (cables), IEEE Std 638 (transformers), IEEE Std 650 (chargers/ inverters), and IEEE Std 1205 (aging).

03.11-1

The following RGs provide guidance for meeting the requirements of 10 CFR 50, Appendix A, General Design Criteria GDC 1, 2, 4 and 23; 10 CFR 50 Appendix B, Criterion III, XI, and XVII, to 10 CFR 50 and 10 CFR 50.49, and are used for qualification purposes for the EQ Program: RGs 1.9, 1.40, 1.63, 1.73, 1.89, 1.97, 1.100, 1.209, 1.131, 1.152, 1.156, 1.158, 1.180, and 1.209. A comparison of the related qualification standards and the associated RG that endorses them is provided in Table 3.11-4. Table 3.11-5 provides a summary of the related qualification standards that are not associated with a RG.

NUREG-0588, Revision 1 (Reference 23), also provides guidance for assessing the compliance of an environmental qualification program with 10 CFR 50.49. As noted in SRP 3.11, for future plants, RG 1.89 provides the principal guidance for implementing the requirements and criteria of 10 CFR 50.49 for environmental qualification of electrical equipment that is important to safety and located in a harsh environment. However, certain NUREG-0588 Category I guidance may be used to enhance the guidance provided in RG 1.89.

PAM equipment is also environmentally qualified in accordance with Regulatory guide 1.97, Rev 4. The method used to identify and qualify this equipment is described in Section 7.5. The minimum list of PAM equipment, which is identified in Section 7.5 as potentially requiring operation in harsh environments, is also qualified according to the acceptance criteria of Section 3.11. PAM equipment is identified as Type A, B, C, D or E, according to RG 1.97, Rev 4 and Type A, B, C and D is environmentally qualified as required by 10 CFR 50.49 and the guidelines of Branch Technical Position (BTP) 7-10. Type E variables are not required to be environmentally qualified. BTP 7-10 states:

---

1. Section 3.11.2.3 provides the justification for the use of the latest version of the IEEE standards referenced in this section that have not been endorsed by existing RGs. AREVA NP maintains the option to use current NRC-endorsed versions of the IEEE standards.

3.11.2.3.1 IEEE Std 317-1983/R2003, Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generation Stations

The first issuance of this document was cited as IEEE Std 317-1976. It was then revised and issued as IEEE Std 317-1983 (Revision of IEEE Std 317-1976), and subsequently noted as reaffirmed in 1988. The document was again reaffirmed in 2003 and cited as IEEE Std 317-1983 (R2003), noted as the revision to IEEE Std 317-1976.

The latest NRC endorsement was for the 1983 version of the standard, via RG 1.63, Revision 3. As shown above, the 1983 version has been reaffirmed in 2003, but not revised. It is reasonable to conclude that, pending a revision to the document, the NRC endorsement of the 1983 version would also apply to the 2003 version. Therefore, AREVA NP believes that it is acceptable to use IEEE Std 317-2003 as the document to be used for qualification.

03.11-1

3.11.2.3.2 ~~IEEE Std 323-2003, Standard~~Deleted ~~for Qualifying Class 1E Equipment for Nuclear Power Generation Stations~~

~~IEEE Std 323-1983/2003 editions place more emphasis on the utility for periodic surveillance and maintenance than IEEE Std 323-1974, although the standard imposes no new requirements in this area. In addition, IEEE Std 323-1983/2003 editions clarify the utilization of margin during testing as applied to environmental transients by either adding the temperature and pressure margin to the postulated service condition profile or by applying the peak transient twice, but not applying both types of margin simultaneously.~~

~~IEEE Std 323-1983/2003 editions incorporate the knowledge and experience gained in the application of the 1974 edition and recognize elements of 10 CFR 50.49. For example, this edition contains a distinction consistent with 10 CFR 50.49 regarding qualification methods applicable to equipment located in mild and harsh environments. Equipment may be qualified to either the 1983/2003 or 1974 edition of IEEE Std 323 to meet the requirements of 10 CFR 50.49.~~

~~Because most existing test reports were based on IEEE Std 323-1974 requirements, AREVA NP will apply the following guidelines:~~

- ~~Equipment certified to IEEE Std 323-1983/2003 requirements that is also certified to IEEE Std 323-1974 version of the test report is considered acceptable for use.~~
- ~~Equipment certified to IEEE Std 323-1983/2003 that was subjected to a new type test would also have a revised test report to document the new testing. Certification for this material will reflect a later test report, and this report will require approval prior to use of the equipment.~~

~~Certification to IEEE standards alone is insufficient for 10 CFR 50.49 equipment. The vendor must also certify to the applicable test report.~~

03.11-1

~~The latest edition of the standard, IEEE Std 323-2003, is a clarification and more up to date qualification standard that incorporates the knowledge and experience gained in the application of earlier standards. Therefore, AREVA NP believes that it is acceptable to use IEEE Std 323-2003 as the document to be used for qualification.~~

3.11.2.3.3 IEEE Std 334-2006, Standard for Qualifying Continuous-Duty Class 1E Motors for Nuclear Power Generating Stations

The original document was published as IEEE Std 334-1971. The 1971 version specified two accident transients with 15°F margin on peak temperature and 10 percent on pressure. The 1994 version allowed either two transients or application of margin. The 2006 version specifies one transient with 15°F margin. The 1971 and 1994 versions do not address condition monitoring, but the 2006 version does.

The 1971 and 1994 versions define formettes and motorettes, but give no explanation how to include them in qualification. The 2006 version addresses how to include these items into the qualification test program as test specimens. The 1971 and 1994 versions do not include loading versus thermal requirements during qualification test. The 2006 version requires evaluation of the worst-case loading in DBA (continuous run or start/stop).

The latest edition of the standard, IEEE Std 334-2006 is a clarification and more up-to-date qualification standard that incorporates the knowledge and experience gained in the application of earlier standards. Therefore, AREVA NP believes that it is acceptable to use IEEE Std 334-2006 as the document to be used for qualification.

3.11.2.3.4 IEEE Std 344-2004, Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

IEEE Std 344-2004 provides the recommended practices for seismic qualification of class 1E equipment. The following is a summary of a comparison of the various versions of this standard.

The IEEE Std 344-1971/1975 versions do not mention the Seismic Qualification Utility Group experience databases. The 1987 and 2004 versions discuss experience databases and how to apply operating experience to seismic qualification. Similarity for type testing is mentioned briefly in IEEE Std 1971/1975. Further discussion is given in IEEE Std 1987/2004. The IEEE Std 344-1971/1975 versions address uniaxial and biaxial excitation only. The 1987/2004 versions specify triaxial (preferred), then biaxial, then uniaxial and axial independence must be justified.

The IEEE Std 344-1971/1975 versions specify RMF or single frequency testing; 1987/2004 specifies RMF or RIM. Per application RMF can be supplemented with single frequency for peaks. The IEEE Std 1971/1975 versions specify static and dynamic analysis methods in general terms. The IEEE Std 344-1987/2004 versions specify numerous varieties of static and dynamic analyses with specific guidance. The IEEE Std 344-1971/1975 versions discuss only resonant search and modal testing. The IEEE Std 344-1987/2004 versions specify resonant search and modal testing and requirements to address resonances in testing to justify coupling. Transmissibility plots are required.

The IEEE Std 344-1971/1975 versions discuss the low impedance method and the exploratory tests used for qualification method selection. The IEEE Std 344-1987/2004 versions allow exploratory tests to be used as input for dynamic/static qualification analyses. The IEEE Std 344-1971/1975 versions defined "damping;" the 1987/2004 versions provide a method for calculating damping. The IEEE Std 344-1971/1975 versions define "seismic vibration." The IEEE Std 1987/2004 versions define and differentiate between Seismic and Non-Seismic vibration. The IEEE Std 344-1971/1975 versions defined "ZPA;" the IEEE Std 1987/2004 versions provide a method for calculating ZPA.

The latest edition of the standard, IEEE Std 344-2004, is a clarification and more up-to-date qualification standard that incorporates the knowledge and experience gained in the application of earlier standards. Therefore, AREVA NP believes that it is acceptable to use IEEE Std 344-2004 as the document to be used for qualification.

3.11.2.3.5 IEEE Std 382-2006, Standard for Type Test of Class 1 Electric Valve Operators for Nuclear Power Generating Stations

The following discussion provides technical justification for the use of IEEE Std 382-2006 versus IEEE Std 382-1972, as endorsed by RG 1.73, Revision 0. A comparison of these documents is provided below:

- Documentation: The 2006 version requires additional configuration detail and specimen selection justification over the 1972 version and is considered to be more conservative.
- Type Testing: The 1972 version defines type testing and requires it, but provides no guidance or information on how to accomplish it. The 2006 version requires strict adherence to type test procedures and provides a definitive means to determine representative specimens to qualify a complete range of different equipment sizes. Therefore, the 2006 version is considered to be more conservative than the 1972 version.
- Test Sequence/Synergisms: Although synergisms were unknown in the 1972 version, test sequence was specified, in a manner similar to that provided by IEEE Std 323-1974, endorsed by RG 1.89 Revision 1. The 2006 version does account for synergisms, and requires the most severe test sequence to be followed, in accordance with IEEE Std 323-1974~~/2003~~. Therefore, there is no significant difference between the two versions.

03.11-1

- Margin: Margin was not addressed in the 1972 version. The 2006 version requires that margin be addressed, in accordance with IEEE Std 323-1974/2003. Therefore, the 2006 version is considered to be more conservative than the 1972 version.

03.11-1

- Functional Tests: These are stated only in very general terms in the 1972 version. The 2006 version contains specific requirements for the performance of functional testing during the qualification program, including the specific times during testing. Therefore, the 2006 version is considered to be more conservative than the 1972 version.

- Monitoring of Data: The 1972 version requires specific variable types to be monitored; the 2006 version requires additional data monitoring and provides examples for use. Therefore, both versions can be considered equally conservative.

- Aging: The 1972 version required thermal aging, radiation aging, vibration conditioning, and cycling for a specific number of times. The 2006 version also requires thermal aging, radiation aging, vibration conditioning, and cycling, but to more cycles than previously required. Therefore, both versions are similar, but the 2006 version is considered more conservative.

- DBA Transients: The 1972 version required two peak transients with an additional 15°F margin. The 2006 version corrected the peak transient requirement and the overall margin requirement. (Refer to discussion on "Margin," above.)

- Seismic: The 1972 version required seismic testing to be in accordance with IEEE Std 344-1971, endorsed by RG 1.100, Revision 0, and specified random, multi-frequency (RMF) testing. The 2006 version also requires RMF testing, required input motion (RIM) testing, and increased documentation and compliance with IEEE Std 344-2004. Therefore, the 2006 version is considered to be more conservative than the 1972 version.

- Service Conditions: The 1972 version specified actual power, signal, and environmental conditions to be used for type testing; the 2006 version provided the methodology for the determination of service conditions, based on particular applications and classes of use. Because qualification could be performed on a generic basis, without regard for the end-use, either method is considered acceptable, and the 2006 version has been selected in order to be consistent with the overall qualification program.

As a result of the above discussions, AREVA NP believes that the 2006 version of IEEE Std 382 is more conservative than the 1972 version; therefore, AREVA NP believes it is acceptable to use the 2006 version of IEEE Std 382 as the document to be used for qualification.

3.11.2.3.6 IEEE Std 383-2003, Standard for Type Test of Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations

The following is a summary of a comparison of the various versions of IEEE Std 383-2003:

19. IEEE Std 650-2006, "IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 2006.

20. IEEE Std 1202-1991/R1996, "IEEE Standard for Flame Propagation Testing of Wire and Cable," Institute of Electrical and Electronics Engineers, 1996.

21. IEEE Std 1205-2000, "Guide for Assessing, Monitoring, and Mitigating Aging Effects on Class 1E Equipment used in Nuclear Generating Stations," Institute of Electrical and Electronics Engineers, 2000.

22. IEEE Std 1290-1996/R2005, "IEEE Guide for Motor Operated Valve (MOV) Motor Application, Protection, Control, and Testing in Nuclear Power Generation Station," Institute of Electrical and Electronics Engineers, 2005.

23. NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," U.S. Nuclear Regulatory Commission, November 1979.

24. Letter from L.E. Martin, Houston Lighting & Power, to the U.S. Nuclear Regulatory Commission, "South Texas Project, Units 1 and 2, Docket Nos. STN 50-498, STN 50-499, 10 CFR 50.59 Summary Report," December 17, 1996.

25. Letter from Thomas Alexion, NRC, to William Cottle, STP Nuclear Operating Company, "Request for Additional Information on Elimination of EQ of Mechanical Components, South Texas Project, Units 1 and 2 (STP) (TAC Nos. M98912 and M98913)," April 8, 1998.

26. Letter from S.E. Thomas, STP Nuclear Operating Company, to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information on Elimination of EQ of Mechanical Components, " Docket Nos. STN 50-498, STN 50-499, Units 1 and 2 (STP), May 6, 1998.

27. Letter from Thomas Alexion, NRC, to PD IV-1 File, "Licensee's 10 CFR 50.59 Evaluation of Elimination of EQ of Mechanical Components, South Texas Project, Units 1 and 2 (STP) (TAC Nos. M98912 and M98913)," September 24, 1998.

28. IEEE Std 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1974.

03.11-1

Next File

system or the engineered safety features concurrent with the completion of required protective actions by the auxiliary supporting features, or both.

19. Service conditions—Environmental, loading, power, and signal conditions expected as a result of normal operating requirements, expected extremes (abnormal) in operating requirements, and postulated conditions appropriate for the DBEs of the station.

3D.4.3 Mild versus Harsh Environments

Section 3.11.1.2 provides a description of mild and harsh environments.

3D.4.4 Test Sequence

Type testing is generally done in the following sequence:

1. Inspections identify the test sample and verify that it is not damaged.
2. Specified baseline functional tests are performed on the test sample under normal conditions.
3. The test sample is operated to the extremes of performance, operating environments, surge voltages, and electrical characteristics in the equipment specifications, unless these data are available from other tests (e.g., design verification tests) on identical or similar equipment. These tests exclude DBE and post-DBE conditions. Electromagnetic interference (EMI) and radio frequency interference (RFI) susceptibility are a service condition for electromagnetic compatibility (EMC) as addressed in Table 3.11-1. testing may be performed on a separate test specimen, per IEEE Std 323-2003[1].

03.11-1

4. When required, the test sample is age conditioned to simulate its functional capability at the end of its qualified life. Measurements made during, or baseline tests following, age conditioning can verify that the test sample is performing satisfactorily prior to subsequent testing. If condition monitoring is to be used in service, measurements after age conditioning establish the qualified end condition.
5. The test sample is subjected to specified non-seismic mechanical vibration.
6. The test sample is subjected to simulated OBE and SSE seismic vibration in accordance with IEEE Std 344-2004[1].
7. The test sample performs its required safety function(s) while exposed to simulated accident conditions, including conditions following the accident for the period of required equipment operability, as applicable. Accident radiation may have been included in Step 4 and need not be repeated here. Safety function performance,

1. Section 3.11 provides the justification for the use of the latest version of the IEEE standards referenced in this section that have not been endorsed by existing Regulatory Guides. AREVA NP maintains the option to use current NRC-endorsed versions of the IEEE standards.

demonstrate that equipment, for which a qualified life or condition has been established, can perform its safety functions without experiencing common-cause failures before, during, and after applicable DBEs. The continued capability for this equipment and its interfaces to meet or exceed its specification requirements is provided through a program that includes, but is not limited to, design control, quality control, qualification, installation, maintenance, periodic testing, and surveillance.

3D.4.8 Margin

The purpose of using margin in the qualification program is to account for commercial production variability, errors in establishing satisfactory performance, and errors in experimental measurements, thereby providing greater assurance that the equipment can perform under the specified service conditions. Table 3D-3—EQ Program Margin Requirements presents the margins for various environmental parameters. The margins shown in the table are those recommended in IEEE Std 323-~~2003~~1974. The operability time margin may be different as allowed by Section 3D.4.6.1 above.

03.11-1

3D.4.9 Treatment of Failures

Any failure to meet the acceptance criteria is analyzed to determine the cause. Equipment modifications, equipment retesting, or equipment use limitations are imposed as necessary to address the failure.

3D.4.10 Traceability

The installed equipment is compared to the qualified equipment to verify the test sample is representative of the qualified equipment. The tested and installed equipment are considered the same if the manufacturer, model number, and the specifications, including materials of constructions, are the same. Differences between the installed and tested equipment are evaluated to determine the impact on qualification.

3D.5 Design Specifications

The equipment design specification identifies the performance requirements, safety functions, environmental service conditions, accepted methods of qualification, and acceptance criteria. The design specification also provides the basis for establishing the EQ of the specific equipment or the family of equipment.

3D.5.1 Normal Operating Conditions

Normal operating conditions are summarized in Table 3D-4—Normal Operating Environments. Pressure requirements of controlled buildings are summarized in Table 3D-5—Pressure Requirements of Controlled Buildings. Operating temperature ranges for selected components are shown in Table 3D-6—Operating Temperature Ranges for Selected Components. For qualification under normal operating

- Figure 3D-2—Typical Combined LOCA/SLB Inside Containment Pressure Service Conditions Envelope.
- Figure 3D-3—Outside Containment Temperature Service Conditions Envelope (Feedwater Valve Compartment).
- Figure 3D-4—Outside Containment Pressure Service Conditions Envelope (Feedwater Valve Compartment).
- Figure 3D-5—Outside Containment Temperature Service Conditions Envelope (Main Steam Valve Compartment).
- Figure 3D-6—Outside Containment Pressure Service Conditions Envelope (Main Steam Valve Compartment).

3D.5.5.1 Design Basis Event Radiation Doses

The accident cumulative doses are based on the guidance provided in Regulatory Guide 1.183 for equipment following design basis events. The doses resulting from a LOCA event bound those from a main steam line break accident.

The accident conditions cumulative doses within the reactor building and the annulus were determined using the maximum normal core radionuclide inventory. The maximum normal core inventory (5-41 GWD/MTU for 5% enrichment) bounds the equilibrium cycle burnup (27 GWD/MTU) for the U.S. EPR and is representative of operating cycle characteristics for environmental qualification purposes.

Based on the above, the cumulative doses following a design basis event are shown in Table 3D-9—Accident EQ Radiation Dose and represent the summation of the direct and air submersion doses.

For discussion on beta radiation, refer to Section 3.11.5.

3D.6 Qualification Methods

This section describes the methodologies used to qualify equipment. Alternative approaches are available; however, the equipment vendor selects the methods best applied to the equipment. The result is an auditable record demonstrating that the equipment can perform its safety functions, under the specified service conditions, during its QL.

03.11-1

IEEE Std 323-2003 ~~allows~~(as endorsed by RG 1.209 for computer-based digital I&C equipment in a mild environment) and IEEE Std 323-1974 allow various qualification methods (e.g., testing, analysis, operating experience, or a combination of methods) as applicable to the equipment scope. Although type testing is the preferred method of qualification, a qualification program usually involves some combination of these methods. The qualification methods used depend on factors such as the:

- Verification of a mathematical model using partial type test to determine mode shapes and resonant frequencies.
- Operating experience provides the basis for developing simulated aging techniques.
- Analysis of an assembly to determine the environment to which components are to be tested.
- Two subassemblies that have been tested and qualified separately are combined into a module, and analysis of certain parameters (e.g., individual subassemblies' error rates and response times) demonstrates that the combination is also qualified.

The combined qualification demonstrates that the equipment can perform its safety function under normal, abnormal, and DBE service conditions throughout its QL. Certain portions of the qualification (e.g., operation during normal and abnormal service conditions) may be demonstrated by operating experience. Other portions (e.g., seismic and LOCA operability) may be demonstrated by testing. Combined qualification provides auditable data by which the various primary qualification methods may be brought together to satisfy the qualification program requirements.

3D.8 Documentation

The U.S. EPR equipment qualification program documentation consists of equipment qualification data packages, equipment qualification test reports, and qualification maintenance requirements.

3D.8.1 Equipment Qualification Data Package

The EQDP for each equipment item contains the documentation that demonstrates that the equipment or system is environmentally qualified for its application, and can accomplish its specified safety functions. An equipment item refers to electrical equipment categorized by manufacturer and model, which is representative of identical or similar equipment in plant areas potentially exposed to the same bounding environmental conditions during and after a design basis event. Documentation that supports EQ for the equipment is compiled in the EQDP or referenced therein. The elements of the EQDP include: equipment identification, interfaces, qualified life, safety functions, service conditions (e.g., normal, abnormal, DBE), qualification program plan, and qualification program implementation following the guidance of IEEE Std 323-~~2003~~1974. Refer also to Appendix 3D, Attachment A.

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3D.8.2 Equipment Qualification Test Reports

The equipment qualification test report is prepared by the equipment vendor or an independent testing laboratory. This report documents the tests that demonstrate the capability to meet specified functional requirements under specified environmental conditions and operational parameters. These tests subject one or more equipment samples to conditions designed to simulate normal, abnormal, containment test, DBE, and post-DBE conditions, as applicable.

3D.8.3 Qualification Maintenance Requirements

The qualification maintenance requirements document identifies the specific EQ-related maintenance activities, condition monitoring activities, and preventive maintenance activities required to maintain equipment qualification. These form part of the EQDP described in Section 3D.8.1, and the document is described in greater detail in Section 3D.7.

3D.9 References

1. IEEE Standard 323-2003, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., ~~2004~~2003.

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2. IEEE Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., 2005.

3. IEEE Standard 101-1987 (R2004) "IEEE Guide for the Statistical Analysis of Thermal Life Test Data," Institute of Electrical and Electronics Engineers, Inc.

4. IEEE Std 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Institute fof Electrical and Electronic Engineers, 1974.

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Table 3D-2—Equipment Post-Accident Operability Times

Description	Required Post-Accident Operability Duration	Notes
Immediate Operability	2 hours	1
Short-Term	24 hours	2
Medium-Term	4 months	3
Long-Term	1 year	4

Notes:

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1. Immediate operability includes components that must remain operational for a maximum of two hours after the onset of the event. Equipment automatically triggered by the ~~reactor~~ protection system is qualified according to this category, except if it is also required for operating the reactor to the cold shutdown conditions or for the long-term plant operation. The qualification time is established based on a conservative estimate consistent with the analyses of when and for how long the component is required to function, plus margin, per IEEE Std 323-~~2003~~1974.

2. Short-term operability includes components that must remain operational for a maximum of 24 hours after onset of the event. Equipment operated to reach the cold shutdown conditions is qualified according to this category, except if it is also required for the long-term plant operation. Per IEEE Std 323-~~2003~~1974 margin is also included.

3. Medium-term operability includes replacement, repair, or recalibration of equipment accessible outside containment or inaccessible instrumentation inside containment required for post-accident monitoring. In the event of post-accident monitoring, the period of operability allows for identification of an alternate indication for the affected instrument. The four months is assumed to include the margin, as required by IEEE Std 323-~~2003~~1974.

4. Long-term operability includes equipment needed to operate for the entire duration of the accident as well as into the start of the recovery phase. The qualification time for individual components is based on an evaluation of alternate methods that can be used to perform the function, or when replacement components can be installed. The one-year duration is assumed to include the margin, as required by IEEE Std 323-~~2003~~1974.

3 QUALIFICATION CRITERIA:

Criteria used to demonstrate qualification is in accordance with the following (indicate documents that are applicable):

___ 10CFR50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants".

___ IEEE Std 323 (~~2003~~1974) - "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

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___ Other. Specify ______________________________

____

____

CHECKLIST FOR ENVIRONMENTAL QUALIFICATION DATA PACKAGE (EQDP)

1 QUALIFICATION METHODOLOGY

1.1 Description of Methodology: _____

1.2 Does the qualification report state that the qualification method conforms to IEEE Std 323(~~2003~~1974) or an IEEE "daughter" standard? _____ Reference: _____

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COMMENTS:_____

1.3 If analysis was performed in lieu of testing:

1.3.1 Was justification provided? ___ Reference: _____

Identify analysis performed:_____

1.3.2 Was partial type test data provided to support the analytical assumptions and conclusions? ___ Reference: _____

1.3.3 Were equipment performance requirements identified? ___ Reference: _____

1.3.4 Were specific features and failure modes and effects analyzed? ___ Reference: _____

1.3.5 Were assumptions and mathematical models used together with appropriate justification for their use? ___ Reference: _____

COMMENTS:_____

1.4 When test data or operating experience data have been extrapolated, has the basis been appropriately identified and justified? ___ Reference: _____

Identify extrapolated data:_____

COMMENTS:_____

4 TEST SEQUENCE

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4.1 Test Sequence: Was the test sequence established to simulate the accident environment in accordance with IEEE Std 323 (~~2003~~1974), paragraph 6.3.1.7? ___ (note below)

	RELATIVE ORDER/ NO/NA	REFERENCE
4.1.1 Test sample inspected for damage:		
4.1.2 Baseline functional tests performed under normal conditions		
4.1.3 Test sample operated at extremes of all performance, operating, surge voltages and electrical characteristics given in equipment specifications, excluding DBE and post DBE events.		
4.1.4 Equipment aged:		
Thermal:		
Radiation:		
Wear:		
4.1.5 Test sample subjected to specified nonseismic mechanical vibration		
4.1.6 Test sample subjected to simulated OBE and safe shutdown earthquake (SSE) seismic vibration in accordance with IEEE Std 344 (2004)		
4.1.7 Test sample performs required safety function(s) while exposed to simulated Design Basis Event (DBE) exposure:		
4.1.8 Test sample performs required safety function(s) while exposed to simulated Post-DBE exposure:		
4.1.9 Post test final inspection and disassembly of test sample		

COMMENTS:_____

4.2 Was the same piece of equipment used throughout the test sequence described in question 4.1 above? _ Reference: _____

COMMENTS:_____

4.3 Have the test equipment, test equipment accuracies and calibration data been appropriately documented? _ Reference: _____

COMMENTS:_____

6.2 Special environmental calculations (temperature, radiation, etc.)

Type	Reference

6.3 Was margin applied to the test parameters or otherwise addressed in the test program to assure that normal variation and uncertainties are accounted for? ___

Suggested Margin According to IEEE Std 323(~~2003~~1974)	Margin Applied	Reference
Temperature: +15°F		
Pressure: +10% of gauge		
Radiation: +10% of accident dose		
Operating Time: +10% of the period of time the equipment is required to operate following the start of the design basis event or 2 hours.		
Voltage: ±10% of rated value, but not to exceed equipment design limits		
Frequency: ±5% of rated value, but not to exceed equipment design limits		
Vibration: +10% added to acceleration requirements at the mounting point of the equipment.		

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COMMENTS:_____

6.4 For equipment that is required to perform its safety function within a short time following an accident, was the equipment qualified for at least 2 hours? ___ Reference: _____
COMMENTS:_____

6.4.1 If equipment is to operate in the short term, does the test discuss the long-term equipment failure modes? ___ Reference: _____

6.5 Is the equipment subject to moisture or liquid intrusion that can affect the performance of the equipment under design basis event conditions? ___ Reference: _____
COMMENTS:_____

6.6 Was process/component induced temperature rise considered during DBE testing? ___
Reference: _____
COMMENTS:_____

3D Attach B Aging Evaluation Program

B.1 Introduction

An important concept in equipment qualification is the recognition that significant degradation could be caused by aging mechanisms occurring from the environments during the service life. Significant aging mechanisms are those that, under normal and abnormal service conditions, cause degradation of equipment that progressively and appreciably renders the equipment vulnerable to failure to perform its safety functions during design basis events. Therefore, safety-related electric equipment should be aged to a state of degradation prior to simulating design basis events.

B.2 Objectives

The objective of the U.S. EPR aging evaluation program is to verify, for safety-related electrical equipment with an established qualified life (QL) or condition, that the significant aging mechanisms have been identified and addressed. This provides reasonable assurance that the safety-related electrical equipment can perform its safety functions without experiencing common-cause failures before, during, and after applicable design basis events.

B.3 Basic Approach

The aging evaluation program addresses the effects of significant aging mechanisms through operating experience, testing, analysis, inservice surveillance, condition monitoring, and maintenance activities, as noted in IEEE Std 323-~~-~~19742003[1].

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Safety-related electrical equipment that is located in a harsh environment, and for which significant aging mechanisms have been identified, is classified in the harsh location category. The aging mechanisms for this equipment are accounted for in the qualification program.

Safety-related electrical equipment that is located in a mild environment, and for which significant aging mechanisms have been identified, is classified in the mild location category. The aging mechanisms for this equipment are accounted for in the design and purchase specification.

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1. ~~Section 3.11 provides the justification for the use of the latest version of the IEEE standards referenced in this section that have not been endorsed by existing Regulatory Guides. AREVA NP maintains the option to use current NRC-endorsed versions of the IEEE standards.~~

organic material could withstand a radiation environment up to about 10^3 R, TID, measured against a damage threshold based on some particular property, including physical and chemical.

As noted in RG 1.89, Rev. 1 and Reference 1, these criteria are misleading because the primary concern is the ability of the equipment to perform specific functions, rather than the point at which damage is detected. Thus, equipment testing was conducted to determine the difference, if any, between the threshold values and actual degradation of performance, with subsequent loss of function.

Subsequent equipment tests by EPRI, Sandia Labs, and others (e.g., References 1 and 2) found that nearly all types of electronic equipment could withstand at least an order of magnitude more radiation exposure before performance degradation became a concern. Also, Regulatory Guide 1.89 ~~and IEEE Std 323-2003 (Reference 3)~~ suggested that the operability threshold was near 1 $x10^4$ R TID before noticeable degradation of performance, and in some cases, levels ≥1 $x10^5$ R TID could be tolerated.

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In addition, for current-generation operating reactors, the NRC definition of a mild radiation environment for electronic components (e.g., semiconductors or any electronic component containing organic materials) differs from the definition of a mild radiation environment for other equipment. NUREG-1793 (Reference 4) defines a mild radiation environment for such electronic equipment as a total integrated dose of less than 10 gray (Gy) (1 $x10^3$ R). For other equipment, it is less than 100 Gy (1 $x10^4$ R).

C.4 Results

The ability of equipment to withstand radiation is based on performance degradation and not just a threshold value of susceptibility. A reasonable level of radiation tolerance would be in the range of 1 $x10^4$ R to 1 $x10^5$ R TID.

On the basis of investigations and evaluations of similar equipment exposed to similar radiation environments, the TXS system is qualified to a radiation exposure of at least 1 x 10^3 R TID.

C.5 References

1. EPRI NP-2129, "Radiation Effects on Organic Materials in Nuclear Plants," Georgia Institute of Technology, 1981.

2. EPRI NP-1558, "A Review of Equipment Aging Theory and Technology," Franklin Research Center, 1980.

3. IEEE Std 323-~~2003~~1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., ~~2004~~1974.

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E.4.6 Other Dynamic Loads

In addition to normal operating loads and seismic loads, other vibratory loads such as hydrodynamic loads, if applicable, must be evaluated for their effect on Seismic Category I equipment in accordance with IEEE Std 344 (Reference 1).

E.5 Qualification by Test

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Qualification by testing is the preferred method for EQ. As described in Section 3.10.2 and in accordance with IEEE Std 323-19742003[1] (Reference 4), the overall qualification program shall be performed in its proper sequence. The test plan includes pretest functional baseline tests, environmental aging, non-seismic vibration aging (e.g., vibration from piping, pumps, and motors among others), SSE-based seismic inertia tests, and post testing inspection. Other types of vibration, such as hydrodynamic loadings, should be simulated and included with the seismic qualification. Only the seismic qualification of equipment is addressed within this section.

Many factors, including the type of equipment, its safety function, and its location (i.e., hard-mounted or line-mounted) must be considered to determine the type of test that is used to establish the seismic qualification of equipment.

Since the OBE defined in Section 3.7 is one-third of the SSE, consideration of design or qualification cases for an OBE is not a requirement for the design of the U.S. EPR, and the COL applicant is therefore not required to perform explicit response or design analyses. Qualification by testing for the U.S. EPR is only performed according to the SSE event, and the simulation of seismically induced fatigue effects from low-level seismic events preceding the SSE are specified in terms of full or fractional SSE events. In accordance with IEEE Std 344 (Reference 1), Appendix D and information included in Section 3.7.3.2, for the simulation of seismically induced fatigue effects, the SSE test is preceded by either five tests at the OBE levelone-half SSE or by a number of fractional peak cycles equivalent to the maximum peak cycles for five one-half SSE events.

In accordance with IEEE Std 344 (Reference 1), multi-frequency testing is the preferred qualification method. It is normally used unless single frequency tests can be justified. Single frequency tests are justified when the equipment is line mounted and the seismic input motion is dominated by one frequency (see Section E.5.2). Single frequency testing is also used to determine the natural frequency of equipment. Regardless of the type of testing utilized, the TRS must envelop the RRS over the frequency range of interest at comparable levels of damping for the test input motion (see Section E.4.1.1). The peak test amplitude for each sine beat is at least that required in IEEE Std 382 (Reference 2), or the maximum g-level specified by analysis at the mounting location of the equipment.

2. IEEE Std 382-2006, “Standard for Qualification of Actuators for Power-Operated Valve Assemblies with Safety Related Functions for Nuclear Power Plants,” Institute of Electrical and Electronics Engineers, 2006.

3. SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water (ALWR) Designs," Nuclear Regulatory Commission, July 1993.

4. IEEE Std 323-~~2003~~1974, “Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers, ~~2003~~1974.

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