ArevaEPRDCPEm Resource

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Sent:	Wednesday, June 09, 2010 2:25 PM
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Cc:	WELLS Russell D (AREVA NP INC); ROMINE Judy (AREVA NP INC); SLAY Lysa M (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)
Subject:	DRAFT RAI 381 Supplement 1 response for questions 03.09.06-15, 03.09.06-16, and 03.09.06-17
Attachments:	RAI 381 Supplement 1 Response US EPR DC - DRAFT.pdf

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to the 4 Open Item questions of RAI No. 381 on May 20, 2010. The attached file, "RAI 381 Supplement 1 Response US EPR DC-Draft.pdf" provides a DRAFT response to 3 of the 4 remaining Open Item questions. The final response date of July 14, 2010 is unchanged.

Appended to this file is the affected page of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 381 Questions 03.09.06-15, 03.09.06-16, and 03.09.06-17

AREVA NP requests a conference call with NRC to discuss this DRAFT RAI response, unless the NRC has no questions. Available times and dates are provided below:

- June 21 10:30AM-11:30AM or 2-4PM
- June 24 9-11AM or 2-4PM
- June 25 9-11AM or 2-4PM

Sincerely,

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Response to

Request for Additional Information No. 381(4421, 4529)
Supplement 1, Revision 1,
4/21/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.07.04 - Seismic Instrumentation
SRP Section: 03.09.06 - Functional Design Qualification and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints

Application Section: FSAR Chapter 3

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)
QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects) (CIB1)

Question 03.09.06-15:

OPEN ITEM

FSAR Tier 2, Sections 3.9.3.3 and 3.9.3.4 state that FSAR Tier 2, Section 3.9.6 provides a description of the functional design and qualification provisions for pumps, valves, and snubbers. While FSAR Tier 2, Section 3.9.6.1 states that the "functional design and qualification of each safety-related pump and valve is performed such that each pump and valve is capable of performing its intended function for a full range of system differential pressure and flow, ambient temperatures, and available voltage (as applicable) under conditions ranging from normal operating to design-basis accident conditions," this FSAR section focuses on IST rather than functional design and qualification. As discussed below, the staff has determined that the current provisions in FSAR Tier 2, Section 3.9.3.3, 3.9.3.4, and Section 3.9.6 are not sufficient to adequately describe a program that will provide reasonable assurance of the design-basis capability of pump, valves, and dynamic restraints for the U.S. EPR.

As documented in numerous NRC generic communication issuances, weaknesses in the design programs for plant components used at operating nuclear power plants have resulted in situations in which valves might not have been able to perform their safety-related functions under design-basis conditions. As a result of the lessons learned from nuclear power plant operating experience and NRC and industry research programs, the staff has provided guidance related to the functional design of safety-related pumps, valves, and dynamic restraints in SRP Section 3.9.6; RG 1.206, and RG 1.100. One lesson learned from nuclear power plant operating experience and research programs is that the IST provisions of the ASME OM Code alone do not adequately provide assurance of the design-basis capability of safety-related valves.

In RAI 49, Question 03.09.06-1, the staff requested that the Design Certification applicant describe its plans to provide assurance of the design-basis capability of pumps, valves, and dynamic restraints for the U.S. EPR design.

In a June 11, 2009, Supplement 2 response to RAI 49, Question 03.09.06-1, the applicant indicated that it intended to use ASME QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," as guidance for qualifying active mechanical equipment. However, the applicant did not provide an FSAR markup indicating that it would follow all of the provisions of ASME QME-1-2007, nor are the current provisions in the U.S. EPR FSAR Tier 2 for design testing in Sections 3.9.3 and 3.9.6 sufficient to allow the staff to evaluate the process for the functional design and qualification to ensure the systematic review and documentation of the design basis for safety-related pumps, valves, and snubbers. For example, the design process should include consideration of the maximum differential pressure and flow rate expected during operation of the component for both normal operations and abnormal events, to the extent that these operations and events are part of the design basis. One acceptable method for providing assurance that active mechanical equipment (such as pumps, valves, and dynamic restraints) will meet their design-basis functional capability is specified in ASME QME-1-2007, as accepted by the staff in Revision 3 to RG 1.100. Therefore, in follow-up RAI 49, Question 03.09.06-15, the staff requests that the applicant revise the U.S. EPR FSAR to adequately describe the functional design and qualification process for pumps, valves, and dynamic restraints (or specify implementation of QME-1-2007 as accepted in Revision 3 to RG 1.100), with examples of the implementation of the FSAR provisions in the design specifications made available for NRC audit.

Response to Question 03.09.06-15:

U.S. EPR FSAR Tier 2, Section 3.9.6.1, Section 3.10.1.1, and Section 3.10.2 will be revised to indicate that the functional design and qualification testing of safety-related pumps, valves, and snubbers is performed in accordance with ASME QME-1-2007, with clarifications regarding the non-mandatory appendices of ASME QME-1-2007 as described in U.S. EPR FSAR Tier 2, Section 3.10.2. U.S. EPR FSAR Tier 2, Table 1.9-2 will be revised to change the reference from RG 1.100, Revision 2 to Revision 3. U.S. EPR FSAR Tier 2, Section 3.10.1.1, Section 3.11.2.3.4, and Table 3.11-4 will be revised to indicate that RG 1.100, Revision 3 endorses IEEE Std 344-2004.

The availability of design specifications for NRC audit will be addressed in the Response to RAI 404, Question 03.09.03-24, which is a follow-up question to the Response to RAI 107, Question 03.09.03-4 and the Response to RAI 178, Question 03.09.03-18.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 1.9-2, Section 3.9.6.1, Section 3.10.1.1, Section 3.10.2, Section 3.11.2.3.4, and Table 3.11-4 will be revised as described in the response and indicated on the enclosed markup.

Question 03.09.06-16:

OPEN ITEM

FSAR Tier 2, Section 3.9.6.1 indicates that the IST program provides for pump and valve testing over the full range of system differential pressures, flow-rates, temperatures, and available voltages (as applicable) from normal operating to design-basis conditions and considers degraded flow that may occur during post-accident conditions. The staff was unable to confirm that safety-related systems were provided with full-flow test capabilities on design drawings. This was the subject of RAI 49, Question 03.09.06-3. In a June 11, 2009, Supplement 2 response to RAI 49, Question 03.09.06-3, the applicant explained how each safety-related pump was capable of being tested at the accident assumed flow rates. In regard to safety-related valves, the applicant referred to the test procedures, acceptance criteria, and corrective actions specified in the ASME OM Code. As discussed above, the ASME OM Code inservice test alone cannot be used to demonstrate the design-basis capability of safety-related valves. Therefore, in follow-up RAI 49, Question 03.09.06-16, the staff requests that the applicant revise the U.S. EPR FSAR to describe the testing and/or analysis performed to demonstrate the design-basis capability of safety-related valves.

Response to Question 03.09.06-16:

Additional information on the testing and/or analysis performed to demonstrate the design-basis capability of safety-related valves will be added to new U. S. EPR FSAR Tier 2, Section 3.9.6.1.1. As stated in the Response to Question 03.09.06-15, the primary method for functional design and qualification is based on ASME QME-1-2007. Based on the Response to Question 03.09.06-15 and its associated U.S EPR FSAR Tier 2, Section 3.9.6.1 markup, U.S. EPR FSAR Tier 2, Section 3.9.6.1 has been revised to delete extraneous information or relocate some of the information to U.S. EPR FSAR Tier 2, Section 3.9.6.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 3.9.6 and 3.9.6.1 will be revised as described in the response and indicated on the enclosed markup.

Question 03.09.06-17:

OPEN ITEM

In RAI 49, Question 03.09.06-6 the staff requested that the applicant clarify the use of static tests for the operability determinations of POVs. In a June 11, 2009, response to RAI 49, Question 03.09.06-6, the applicant proposed revisions to FSAR Tier 2, Sections 3.9.6.3.1, "Inservice Testing Program for Motor-Operated Valves," and 3.9.6.3.2, "Inservice Testing Program for Power-Operated Valves Other Than MOVs."

1. Proposed FSAR Tier 2, Section 3.9.6.3.1.3 states that the interval between testing to demonstrate continued design-basis capability does not exceed 5 years or three refueling outages, whichever is longer. However, the JOG MOV programs test frequencies vary from one refueling outage (e.g., for high-risk low-margin MOVs) up to 5 years or three refueling outages, whichever is longer. Test frequency should be established to provide assurance that the MOVs will remain capable of performing their design-basis function until at least the next scheduled test. Test frequencies should be evaluated each refueling outage based on data trends from MOV test results and operating experience. Therefore, the staff requests that the applicant revise the frequency of MOV testing to be consistent with the JOG MOV program.

2. Based on its review, the staff does not consider the applicant to have fully described the IST program for POVs, other than MOVs, for the U.S. EPR. In particular, the applicant has not described how the POV testing program for the U.S. EPR compares to the JOG AOV Program, how POV functional margin and test frequencies will be determined, and how static or dynamic tests (or both) will be performed to confirm operability and develop the basis for future testing for POVs. Therefore, in follow-up RAI XXX, Question 03.09.06-17, the staff requests that the applicant revise the U.S. EPR FSAR to (1) reference the NRC comments on the JOG AOV program contained in the NRC letter to the Nuclear Energy Institute (NEI), October 8, 1999, and (2) incorporate into the FSAR additional attributes of a successful POV design capability and long-term periodic verification program as listed in Regulatory Issue Summary (RIS) 2000-3. The following program attributes should be included in the description of the IST program for POVs:

   a. Valves will be categorized according to their safety significance and risk ranking.

   b. Post-maintenance procedures will include appropriate instructions and criteria to ensure baseline testing is re-performed as necessary when maintenance on a valve, valve repair, or replacement has the potential to affect valve functional performance.

   c. Procedures and training specific to the AOV program will address lessons learned from other valve programs and documentation from AOV testing, and maintenance records and records from the corrective action program will be retained and periodically evaluated as part of the AOV program.

3. Finally, the U.S. EPR FSAR should indicate that the attributes of the AOV testing program described above, to the extent that they apply to and can be implemented with respect to other safety-related POVs will be applied to those other POVs.

Response to Question 03.09.06-17:

1. The test frequency in U.S. EPR FSAR Tier 2, Section 3.9.6.3.1.3 is based on the initial test interval for motor operated valves (MOVs) in the ASME OM code. As noted in U.S. EPR FSAR Tier 2, Section 3.9.6.3.1.3, longer design-basis verification intervals may be justified through implementation of ASME Code Case OMN-1, as accepted in RG 1.192. U.S. EPR FSAR Tier 2, Section 3.9.6.3.1.3 will be revised to state that test frequency is specified and evaluated in each refueling outage based on data trends as a result of testing in accordance with the Joint Owners Group (JOG) MOV Program (See U.S. EPR FSAR Tier 2, Section 3.9.6.6, Reference 9).
2. The last bullet in U.S. EPR FSAR Tier 2, Section 3.9.6.3.2.2 will be revised to state that the frequency for periodic testing is in accordance with the JOG AOV Program (See U.S. EPR FSAR Tier 2, Section 3.9.6.6, Reference 11) and the NRC comments on the JOG AOV program (See U.S. EPR FSAR Tier 2, Section 3.9.6.6, Reference 13) with a minimum of five years (or three refueling cycles) of data collected and evaluated before extending test intervals.
   A. Because of the small number of safety-related air-operated valves (AOVs) in the U.S. EPR (i.e., 10) as shown in U.S. EPR FSAR Tier 2, Table 3.9.6-2, the safety-related AOVs will be assigned the highest category according to the JOG AOV Program (i.e., Category 1, which are AOVS that are safety-related, active, and have high safety significance). This statement will be added to U.S. EPR FSAR Tier 2, Section 3.9.6.3.2.2. According to the JOG AOV program, high safety significance is defined as "designation referring to the importance to plant safety by a blended process of risk ranking and expert panel evaluations." This ranking will be assigned in accordance with the reliability assurance program described in U.S. EPR FSAR Tier 2, Section 17.4.
   B. The requested information regarding post-maintenance procedures will be added to U.S. EPR FSAR Tier 2, Section 3.9.6.3.2.2.
   C. The requested information regarding procedures and training specific to the AOV program will be added to U.S. EPR FSAR Tier 2, Section 3.9.6.3.2.2.
3. The requested information regarding the attributes of the AOV testing program will be added to U.S. EPR FSAR Tier 2, Section 3.9.6.3.2.2.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.9.6.3.1.3 and Section 3.9.6.3.2.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 1.9-2—U.S. EPR Conformance with Regulatory Guides
Sheet 8 of 19

RG / Rev	Description	U.S. EPR Assessment	FSAR Section(s)
1.96, R1	Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants	N/A-BWR	N/A
1.97, R4	Criteria For Accident Monitoring Instrumentation For Nuclear Power Plants	Y	3.10
			3.11.2
			7.1
			7.5
			11.5
			12.3
			16.B3.3
			18.7
1.98, 03/1976	Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor	N/A-BWR	N/A
1.99, R2	Radiation Embrittlement of Reactor Vessel Materials	Y	5.3.1
			5.3.2
1.100, R~~2~~3	Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants 03.09.06-15	Y	3.10
			3.11
			~~App 3D, Att. E~~ 3.9.6, Appendix 3D Attach E
1.101, R5	Emergency Planning and Preparedness for Nuclear Power Reactors	N/A-COL	N/A
1.102, R1	Flood Protection for Nuclear Power Plants	Y	3.4

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This information was previously in 3.9.6.1.1

Reference 2 defines the IST scope by establishing the PST, IST, and examination of components to assess their operational readiness. The ASME OM Code identifies components subject to test examination, as well as testing responsibilities, methods, intervals, parameters to be measured and evaluated, criteria for evaluating results, corrective action, personnel qualification, and record keeping. These requirements apply to:

- Pumps and valves that are required to perform a specific function in bringing the reactor to a safe shutdown condition, maintaining the reactor in safe shutdown condition, or mitigating the consequences of an accident.
- Pressure relief devices that protect systems, or portions of systems, that perform one or more of the three functions described above.
- Dynamic restraints used in systems that perform one or more of these three functions, or that protect the integrity of the RCPB.

The initial testing program (ITP) is described in Section 14.2 and envelopes the PST program. Detailed test procedures are developed and conducted as a part of the initial plant startup program. These tests include parameters and acceptance criteria that can be used to establish and measure reference values for components in the IST program. These tests also include requirements for instrumentation range and accuracy. The IST program will evaluate results of preoperational testing to establish IST baseline values.

The IST program for pumps is addressed in Section 3.9.6.2, for valves in Section 3.9.6.3, and for snubbers in Section 3.9.6.4. The IST program also includes provisions for relief requests and requests for alternate testing methods, which are addressed in Section 3.9.6.5.

A COL applicant that references the U.S. EPR design certification will submit the PST program and IST program for pumps, valves, and snubbers as required by 10 CFR 50.55a.

A COL applicant that references the U.S. EPR design certification will identify the implementation milestones and applicable ASME OM Code for the preservice and inservice examination and testing programs. These programs will be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

3.9.6.1 Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints

IST of safety-related pumps, valves, and snubbers is performed in accordance with Reference 2 and applicable addenda, as required by 10 CFR 50.55a(f), and the guidance provided in RG 1.192 and NUREG-1482, Revision 1 (Reference 3). The ASME OM

Code is incorporated by reference in 10 CFR 50.55a(b)(3). ASME OM Code Subsection ISTB defines the functional testing requirements for pumps. Subsection ISTC defines the functional testing requirements for valves, and Subsection ISTD defines the functional testing requirements for snubbers.

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The functional design and qualification of safety-related pumps, valves, and snubbers is performed in accordance with ASME QME-1-2007 (Reference 12) with clarifications as described in Section 3.10.2. The IST program for pumps is addressed in Section 3.9.6.2, for valves in Section 3.9.6.3, and for snubbers in Section 3.9.6.4. The IST program also includes provisions for relief requests and requests for alternate testing methods, which are addressed in Section 3.9.6.5.. As described in Section 3.9.6.3, the IST program also incorporates operating experience.

In accordance with RG 1.206 and the acceptance criteria of SRP 3.9.6, functional design and qualification of pumps, valves, and snubbers includes the following:

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this bullet is identical to the criteria in RG 1.206 and the SRP

- Safety-related pump, valve, and piping designs include provisions to allow testing of pumps and valves at the maximum flow specified in the plant accident analyses.
- Functional design and qualification of each safety-related pump and valve is performed such that each pump and valve is capable of performing its intended function for a full range of system differential pressure and flow, ambient temperatures, and available voltage (as applicable) under conditions ranging from normal operating to design-basis accident conditions.
- The provisions for the design and qualification of snubbers are provided in Section 3.9.3, Section 3.9.6.4, and the U.S. EPR Piping Analysis and Pipe Support Design Topical Report, Section 6.6 (Reference 6). Snubbers in safety-related systems include provisions to allow access for IST program activities (Section 3.9.6.4).
- The design and installation of safety and relief valves is described in Section 3.9.3.
- The seismic and dynamic qualification of mechanical and electrical is described in Section 3.10.
- Section 3.11 addresses the environmental qualification of safety-related pumps and valves.
- As required by GDC 14, safety-related valves that are part of the RCPB are designed and tested such that these valves will not experience any abnormal leakage, or increase in leakage, from their loading, as addressed in Section 3.10.
- As required by GDC 15 and in accordance with SRP 3.9.6, pumps, valves, and snubbers are designed with sufficient margin to demonstrate that the design conditions are not exceeded in accordance with Reference 2. Pump motors are designed to tolerate anticipated frequency and voltage variations due to degraded electrical power supply line conditions.

3.9.6.1.1 Additional Information on Design and Qualification of Valves

Consistent with Bellefonte COLA

The ability of a valve to meet its design basis functional requirements (i.e., required capability) is verified during valve qualification testing as required by procurement specifications. Requirements for qualification testing of motor-operated active valves are included in procurement specifications. Valve qualification testing measures valve actuator output capability. Actuator output capability is compared to the valve's required capability defined in procurement specifications, establishing functional margin; that is, that increment by which the MOV's actual output capability exceeds the capability required to operate the MOV under design basis conditions.

3.9.6.1.1.1 Motor-Operated Valves (MOV) Design and Qualification

Consistent with AP1000 Section 5.4.8.1.2

Design basis and required operating conditions are established for active safety-related MOVs. Based on the design conditions, the MOVs have a structural analysis performed to demonstrate their components are within the structural limits at the design conditions. The MOVs are designed for a range of conditions up to the design conditions, which includes fluid flow, differential pressure (including line break, if necessary), system pressure and temperature, ambient temperature, operating voltage range, and stroke time. The sizing of the motor operators on the valves consider diagnostic equipment accuracies, changes in output capability for increasing differential pressures and flow, and ambient temperature and reduction in motor voltage, control switch repeatability, friction variations, and other changes in parameters that could result in an increase in operating loads or a decrease in operator output.

The MOVs have a functional qualification performed to demonstrate by test, by analysis, or by a combination thereof, the ability to operate over a range up to the design conditions. This functional qualification demonstrates the MOV capability during and after loads representative of the maximum seismic or vibratory event (as required to perform their intended function), demonstrate the valve sealing capability, demonstrate capability under cold and hot operating conditions, demonstrate capability under maximum pipe end loads, and demonstrate flow interruption and functional capability. The testing includes test data provided by the manufacturer, field test data, empirical data supported by testing or analysis of prototype tests of similar MOVs that support the qualification where similarity must be justified by technical data. The qualification is used for validating the required thrust and torque as applicable to operate the valve and the output capability of the motor operator.

Further information on MOVs is described in Section 3.9.6.3.1.

3.9.6.1.1.2 Other Power-Operated Valves (POV) Design and Qualification

Consistent with AP1000 Section 5.4.8.1.2

Design basis and required operating conditions are established for POVs with an active safety-related function. POV assemblies include pneumatic-hydraulic-, air piston-,

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and solenoid-operated assemblies. POVs have a structural analysis performed to demonstrate their components are within the structural limits at the design conditions. POVs are designed to accept the maximum compression, tension, and torsional loads which the assembly is capable of producing in combination with other loads such as pressure, thermal, or externally applied loads. The maximum loading resulting from the design conditions and transients is evaluated in accordance with the ASME Code Section III, Class 1 design requirements. Packing adjustment limits are identified to reduce the potential for stem binding.

POVs have a functional qualification performed to demonstrate by test, by analysis, or by a combination thereof, the ability to operate at the design conditions. Qualification testing of each size, type, and model is performed under a range of differential pressures and maximum achievable flow conditions up to the design conditions. This functional qualification will demonstrate the POVs capability during and after loads representative of the maximum seismic or vibratory event (as required to perform their intended function), demonstrate the valve sealing capability, demonstrate capability under cold and hot operating conditions, demonstrate capability under maximum pipe end loads and demonstrate flow interruption and functional capability. The testing includes test data from the manufacturer, field test data, empirical data supported by test, or analysis of prototype tests of similar power-operated valves that support qualification of the power-operated valve. Similarity must be justified by technical data. Solenoid-operated valves are verified to satisfy the applicable requirements for Class 1E components. Solenoid-operated valves are verified to perform their safety-related design requirements over a range of electrical power supply conditions including minimum and maximum voltage.

Further information on POVs is described in Section 3.9.6.3.2.

~~Pumps and valves are tested within the IST program requirements to confirm that the required components are capable of performing their intended safety function. The safety analysis includes information concerning the design limitations and functional requirements for the performance of pumps and valves, including operation at the maximum flowrate. The IST pump functional design and pump qualification include an assessment for degraded flow conditions. The IST program requires pump and valve testing over the full range of system differential pressures, flowrates, temperatures, and available voltages (as applicable), from normal operating to design basis conditions and considers degraded flow that may occur during post-accident conditions. IST testing is also performed on RCPB valves to demonstrate that they will not experience leakage, or increased leakage, from their loading.~~

~~The U.S. EPR design provides ready access to SSC to facilitate comprehensive testing using currently available equipment and techniques. Accessibility incorporated into the design complies with the requirements of Reference 2 and 10 CFR 50.55a(f). System design incorporates provisions, including alternate flow paths and required~~

MOVs are tested in accordance with the Reference 2 and the guidance of Reference 3, including the following:

- Remote position-indication tests: Valves with position indicators that are included in the IST program are observed locally during valve exercising to verify that the indicators are operating correctly. Where local observation is not practical, other methods are used to verify correct valve position indicator operation.
- Leakage tests: Safety-related valves with seat leakage limits are tested to verify that leakage does not exceed allowable limits. This testing includes valves that isolate piping and lines that penetrate containment; these valves are tested in accordance with 10 CFR 50, Appendix J. Most valves are tested individually as a part of the Type C testing, depending on the valve function and configuration.
- Exercise tests: Safety-related MOVs are exercised periodically, and generally undergo full-stoke exercise testing quarterly. Measuring stroke time is not a separate inservice test, but is done as part of periodic testing. If it is impractical to exercise a valve during plant operation, the valve may be full-stroke tested during cold shutdowns. Valves that operate during normal plant operation and at a frequency that satisfies exercising requirements need not be additionally exercised, provided that IST-required observations are made at intervals no greater than that specified in the IST plan.

A list of MOVs included in the IST program is provided in Table 3.9.6-2.

Non-Code Testing of MOVs

The MOV testing program incorporates the Joint Owners' Group (JOG) Motor-Operated Valve (MOV) Periodic Verification (PV) Program (Reference 9) to address Generic Letter 96-05, (Reference 4).

Operability testing relies on non-intrusive diagnostic techniques. These tests are conducted in either static or dynamic conditions in accordance with Reference 9.

Testing is performed to confirm that an adequate margin exists in MOV capabilities. These tests include verification that the MOV achieves maximum required torque or thrust, as applicable. The tests include consideration of diagnostic equipment inaccuracies, degraded voltages, control switch repeatability, load-sensitive MOV behavior, and the margin for degradation. These tests also indicate hard seat-contact and verify that the tests performed do not exceed the allowable structural and under-voltage motor capability limits for the individual parts of the MOV.

3.9.6.3.1.3 Testing Frequency

The interval between testing to demonstrate continued design basis capability does not exceed five years or three refueling outages, whichever is longer. Longer design-basis verification intervals may be justified through implementation of ASME Code Case OMN-1, as accepted in RG 1.192. Test frequency is also specified and evaluated each

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refueling outage based on data trends as a result of testing. Frequency for periodic testing is in accordance with Reference 9.

3.9.6.3.1.4 Acceptance Criteria

Acceptance criteria for successful completion of the PST and IST of MOVs includes the following:

- Consistent with the safety function, the valve fully opens and/or the valve fully closes or both. Diagnostic equipment indicates hard seat contact.
- The testing demonstrates adequate margin with respect to the design basis, including consideration of diagnostic equipment inaccuracies, degraded voltage, control switch repeatability, load sensitive MOV behavior, and margin for degradation.
- The maximum torque and/or thrust (as applicable) achieved by the MOV, allowing sufficient margin for diagnostic equipment inaccuracies and control switch repeatability, does not exceed the allowable structural and undervoltage motor capability limits for the individual parts of the MOV.

~~IST of ASME Section III Class 1, 2, and 3, and safety-related motor-operated valves (MOV) is performed in accordance with the Reference 2 and applicable addenda, as required by 10 CFR 50.55 a(f). Testing is required except where specific relief has been granted by the NRC. The IST program incorporates the guidance of RG 1.192 and Reference 3. NRC accepted Code Case OMN-1 (RG 1.192) is also used for PST and IST to assess the operational readiness of MOVs.~~

~~Periodic verification of safety-related MOVs is performed in accordance with Generic Letter 96-05 (Reference 4) which supersedes Generic Letter 89-10 (Reference 5) and its supplements with regard to MOV periodic performance verification. The MOV testing program also incorporates the recommendations from the Joint Owners Group (JOG) MOV Periodic Verification (Reference 9).~~

~~The MOV testing program requires either in-plant valve operation or prototype valve testing at system flow and pressure or system differential pressure to verify correct MOV actuator sizing and control settings. The PST program for MOVs is conducted in accordance with 10 CFR 50.55a(b)(3)(ii) and Reference 2, ISTC 3100 under conditions as near as practical to those expected during subsequent IST. The interval between testing to demonstrate continued design basis capability does not exceed five years or three refueling outages, whichever is longer.~~

~~IST of an MOV relies on diagnostic techniques that assess valve performance under actual loading. Periodic testing per Reference 2, Subsection ISTC and Reference 4 is conducted under adequate differential pressure and flow conditions to demonstrate that the MOV continues to perform its safety function to open and close, as applicable,~~

the plant for the valve, which would provide adequate periodic demonstration of air-operated valve capability. If required based on valve qualification or operating experience, periodic dynamic testing is performed to re-verify the capability of the valve to perform its required functions.

- Sufficient diagnostics are used to collect relevant data (e.g., valve stem thrust and torque, fluid pressure and temperature, stroke time, operating and/or control air pressure, etc.) to verify the valve meets the functional requirements of the qualification specification.

- Test frequency is specified, and is evaluated each refueling outage based on data trends as a result of testing. Frequency for periodic testing is in accordance with References 11 and 13, with a minimum of five years (or three refueling cycles) of data collected and evaluated before extending test intervals.

- Safety-related air operated valves are assigned the highest category according to Reference 11.

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- Post-maintenance procedures (which are the responsibility of the COL applicant as described in Section 17.6) include appropriate instructions and criteria to demonstrate baseline testing is re-performed as necessary when maintenance on a valve, valve repair, or replacement has the potential to affect valve functional performance.

Consistent with North Anna COLA

- Guidance is included to address lessons learned from other valve programs in procedures and training specific to the AOV program.

- Documentation from AOV testing, including maintenance records and records from the corrective action program, are retained and periodically evaluated as a part of the AOV program.

- The attributes of the AOV testing program described above, to the extent that they apply to and can be implemented on other safety-related power-operated valves, such as electro-hydraulic valves, are applied to those other power-operated valves.

~~Power-operated valves (POV), other than MOVs, include valves actuated by solenoid, hydraulic, or pneumatic operators. The ability of POVs to perform their design-basis functions is verified either before installation or as part of preoperational testing performed during the initial plant startup test program, as described in Section 14.2. This includes verification that solenoid-operated valves (SOV) continue to be capable of performing their design-basis safety functions.~~

~~The POV IST program incorporates industry and regulatory experience (including Generic Letters 89-10 and 96-05 (Reference 4 and Reference 5) and INPO operating experience) and information gained through analysis, design, maintenance, and testing of the valves within specific safety-related systems. The IST program for POVs includes programmatic features of the Joint Owners Group (JOG) Program in response to Reference 4. When the margin between component capability and design-basis~~

4. Generic Letter 96-05, "Periodic Verification of Design Basis Capability of Safety-Related Motor-Operated Valves," U.S. Nuclear Regulatory Commission, September 18, 1996.

5. Generic Letter 89-10, "Safety-Related Motor-Operated Valve testing and Surveillance," U.S. Nuclear Regulatory Commission, June 28, 1989.

6. ANP-10264NP-A, Revision 0, "U.S. EPR Piping Analysis and Pipe Support Design Topical Report," AREVA NP Inc., November 2008.

7. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," The American Society of Mechanical Engineers, 2004 edition.

8. Generic Letter 90-09, "Alternative Requirements for Snubber Visual Inspection Intervals and Corrective Actions," U.S. Nuclear Regulatory Commission, May 14, 1990.

9. MPR-2524-A, "Joint Owners Group (JOG) Motor Operated Valve Periodic Verification Program Summary," MPR Associates, November 2006.

10. Regulatory Issue Summary 2000-03, "Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions," March 15, 2000.

11. Joint Owners Group Air Operated Valve Program Document, Revision 1, December 13, 2000.

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12. ASME QME-1-2007 Edition, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," 2007 edition.

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13. Eugene V. Imbro (NRC) to Mr. David J. Modeen, Nuclear Energy Institute, Comments On Joint Owners' Group Air Operated Valve Program Document, October 8, 1999.

3.10.1 Seismic Qualification Criteria

3.10.1.1 Qualification Standards

The methods employed for seismic and dynamic qualification of mechanical and electrical equipment are described or referenced in Section 3.10.2. These methods comply with the requirements of GDC 1, GDC 2, GDC 4, GDC 14, GDC 30, and 10 CFR 50, Appendix S. The methods used to implement the requirements of 10 CFR 50, Appendix B are described in Chapter 17.

An acceptable method for complying with the NRC regulations on the seismic qualification of electrical and mechanical equipment is described in RG 1.100, Revision ~~2~~3. This Regulatory Guide states that the procedures described in IEEE Std 344-~~1987~~2004 are acceptable to the NRC staff for satisfying the NRC regulations pertaining to seismic qualification of electrical and mechanical equipment. AREVA NP ~~plans to~~ uses IEEE Std 344-2004[1] (Reference 5) to provide the technical requirements for seismic qualification of components that are included in the environmental qualification (EQ) program, along with other components that are not addressed in the EQ program. Seismic qualification based on experience, per Section 10 of IEEE Std 344-2004, is not utilized by AREVA NP.

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The methods and guidance in ASME QME-1-2007 (Reference 7), as endorsed in RG 1.100, Rev. 3 are also used for seismic qualification of active mechanical equipment. See Section 3.10.2 for further discussion on QME-1-2007.

The U.S. EPR design utilizes the following procedures in IEEE Std 344 for seismic qualification of electrical and mechanical equipment:

- Predicting equipment performance by analysis.
- Testing the equipment under simulated seismic conditions.
- Qualifying the equipment by a combination of analysis and testing.
- Use of applicable test data from previous qualification of similar equipment.

Electrical and mechanical equipment for the U.S. EPR is qualified only for the case of the SSE defined in Section 3.7.1. As described in Section 3.7, consideration of design cases for an operating basis earthquake (OBE) is not a design requirement for the U.S. EPR. Therefore, low-level seismic effects (fatigue) required by IEEE Std 344 to qualify electrical and mechanical equipment are considered using the equivalent of five OBE

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.

Testing is the preferred method for seismic equipment qualification. The type of test used to establish qualification depends on many factors, such as the type of equipment, its safety function, its location, and its flexibility.

Qualification by analysis only, can be used under the following conditions:

- Maintaining the structural and pressure boundary integrity is sufficient to perform its safety-related functions.
- The equipment is structurally simple and its behavior can be predicted by a conservative analytical approach.
- The equipment is too large or heavy to obtain a representative test input at existing test facilities. As required, the essential control devices and electrical parts of the equipment are tested separately.
- The interfaces, such as interconnecting cables to a cabinet, cannot be conservatively considered in the testing.

The loads to be considered in the analysis and the methods of combining responses are described in Section 3.9 and Attachment E to Appendix 3D.

Active valves and dampers can be qualified by a combination of analysis and testing to demonstrate operability and structural integrity. Attached appurtenances, such as operators, limit switches, and solenoid valves, can be qualified separately by testing, as recommended in IEEE Std 382 (Reference 6) and IEEE Std 344.

Mechanical and electrical equipment may also be seismically qualified using previous seismic qualification testing, subject to suitable similarity analyses, where such previous testing has been determined to meet the specified performance requirements and acceptance criteria. This qualification is based on the guidelines in IEEE Std 344-2004, supplemented with analysis as required.

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AREVA position developed on QME-1, consistent with similar position taken by GE in a recent RAI response

In endorsing the use of ASME QME-1-2007, the NRC in RG 1.100 Rev. 3 acknowledged that several appendices are designated as either non-mandatory or mandatory (e.g., Non-mandatory Appendix QR-A; Nonmandatory Appendix QR-B; Non-mandatory Appendices QDR-A, QDR-B, and QDR-C; Nonmandatory Appendices QP-A, QP-B, QP-C, QP-D, and QP-E; and Mandatory Appendix QV-I and Non-mandatory Appendix QV-A). RG 1.100 Rev. 3 states that if a licensee commits to the use of non-mandatory appendices in ASME QME-1-2007 for its qualification of active mechanical equipment, then the criteria and procedures delineated in those nonmandatory appendices become part of the requirements for its qualification program, unless specific deviations are requested and justified. Section 3.9.6 defines the functional design, qualification, and inservice testing programs for pumps, valves, and dynamic restraints.

As noted in Section 3.10.1.1, QME-1-2007 is used for the seismic qualification of active mechanical equipment with the following clarifications:

Non-mandatory Appendix QR-A, "Seismic Qualification of Active Mechanical Equipment."
Non-mandatory Appendix QR-A is not utilized because seismic qualification is in accordance with IEEE 344-2004, which is consistent with QME-1-2007, Sections QV-7450(b), QR-A7100, QR-A7200, and QR-A7300. Additionally, Section 10.2, Earthquake Experience Data, QR-A7400 and QR-A7500, is not utilized by AREVA NP.

Non-mandatory Appendix QR-B, "Guide for Qualification of Nonmetallic Parts."
Qualification of non-metallic parts is consistent with non-mandatory Appendix QR-B as described in Section 3.11.2.2.5.

Non-mandatory Appendices to Section QDR, "Qualification of Dynamic Restraints."
The provisions for the design and qualification of snubbers, regarding Section Appendix QDR and non-mandatory Appendices QDR-A, QDR-B, and QDR-C, are provided in Section 3.9.3, Section 3.9.6.4, and Reference 3, Section 6.6. As noted in Section 3.9.6.4, snubbers in safety-related systems include provisions to allow access for IST program activities.

Non-mandatory Appendices to Section QP, "Qualification of Active Pump Assemblies."
AREVA NP is not utilizing non-mandatory Appendices QP-A through QP-E. Pump and motor assemblies are designed and qualified in accordance with applicable standards (e.g., ASME B&PV Code, QME-1, ASME B16, IEEE 323, IEEE 334, IEEE 344, RG 1.84, ASME NQA-1).

Appendices to Section QV, "Functional Qualification Requirements for Active Valve Assemblies for Nuclear Power Plants."

- Mandatory Appendix QV-I, "Qualification Specification for Active Valves," was used in the development of valve specifications.

- Non-mandatory Appendix QV-A, "Functional Specification for Active Valves for Nuclear Power Plants," is used as guidance in the development of valve specifications to demonstrate that lessons learned from industry experience are included in the specifications.

- The definition of "valve assembly" in Section QV-4000, "Definitions," refers to power operated valves. NRC considers the power actuators for valve assemblies to include all types of power actuators, such as motor, pneumatic, hydraulic, solenoid, and other drivers. The guidance in ASME QME-1-2007 may also be used, where applicable, in the qualification of manually operated valves.

- Section QV-6000, "Qualification Specification," states that the owner or owner's designee is responsible for identifying the functional requirements for

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a valve assembly, and that these requirements be provided in a qualification specification prepared in accordance with Mandatory Appendix QV-I. NRC considers Mandatory Appendix QV-I to be a necessary part of the implementation of Section QV of ASME QME-1-2007. For example, Mandatory Appendix QV-I provides the definitions of QV Category A and B valve assemblies used in Section QV of ASME QME-1-2007. As previously noted, Mandatory Appendix QV-I is used by AREVA NP in the development of valve specifications. Valves listed as active valves on the valve data sheets shall be functionally qualified in accordance with Section QV of ASME QME-1-2007, including mandatory Appendix QV-1 and Section QV-G, while being subjected to mechanical operating and mechanical loads (e.g., connected pipe loads), design pressure as specified in the valve data sheet, and the specified seismic accelerations. Functional testing includes mounted appurtenances.

3.10.2.1 Seismic Qualification of Electrical Equipment and Instrumentation

3.10.2.1.1 Seismic Qualification by Type Test

Seismic qualification by testing is performed in accordance with IEEE Std 344. Multi-frequency and multi-axis testing are the preferred method of qualification, though the standard allows alternative testing methods, such as single-frequency and single-axis testing. Regardless of which testing method is used, the test will conservatively simulate and envelop the required seismic motion at the location of the equipment.

Recommended testing methods for different types and locations of equipment are detailed in Appendix 3D, Attachment E.

3.10.2.1.2 Seismic Qualification by Analysis and Test

Qualification by analysis only when justified, or by analysis and testing when required, is permitted per IEEE Std 344. Operability and structural integrity of some components can be demonstrated by calculating critical component deflections and stresses under various combinations of operational and seismic loads. Resulting values are then compared to allowable levels, per applicable codes and equipment specification.

The methods of qualification by analysis are described in Appendix 3D, Attachment E.

3.10.2.2 Seismic Qualification of Active Mechanical Equipment

Active mechanical equipment is equipment that is required to perform a mechanical operation during or after a seismic event, while accomplishing its safety-related functions. The equipment in this category includes, but is not limited to, active valves and pumps. A list of all active valves and pumps is included in Section 3.9.6.

Active mechanical equipment is seismically qualified either by testing, using the methodology stated in IEEE Std 344 and detailed in Appendix 3D, Attachment E, or by compliance with the specified criteria. These records are updated and maintained current as equipment is replaced, modified, further tested, or requalified.

The equipment seismic qualification file contains a list of the systems' equipment and the equipment support structures. The equipment list identifies which equipment is NSSS supplied and which equipment is balance-of-plant supplied. The equipment qualification file includes qualification summary data sheets for each mechanical and electrical component of each system which summarizes the component's qualification. See Appendix 3D, Attachment F for a sample SQDP and Appendix 3D, Attachment A for a sample equipment qualification data package.

3.10.5 References

1. NUREG-1030, "Seismic Qualification of Equipment in Operating Nuclear Power Plants," U.S. Nuclear Regulatory Commission, February 1987.

2. European Utility Requirement for LWR Nuclear Power Plants, Volume 3, EPR Subset, December 1999.

3. ANP-10264NPA, Revision 0, "U.S. EPR Piping Analysis and Pipe Support Design," AREVA NP Inc., November 2008.

4. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Power Plant Components," The American Society of Mechanical Engineers, 2004.

5. 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, June 2005.

6. IEEE Standard 382-2006, "IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, March 2007.

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7. ASME QME-1-2007 Edition, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," 2007 edition.

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

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IEEE Std 344-2004 provides the recommended practices for seismic qualification of class 1E equipment. IEEE Std 344-2004 has been endorsed by NRC in RG 1.100, Rev. 3 (see Section 3.10.1.1).~~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. Therefore, there is no significant difference between the two versions.

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

- 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.

Table 3.11-4—Summary Comparison of IEEE Endorsed Standards versus Latest IEEE Standards

Endorsed IEEE Standard	Regulatory Guide	Equipment Type/ Subject	Latest IEEE Standard Edition
317-1983	1.63, Rev. 3	Penetrations	317-1983 R2003[2]
323-1974 (Harsh Env.)	1.89, Rev. 1	Electrical /I&C	323-2003
323-2003 (Mild Env.)	1.209 (3/2007)	Computer Based/Digital I&C	323-2003
334-1971	1.40, Rev. 0	Motors	334-2006
344-~~1987~~2004	1.100, Rev. ~~2~~3	Seismic	344-2004
382-1974	1.73, Rev. 0	Actuators	382-2006
383-1974	1.131, P1[1]	Cables	383-2003
387-1995	1.9, Rev. 4	EDG	387-1995 R2007
497-2002	1.97, Rev. 4	PAM	497-2002
535-1986	1.158, Rev. 0	Batteries	535-1986 R1994
572-1985	1.156, Rev. 0	Connectors	572-2006
7-4.3.2-2003	1.152, Rev. 2	Computers	7-4.3.2-2003
None	1.180, Rev. 1	RFI/EMI	None
None	1.183 (7/2000)	Alt. Radiation Source Term	None

Notes:

1. RG 1.131, P1, 1979 is a Proposed Revision 1 (P1) "for comment" version of the Reg. Guide revision.

2. For an IEEE standard, the "R" just prior to the year means that the previously cited version of the standard was "Reaffirmed" in the later year shown. Reaffirmation is an approval process whereby the document is not changed, just agreed to be re-issued, as is. This reaffirmation is performed and noted because there is an IEEE requirement that standards be re-evaluated every 5 years to determine if a revision is deemed necessary. If a change is needed, then the document will be revised, and the year of revision is cited for the new document. If no changes are needed, then the document is cited with the date of latest publication followed by a notation that it was reaffirmed and the year of reaffirmation.