ArevaEPRDCPEm Resource

From: Getachew Tesfaye
Sent: Wednesday, January 28, 2009 8:09 PM
To: 'usepr@areva.com'
Cc: Pei-Ying Chen; Kaihwa Hsu; Jennifer Dixon-Herrity; Anthony Hsia; Michael Miernicki; Joseph Colaccino; Meena Khanna; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 161 (1876, 1830, 1880), FSAR Ch. 3
Attachments: RAI_161_EMB2_1876_EMB1_1830_1880.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 22, 2008, and discussed with your staff on January 13, 2009. Draft RAI Questions 03.10-1, 03.10-6(1), 03.12-3, and 03.12-6 were deleted and Draft RAI Questions 03.12-11 was modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

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

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 173

Mail Envelope Properties (C56E360E9D804F4B95BC673F886381E71D5E2039EE)

Subject: U.S. EPR Design Certification Application RAI No. 161 (1876, 1830, 1880), FSAR Ch. 3
Sent Date: 1/28/2009 8:09:07 PM
Received Date: 1/28/2009 8:09:09 PM
From: Getachew Tesfaye

Created By: Getachew.Tesfaye@nrc.gov

Recipients:
"Pei-Ying Chen" <Pei-Ying.Chen@nrc.gov>
Tracking Status: None
"Kaihwa Hsu" <Kaihwa.Hsu@nrc.gov>
Tracking Status: None
"Jennifer Dixon-Herrity" <Jennifer.Dixon-Herrity@nrc.gov>
Tracking Status: None
"Anthony Hsia" <Anthony.Hsia@nrc.gov>
Tracking Status: None
"Michael Miernicki" <Michael.Miernicki@nrc.gov>
Tracking Status: None
"Joseph Colaccino" <Joseph.Colaccino@nrc.gov>
Tracking Status: None
"Meena Khanna" <Meena.Khanna@nrc.gov>
Tracking Status: None
"ArevaEPRDCPEm Resource" <ArevaEPRDCPEm.Resource@nrc.gov>
Tracking Status: None
"'usepr@areva.com'" <usepr@areva.com>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	848	1/28/2009 8:09:09 PM
RAI_161_EMB2_1876_EMB1_1830_1880.doc	94202	

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

Request for Additional Information No. 161 (1876, 1830, 1880), Revision 0

01/28/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.10 - Seismic and Dynamic Qualification of Mechanical and Electrical Equipment
SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports

Application Section: FSAR Ch 3

QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)
QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

03.10-1

[Intentionally deleted.]

03.10-2

In Section 3.10.1.3 of the submittal, the applicant indicates, as one acceptance criterion, that seismic qualification should demonstrate that the equipment is capable of performing its safety related functions when subjected to normal operating loads or the maximum expected seismic loads (e.g., the SSE loads). SRP 3.10 requires that seismic qualification consider the full range of normal and accident loadings; GDC 2 states that design bases for equipment shall reflect appropriate combinations of the effects of normal and accident conditions together with the effects of natural phenomena (without loss of capability to perform their safety functions); and Section III of Appendix B to 10 CFR Part 50 indicates that a testing program shall include qualifications testing of a prototype unit under the most adverse design conditions. The staff finds that relevant sections of the applicant's submittal (e.g., Sections 3.10 and 3.9.3) do not convey a consistently appropriate treatment for combining seismic loads with loads from other accident conditions and normal operating conditions. Therefore, the applicant is requested to revise the submittal (including the noted sections) to provide a specific description of the combined load cases involving seismic, and to clearly explain how these combined load effects will be suitably addressed in seismic qualification tests and/or analyses for the various categories of mechanical and electrical equipment.

03.10-3

SRP 3.10 (SRP Acceptance Criteria 6.B.ii) indicates that an FSAR should provide information on any in-plant (in-situ) tests, as well as any plans for operational tests which may be used in confirming the qualification of any item of equipment. SRP 3.10 mentions in-situ impedance testing (e.g., for systems/circuit-level testing of power distribution), however, in-situ testing is similarly applicable for other systems or elements (e.g., in-situ application of vibratory devices to simulate the seismic and dynamic vibratory motions on a complex active device; in-situ functionality testing of instrumentation and control components for simulated seismic conditions, potentially including automatic seismic SCRAM; and so forth).

Section 3.10 of the applicant's submittal does not provide such information on in-situ / operational tests (or demonstration that in-situ / operational tests are not needed to confirm the qualification for any item of equipment and/or associated system). Therefore, the applicant is requested to report on any plans for in-situ / operational tests, fully explaining the test program, its purpose, procedure, and criteria for test success. If in-situ / operational tests are not anticipated, then the applicant should fully explain and justify why such tests are not needed to confirm any qualification or basis for qualification.

03.10-4

Section 3.10 of the applicant's submittal indicates that, aside from loss of offsite power, no other extraordinary events or accidents (including LOCAs, high-energy line breaks, and other events) are postulated to occur together with the SSE. The submittal also cites NUREG-1030 and European Utility Requirements as bases for excluding consideration of the simultaneous occurrence of a LOCA with a seismic event. Such approaches are not in accordance with NRC's regulation (GDC 4). SRP 3.10 (e.g., Acceptance Criteria, Items A.xiv(2)(c,d); Technical Rationale for acceptance criteria, Item 3; and approach for staff Evaluation Findings), as well as applicable GDCs and NRC regulations, explicitly require that occurrence of a LOCA, and other appropriate accident conditions, be considered in combination with a seismic event. Therefore, the staff does not find the applicant's approach, of excluding occurrence of LOCAs and other postulated accident conditions (in combination with a SSE event), to be justified. Hence, the applicant is requested to revise Section 3.10 of the submittal to, in accordance with SRP Section 3.10 or other suitable methodology, provide a description of procedures for addressing LOCAs and other accident conditions in combination with seismic events, or alternatively, provide additional information that clearly demonstrates justifiable basis for excluding consideration of LOCAs and other appropriate accident conditions in combination with seismic events.

03.10-5

In Section 3.10.1.3 of the submittal, the applicant's indication that "some" permanent deformation of component supports and structures is acceptable in seismic qualification is considered to be overly vague and potentially inconsistent with NRC's regulations and guidance. Therefore, the applicant is requested to provide additional information and to revise Section 3.10 of the submittal to explicitly clarify and justify the level, and locations/situations, of "some" permanent deformation that will be allowable according to the proposed approaches for seismic qualification testing and/or analysis. In this additional information, the applicant should specify the permissible extent and degree of inelasticity at the SSE design level for the various categories of equipment (and types of equipment supports), the criteria (or reference state) for successful performance of the equipment safety function during seismic qualification (to at least 10 percent beyond the RRS level), and the applicant's basis (whether implicit or explicit) for assuring adequate beyond-design-basis margin with respect to both inelastic capacity reserve and equipment functionality reserve.

03.10-6

Sections 3.10 and 3.10.1.1 of the submittal indicate that the applicant plans to use versions of standards (e.g., IEEE Std 344-2004 and IEEE Std 382-2006) that are not

endorsed by the NRC in SRP 3.10 for purposes of seismic qualification of equipment. Although the submittal states that the applicant maintains the option to use current NRC-endorsed versions of the standards, it does not state that the applicant actually intends to use the NRC-endorsed versions of standards (e.g., IEEE Std 344-1987). However, the staff does not consider the applicant's approach to be generally justified, and finds that additional clarification is needed in order to identify the situations, applicable to US-EPR, where material differences in approaches are expected, and to ascertain any specific conditions that may be relevant with respect to applying the non-endorsed standards for US-EPR. Hence,

(1) [Intentionally deleted.]

(2) Section 3.10.2 of the applicant's submittal indicates that the recommendations of IEEE Std 382 (2006 version) apply to qualification, by separate testing, of attached appurtenances, such as operators, limit switches, and solenoid valves.

It is noted that the testing frequency range used in IEEE 382-2006 may not be adequate for USEPR equipment. Therefore, the applicant is requested to either justify its intended use of IEEE Std 382-2006 as an appropriate basis that accords with USNRC regulations, or to alternatively cite standards and approaches that are consistent with relevant regulatory guidance. In the former case, the applicant should additionally:

a. Identify all components that are being addressed using IEEE Std 382;

b. Provide complete justification in regard to HF motions, including any caveats on use of IEEE Std 382-2006, for application to sites where site-specific design-basis motions are expected to have significant HF energy beyond what may have been considered as basis in the development of IEEE Std 382 (e.g., up to 65 Hz).

03.10-7

Section 3.10 (Introduction) of the applicant's submittal identifies a number of assumptions that appear unclear or not clearly justified, and yet are cited as basis for determining the scope of equipment to be included in the seismic qualification program. These assumptions including the following:

1. The single failure criterion is applied.

2. Exclusion of the following equipment types:

i. Equipment which could operate, but does not need to operate, and which, upon loss of offsite power, will fail in the desired position or state.

ii. Self-actuated check valves and manual valves.

Therefore, the applicant is requested to provide clarifying information on the specific bases and justifications for these assumptions and their effects on the scope of equipment to be qualified, and to ascertain if additional components need to be included in the seismic qualification program. In so clarifying, the response should additionally

address the following items in a manner that meets NRC's regulations or guidance: (a) Indicate precisely how the single failure criterion is applied, including comparison of results (for equipment scope) with application of risk-informed bases; (b) Identify the components of type 2(i) above (and their corresponding systems) that were excluded from the scope of qualification, clarify why they were excluded, and discuss how it can be known or assured without seismic qualification that they will fail in a safe position or state; (c) Identify which components of type 2(ii) were excluded from the scope of qualification, and explain on what basis they were excluded; and (d) Based on a corresponding more detailed consideration, determine which (if any) components may need to be included in the scope of equipment qualification (such determination may require an individual component-by-component assessment for the preceding excluded equipment types and/or similarly excluded equipment).

03.10-8

Table 3.10-1 of the applicant's submittal includes a list of all Seismic Category I and II components in the systems screened for seismic qualification, but Section 3.10 of the submittal does not discuss potential seismic Category II/I issues in terms of influences on scope of equipment. SRP 3.10.I (Areas of Review), indicates that equipment whose failure "can prevent the satisfactory accomplishment" of any essential safety function (whether for seismic Category II/I or other reasons) should also be included in the scope of the seismic and dynamic qualification of electrical and mechanical equipment. Section 3.10 of the submittal does not provide a clear delineation and description of the items that, pertaining to the applicant's qualification program, were included, or excluded, on the basis of this requirement. Therefore, the applicant is requested to provide a list of such components, and in each case, sufficiently describe the potential situation of concern. As a result, it should be clearly demonstrated that no situation exists where failure of any Category I component could occur by means of failure of any equipment item that is outside the scope of the applicant's seismic and dynamic qualification program. In case the applicant does not have suitable information to completely report on the preceding, the applicant's response should explain and justify why the requested information is not currently available, and on what general bases the scope of the seismic qualification program was adequately developed (lending confidence that a successful and safe installation is possible) without this information. Additionally in such case, the applicant is requested to revise submittal Section 3.10 to include any relevant requirements for COL applicants.

03.10-9

Section 3.10.2.2 of the applicant's submittal is not explicitly consistent with SRP 3.10 in its treatment of check valves (i.e., operability being verified only by an analysis of structural integrity). Additionally, Section 3.10.2 of the submittal is potentially inconsistent in its treatment of active valves, dampers and active pumps through structural analysis and stress/deflection checks. In particular, SRP 3.10 requires that valve operators, damper mechanisms, pump motors, and similarly complex active devices must be tested for integrity and functionality. Therefore, the applicant is requested to accordingly revise Section 3.10 of its submittal to be fully consistent with SRP 3.10, and/or to provide appropriately clarifying information that justifies that the approach taken meets NRC's regulations.

03.10-10

The applicant's description of fractional SSE events (in subsections E.4.4, E.5, and E.5.2.3 of Attachment E to Appendix 3D of the submittal), to address low-cycle fatigue effects, contains apparent discrepancies (or perhaps a typographical mistake). For example, submittal Section 3.7 (referenced from Section 3.10) indicates that earthquake cycles included in the fatigue analysis are composed of five one-third SSE (i.e., five OBEs) events followed by one full SSE event. However, the submittal subsequently states that "a number of fractional peak cycles equivalent to the maximum peak cycles for five one-half SSE (i.e., five OBEs) events may be used in accordance with Appendix D of [IEEE Std 344-2004] when followed by one full SSE event."

As a result of problems mentioned above, the applicant's proposed approach is not clearly and adequately described. Therefore, the applicant is requested to provide a definitive, consistent, and complete statement concerning the proposed treatment of fatigue effects in the seismic qualification of electrical equipment by testing (including instrumentation and control), which accords with appropriate regulatory guidance (i.e., five one-half SSE as delineated in SECY-93-087, Section on Elimination of OBE).

03.10-11

Section 3.10.2.1.1 of the applicant's submittal indicates that alternative testing methods, such as single frequency and single-axis testing, are permissible in some cases. The staff considers that such testing methods have very limited applicability, and accordingly, the staff believes that it is important to specifically identify and consider such cases. Therefore, the applicant is requested to identify cases where such testing methods will be applied for qualification of any item of equipment, and to provide appropriately clarifying information to justify use of these limited methods, or to select more generally applicable multi-frequency and multi-axis testing methods. (Note: This RAI pertains not only to electrical equipment, but to all equipment – mechanical, electrical, I&C – included in the scope of the seismic and dynamic qualification program.)

03.10-12

Section 3.10 of the applicant's submittal does not describe a proposed approach for installation (seismic detailing) and seismic adequacy of electrical cables (e.g., power cables and instrument cables), cable connections, and cable penetrations. Therefore, the applicant is requested to describe the installation procedures and qualification test plans, including test specifications and acceptance criteria, for these items. The potential need for seismic qualification of cables and connections themselves will depend on what extent appropriate attention is given to seismic detailing and installation (e.g., to ensure sufficient flexibility that limits the stresses in these components). Correspondingly, the applicant should identify the appropriate standard of practice for installation of these components and describe the associated approach. For any case where the installation procedures alone are not demonstrated to be sufficient to conservatively eliminate the possibility of impairment of safety function of these components under seismic conditions in combination with normal operating and accident loads, then an adequate seismic qualification approach for the component should be presented. Additionally, since SRP 3.10 specifically includes electrical penetrations in the scope of seismic and dynamic qualification, the applicant's submittal should

correspondingly describe the qualification (testing and/or analysis) approach for cable penetrations, which satisfies NRC's regulations.

03.10-13

SRP 3.10 specifies that instrumentation and control (I&C) for all in-scope equipment – as well as for Category 1 accident monitoring instrumentation as defined in Revision 2 and 3 of RG 1.97 and Type A, B, C, and D accident monitoring instrumentation as defined in Revision 4 of RG 1.97 – are to be included in the seismic and dynamic qualification program. Although Section 3.10 of the submittal notes that instrumentation and controls (I&C) equipment are included in the scope of the seismic qualification program, the submittal cites Chapter 7, Section 7.5, and Section 3.11 of the submittal for further information regarding I&C. Chapter 7 of EPR FSAR submittal indicates that the TELEPERM XS digital I&C (DI&C) system is employed for US-EPR, but does not provide adequate seismic qualification approach for the equipment.

The staff noticed that the test spectrum used for seismic qualification of the TELEPERM XS DI&C equipment appears to be inconsistent with the USEPR required seismic spectra for the equipment, in particular, the frequency range of the seismic spectra. Therefore, the applicant is requested to provide more detailed information to justify the use of single axis testing, not considering the potential coupling effects of the equipment axes, and also justify the overall seismic adequacy of the instrument and control devices in the TELEPERM XS system.

03.10-14

DI&C generally involves a number of new and unique components and elements not previously encountered in qualification of older analog I&C. Additionally, seismic events present potentially unique challenges to DI&C systems and components. For instance, accident monitoring and control equipment that support functionality in case of a seismic event will generally include distributed networked sensors and actuators – some of which may include embedded software. In general, assurance of proper functionality of DI&C will involve requirements for digital-electronic computing hardware; digital sensors, integrated software; human interaction as regards configuration, maintenance, and intervention (e.g., potential intervention and/or recovery in case of seismic events); integrated performance of components; and other elements.

With respect to seismic qualification under SRP 3.10, Section 3.10 of the applicant's submittal does not include a sufficient delineation of the components of DI&C that will be subject to seismic qualification, nor a sufficient description of criteria, for determining successful functionality at the component level. Therefore, the applicant is requested to provide additional information to identify DI&C components and justify their seismic qualification in sufficient detail to ensure that NRC regulations are met. The applicant's response should, from the perspective of equipment functionality, define what constitutes a component of the DI&C systems for US-EPR, and identify all such DI&C components. For each identified DI&C component, the applicant should provide complete specifications as to the behavioral and state parameters that define proper functionality of the component and associated success criteria for purposes of seismic qualification. The applicant should also fully describe any non-hardware components / elements

(whether integrated, embedded, installed, etc.) that are needed to ensure proper functionality of any DI&C component under seismic conditions, and explain/justify the testing, certification and other approaches employed in the US-EPR seismic qualification program, and/or other aspect of the US-EPR FSAR submittal, for ensuring proper safety function for these non-hardware components / elements for scenarios representative of design-basis seismic events and other postulated accident conditions.

03.10-15

Section 4 (last paragraph) of IEEE Std 344-1987 (the SRP 3.10 endorsed standard for seismic qualification of equipment) states: “The seismic testing, when part of an overall qualification program, should be performed in its proper sequence as indicated in IEEE Std 323-1983 and care should be taken to identify and account for significant aging mechanisms with test margins as discussed therein. Within these guidelines, it must be demonstrated that the equipment is capable of performing its safety function throughout its qualified life, including its functional operability during and/or after an SSE at the end of that qualified life.”

There exist substantially unique challenges with respect to aging effects on seismic capability for DI&C, which (as justified by the IEEE guidance relevant to SRP 3.10) need to be considered and addressed. In particular, there exist a number of failure modes and aging mechanisms in safety related electronics and associated servo-mechanical equipment, such as DI&C components, that are substantially new and different – with different aging time-frames and maintenance requirements / limitations – as compared to failure modes and aging mechanisms for other (e.g., power distribution, analog I&C) electrical equipment and for conventional mechanical equipment. These unique aging mechanisms lead to special considerations for the case of seismic events. Some examples include: physical aging effects, such as solder aging and associated brittle solder failure, electro-migration, temperature effects, humidity effects, cosmic radiation effects; as well as logical “aging” effects in non-hardware DI&C components (e.g., associated with software design, memory management, etc.) that potentially have unique impacts on the robustness of control logic under seismic events. This concern is particularly relevant to seismic qualification testing of sensor or control components that contain embedded microprocessors, software, and/or firmware.

The staff finds that the applicant’s submittal does not adequately address many of these unique physical and logical failure modes and aging mechanism that can significantly increase the failure potential in the case of a seismic event, and thus need to be addressed accordingly (e.g., via testing of representatively age-accelerated hardware / software / firmware configurations) in seismic and dynamic qualification of DI&C. Therefore, the applicant is requested to provide complete explanation/justification as to how the seismic qualification test program for US-EPR will suitably demonstrate integrity and safety function for the possibly age-modified/representative status of electronic equipment, servo-mechanical equipment, non-hardware (software, firmware) components of DI&C, and similar elements. Additionally, the applicant is requested to identify any RoHS-compliant electronic components intended for application in US-EPR safety systems, and to discuss how such components will be tested in the seismic qualification program, and how they will be inspected and maintained to ensure that the actual situation of aging in deployed equipment will be less critical/severe than the

seismically tested/qualified situation. In case the applicant does not intend to explicitly address such aging effects in the seismic qualification testing and/or analysis program for US-EPR, the applicant's response to this RAI should clearly and fully explain/justify how other aspects of the US-EPR FSAR submittal (in conjunction with the US-EPR seismic qualification program), will ensure proper safety function in the case of a seismic event.

03.10-16

Tier 1 of the applicant's submittal indicates that US-EPR includes a Seismic Monitoring System (SMS), but submittal Section 3.10 does not clarify if an automatic seismic SCRAM capability is intended as a feature or option of US-EPR (and if so, what seismic qualification approach is intended for the system). Therefore, the applicant is requested to clarify whether or not an automatic seismic SCRAM capability is included as a feature or option for US-EPR, and if it is, to provide complete information concerning the seismic qualification of the automatics seismic SCRAM systems and components. In case automatic seismic SCRAM is a feature or option for US-EPR, the applicant is requested to:

1. Identify the components of the automatic seismic SCRAM system, and provide a comprehensive discussion of the approach for seismic qualification for those components.

2. Provide the specifications for successful functionality of all components of the automatic seismic SCRAM system.

3. Provide a complete discussion of the ITAAC approach, at both the DC and COL stages, for system verification, including verification of system logic, for ensuring success of the automatic seismic SCRAM function for the range of possible seismic events.

03.10-17

Although Section 3.7.1.1 of the applicant's submittal indicates that the US-EPR design concept is targeted for application to CEUS sites, the applicant's submittal does not contain adequate information about treatment of the HF seismic motions characteristic of such sites. The NRC staff has developed "Interim Staff Guidance (ISG) on Seismic Issues" that suggests related requirements for interface issues and ITAAC pertaining to HF ground-motion effects. Therefore, the applicant is requested to provide clarifying information on the proposed treatment of HF ground motions in the seismic qualification approach for US-EPR. The applicant's response should include demonstration of compliance with SRP interface requirements as they pertain to the issue of HF ground motion analysis, and also explain the applicant's approach for ITAAC pertaining to HF ground motion effects on qualification of equipment.

03.10-18

Section 3.7.1 of the applicant's submittal proposes use of three control ground motions (EUR control motions) that are representative of common general safety requirements

for European conditions. These motions were not developed according to any NRC regulatory guidance, and the submittal does not adequately clarify how these three control motions will be used for developing realistic input motions (representing the HF input for CEUS sites) for seismic qualification of US-EPR, in accordance with SRP 3.10. Additionally, for purposes of certification of a standard design for US-EPR, it needs to be established whether the seismic qualification testing will be done once for an enveloping of the in-structure responses and effects of all three control motions, or will be done three times to address the specific responses and effects for each of the three control motions. Therefore, the applicant is requested to fully explain, in relation to effects on motions used for seismic qualification, the applicability of the EUR control ground motions to NRC regulations, and how the three control motions of the standard design for US-EPR will be addressed in the applicant's seismic qualification program, including suitable clarification and justification of the development of input motions, or sets of input motions, at equipment mounting locations. The applicant should accordingly revise Section 3.10 of the submittal to reflect these explanations, clarifications and justifications.

03.10-19

General comparison of design-representative site-specific spectra for relevant CEUS sites, against the design-basis ground-motion spectra for the three control motions of the proposed US-EPR standard plant design SSE (as conveyed in Section 3.7.1 of the applicant' submittal), reveals that the applicant's proposed design basis would be inadequate over a significant range of high frequencies, for many of the CEUS sites. This situation indicates that the applicant's guiding intent (stated in submittal Section 3.7.1.1) – i.e., for the certified design to be suitable for most of the potential CEUS sites – may not be realized.

According to NRC's regulations, the SSE is established based on site-specific consideration of the maximum earthquake potential considering the regional and local geology, seismology, and specific characteristics of local subsurface material. Furthermore, developing site-representative inputs for soil-structure interaction and/or structural analyses (used to determine in-structure responses) is needed in order to obtain representative input motions for purposes of equipment qualification. Correspondingly, SRP 3.10 indicates that motion inputs used for seismic qualification should be conservatively representative of the actual input motions at equipment mounting locations. Additionally, IEEE Std 344-1987 indicates that, for seismic qualification purposes, the goal of seismic simulation is to reproduce the postulated earthquake environment in a realistic manner. Developing input motions for equipment qualification that are not representative of, or demonstrably more severe in all cases than, what is actually expected for a given site, is an inadequate approach.

Accordingly, the staff finds that the applicant's submittal does not adequately demonstrate that the input motions (e.g., time histories at equipment locations) will suitably represent the character (including HF effects) of motions expected at CEUS sites. Therefore, the applicant is requested to provide complete justification demonstrating that the input motions to be used for seismic qualification of equipment will be suitably representative (or a conservatively bounding representation) of the actual design-level input motions for equipment. The applicant should revise Section 3.10 to accordingly justify the input motions to be used for equipment qualification.

03.10-20

As suggested from preceding RAIs (No. 17 to 18), the applicant's submittal is likely to not produce suitably representative motion input, for purposes of equipment qualification, for a significant set of CEUS sites. This situation may present potentially significant implications/difficulties during the COL stage, and thereby may significantly limit the potential utility of the US-EPR design concept. Therefore, the applicant is requested to consider to re-define a seismic input basis that generally satisfies NRC's regulations and guidance for all foreseen cases of application of a US EPR standard design, or provide general criteria and procedures for use by COL applicants who may be faced with the case that the proposed US-EPR standard plant design SSE does not meet USNRC regulations and guidance (as pertaining to site-specific motions input for seismic design and seismic qualification of equipment) with respect to their proposed site(s).

03.10-21

Section 3.10 of the applicant's submittal does not have a sufficiently detailed and complete description of the proposed approach for seismic and dynamic qualification of supports for mechanical and electrical equipment (including I&C), according to the requirements specified in SRP 3.10 subsection II.1.B. Therefore, the applicant is requested to revise Section 3.10 of the submittal to suitably address requirements for design adequacy of supports, in a manner consistent with SRP 3.10 or NRC's regulations. In the applicant's response, the methods and procedures of analysis or testing of the supports for mechanical and electrical equipment, and the procedures used to account for possible amplification of vibratory motion (amplitude and frequency content) under seismic and dynamic conditions, should be presented and reviewed. Additionally, as required by SRP 3.10, for establishing design adequacy of supports, analyses or tests should be performed for all supports of mechanical and electrical equipment to ensure their structural capability; the analytical results should include the required input motions to the mounted equipment, and the combined stresses of the support structures should be in accordance with criteria specified in SRP Section 3.9.3; and supports should be tested with equipment installed or with a dummy simulating the equivalent equipment inertial mass effects and dynamic coupling to the support. (If the equipment is installed in a non-operational mode for the support test, the response in the test at the equipment mounting location should be monitored and characterized. In such a case, equipment should be tested separately for functionality, and the actual input motion to the equipment in this test should be more conservative in amplitude and frequency content than the monitored response from the support test.)

03.10-22

Section 3.10 of the applicant's submittal does not currently have a completed SQR / SQDP; however, several general items of information may be potentially available for review prior to development of a complete package. These general items may include:

For each configuration (e.g., element, assembly, or mounting) of equipment to be qualified by separate tests and/or analyses:

(a) Tables of the intended physical locations of the equipment, mounting/support description for the tests and/or analyses of the to-be-

qualified configuration, and mounting/support description (e.g., wall, floor, pipe supported and/or other configurations) for each intended field installation.

(b) Approximate masses (e.g., typical range) for the to-be-qualified configuration (with values for masses of supports/mounts distinctly identified).

(c) Description of the systems and the equipment's function within the system, for which each equipment-test apply.

(d) The general design / functional specifications for each case where the equipment-test is intended to apply.

(e) Indication as to whether the to-be-qualified configuration pertains to the NSSS or balance of plant (BOP).

(f) Explanation (identification and justification) of the required response spectra, test response spectra, associated damping, and time histories for testing and/or analysis.

(g) The general criteria for demonstrating successful equipment functionality and successful structural integrity in the tests and/or analyses of each to-be-qualified configuration.

(h) A general description of the decision, and associated deciding factors, as to whether the to-be-qualified configuration will be qualified by means of testing, analyses, or combined testing and analysis, and additionally:

1) If qualification will be by testing alone, explain (identify and justify) the intended test methods and procedures (e.g., multi-frequency, multi-directional), as well as other significant test conditions or parameters

2) If the qualification will be by analysis alone, explain (identify and justify) the intended analysis methods and assumptions, as well as why analysis alone is sufficient for qualification

3) If qualification is by testing and analysis, provide relevant explanations as identified in both of the preceding items

(i) The load combinations, their bases, and the intended methods for introducing/superimposing the effects of combined loads in the tests and/or analyses

(j) The candidate equipment vendors, equipment models, and vendor descriptions for each item of equipment that may be qualified

The DC applicant is requested to explain the evolution in status of SQR/SQDP-relevant information for the following time-frames: current status, status during the FSAR review, and status at the COL stage. In case any portion of the applicant's SQR will be available during the present FSAR review, the DC applicant is requested to inform the NRC of this

information, or specify when they may be available for review in a site audit. Additionally, the applicant is requested to now provide any items of general information, as noted above, that may be available (particularly the three items indicated under Item (h) above). In case the applicant does not have general information to report concerning any requested item, the applicant's response should explain and justify why the requested general information is not currently available, and on what basis the USEPR FSAR design could be developed (lending confidence that a successful and safe installation is possible) without at least such general information.

03.10-23

Section 3.10.4 of the applicant's submittal provides a very brief general description regarding updating and maintenance of plant-specific records and qualification reports. The submittal does not provide a detailed description, in accordance with SRP 3.10, which is needed to lend high confidence that an appropriate workflow and set of associated procedural methods/controls will be implemented for a successful system of managing qualification documents. Additionally, based on requirements of Appendices A and B of 10 CFR Part 50, SRP 3.10 stipulates that applicants should establish and maintain an acceptable quality assurance program for records control, including seismic qualification documents.

The staff finds that the applicant's submittal does not provide a sufficiently detailed description regarding administrative controls of the equipment qualification file, the handling of documentation, internal acceptance procedures, identification of the scope of NSSS and A/E suppliers, and the procedures for interchange of information between NSSS, A/E, equipment vendors, and testing laboratories. Therefore, the applicant is requested to provide a complete and detailed description of approaches to management of qualification documents. The detailed description should discuss procedures (e.g., document handling and acceptable, check-in/check-out), workflow, technology, documentation media and version control, document retrieval and back-up, and so forth. Association of documents with NSSS and A/E suppliers should be clearly identified, and consistency – or issues pertaining to inconsistency – in methods for interchanging information between NSSS, A/E, equipment vendors, and testing laboratories should be adequately addressed. Although the applicant has identified that updates and maintenance to records will occur as equipment is replaced, modified, further tested, or re-qualified, additional events may need to be anticipated – for example, plant configuration changes that may indirectly affect the qualification (and qualification file) for a given component (or components).

The applicant's response to this RAI should also address suitable quality assurance procedures and should describe the associated technologies to be employed (e.g., electronic database management). In case a consistent design of a formalized system for administrative controls and records management procedures cannot be specified by the applicant, the submittal should be revised to introduce an action item for each COL applicant to develop, document and implement such a system.

03.12-1

In FSAR Tier 2 subsection 3.12.5.9, AREVA states that the RCS attached piping will be instrumented and monitored during first cycle of the first U.S. EPR initial plant operation to verify that the operating conditions have been considered in the design unless data from similar

plant's operation demonstrates that thermal oscillation is not a concern for piping connected to the RCS.
The staff noted that this monitoring activity is not listed in Table 1.8-2 as part of the COL items. Clarify who is responsible for this activity and describe the monitoring program/methodology for confirming the integrity of the RCS attached piping.

03.12-2

In FSAR Tier 2 subsection 3.12.5.10.1, AREVA states that the pressurizer surge line temperatures will be monitored during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the surge line are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted. AREVA also states that the monitoring program, if required, includes temperature measurements at several locations along the pressurizer surge line and plant parameters including pressurizer temperature, pressurizer level, hot leg temperature, and reactor coolant pump status.
The staff noted that this monitoring activity is not listed in Table 1.8-2 as part of the COL items. Clarify who is responsible for this activity and describe the monitoring program/methodology for confirming the pressurizer surge line integrity

03.12-3

[Intentionally deleted.]

03.12-4

In FSAR Tier 2 subsection 3.12.5.10.3, AREVA states that the normal spray line temperatures will be monitored during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the normal spray are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted.
The staff noted that this monitoring activity is not listed in Table 1.8-2 as part of COL items. Clarify who is responsible for this activity and describe the monitoring program/methodology for confirming the integrity of the normal spray.

03.12-5

In FSAR Tier 2 subsection 3.12.5.10.4, AREVA states that the temperature of main feedwater lines will be monitored during the first cycle of the first U.S. EPR initial plant operation to verify the design transients for the main feedwater lines are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted.
The staff noted that this monitoring activity is not listed in Table 1.8-2 as part of COL items. Clarify who is responsible for this activity and describe the monitoring program/methodology for confirming the main feedwater integrity.

03.12-6

[Intentionally deleted.]

03.12-7

In FSAR Tier 2 Section 3C.4.1.3, AREVA states that under 100 percent power steady flow conditions the RCS components and piping are subjected to flow loads at locations where flow direction or flow area change. Describe the method for applying this load in analysis model and how to apply the results (stress, support load) of this loading.

03.12-8

In FSAR Tier 2 Section 3.12.5.10.4, AREVA states that the emergency feedwater system (EFWS) is not actuated during normal or upset operation and the EFWS piping layout minimizes thermal stratification during emergency and faulted operation. This statement does not justify why thermal stratification will be minimized by EFWS piping layout. The staff request AREVA to provide detailed justification to substantiate that EFWS thermal stratification is minimized. Explain what the layout is and how the layout can minimize thermal stratification.

03.12-9

In FSAR Tier 2 Section 3.12.5.9, AREVA's thermal stratification discussion described the RCS non-isolable piping flow turbulent penetration without mentioning valve leakage cases. Provide approach to address BL 88-08 issues and ensure that valve leakage cases are evaluated and addressed.

03.12-10

In FSAR Tier 2 Section 3.12, AREVA did not address inter-building settlement difference in piping design. Clarify if building settlement cases are considered for piping design.

03.12-11

In FSAR Tier 2 Section 3.9.1.2, the applicant identified the computer program used in analyses. The staff noted that CASS and EBDynamics were identified as part of sections 3.12 and Appendix 3C but were not identified in Section 3.9.1.2.. The staff requests the applicant to revise Section 3.9.1.2 to include these codes for consistency.

In FSAR Tier 2 Section 3.12.3.6, the applicant identified the equivalent static method described in Section 4.2.3 of reference 1(ANP-10264(NP). The staff noted that the equivalent static method is described in Section 4.2.4 as ANP-10264(NP)-**A**. The staff requests the applicant to revise the section and reference.

In FSAR Tier 2 Section 3.7.1.2, the applicant states that the analysis of piping that uses the uniform support motion (USM) response spectrum method is performed with 5 percent damping. Table 3.7.1-1 also states that 5 percent damping is used for piping analysis. Topical report TR-10264(NP)-A does not address 5% damping. The staff requests the applicant to make appropriate revisions to resolve the difference.