RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**81-8000**
SRP Section:	**03.10 - Seismic and Dynamic Qualification of Mechanical and Electrical Equipment.**
Application Section:	**3.10**
Date of RAI Issue:	**07/16/2015**

Question No. 03.10-1

DCD Tier 2, Rev. 0, Section 3.10.1.3 states that with the elimination of operating basis earthquake ground motion (OBE), analysis checks for fatigue effects can be performed at a fraction of the safe shutdown earthquake (SSE) (such as 50 cycles at one-half of the SSE peak amplitude, or 150 cycles at one-third of the SSE peak amplitude). In KHNP letter dated June 1, 2015, the applicant references SECY-93-087 (dated April 2, 1993) and IEEE Std 344 as the basis for this approach. The NRC staff recognizes that SECY-93-087 discusses this approach as one of the alternatives; however in Staff Requirement Memorandum (SRM) for SECY-93-087 (dated July 21, 1993), the NRC does not specifically approve this alternative.

The approved alternatives for equipment qualification are (1) five one-half SSE events followed by one full SSE event, and (2) a number of fractional peak cycles equivalent

to the maximum peak cycle for five one-half SSE events may be used in accordance with Appendix D to IEEE Std 344-1987 when followed by one full SSE. SRP Section 3.10 Section III.3.C also states the same guidance for equipment qualification. In a public meeting on June 23, 2013, the applicant indicated its intent to follow the approved alternatives in the SRM. Therefore, the NRC staff requests that the applicant revise the DCD and reference the specific alternative selected, with reference to the SRM on SECY-93-087.

Response

DCD Section 3.10.1 will be revised to follow the approved alternatives in the SRM regarding the fatigue effects with the elimination of OBE and the reference to the Staff Requirement Memorandum SECY-93-087.

Impact on DCD

DCD Section 3.10.1.3 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Reports.

d. Demonstrating the capability of the equipment to perform its safety-related function

e. Documenting that the process has been done in accordance with accepted regulatory and industry standards

In general, seismic Category I electrical equipment, for which functional operability must be demonstrated, is qualified by tests. Analysis alone is used for qualification of seismic Category I mechanical equipment if structural integrity alone can provide reasonable assurance of the design intended function.

For equipment whose functional operability cannot be demonstrated by analysis or testing because of its size, complexity, or the large number of similar configurations, a combination of test and analysis may be used. With the elimination of OBE, analysis checks for fatigue effects can be performed at a fraction of the SSE ~~(such as 50 cycles at one-half of the SSE peak amplitude, or 150 cycles at one-third of the SSE peak amplitude).~~

3.10.2 Methods and Procedures for Qualifying Mechanical and Electrical Equipment and Instrumentation

Qualification of seismic Category I equipment and its supports meets the requirements of NRC RG 1.100 and IEEE Std. 344-2004. Qualification methods of testing and analysis for confirming the functionality of equipment during and after an SSE, and for all static and dynamic loads from normal, transient, and accident conditions, are presented in this section.

3.10.2.1 Qualification by Analysis

The seismic analysis methods are in accordance with the guidance of IEEE Std. 344-2004. Analysis without testing may be acceptable only if structural integrity alone can provide reasonable assurance of the design-intended function.

Procedures are presented that can be used to seismically qualify equipment by analysis for a number of OBEs followed by an SSE. Two approaches to seismic analysis are described. One approach is based on dynamic analysis, the other on static coefficient analysis.

(Such as five one-half SSE events followed by one full SSE event or a number of fractional peak cycles equivalent to the maximum peak cycle for five one-half SSE events followed by one full SSE event).

8. Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," Rev. 1, U.S. Nuclear Regulatory Commission, March 2007.

9. ~~SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," U.S. Nuclear Regulatory Commission, 1993.~~

10. Regulatory Guide 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, June 2007.

11. IEEE Std. 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1995.

12. ANSI/AISC N690-1994, "Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities," American National Standard Institute, 1994

9. Staff Review Memorandum for SECY-93-087, "SECY-93-087 - Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," U.S. Nuclear Regulatory Commission, July 1993.

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Question No. 03.10-2

SRP Section 3.8.3 endorses American National Standards Institute/American Institute of Steel Construction (ANSI/AISC) N690- 1994 including Supplement 2 (2004), “Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities.”

In addition, DCD Tier 2, Rev. 0, Table 3.2-1 references ANSI/AISC N690-1994 including supplement 2 (2004).

However, DCD Tier 2, Rev. 0, Section 3.10.6 and Technical Repot [sic] APR1400-E-X-NR-14001-P, Rev. 0, Part 2 reference ANSI/AISC-N690-1994 without stating Supplement 2 (2004).

For consistency, the staff requests that the applicant revise the DCD and the Technical Report to reference ANSI/AISC N690-1994 including Supplement 2 (2004), or justify using this earlier version of the ANSI/AISC standard in DCD Tier 2, Section 3.10 and the Technical Report.

Response

DCD Section 3.10.6, and Technical Report APR1400-E-X-NR-14001-P/NP, Rev. 0, Part 2 will be revised to incorporate (ANSI/AISC) N690-1994 including the Supplement 2 (2004).

Impact on DCD

DCD Section 3.10.6 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical Report APR1400-E-X-NR-14001-P/NP, Rev. 0, Part 2 will be revised as indicated in the Attachment.

7 REFERENCES

All codes and standards shall be the edition in effect as of December 31, 2010 unless identified otherwise.

1 Regulatory Guide 1.100, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," Rev. 3, U.S. Nuclear Regulatory Commission, September 2009.

2 Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," Rev. 2, U.S. Nuclear Regulatory Commission, July 2006.

3 NUREG-0800, Standard Review Plan, Section 3.11, "Environmental Qualification of Mechanical and Electrical Equipment." Rev. 3, U.S Nuclear Regulatory Commission, Marcg 2007.

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

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

6 ASME QME-1-2007 "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," The American Society of Mechanical Engineers, 2007.

7 Generic Letter 89-10, "Safety-Related MOV Testing and Surveillance," U.S. Nuclear Regulatory Commission, June 28, 1989.

8 IEEE Std 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Suppliers for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1995.

9 Regulatory Guide 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, June 2007.

10 ACI 349-01, "Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-01) and Commentary," American Concrete Institute, February 2001.

11 ~~ANSI/AISC N690 1994~~, "Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities," American National Standard Institute, ~~1978~~

ANSI/AISC N690 - 1994 including Supplement 2 (2004),

1994 & 2004

/American Institute of Steel Construction

result of these loads will be smaller than the recommended clearance by the manufacturer.

e. Diesel Engine

For the operability of the diesel engine and its auxiliary active components (valves, pumps, instruments), the methods described in NRC RG 1.9 (Reference 10) and IEEE Std. 387 (Reference 11) are used.

3.10.2.3.2 Electrical and Instrumentation

The supplier is to use the qualification test methods described in Subsection 3.10.2.2 to prove the operability of active electrical and instrumentation equipment.

3.10.3 Methods and Procedures of Analysis or Testing of Supports of Mechanical and Electrical Equipment and Instrumentation

Analyses or tests are performed for all supports of mechanical and electrical equipment to provide reasonable assurance of their structural capability.

The analytical results include the required input motions to the mounted equipment obtained in the manner stated in Subsection 3.10.1.2. Combined stresses of the designed component supports are maintained within the stress limits of the ~~ANSI/AISC-N690~~ (Reference 12). The loads, load combinations, combined stresses, and stress criteria to demonstrate the design adequacy of cable trays, conduits, and their supports are provided in Appendix 3.9A.

ANSI/AISC N690 -1994 including Supplement 2 (2004),

For supports of mechanical (ASME Section III) equipment, the analytical results include the loads, loading combinations, and combined stress limits described in Subsection 3.9.3 for ASME Section III Class 1, 2, and 3 component supports. The jurisdictional boundary between ASME Section III Class 1, 2, and 3 component supports and the building structure are established in accordance with ASME Section III, NF.

Supports are 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

8. Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," Rev. 1, U.S. Nuclear Regulatory Commission, March 2007.

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

10. Regulatory Guide 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, June 2007.

11. IEEE Std. 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1995.

12. ~~ANSI/AISC N690-1994~~ ANSI/AISC N690 -1994 including Supplement 2 (2004), "Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities," American National Standard Institute, ~~1994~~ 1994 & 2004 /American Institute of Steel Construction

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**81-8000**
SRP Section:	**03.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment.**
Application Section:	**3.10**
Date of RAI Issue:	**07/16/2015**

Question No. 03.10-3

SRP Section 3.10 Section II.1.A.ii states that equipment should be tested in the operational condition. Technical Report APR1400- E-X-NR-14001-P, Rev. 0, Part 2, Section 5.7 states that active equipment should be tested under operating conditions in accordance with the provisions in NRC RG 1.100 and IEEE Std 344. The section goes on to state that equivalent operating loads should be simulated to act on passive equipment, but the equipment itself need not be under an operating condition. The NRC staff requests that the applicant provide the justification for not testing the passive equipment under operating conditions.

Response

If testing is conducted for passive equipment, equivalent loads (such as non-seismic operating loads) are imposed as the test input as well as the seismic loads. For passive equipment that must maintain its pressure boundary and/or structural integrity, but not necessarily perform mechanical motion or have certain deflection limits, during the course of accomplishing a system safety function, the passive equipment does not need to be in an operating condition.

Simple and passive equipment may be analyzed to confirm their structural integrity under postulated event loadings.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Reports.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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Docket No. 52-046

RAI No.:	**81-8000**
SRP Section:	**03.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment.**
Application Section:	**3.10**
Date of RAI Issue:	**07/16/2015**

Question No. 03.10-4

SRP Section 3.10 indicates that the following mechanical and electrical equipment should be seismically qualified: equipment associated with systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, containment and reactor heat removal or are otherwise essential in preventing significant release of radioactive material to the environment, and instrumentation that is needed to assess plant and environmental conditions during and after an accident, as described in RG 1.97.

Also covered by SRP Section 3.10 is equipment (1) that performs the above functions automatically, (2) that is used by the operators to perform these functions manually, and (3) whose failure can prevent the satisfactory accomplishment of one or more of the above safety functions.

The NRC staff recognizes that these equipment within the scope of seismic qualification may contain more than the safety-related equipment as defined in 10 CFR 50.2.

As an example, the instrumentation that is needed to assess plant and environmental conditions during and after an accident may not be included in the safety-related equipment as defined in 10 CFR 50.2.

In DCD Tier 2, Rev. 0, Section 3.10, the applicant refers to the equipment within the scope of seismic qualification as safety-related equipment. In DCD Tier 2, Rev. 0, Section 3.10.4.1, COL Item 3.10(3), the applicant refers to the equipment within the scope of seismic qualification as safety-related seismic Category I equipment.

The NRC staff requests that the applicant update the DCD to refer to the equipment included in the scope of SRP 3.10 as “seismic Category I equipment,” “equipment as defined in DCD Tier 2, Section 3.10,” or other alternative terminologies. The NRC staff also requests that the applicant review Technical Report, APR1400-E-X-NR-14001-P, Rev. 0, Part 2 and apply the updated terminology consistently.

Response

DCD Table 1.8-2, Section 3.10, and Technical Report APR1400-E-X-NR-14001-P/NP, Rev. 0, Part 2 will be updated to refer to the equipment included in the scope of SRP 3.10 as “seismic Category I equipment”

Impact on DCD

DCD Table 1.8-2 and Section 3.10 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical Report, APR 1400-E-X-NR-14001-P/NP Rev.0, Part 2 will be revised as indicated in the Attachment.

1 OBJECTIVES

electrical and active mechanical

Seismic qualification is a means to verify the ~~Class 1E safety-related electrical equipment and active~~ equipment can meet its performance requirements during and following one safe shutdown earthquake (SSE) preceded by a number of operating basis earthquakes (OBEs). This program establishes the seismic and dynamic qualification procedures and criteria for ~~safety-related mechanical equipment, controls and instrumentation, and Class 1E electrical~~ equipment in APR1400. This program is part of the overall APR1400 Equipment Qualification Program (EQP). This program provides the seismic and dynamic qualification requirements and general procedures to qualify ~~safety-related~~ equipment in accordance with NRC RG 1.100 (References 7.1 and 7.5) and IEEE Std 344. It is expected that this report may be referenced by license applicants for the scope and methods employed herein.

electrical and active mechanical

seismic Category I

seismic Category I

1.1 CRITERIA AND STANDARDS

The seismic requirements to be considered in the design of all the ~~safety-related~~ equipment are embodied in Title 10 Code of Federal Regulations (10 CFR), Appendix A to Part 50, General Design Criterion 3.

The qualification program is designed to meet the requirements of SRP 3.9.2 (Reference 7.3), NRC RG 1.100, IEEE Std 344, and IEEE Std 627. IEEE Std 344 was issued to provide guidance for demonstrating the seismic qualifications of Class 1E equipment for nuclear generating stations. The individual supporting standards that the A/E will employ, either in whole or in part, are listed in Section 7.

seismic Category I equipment such as

1.2 SUMMARY

A summary of the various sections of this program is given below:

Scope of Equipment Seismic and Dynamic Qualification (Section 3)

The general scope of supply and the various qualification program activities are described. This program will cover safety-related electrical and all the mechanical equipment including passive mechanical equipment in harsh and mild environments.

Seismic Qualification Requirements (Section 4)

The methods required in performing seismic qualification are presented.

Qualification Programs (Section 5)

Information is provided for the detailed seismic qualification methods to be employed in compliance with NRC RG 1.100, IEEE Std 344, and ASME QME-1 (Reference 7.6) requirements. Demonstration of the conservatism of the qualification parameters is described.

Documentation (Section 6)

This section describes the documentation required for qualification. The qualification reports and their generation are described. Documentation necessary to support the review of a particular applicant's docket will be available for audit.

2 DEFINITIONS

2.1 Safe Shutdown Earthquake (SSE)

An earthquake that is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake that produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional.

2.2 Operating Basis Earthquake (OBE)

An earthquake that could reasonably be expected to occur at the plant site during the operating life of the plant considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake that produces the vibratory ground motion for which those features of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public, are designed to remain functional.

2.3 Safety-Related Equipment ~~(Seismic Category I Equipment)~~

Safety-related equipment is the equipment necessary to provide reasonable assurance of:

a. The integrity of the reactor coolant pressure boundary,

b. The capability to shut down the reactor and maintain it in a safe shutdown condition, or

c. The capability to prevent or mitigate the consequences of accidents that could result in potential off-site exposures in excess of the limits stated in 10 CFR 100.

Electrical equipment falling in this category is called Class 1E equipment.

All safety-related equipment shall be either active or passive.

2.3.1 Active Equipment

Equipment containing moving parts, which in order to accomplish its function, must undergo mechanical movement of those parts, or must prevent a movement of those parts to ensure that the equipment will remain in its last position.

2.3.2 Passive Equipment

Equipment that must maintain its pressure boundary and/or structural integrity, but not necessarily perform mechanical motion or have certain deflection limits, during the course of accomplishing a system safety function.

3 SCOPE OF EQUIPMENT SEISMIC AND DYNAMIC QUALIFICATION

3.1 ~~SAFETY-RELATED EQUIPMENT (~~SEISMIC CATEGORY I EQUIPMENT~~)~~

Seismic Category I equipment is required to be seismically and dynamically qualified by demonstrating that its structural integrity and safety function during and after a postulated earthquake in conjunction with the full range of applicable normal and accident loads and conditions.

Seismic Category I equipment requiring qualification in accordance with the APR1400 EQP is described as follows:

a. Equipment associated with systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment reactor heat removal

b. Equipment and systems used to power, control, or monitor other structures, systems, and components (SSCs) important to safety

c. Equipment essential to preventing significant release of radioactive material to the environment

d. Instrumentation (including accident and post-accident monitoring) needed to assess plant and environmental conditions during and after an accident, as described in NRC RG 1.97, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants”

The equipment seismic qualification program criteria define specific technical requirements for seismic and dynamic qualification of seismic category I, safety-related mechanical equipment (excluding piping), and seismic category I (Class 1E) electrical and instrumentation equipment, including associated supports and mountings. The program includes qualification of category I tanks and reservoirs for hydrodynamic seismic loads, where applicable. All such equipment that is required to perform functionally or maintain its structural integrity, as described above, is subject to rigorous seismic/dynamic qualification. A detailed listing of APR1400 standard plant seismic category I equipment, requiring seismic qualification, is given in Table 3 of the Environmental Qualification Parameters Report (EQPR).

It should be noted that detailed criteria for functionality testing and inspection of mechanical and electrical equipment (e.g., performance tests, hydrostatic tests, and leakage tests) are not within the scope of the equipment seismic qualification program.

3.2 ~~IMPORTANT TO SAFETY (~~SEISMIC CATEGORY II EQUIPMENT~~)~~

The equipment seismic qualification program criteria also define technical requirements for seismic and dynamic qualification of equipment important to safety whose failure could prevent satisfactory accomplishment of one or more of the safety-related functions.

This includes seismic Category II equipment, defined as that equipment which performs non-safety-related functions, and whose continued function is not required, but whose structural or functional failure or interaction could degrade the function or integrity of a seismic Category I SSC to an unacceptable level, or could result in incapacitating injury to occupants of the control room.

Therefore, seismic Category II equipment can be seismically qualified by demonstrating that it retains its position sufficiently in an SSE that it will not cause unacceptable structural interaction with or failure of

4 SEISMIC QUALIFICATION REQUIREMENTS

seismic Category I

The dynamic qualification of ~~safety-related~~ equipment is achieved by providing reasonable assurance of its structural integrity and verifying the operability of active equipment when subjected to equivalent conditions that would be present during the postulated plant conditions. The following qualification programs are required:

a. Qualification by tests only

b. Qualification by analytical methods only

c. Qualification by the use of experience data

d. Qualification by any combination of supporting tests, supporting calculations, qualification tests, analytical calculations and experience.

Regardless of the equipment qualification programs chosen, the conditions and requirements for those portions of the program are stated in the following sections and shall be met.

SRSS to obtain the dynamic stresses and deflections. These dynamic stresses and deflections shall be added to all stresses and deflections resulting from all applicable loads and then compared with the design limits stated in Subsection 5.11.

5.11.6 Basis of Acceptability

The resultant stresses and deflections due to all loads included in the loading combinations stated in the procurement specification shall be within the design limits stated also in the procurement specification. Any deviation from these criteria shall be justified and the calculations shall show that the structural integrity of ~~all safety related~~ equipment, as well as the operability of active equipment, is maintained when subjected to the specified loading combinations. The Supplier shall submit to the combined license applicant a report that includes the data, calculations, results, and conclusions of the analysis. A suggested form for the report is presented in Section 5.14.

5.12 EXPERIENCE DATA

The method to be used for qualification by the use of experience data is described in this section. This method may be accomplished by justifying similarity with previously qualified equipment or with equipment that has proven performance during earthquakes. Experience data may be derived from the following sources:

a. Previous qualifications: Analysis or test data from previous equipment qualification programs

b. Earthquakes: Documented performance for similar equipment in facilities that have been subjected to earthquakes

c. Other experience: Data from operating dynamic loading or other dynamic environments

Similarity

Qualification by the use of experience data shall be based on the concept of dynamic similarity for excitation, physical system, dynamic response, and operability as follows:

a. Similarity of excitation exists, such as spectral characteristics, duration, directions of excitation axes, and location of measurement, for the motions relative to the equipment mounting.

b. Similarity of the equipment configuration shall be established.

c. A physical system dynamic response can be described through the same quantities as those applied to excitation or through a physical system description.

The experience data shall provide documented evidence to support the demonstration of proper operability.

5.13 OPERABILITY OF ACTIVE EQUIPMENT

The methods and guidance in ASME QME-1 including Appendix QRA, with exceptions provided in NRC RG 1.100, are used for seismic qualification of active mechanical equipment. The seismic and dynamic

analysis, or a combination of test and analysis are performed except an experience-based qualification. An experience-based qualification is not used for any equipment until it is endorsed by NRC RG 1.100.

The ~~safety-related,~~ seismic Category I mechanical equipment is designed to provide reasonable assurance of structural integrity of pressure boundary components for the intended service load conditions identified in the equipment's design specification, in accordance with the requirements in ASME Section III (Reference 6) described in Section 3.9. For seismic qualification of active mechanical equipment, the methods and guidance in ASME QME-1-2007 (Reference 7), including Appendix QR-A, with exceptions provided in NRC RG 1.100, are used.

For procurement of equipment, the dynamic requirements for the seismic qualification are specified in the equipment's design specifications. The equipment supplier is to submit a seismic qualification plan/procedure for review and approval prior to performing the seismic qualification. When test is employed, the equipment supplier is to submit a detailed test plan prior to conducting the test. When analysis is employed, the equipment supplier is to submit a detailed analysis procedure showing the methodology, approval, and description of the computer program used. If the plan/procedure is not acceptable, the seismic test plan or analysis procedure will be modified accordingly. The choice between testing and analysis may be made by the equipment supplier. However, the selected qualification program shall satisfy the requirements of the purchase specifications in accordance with the guidelines provided in IEEE Std. 344-2004.

An existing seismic qualification is acceptable if it is properly documented, and if it meets all the requirements of the purchase specifications. The equipment supplier is to submit the seismic qualification documentation for review and approval prior to installation in the plant. The seismic qualification documentation is to include all the information stated in Subsection 3.10.4, to demonstrate that the equipment is qualified in accordance with the requirements of the purchase specifications.

3.10.1.2 Input Motion

The postulated dynamic loads related to the qualification of seismic Category I equipment are seismic loads (OBE and SSE), if applicable, hydrodynamic loads, and non-seismic

installed in a nonoperational mode for the support test, the response at the equipment mounting location is monitored and characterized in the manner as stated in Subsection 3.10.2.2. In such a case, equipment is tested separately for operability and the actual input motion to the equipment in this test is to be more conservative in amplitude and frequency content than the monitored response from the support test.

3.10.4 Test and Analysis Results and Experience Database

Complete and auditable records are maintained for the life of the plant at the plant administrative facilities. These records are updated and kept current as equipment is replaced, further tested, or otherwise further qualified.

The COL applicant is to develop the equipment seismic qualification files that summarize the component's qualification, including a list of equipment classified as seismic Category I in Table 3.2-1 and seismic qualification summary data sheets (SQSDS) for each piece of ~~safety-related~~ seismic Category I equipment (COL 3.10(3)). The SQSDS include the following information:

a. Identification of equipment, including vendor, model number, and location within each building. Valves that are part of the RCPB are identified.

b. Physical description, including dimensions, weight, and field mounting condition

c. A description of the equipment's function within the system

d. Identification of all design (functional) specifications and qualification reports, and their locations

e. Description of the required loads and their intensities for which the equipment is qualified

f. If qualified by test, identification of the test methods and procedures, important test parameters, and a summary of the test results that includes test response spectra (TRS) enveloping required response spectra (RRS)

functional performance of vibration-sensitive components in the high-frequency range.

COL 3.10(3) The COL applicant is to develop the equipment seismic qualification files that summarize the component's qualification, including a list of equipment classified as seismic Category I in Table 3.2-1 and SQSDS for each piece of ~~safety-related~~ seismic Category I equipment.

COL 3.10(4) The COL applicant is to perform equipment seismic qualification for seismic Category I equipment and provide milestones and completion dates of the equipment seismic qualification program.

3.10.6 References

1. Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, June 2006.

2. 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," U.S. Nuclear Regulatory Commission.

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

4. Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," Rev. 3, U.S. Nuclear Regulatory Commission, September 2009.

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

6. ASME Boiler and Pressure Vessel Code, Section III, Disvion 1, "Rules for Construction of Nuclear Facility Components," The American Society of Mechanical Engineers, the 2007 Edition with the 2008 Addenda.

7. ASME QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," The American Society of Mechanical Engineers, 2007.

Table 1.8-2 (6 of 29)

Item No.	Description
COL 3.10(1)	The COL applicant is to provide documentation that the designs of seismic Category I SSCs are analyzed for OBE, if OBE is higher than 1/3 SSE.
COL 3.10(2)	The COL applicant is to investigate if site-specific spectra generated for the COLA exceed the APR1400 design spectra in the high-frequency range. Accordingly, the COL applicant is to provide reasonable assurance of the functional performance of vibration-sensitive components in the high-frequency range.
COL 3.10(3)	The COL applicant is to develop the equipment seismic qualification files that summarize the component's qualification, including a list of equipment classified as seismic Category I in Table 3.2-1 and seismic qualification summary data sheets (SQSDS) for each piece of ~~safety-related~~ seismic Category I equipment.
COL 3.10(4)	The COL applicant is to perform equipment seismic qualification for seismic Category I equipment and provide milestones and completion dates of equipment seismic qualification program.
COL 3.11(1)	The COL applicant is to identify and qualify the site-specific mechanical, electrical, I&C, and accident monitoring equipment specified in RG 1.97.
COL 3.11(2)	The COL applicant is to document the qualification test results and qualification status in an auditable file for each type of equipment in accordance with the requirements 10 CFR 50.49(j).
COL 3.11(3)	The COL applicant is to describe the EQP implementation milestones based on the APR1400 EQP.
COL 3.11(4)	The COL applicant is to identify the nonmetallic parts of mechanical equipment in procurement process.
COL 3.12(1)	The COL applicant is to prepare design reports for ASME Class 1, 2, and 3 piping system in accordance with ASME Section III.
COL 3.12(2)	The COL applicant is to design the piping exposed to wind and/or tornado, if any, to the plant design basis loads.
COL 3.12(3)	The COL applicant is to perform fatigue evaluations of ASME Class 1 piping.
COL 3.12(4)	The COL applicant is to perform stress evaluations for ASME Class 2 and 3 piping.
COL 3.12(5)	The COL applicant is to perform fatigue evaluations of environmental impact on ASME Class 1 piping, except for the RCS primary loop, using methods acceptable to the NRC at the time of evaluation.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**81-8000**
SRP Section:	**03.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment.**
Application Section:	**3.10**
Date of RAI Issue :	**07/16/2015**

Question No. 03.10-5

Technical Report APR1400-E-X-NR-14001-P, Rev. 0, Part 2, Section 6.1 states that the dynamic qualification reports should include information suggested in IEEE Std. 344-2004, Section 10.3. However, IEEE Std. 344-2004, Section 10.3 discusses test experience data. The NRC staff requests that the applicant verify the IEEE Std. 344-2004 section number.

Response

Technical Report APR1400-E-X-NR-14001-P/NP, Rev. 0, Part 2 will be revised to correct typographical error from Section 10.3 to Section 11.3.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical Report APR1400-E-X-NR-14001-P/NP, Rev. 0, Part 2, Section 6.1 will be revised as indicated in the Attachment.

6 DOCUMENTATION

The dynamic qualification documentation shall include all the information stated in Section 6.1 in an auditable form.

6.1 FORMAT OF THE DYNAMIC QUALIFICATION REPORTS

The dynamic qualification reports shall include both information suggested below and in IEEE 344 Section ~~10.3.~~ 11.3 and should present a clear, logical explanation of how the data have been used to achieve qualification.

Title Page

The following information should be shown on the title page:

a. Buyer

b. Supplier and Equipment Name

c. Specification Number

d. Revision Number

e. Date

f. Equipment Tag No.

I – General

This section shall include a description of the equipment, its safety function(s), and the qualification program used to verify the safety function(s). In addition, the following information shall be provided:

a. Project and the Buyer Names

b. Specification and Purchase Order Numbers

c. Equipment Name and Number

d. Organization(s) performing qualification program

e. Similarity analysis showing the similarity between the equipment being qualified and the equipment purchased from Supplier.

II – Data and Assumptions

a. Testing Section

The following data shall be included:

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**81-8000**
SRP Section:	**3.9.3 - ASME CODE CLASS 1, 2, AND 3 COMPONENTS AND COMPONENT SUPPORTS, AND CORE SUPPORT STRUCTURES**
Application Section:	**3.9.3**
Date of RAI Issue:	**07/16/2015**

Question No. 03.10-6

In Table 3.9-6, “Stress Criteria for ASME Section III Class 2 and 3 Inactive Pumps,” in DCD Tier 2 provides a list of stress limits for various plant conditions to be applied to ASME Boiler and Pressure Vessel Code, Section III, Class 2 and 3 “inactive” pumps.

The NRC staff requests that the applicant revise Section 3.9, “Mechanical Systems and Components” in DCD Tier 2 to clarify its definition of “inactive” components and to identify any “inactive pumps” for the APR1400 design in the DCD.

Response

Section 3.9 of the DCD will be revised to include the definition of “inactive” components and to identify “inactive pumps” for the APR1400 design.

An inactive pump is a component that is not an active pump. As indicated in DCD Section 3.9.3.3, active pumps are defined as those pumps that perform a mechanical motion in order to shutdown the plant, maintain the plant in a safe shutdown condition, or mitigate the consequences of a postulated event.

Inactive pumps are those whose operability is not relied upon to perform a safety related function for the various transients and plant conditions. ASME Section III Class 2 and 3 inactive pumps include the charging pumps, auxiliary charging pump, and the boric acid makeup pumps.

Stress limits for inactive pumps and active pumps are shown in Table 3.9-6 and Table 3.9-7, respectively.

Impact on DCD

DCD Section 3.9.3.3.2 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical and Environmental Reports.

3.9.3.3.2 Pump Operability

ASME Class 2 and 3 safety-related active pumps are listed in Table 3.9-18. The following criteria are employed in a qualification program to ensure operability of the pumps required to function during and following design basis events.

a. Analysis, test, or a combination of test and analysis are used in accordance with ASME QME-1-2007 as endorsed by NRC RG 1.100 to confirm the adequacy of the pumps to function over the expected range of service conditions specified, including design basis event and post-design-basis event conditions, as well as inservice testing (IST) conditions.

b. The loads imposed by the attached piping along with the sustained dynamic and seismic loads are taken into account. The design specification includes applicable loading combinations and design stress limits for the pumps. In order to provide reasonable assurance of operability under combined loadings, the stresses resulting from the applied test loads envelop the specified service stress limit for which the pump's operability is intended. Design stress limits applied in evaluating loading combinations are described in Subsection 3.9.3.1.3.

3.9.3.3.3 Valve Operability

Safety-related active valves are listed in Table 3.9-4. ASME Class 1, 2, and 3 valves are designed and analyzed according to the requirements of ASME Section III, subarticles NB/NC/ND-3500.

Inactive pumps are those whose operability is not relied upon to perform a safety related function for the various transients and plant conditions. ASME Section III Class 2 and 3 inactive pumps include: charging pumps, auxiliary charging pump, and boric acid makeup pumps.
Stress limits for inactive pumps and active pumps are shown in Table 3.9−6 and Table 3.9−7, respectively.

ASME QME-1-2007 as endorsed by NRC RG 1.100 to confirm the adequacy of the valves to function over the expected range of service conditions specified, including design basis event and post-design-basis event conditions, as well as IST conditions.