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December 6, 2013

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Perry Buckberg

Docket No. 52-021
MHI Ref: UAP-HF-13284

Subject: MHI's Supplemental Response to US-APWR DCD RAI No. 1034-7055 (SRP 03.11)

Reference: 1) "Request for Additional Information No. 1034-7055, SRP Section 03.11 – Environmental Qualification of Mechanical and Electrical Equipment - Application Section: 3.11", dated May 16, 2013, ML13136A176.
2) "MHI's Response to US-APWR DCD RAI No. 1034-7055 (SRP 03.11)", dated June 13, 2013, ML13175A012.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Supplemental Response to US-APWR DCD RAI No. 1034-7055 (SRP 03.11)."

Enclosed is the supplemental response to Question 3.11-63 contained within Reference 1. The response to the RAI question was submitted in Reference 2 and is being supplemented to address comments from the NRC staff regarding use of the terminology "important to safety."

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Yoshiki Ogata,
Executive Vice President
Mitsubishi Nuclear Energy Systems, Inc.
On behalf of Mitsubishi Heavy Industries, Ltd.

Enclosure:

1. Supplemental Response to US-APWR DCD RAI No. 1034-7055 (SRP 03.11)

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NRO

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Docket No. 52-021
MHI Ref: UAP-HF-13284

Enclosure 1

UAP-HF-13284
Docket No. 52-021

Supplemental Response to US-APWR DCD RAI No. 1034-7055
(SRP 03.11)

December 2013

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 1034-7055**
SRP SECTION:	**03.11 - ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT**
APPLICATION SECTION:	**3.11, APPENDIX 3D**
DATE OF RAI ISSUE:	**05/16/2013**

QUESTION NO. 03.11-63:

In the supplemental response to RAI 805-5915, dated November 1, 2012, the applicant replaced "SSCs important to safety" with "safety-related and specified nonsafety-related SSCs requiring environmental, seismic and functional qualification" in MUAP-08015. The staff understands that the applicant did this in part because there may be important to safety SCCs not required to be in an environmental qualification program. However, the proposed language changes are unacceptable because: (1) the proposed language departs from 10 CFR 50.49,and 10 CFR Part 10, Appendix A (GDC 1, 2, 4, and 23) which uses important to safety in its title and definitions, and (2) the above replaced phrase "specified nonsafety-related," is not in the above cited regulations. The staff finds this phrase in MUAP-08015 does not adequately describe the equipment that is required to be environmentally qualified under 10 CFR 50.49. Therefore, the staff requests that the applicant describe the SSCs in the environmental qualification program consistent with the regulations, e.g. using language in SRP Section 3.11.

ANSWER:

MHI will remove the phrase "safety-related and specified nonsafety-related" from DCD Section 3.11, Appendix 3D, and MUAP 08015 when referring to the scope of equipment addressed by the environmental qualification program. The term "important to safety" will not be added to the environmental qualification equipment scope description because the term does not have a single definition in either in the DCD or in NRC regulatory guidance. Instead, MHI will revise DCD Section 3.11, *Introduction*, to replace the existing description of the environmental qualification program equipment scope with text from Standard Review Plan (SRP) Section 3.11, paragraph I.1, to read as follows:

> Mechanical, electrical, and I&C equipment associated with systems described in this paragraph are included within the scope of this environmental qualification program:

a. Equipment associated with systems that are essential for emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment,
b. Equipment that initiates the above functions automatically,
c. Equipment that is used by the operators to initiate the above functions manually,
d. Equipment whose failure can prevent the satisfactory accomplishment of one or more of the above safety functions,
e. Other electrical equipment important to safety, as described in 10 CFR 50.49(b)(1) and (2), and
f. Certain post-accident monitoring equipment, as described in 10 CFR 50.49(b)(3) and Regulatory Guide 1.97.

Other locations in DCD Section 3.11 and Appendix 3D, and MUAP-08015 that describe the scope of equipment addressed by the environmental qualification program will reference the above discussion in DCD Section 3.11.

Additional text from SRP Section 3.11 will also be added to DCD Section 3.11, *Introduction*, to clarify the program's scope as described below:

- Text added to more clearly define what is meant by "environmental qualification"
- State that compliance with the environmental design provisions of GDC 4 for active mechanical equipment meeting the equipment scope described above and located in a harsh environment is generally achieved by demonstrating that the non-metallic parts/components are suitable for the postulated design basis environmental conditions
- State that for electrical and active mechanical devices located in mild environments, compliance with the environmental design provisions of GDC 4 are generally achieved and demonstrated by proper incorporation of relevant environmental conditions into the design process, including the equipment specification

Impact on DCD

DCD Section 3.11 and Appendix 3D will be revised as shown in the attachment-1.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

MUAP-08015 will be revised as shown in the attachment-2.

SUPPLEMENTAL RESPONSE

This response supplements the response provided in MHI letter UAP-HF-13130, dated June 13, 2013 (ML13175A012). As a result of subsequent discussions with the NRC staff regarding the scope of equipment to be included in the Environmental Qualification (EQ) Program, additional changes will be made to DCD Section 3.11, Appendix 3D, and MUAP-08015. These changes will add the phrase "important to safety" in several paragraphs to emphasize that equipment important to safety required by 10 CFR 50.49(b)(1) and (b)(2) as well as 10CFR50, Appendix A, General Design Criteria 4, is included within the scope of equipment addressed by the EQ program.

Impact on DCD

DCD Section 3.11 and Appendix 3D will be revised as shown in Attachment-1.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

MUAP-08015 will be revised as shown in Attachment-2. In Attachment-2, the sentences that have been modified this time are highlighted for the staff's convenience.

This completes MHI's response to the NRC's question.

3.11 Environmental Qualification of Mechanical and Electrical Equipment

Introduction

This section describes the implementation of the US-APWR environmental qualifications (EQ) program. The US-APWR EQ Program demonstrates and documents compliance with the requirements of 10 CFR 50, Appendix A, General Design Criteria 4, "Environmental and Dynamic Effects Design Bases," (Reference 3.11-1) which requires:

> Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.

Mechanical, electrical, and I&C equipment important to safety associated with systems described in this paragraph are included within the scope of this environmental qualification program: | DCD_03.11-63 S01

a. Equipment associated with systems that are essential for emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment,

b. Equipment that initiates the above functions automatically,

c. Equipment that is used by the operators to initiate the above functions manually,

d. Equipment whose failure can prevent the satisfactory accomplishment of one or more of the above safety functions,

e. Other electrical equipment important to safety, as described in 10 CFR 50.49(b)(1) and (2), and

f. Certain post-accident monitoring equipment, as described in 10 CFR 50.49(b)(3) and Regulatory Guide 1.97.

In this section the term "environmental qualification" means verification of design, limited to demonstrating that mechanical, electrical or I&C equipment are capable of performing their safety function under significant environmental stresses (i.e., harsh environments) resulting from design basis events in order to avoid common-cause failure. Additionally, environmental design requirements apply to all equipment listed above (i.e., both mild and harsh environments).

For active mechanical equipment meeting the equipment scope described above located in a harsh environment, compliance with the environmental design provisions of GDC 4 are generally achieved by demonstrating that the non-metallic parts/components are suitable for the postulated design basis environmental conditions.

For electrical and active mechanical devices located in mild environments, compliance with the environmental design provisions of GDC 4 are generally achieved and

- **Accident Conditions** – An unexpected event occurring during normal operating conditions, which may have potentially harmful effect.

- **Post-Accident Conditions** – The end result of accidental conditions.

These environmental conditions are normally associated with various plant areas by environmental zones or locations. Environmental conditions within these zones are defined as either mild or harsh based on the anticipated most extreme condition anticipated for this zone.

3.11.1 Equipment Location and Environmental Conditions

The US-APWR EQ Program complies with the applicable requirements delineated in RG 1.89 (Reference 3.11-4). However, while NUREG-0588 (Reference 3.11-5) is not directly applicable, this NUREG did provide guidance on classifying equipment based on generic locations (A, B, C, and D). A similar approach is used for the US-APWR EQ Program. These locations are described below.

Equipment Category A Location: Equipment that will experience the environmental conditions associated with a DBA for which it must function to mitigate the accident and that will be qualified to demonstrate operability in the accident environment for the time required for accident mitigation with safety margin to failure (per 10 CFR 50, Appendix E [Reference 3.11-6], and NUREG-0588 [Reference 3.11-5]).

Equipment Category B Location: Equipment that will experience the environmental conditions associated with DBAs through which it need not function for the mitigation of said accidents, and through which it must not fail in a manner detrimental to plant safety or accident mitigation, and that will be qualified to demonstrate the capability to withstand any accident environment for the time during which it must not fail with safety margin to failure.

Equipment Category C Location: Equipment that will experience the environmental condition of DBAs through which it need not function for mitigation of said accidents, and whose failure (in any mode) is deemed not detrimental to plant safety or accident mitigation, and need not be qualified for any accident environment, but will be qualified for its non-accident service environment.

Equipment Category D Location: Equipment that will not experience environmental condition of DBAs and that will be qualified to demonstrate operability under the expected extremes for its non-accident service environment.

3.11.1.1 Equipment Identification

Safety-related systems are identified in Section 3.2. ~~Equipment~~ Equipment important to safety within the scope described in Section 3.11, *Introduction*, that is required to be qualified by the EQ Program is listed in Table 3D-2. The equipment is identified by system, location, type (electrical or mechanical or both), environment, and associated environmental parameters. Appendix 3D provides a brief explanation as to how this equipment was identified and the associated analysis that was performed to establish the required environmental parameters. The COL Applicant is to identify the site-specific

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including digital components, that are located in the immediate proximity of the sensor are also subjected to the same harsh environmental conditions and associated EQ Program qualification process. Electrical equipment located in harsh environments is qualified pursuant to the requirements delineated in IEEE Std 323-1974 (Reference 3.11-8).

Mild Environment

Mild environments are similar to those in a factory or office. A mild environment is one in which conditions are not expected to vary during normal and off-normal conditions, including DBAs. The plant MCR, as well as many equipment rooms, are considered mild environments. Normally, equipment located in mild environments can and is qualified by designating the appropriate environmental parameters in the purchase specifications and receiving certification from the supplier or vendor that this equipment will operate satisfactorily in that environment. Seismic and aging qualification may still require testing or additional analysis.

3.11.1.3 Equipment Operability Times (Term)

Equipment operating times and their bases are shown in Appendix 3D.

3.11.1.4 Standard Review Plan Evaluation

Design Control: The US-APWR EQ Program establishes procedures to assure the proper control during the design process to identify, document, and implement the specific EQ parameters for each piece of ~~equipment~~equipment important to safety within the scope described in Section 3.11, *Introduction*, and designated in Appendix 3D. EQ parameters are established during the detailed design and analysis phase of the US-APWR development (see Figure 3.11-1). The applicable design basis codes and standards, equipment performance requirements, and associated EQ parameters for the equipment and the associated systems and components listed in Table 3D-2 are documented in the corresponding equipment specifications, drawings, procedures, instructions, and qualifications packages consistent with the requirements of 10 CFR 50, Appendix B, Section III (Reference 3.11-7), 10 CFR 50.49(f) and 10 CFR 50.49(j). DCD_03.11-63 S01

The specific normal and transient service conditions are identified in the design process for equipment located both inside and outside of the plant. These service conditions may include temperature extremes, including freezing, as part of the environmental requirements. Special considerations (which include heat tracing, insulation, wind shields, etc.) are addressed in the design process for maintaining system operability for outdoor components including instrument sensing lines (Reference 3.11-9).

3.11.2 Qualification Tests and Analyses

ITAAC is also known as the plant operational program review. An applicant or licensee who references the US-APWR Design Certification rule performs and demonstrates conformance with the ITAAC in conjunction with the licensing process. A number of tests and design verifications are performed in conjunction with the US-APWR EQ Program are summarized in Table 3.11-1. Verification of conformance to the EQ Program objectives includes performance of various construction and startup tests and then after turnover to the licensee, periodic surveillances and inspections. Routine maintenance

- Regulatory Guide 1.151, Instrument Sensing Lines (Reference 3.11-9).
- Regulatory Guide 1.156, Environmental Qualifications of Connection Assemblies for Nuclear Power Plants (Reference 3.11-16).
- Regulatory Guide 1.158, Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants (Reference 3.11-17).
- Regulatory Guide 1.180, Guidelines for Evaluating Electromagnetic and Radio Frequency Interference in Safety-Related Instrumentation and Control Systems (Reference 3.11-10).
- Regulatory Guide 1.183, Alternative Radiological Source Term for Evaluating Design Basis Accidents at Nuclear Power Reactors (Reference 3.11-18).
- Adherence to General Design Criteria 1, 2, 4 and 23 of 10 CFR 50, Appendix A (Reference 3.11-1).
- Quality Assurance in accordance with 10 CFR 50, Appendix B (Reference 3.11-7).
- Regulatory Guide 1.211, Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants (Reference 3.11-21).

3.11.2.2 Environmental Qualification of Mechanical Equipment

A discussion of the EQ of the mechanical equipment is included in Subsection 3.11.2.1 and further elaborated in this sub-section. Active and passive mechanical equipment is qualified as part of the US-APWR EQ Program. Active mechanical equipment qualification is discussed in Subsection 3.9.3 and in Appendix 3D. The EQ program provides for qualification of non-metallic components such as gaskets, O-rings, seals, and lubricants for mechanical equipment important to safety included in Table 3D-2. Non-active mechanical equipment, that is equipment whose primary safety function is structural integrity (support or pressure boundary), is qualified pursuant to the requirements of ASME Boiler and Pressure Vessel Code, Section III. In addition, certain mechanical structures are qualified in conjunction with plant startup testing (e.g., the reactor containment structure is qualified, in part, by the performance of various construction tests [e.g., weld certifications] and the performance of the containment ILRT). DCD_03.11-63 S01

3.11.3 Qualification Test Results

Environmental qualification of the equipment listed in Table 3D-2 may rely on testing in conjunction with the verification process. Where the qualification process involves testing, the various tests are conducted following written test procedures in compliance with the requirements of 10 CFR 50, Appendix B, Criterion XI, Test Control (Reference 3.11-7) and 10 CFR 50.49(f). These tests may apply to aging, seismic, radiation, or environmental qualification parameters.

3D Equipment Qualification of Electrical and Mechanical Equipment

3D.1 Introduction

This Appendix describes the mechanical and electrical equipment that is qualified for service in the US-APWR in accordance with the requirements delineated in the US-APWR equipment qualification program that includes the Environmental Qualification (EQ) Program as described in Section 3.11.

3D.1.1 Equipment Identification

Equipment addressed by the equipment qualification program includes:

- Equipment qualified by the EQ Program described in Section 3.11
- Active mechanical components required to be functionally qualified as described in Sections 3.9.3 and 3.9.6
- Mechanical and electrical equipment with special seismic qualification requirements such as seismic categories I and II described in Section 3.10.

Table 3D-2 lists the equipment important to safety within the scope described in Section 3.11, *Introduction*, that is required to be qualified under the EQ Program. Active mechanical components including snubbers are identified in Section 3.9.6 and Tables 3.9-13 and 3.9-14. Equipment with special seismic qualification requirements are identified in Table 3.2-2 for mechanical equipment and Tables 3D-2 and 3D-4 for electrical equipment. DCD_03.11-63 S01

Equipment is identified by system code and component type. Safety-related systems are described in Section 3.2. Safety-related components and systems are relied upon to mitigate the consequences of a design basis accident (DBA). A safety function is an action relied upon during and following a design basis event to provide for:

- Integrity of the reactor coolant system
- The capability to shut down and maintain the reactor in a safe-shutdown conditions
- The capability to prevent or mitigate the consequences of an accident that could result in the potential for offsite exposure pursuant to the requirements delineated in 10 Code of Federal Regulations (CFR) 100.

Safety-related components and systems are selected in accordance with the above definition.

3D.1.2 Describe Tag ID Codes and Systems

Equipment is identified by system code and component type. For safety-related systems, there are normally four separate, independent trains or similar components.

Structures, Systems and Components (SSCs) – terminology used to reflect that the items used to construct the US-APWR can be evaluated as portions of a structure (building), a system (e.g. feed water), or as individual components. ~~SSCs may be important to safety or non-Safety-Related.~~ DCD_03.11-41

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Structures, Systems and Components (SSCs) That Require Environmental, Seismic or Functional Qualification (or Equipment Qualification) ~~Safety-related and specified nonsafety-related~~ SSCs that meet one or more of the following criteria: DCD_03.11-64

- Equipment important to safety within the scope described in DCD Section 3.11, *Introduction*, that is qualified by the Environmental Qualification Program ~~described in US-APWR DCD Section 3.11 Electric equipment required by 10 CFR 50.49~~ DCD_03.11-63 S01

~~Safety-related mechanical equipment that includes non-metallic components~~ DCD_03.11-63

- Mechanical and electric equipment with special seismic qualification requirements such as seismic categories I and II
- Active mechanical components required to be functionally qualified

Operating Basis Earthquake (OBE) – The vibratory seismic motion associated with the plant shutdown and inspection during normal operation of the nuclear plant.

Procurement Phase – The period of time (usually years) in which the components and materials used to construct the US-APWR for a specific project are ordered and delivered to the project site. The Procurement Phase of a Project is normally initiated following detailed project design phases and some procurement will continue through the early Operational Phase as various items are delivered to the project site.

Safe Shutdown Earthquake (SSE) – The vibratory seismic motion (greater than the OBE) for which certain SSCs in a plant are designed to remain functional as specified by safety analysis of plant.

System – A system consists of all components and related equipment needed to fulfill a task or action that is built into a US-APWR (e.g., feed water system, safety injection system). ~~Systems may be important to safety or non Safety-Related. Important to safety systems are relied upon to mitigate the consequences of a DBA.~~ DCD_03.11-41

Test Phase – As used in this report, the test phase of a project encompasses both construction, pre-operational (including Containment Integrated Leak Rate Testing and Plant Hot Functional Testing) and power ascension testing. These tests are sequenced so as to 1) verify SSCs are properly constructed (construction tests), SSCs will operate as designed (preoperational tests), and the plant as a whole will operate as designed (power ascension testing). Construction and Pre-operational testing occur prior to fuel load, power ascension testing occurs after fuel load (low power operational license obtained). Some of these tests are used to verify certain aspects of a SSC's equipment qualification requirements are acceptable.

Turnover phase – A time period when construction/installation is complete and associated SSCs are ready for functional testing and subsequent turnover to the Licensee (U.S. Utility).

2.0 SCOPE

This technical report describes the US-APWR Equipment Qualification ProgramEQP. The Equipment Qualification Program EQP is presented and discussed in the US-APWR Design Control Document (DCD). The equipment qualification (EQ) process is required for the life of the facility (i.e., ~60 years). However, the US-APWR Equipment Qualification Program EQP covered by this Technical Report only addresses the period from plant licensing (Combined License [COL]) submittal for a project through the point the Operating License (OL) is received. Figure 2.1 illustrates the various phases for EQ equipment qualification and the US-APWR Equipment Qualification ProgramEQP. The roles and responsibilities for an Equipment Qualification ProgramEQP change, depending on the phase of a project being considered. At the DCD phase, Mitsubishi Heavy Industries, Ltd. (MHI) is responsible for establishing a generic Equipment Qualification ProgramEQP. The Equipment Qualification ProgramEQP addresses:

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- Equipment important to safety within the scope described in DCD Section 3.11, *Introduction*, that is qualified by the Environmental Qualification Program described in US-APWR DCD Section 3.11Electric equipment required by 10 CFR 50.49
- Safety-related mechanical equipment that includes non-metallic components
- Active mechanical components required to be functionally qualified
- Mechanical and electrical equipment with special seismic qualification requirements such as seismic categories I and II

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- Mechanical, Electrical and I&C equipment important to safety, and
- Seismic qualification of important to safety equipment.

Plant piping systems are analyzed under ASME requirements and are, therefore, not directly covered by the EQP Equipment Qualification Program (active components such as valves in these piping systems are covered by the EQPEquipment Qualification Program).

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MHI is represented in the U.S. by Mitsubishi Nuclear Energy Systems (MNES). MNES is the primary interface between U.S. utilities, the NRC and MHI. The Equipment Qualification Program EQP has been formulated under the basic assumption that MHI/MNES will be contracted to deliver a US-APWR to a U.S. utility (MHI is the reactor vendor pursuant to 10 CFR 52). Under this arrangement, MHI/MNES will most likely contract with a qualified Architect/Engineer (A/E) and others (equipment suppliers) to deliver the plant to a U.S. utility. MHI/MNES is responsible for establishing the contractual relationships between the organizations supporting the delivery of a US-APWR. These contractual relationships, with designated roles and responsibilities, are collectively referred to as the Project Organization. The Project EQP Equipment Qualification Program (PEQP) is a project-specific EQPEquipment Qualification Program. MHI/MNES is responsible for establishing a project EQequipment qualification organization (PEQO) within the Project Organization to implement the PEQP. The PEQO is responsible for preparing Project EQ equipment qualification Implementing Procedure(s) following the guidance given in the US-APWR EQPEquipment Qualification Program. These procedures shall be prepared, reviewed, and approved pursuant to the project Quality Assurance Program (QAP) requirements.

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For each US-APWR project contracted for delivery to a U.S. utility, the PEQP shall be established in such a way that it applies to all project activities, including those associated with the design, procurement, construction, testing, turnover and operational phases of the project.

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3.0 REGULATORY STATUTES, REGULATORY GUIDES, INDUSTRY CODES and STANDARDS APPLICABLE TO EQUIPMENT QUALIFICATION

The regulatory basis for the US-APWR Equipment Qualification Program~~EQP~~ is briefly described in Section 1.0 of this Technical Report. This section expands on the initial regulatory basis and identifies additional guidance documents applicable to the implementation of the Equipment Qualification Program~~EQP~~. The requirements and guidance provided in these documents form the basis for the ~~EQ~~equipment qualification ~~P~~procedures for the US-APWR Equipment Qualification Program~~EQP~~ as described in the DCD. DCD_03.11-68 DCD_03.11-68

This section first identifies the major applicable federal statutes and the associated guidance documents (RGs). RGs are issued by the NRC as guidance to addressing regulatory requirements. RGs usually endorse one or more industry codes and standards. For ~~EQ~~equipment qualification, these are, for the most part, issued by the Institute of Electrical and Electronic Engineers (IEEE) and the American Society of Mechanical Engineers (ASME). Finally, industry groups such as the Electric Power Research Institute (EPRI), Nuclear Procurement Issues Committee (NUPIC) and Nuclear Industry Assessment Committee (NIAC) provide additional guidance and direction to various elements of an effective Equipment Qualification Program~~EQP~~. DCD_03.11-68 DCD_03.11-68

Attachment A summarizes identified regulations, codes, standards and industry documents applicable to the US-APWR Equipment Qualification Program~~EQP~~. This section discusses the major statutory (10 CFR), regulatory (RGs), standards (industry, e.g., IEEE) and other documents that form the foundation for the US-APWR Equipment Qualification Program~~EQP~~. There are additional RGs, industry codes and standards applicable to certain elements of the Equipment Qualification Program~~EQP~~ that are not listed in this section but are listed in the References section (Section 13.0) of this Technical Report. DCD_03.11-68 DCD_03.11-68 DCD_03.11-68

3.1 Code of Federal Regulations and General Design Criteria

The design, construction and operation of a power reactor are governed by general requirements, or design criteria, by which each type of power reactor must comply. These general requirements assure that, regardless of reactor type, adherence to the principles of these criteria will result in a facility that minimizes the risk to workers and the public. These regulations are invoked in Title 10, Energy in the Code of Federal Regulations (CFR), Parts 34, 50 and 52, and particularly in 10 CFR 50, Appendix A. Adherence to the General Design Criteria (GDC) contained in Appendix A is a condition of licensure and is, in part, the basis for the need for an Equipment Qualification Program~~EQP~~. As such, the GDCs form the basis for standards promulgated by IEEE and ASME pertaining to the equipment qualification~~EQ~~. The applicable GDCs, along with a brief explanation, are listed below. DCD_03.11-68

3.1.1 10 CFR 50.49 Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants

This is the key statute regarding equipment qualification~~EQ~~ for ~~important to safety~~ electrical equipment. It should be noted that this statute defines which equipment needs to be qualified and the specifications to which it needs to be qualified. 10 CFR 50.49 requirements are clarified in RG 1.89 and together they reference IEEE Std 323 as an acceptable methodology to follow in qualifying electrical equipment. In 10 CFR 50.49 and IEEE Std 323, a distinction is made between Harsh and Mild environments. In general ~~SSCs~~, equipment important to safety within the scope described in DCD Section 3.11, *Introduction*, located in harsh environments DCD_03.11-41 DCD_03.11-68 DCD_03.11-63 S01

4.0 Euipment Qualification EVALUATION PARAMETERS

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Section 3.0 of this Technical Report identified the applicable statutory, regulatory, industry codes and standards that provide the guidance needed for the US-APWR equipment qualification process. In this section, the parameters that are applied to the qualification process are discussed. The US-APWR equipment qualificationEQ process is based on dividing plant environments into harsh or mild categories and then determining, by analysis, what the expected environmental parameters are for each location. For example, inside containment is considered a harsh environment because during a design basis accident, containment temperatures and pressures can exceed normal ambient conditions. The expected environmental parameters, determined by analysis, applicable to each safety-related and important to safety SSC requiring environmental qualification important to safety within the scope described in DCD Section 3.11, *Introduction*, are shown in the US-APWR DCD and applicable COLA. The evaluation process requires that the SSC location be determined, then the applicable equipment qualification EQ conditions identified as the basis for qualification.

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4.1 Definition of Plant Location by Type of Environment

4.1.1 Mild Environment

A mild environment is one that would, at no time, be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences. From IEEE 100, *The Authoritative Dictionary of IEEE Standard Terms*, the definition is: An environment expected as a result of normal service conditions and extremes (abnormal) in service conditions where seismic is the only design basis accident (DBA) of consequence. IEEE 100 also provides definitions for qualified life and other terms applicable to the Equipment Qualification ProgramEQP. Typically a mild environment conforms with the environmental parameter limits of Table 4-1.

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Mild environments can have exposure to radiation levels during normal operation. SystemsEquipment requiring environmental qualificationimportant to safetyimportant to safety within the scope described in DCD Section 3.11, *Introduction*, but not in the containment or other location where they could see the harsh environmental condition described below, would fall into the mild category. These important to safety systemsequipment would be evaluated for accident conditions to assure the mild category still applies. Refer to RG 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants" for guidance for safety-related computer-based I&C system on this situation. Mild areas are further defined in the US-APWR DCD.

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For electrical and mechanical equipment located in a mild environment, acceptable environmental design can be demonstrated by the "design/purchase" specification process for the equipment. The "design/purchase" specification contains a description of the functional requirements for a specific environmental zone during normal environmental conditions and anticipated operational occurrences. The maintenance/surveillance program, in conjunction with the preventive maintenance program, provides assurance that equipment meeting the design/purchase specifications is qualified for the designed life of the component. Compliance by the Licensee (owner) with 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," and associated guidance in RG 1.160 are considered sufficient to provide reasonable assurance that environmental considerations established during design are reviewed every refueling outage and maintained on a continuing basis to

ensure that the qualified design life has not been reduced by thermal, radiation, and/or cyclic degradation resulting from unanticipated operational occurrences or service conditions.
The environmental design and qualification status of components in both mild and harsh environments are to be maintained by the Licensee Operating Equipment Qualification Program as described in Section 11.0. DCD_03.11-49, 54

4.1.2 Harsh Environment

A harsh environment is expected as a result of the postulated service conditions appropriate for the design basis and post-design basis accidents of the station. (A design basis accident is that subset of a design basis accident which requires safety function performance). Harsh environments are the result of a loss-of-coolant accident (LOCA)/high energy line break (HELB) inside containment and post-LOCA or HELB outside containment (this definition from IEEE, *The Authoritative Dictionary of IEEE 100 Standard Terms*).

These special conditions can cause the local environment for the equipment requiring environmental qualification ~~important to safety~~ to be harsh in one or more parameters. These special conditions can result from a DBA, main steam line break (MSLB), main feedwater line break (MFLB), or other HELB. High radiation areas outside of the containment are also in a harsh environment. DCD_03.11-41

Equipment that must withstand the environmental conditions that would exist before, during, and following a DBA is qualified for use in harsh environments. A DBA, such as LOCA could subject this equipment to elevated pressures, temperatures, humidity, radiation, and chemical effects (including post accident pH control). This equipment must operate without a loss of its safety function, for the time required to perform its engineered safeguards function(s). These environmental conditions for which the equipment is qualified include applicable time dependent temperature and pressure profiles, humidity, chemical effects, radiation, aging, submergence, and those synergistic effects that have a significant effect on the equipment performance. Equipment identified as being qualified for harsh environment includes the following:

a. Equipment located within containment
b. Equipment subject to HELBs (e.g., MSLB) both inside and outside of containment
c. Other SSCs that connect, support, tie into, or that can influence the equipment listed in "a" and "b" above.

4.2 Equipment Qualification Evaluation Parameters

DCD_03.11-68

~~Important to Safety and Safety-Related Certain SSCs which includes electric equipment described in US-APWR DCD Section 3.11~~10 CFR 50.49, are Equipment important to safety within the scope described in DCD Section 3.11, *Introduction*, is required to be qualified by verifying that the appropriate environmental parameters be identified and used in the evaluation process. The main parameters are identified in 10 CFR 50.49, IEEE 323 and IEEE 344. They include, in addition to location discussed in section 4.1, the following: DCD_03.11-41 DCD_03.11-63 S01 DCD_03.11-63

- Aging
- Operating Time