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TOKYO, JAPAN

March 23, 2012

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

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-12075

Subject: **MHI's Response to US-APWR DCD RAI No. 880-6142 Revision 0 (SRP 03.11)**

Reference: 1) "Request for Additional Information No. 880-6142 Revision 0, SRP Section 03.11 – Environmental Qualification of Mechanical and Electrical Equipment - Application Section: 3.11", dated December 21, 2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 880-6142 Revision 0."

Enclosed are responses to questions contained within Reference 1.
The enclosure does not contain the response to question 03.11-43. The response to this question will be submitted separately.

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,

Y. Ogata

Yoshiki Ogata,
Director- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Response to Request for Additional Information No. 880-6142 Revision 0

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NRO

CC: J. A. Ciocco
J. Tapia

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Enclosure 1

UAP-HF-12075
Docket No. 52-021

Response to Request for Additional Information No. 880-6142
Revision 0

March 2012

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 880-6142 REVISION 0**
SRP SECTION:	**03.11 – Environmental Qualification of Mechanical and Electrical Equipment**
APPLICATION SECTION:	**3.11**
DATE OF RAI ISSUE:	**12/21/2012**

QUESTION NO. RAI 03.11-42:

Identify the information that will be contained in the environmental qualification (EQ) data package reports. 10 CFR 50.49(j) requires that a record of EQ qualification documentation be maintained in an auditable form for the entire period while the equipment is installed in the nuclear power plant. Technical Report MUAP-08015, Section 9.9 (EQ Data Package or Data Sheets), under "Equipment Qualification Program," refers to US-APWR EQ Programs Pros-07, 09, and 16 and indicated that the EQ data for each Structure System and Component (SSC) will be compiled and organized for easy access by the licensee and other users. The staff needs to review whether the applicant's EQ documentation contains sufficient information that ensures the electrical and I&C equipment important to safety can withstand a harsh environmental condition and this information will be used to evaluate ITAAC. Provide the information that will be contained in the EQ Data Packages.

Sample EQ data package may contain the following information:

1. Positive statement by the applicant that the equipment is qualified for its application.
2. Full description of the equipment.
3. If qualification sample is not identical to the installed devices; a similarity analysis has been provided.
4. Allowed mounting methods and orientations.
5. Interfaces - conduit, housing, seal, etc.
6. A qualified life has been established based on accelerated aging - thermal, radiation, cyclic, as appropriate.
7. All type tests performed on the same test specimen.
8. Performance/acceptance criteria (operating time, transmitter accuracy to component).
9. Test sequence conforms to IEEE 323-1974 or justification for non-conformance has been provided.
10. Radiation dose covers accident and normal service.
11. Design basis event exposure simulation meets plant requirements.
12. Chemical or water spray simulation performed. (when required)
13. Accident environment margins.
14. Submergence test (if required).
15. Test anomalies resolved.
16. Applicable Information Notices resolved.

17. Maintenance/Surveillance Criteria
18. References clearly identified and attached or retrievable (including identification of plant equipment).

ANSWER:

Documentation pertinent to the qualification of mechanical and electrical equipment that is qualified under the US-APWR Equipment Qualification Program (EQP) is maintained for several purposes. The purpose of the EQP is to qualify SSCs, both seismically and environmentally for use in a US-APWR. Performance of the EQP results in the production of a set of auditable qualification records prior to fuel load (EQ Data Packages). Another result or purpose of the performance of the EQP is to create a master equipment list to be used by the COL holder to support the Operational Equipment Qualification Program. A third purpose is to maintain a set of qualification records that may be adopted for use on other US-APWR projects. The EQP is described in Technical Report (TR) MUAP-08015, "US-APWR Equipment Qualification Program."

Implementation of the EQP on a specific project relies on generic and project specific procedures. The records will be maintained in an electronic database(s) to facilitate their utilization. For example, this database may allow access to pertinent information on a specific component (envision a input/output screen(s) for Item Description, EQ Information, Installation Information, Maintenance Information, Inservice Inspection (ISI) Information, Surveillances, Calibrations and Testing, etc.). It is not possible to fully identify each and every item that may be contained in an EQ Data Package and/or this database as specific projects may necessitate different items. However, it is possible to provide general information on the likely contents of these qualification records. The type and amount of information that is stored to accurately track and maintain structures, systems and components (SSCs) during the design, procurement, construction, testing, and initial operation of a US-APWR is significant. Much of this information may or may not be germane to the EQ process but it may well be comingled (electronically) in many cases to facilitate the completion of the project and to facilitate plant operations. EQ records will contain the following 18 pieces of information:

1. Positive statement by the applicant that the equipment is qualified for its application.
2. Full description of the equipment.
3. If qualification sample is not identical to the installed devices; a similarity analysis has been provided.
4. Allowed mounting methods and orientations.
5. Interfaces - conduit, housing, seal, etc.
6. A qualified life has been established based on accelerated aging - thermal, radiation, cyclic, as appropriate.
7. All type tests performed on the same test specimen.
8. Performance/acceptance criteria (operating time, transmitter accuracy to component).
9. Test sequence conforms to IEEE 323-1974 or justification for non-conformance has been provided.
10. Radiation dose covers accident and normal service.
11. Design basis event exposure simulation meets plant requirements.
12. Chemical or water spray simulation performed. (when required)
13. Accident environment margins.
14. Submergence test (if required).
15. Test anomalies resolved.
16. Applicable Information Notices resolved.

17. Maintenance/Surveillance Criteria
18. References clearly identified and attached or retrievable (including identification of plant equipment).

The following example provides information in a typical EQ Data Package:

Typical EQ Data Package (Record)
note that many items may not apply or other items will apply depending on the type of SSC

Summary Sheet (Per Item)*

- Stating SSC is qualified for its application
- Key summary items

Description of the SSC*:

- Plant Tag No.
- Item Name
- System Code
- Safety (Equipment) Classification
- Seismic Classification (i.e., Seismic Category)
- Reference Drawings / P&ID
- Description (material, size, weight, mounting requirements, access requirements, inspection requirements, calibration requirements, maintenance requirements, etc.)
- Serial Number
- Model Number
- Manufacturing Lot
- Manufacturing Date
- Number of similar items (tag numbers)
- Number of Spares on hand
- Vendor literature (drawings, manuals, spare parts lists, etc.)
- Manufacturer / Supplier name, address, contact information, quality reference (approved supplier list reference)
- 10 CFR 50.59 Safety Evaluation, if required
- Vendor QA Program Information (verification of suppliers QA program. Deviation reports, CG Survey Reports, Special Tests and Inspection Reports.)

Installation Information*:

- Purchase Order Number
- Applicable Purchase Specification title and number
- Date Ordered
- Factory Audit / Inspection Report(s)
- Date Delivered
- Date Receipt Inspection
- Receipt Inspection Report Number
- Receipt inspection disposition (pass/fail/rework)
- Ready for installation, y / n

- Where stored prior to installation
- Storage maintenance requirements (environment, service requirements)
- Storage maintenance dates - records
- Date installed
- Installation records
- Installation inspection report number(s)
- Expendables

EQ Requirements*:

- Plant installation location (e.g., Room No., building, area)
- Environment Classification: Harsh /mild / other
- Maximum / minimum and normal and accident (i.e., EQ) values:
  - temperature, humidity, pressure, radiation, submergence, spray, chemical, RFI / EMI, etc.
- Post Accident Operating Time Requirement
- Seismic acceleration (SSE/OBE)
- Aging
- Margin
- Vendor / manufacturer notices
- Source documents EQ values
- Shelf Life

EQ Qualification*:

- Test / analysis / specification/ description/other
- Test Agency/ Facility/Organization
- Agency on approved list

QA Information/Documentation/Applicable Information

- Third Party of subdivision test and inspection reports
- Identification of Critical Characteristics
- Verification methods and acceptance criteria for critical characteristics
- Statements of Certificates of conformance documents.

Test Types*

- Commercial Grade Dedication information, if appropriate
- Test Parameters
- Test Results, test results reviewed by, test results approved by
- EQ file or test report reviewed by
- EQ file or test report approved by

Master EQ List*:

- SSC Tag No.

- Location
- EQ Parameters or Test Values
- Vendor information
- Qualification information

Maintenance Information*:

- TBD* - operations and initial test program

ISI Information*:

- TBD* - operations and initial test program

Surveillances*:

- TBD - operations and initial test program

Calibrations and Testing*:

- TBD – operations and initial test program

TBD -To be determined, these sections included only to illustrate that the electronic SSC database subsequent to installation of the component will contain other information not necessarily just EQ information. This information applies to the initial test program as well as operations. The licensee may or may not elect to maintain this information in this format after turnover/acceptance by the COL Licensee.

* Note: This is a partial or example list only for each category and is not necessarily an all inclusive list.

In summary, the EQ Data Packages will contain complete information to demonstrate that a SSC has been qualified both environmentally and seismically pursuant to regulatory requirements. The structure of the EQ organization described in TR MUAP-08015 includes representatives from all the major project participants to help ensure the process is satisfactorily executed and the resultant assembled records comply with the identified requirements.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on the Technical/Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 880-6142 REVISION 0**
SRP SECTION:	**03.11 – Environmental Qualification of Mechanical and Electrical Equipment**
APPLICATION SECTION:	**3.11**
DATE OF RAI ISSUE:	**12/21/2012**

QUESTION NO. RAI 03.11-44:

10 CFR 50.49(e)(8) requires margins must be applied to account for uncertainty. Table 4-2, "US-APWR EQP Margin Values," of Technical Report MUAP-08015 lists (+/-) 10%. margin for voltage and frequency parameters. In Section 6.3.1.5, "Margin" of IEEE Std. 323-1974 lists voltage (10%) and frequency (5%). Correct the frequency value, or provide justification for using 10% for the frequency margin.

ANSWER:

The Frequency line entry in Technical Report MUAP-08015, Revision 1, Table 4-2 will be revised to conform with IEEE Standard 323-1974, as shown below:

Condition	Parameter	Required Margin	Notes
ABNORMAL:			
	Voltage	± 10%	Simulated during temperature/humidity test
	Frequency	± 5%	Simulated during temperature/humidity test

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

The Technical/Topical Report will be revised as shown on the Attachment-1 markup.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 880-6142 REVISION 0**
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QUESTION NO. RAI 03.11-45:

Clarify the electromagnetic interference and radio-frequency interference (EMI/RFI) qualification of electrical and instrumentation and control (I&C) equipment.

10 CFR Part 50, Appendix A, General Design Criteria 4, requires SSCs important to safety to be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. RG 1.209, "Guidelines for Environmental Qualification of Safety related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants," includes testing for EMI/RFI compatibility. Section 4.2.10.1 of Technical Report MUAP-08015 discusses the onsite testing of EMI/RFI for its ITAAC requirement in respective locations. However, Section 10.3.1(page 94) of the Technical Report MUAP-08015 states that "Electrical and I&C equipment located in a mild environment are specified to meet the temperature conditions of their respective as-built locations." It implies that equipment in a mild environment should only need to satisfy temperature conditions. Provide the justification or revise the referenced statement, if necessary.

ANSWER:

The EMI/RFI qualification is applied to I&C equipment in accordance with RG 1.180 and RG 1.209. The environmental qualification includes the EMI/RFI qualification.
Onsite testing for the EMI/RFI qualification is not planned for EMI/RFI qualification. The EMI/RFI qualification is confirmed by a type test or a combination of type test and analysis as described in the DCD Tier 1 Table 2.5.1-6 #7, and these tests and analyses are performed in compliance with RG 1.180.

Also, there are no known synergistic effects with the EMI/RFI to have a significant effect on equipment performance as described in 10 CFR 50.49. RG 1.180 has not identified a requirement of synergistic effects on the EMI/RFI.

Sections 4.2.10.1 and 10.3.1 of Technical Report MUAP-08015, Rev. 1 will be revised to clarify above description.

MUAP-08015 Subsection 10.3.1 will be revised as follows:

> Electrical and I&C equipment located in a mild environment are specified to meet the ~~temperature~~ environmental and seismic conditions of their respective as-built locations. ~~ITAAC verifies the HVAC systems' ability to maintain area temperature limits within design conditions.~~

MUAP-08015, Subsection 4.2.10.1 will be revised as follows, and moved to new Subsection 4.2.14:

> ~~The EQ process involves detailed testing during the procurement, construction, and startup phases. During construction, as electrical equipment is installed and tested, synergistic effects are to be evaluated to verify that these effects do not adversely impact the qualification of the electrical equipment. An example of this testing is the onsite testing for electromagnetic and radio frequency interference. This~~ The EMI/RFI qualification is specified to ~~testing will~~ comply with the guidance provided in RG 1.180, "Guidelines for Evaluating Electromagnetic and Radio Frequency Interference in Safety-related Instrument and Control Systems." ~~These various tests augment the EQ process and assist in meeting the intent of evaluating synergistic effects that could have an adverse impact on safety and important to safety equipment.~~

Accordingly, MUAP-08015, Section 4.2 will be changed as follows:

- Aging
- Operating Time
- Temperature
- Pressure
- Humidity
- Chemical Effects
- Vibration
- Radiation
- Submergence
- Synergistic Effects ~~and EMI/RFI~~
- Seismic
- Margins
- Other Parameters
- EMI/RFI

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

The Technical/Topical Report will be revised as shown on the Attachment 1 mark-up.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

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QUESTION NO. RAI 03.11-46:

SECY-05-197 directed implementation of operational programs in FSAR Section 13.4 for Environmental Qualification Program for 10 CFR 50.49(a). Section 11.0 (page 97) of Technical Report MUAP-08015 refers as equipment qualification operating program, not operational program. If this is true, this should be corrected throughout the report.

ANSWER:

The Operational Equipment Qualification Program (OEQP) is a program implemented by the COL holder (plant licensee) [COL Items 3.11(1), 3.11(2), 3.11(3)] and as such describes the requirement for development of an operational equipment qualification program (OEQP). Technical Report (TR) MUAP-08015 describes the initial Equipment Qualification Program (EQP) used during the design, procurement, construction, testing and initial startup of the US-APWR. The EQP described in TR MUAP-08015 is the EQP required for the US-APWR vendor (design certificate holder). The EQP becomes the basis for the long term OEQP, which is used to operate and maintain the plant SSCs, including their qualification bases for the plant design life. This distinction is described in TR MUAP-08015 in Chapters 10 and 11. For clarification, the "operating" terminology will be revised, as appropriate, to be consistent with the term "operational" during the next revision of MUAP-08015.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

The Technical Report will be revised as shown on the Attachment 1 mark-up.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 880-6142 REVISION 0**
SRP SECTION:	**03.11 – Environmental Qualification of Mechanical and Electrical Equipment**
APPLICATION SECTION:	**3.11**
DATE OF RAI ISSUE:	**12/21/2012**

QUESTION NO. RAI 03.11-47:

10 CFR 50.49(f) requires specific electrical equipment to be qualified. Page 139 of Technical Report MUAP-08015 mentioned type testings in EQ program procedures (Pro- 18 and Pro-19) that references IEEE Std, 323-1974, Clause 5.1.1. The reference should be corrected to IEEE Std, 323-1974, Clause 5.1, as the standard does not have Clause 5.1.1.

ANSWER:

The sentence in Technical Report MUAP-08015 that pertains to type testing in EQ program procedures Pro-18 and Pro-19 is revised to read:

"Type testing as described in IEEE Std 323-1974, Clause 5.1 is one of the acceptable methods for qualifying equipment important to safety for a US-APWR project. "

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

The Technical Report will be revised as shown on the Attachment 1 mark-up.

This completes MHI's responses to the NRC's questions.

Operational

OPERATIONAL

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11-46

DCD_03.
11-46

MSLB	Main Steam Line Break
NEMA	National Electrical Manufacturers Association
NIAC	Nuclear Industry Assessment Committee
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NUPIC	Nuclear Procurement Issues Committee
OBE	Operational Basis Earthquake
OEQP	~~Operating~~ Equipment Qualification Program
OL	Operating License (a portion of a Construction and Operating License COL)
PCCV	Pre-stressed Concrete Containment Vessel
PEQO	Project Equipment Qualification Organization
PEQP	Project Equipment Qualification Program
PS/BS	East/West Power Source Buildings
QA	Quality Assurance
QAP	Quality Assurance Program
R/B	Reactor Building
RCS	Reactor Coolant System
RFI	Radio Frequency Interface
RG	Regulatory Guide
RRS	Required Response Spectra
SQUG	Seismic Qualification Utility Group
SRP	Standard Review Plan
SRSS	Square Root Sum of the square
SSC	Structures, Systems and Components
SSE	Safe Shutdown Earthquake
T/B	Turbine Building
TID	Technical Information Document or Total Integrated Dose
TMI	Three Mile Island
TRS	Test Response Spectra

Operational

DCD_03.
11-46

2.0 SCOPE

This technical report describes the US-APWR EQP. The 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 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 and the US-APWR EQP. The roles and responsibilities for an EQP 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 EQP. EQ addresses:

- 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 (active components such as valves in these piping systems are covered by the EQP).

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 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 (PEQP) is a project-specific EQP. MHI/MNES is responsible for establishing a project EQ organization (PEQO) within the Project Organization to implement the PEQP. The PEQO is responsible for preparing Project EQ Implementing Procedure(s) following the guidance given in the US-APWR EQP. These procedures shall be prepared, reviewed, and approved pursuant to the project Quality Assurance Program (QAP) requirements.

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. At the completion of the EQP, EQ records will be turned over to the utility as the basis for the utility's ~~operating~~ Operational EQP. The Scope of this Technical Report is to provide a description of: DCD_03.11-46

1. The basis for EQ
2. The US-APWR positions relative to the applicable governing rules, regulations, standards and industry practices
3. The US-APWR EQP directives and procedures
4. EQ Parameters for a generic plant
5. The EQP generic policies and procedures (that implement a PEQP).
6. The EQP implementation requirements for a specific project
7. Application of the EQP to the design, procurement, construction, testing, turnover and operational phases of a project.

8. Turnover of the EQP/records to the operating utility
9. A description of the EQ process including both environmental and seismic programs.
10. A brief discussion of the implementation of EQ by the operating utility in support of the 60 year design life.

2.1 EQ Program Technical Report Layout

Sections 1.0 and 2.0 of this Report provide the basis for the formal adaptation of an EQP. Section 3.0 describes the applicable statutory (Title 10, Energy Code of Federal Regulation) requirements, the regulatory guidance (RGs and NUREGS), industry codes and standards, and industry practices applicable to the US-APWR EQP. Section 4.0 describes the Qualification Criteria for mild and harsh environment definitions, aging, operability time, performance criterion, margin, treatment of failures and traceability. Section 5.0 discusses the normal, abnormal and DBA conditions. Section 6.0 describes the EQ Methods including type test, analysis, operating experience, on-going qualification and combination of methods. Section 7 describes the EQ process. Section 8 describes the generic MHI US-APWR EQP. Section 9 describes implementation of the EQP from the licensing phase through turnover to the Utility (licensee) for a specific project. Section 10 describes the process for turning the Project EQ Program over to the Utility (licensee) for a specific project and becoming the ~~Operating~~ EQ Program. Section 11 briefly describes the content and scope of the licensee's EQP and Section 11 provides a Summary of the MHI US-APWR EQP. DCD_03. 11-46

Operational

Figure 2-1 illustrates the scope of a project-specific EQP. Projects can be divided into phases, and although the distinctions between these phases are in practice not sharp, from a planning or management perspective, they are unique. The DCD process licenses a standardized US-APWR, including the generic EQP. When a plant is sold, an application is normally submitted for a COL that covers the time period associated with site-specific design, procurement, construction and startup phases of the project. Site design phase in COL also includes development of site-specific environmental data that is used to verify the standard design, and evaluate site-specific portions of the plant, including input design parameters for EQ. Prior to and during the initial power ascension testing, the COL transitions to a full Operating License (OL). The PEQP covers the time period and phases associated with the COL up to the point when a full OL is authorized. At the point that the plant is complete, and the project transitions to the owner and the PEQP transitions to the owner's (plant licensee's) EQP. The licensee's EQP is an ~~operating~~ program primarily designed to assure qualified replacement parts are used during the life of the plant. The PEQP is a design, procure, construct and test EQP. Thus, for each US-APWR, there are three applicable and distinct EQPs. They are: DCD_03. 11-46

Operational

1. **Generic Equipment Qualification Program (EQP):** The program that provides the foundation for the project-specific EQP. This program and the associated commitments to the NRC are addressed in the DCD and in this Technical Report .
2. **Project Equipment Qualification Program (PEQP):** An EQP that is implemented under, and governed by, the MHI/MNES EQ Directives and Procedures for a specific project. A PEQP generates and maintains EQ records in accordance with established project program procedures and quality assurance requirements. This program is implemented under a COL (or associated limited work authorizations). That is, it is implemented when a project transitions from the early licensing phase to the actual implementation phase.

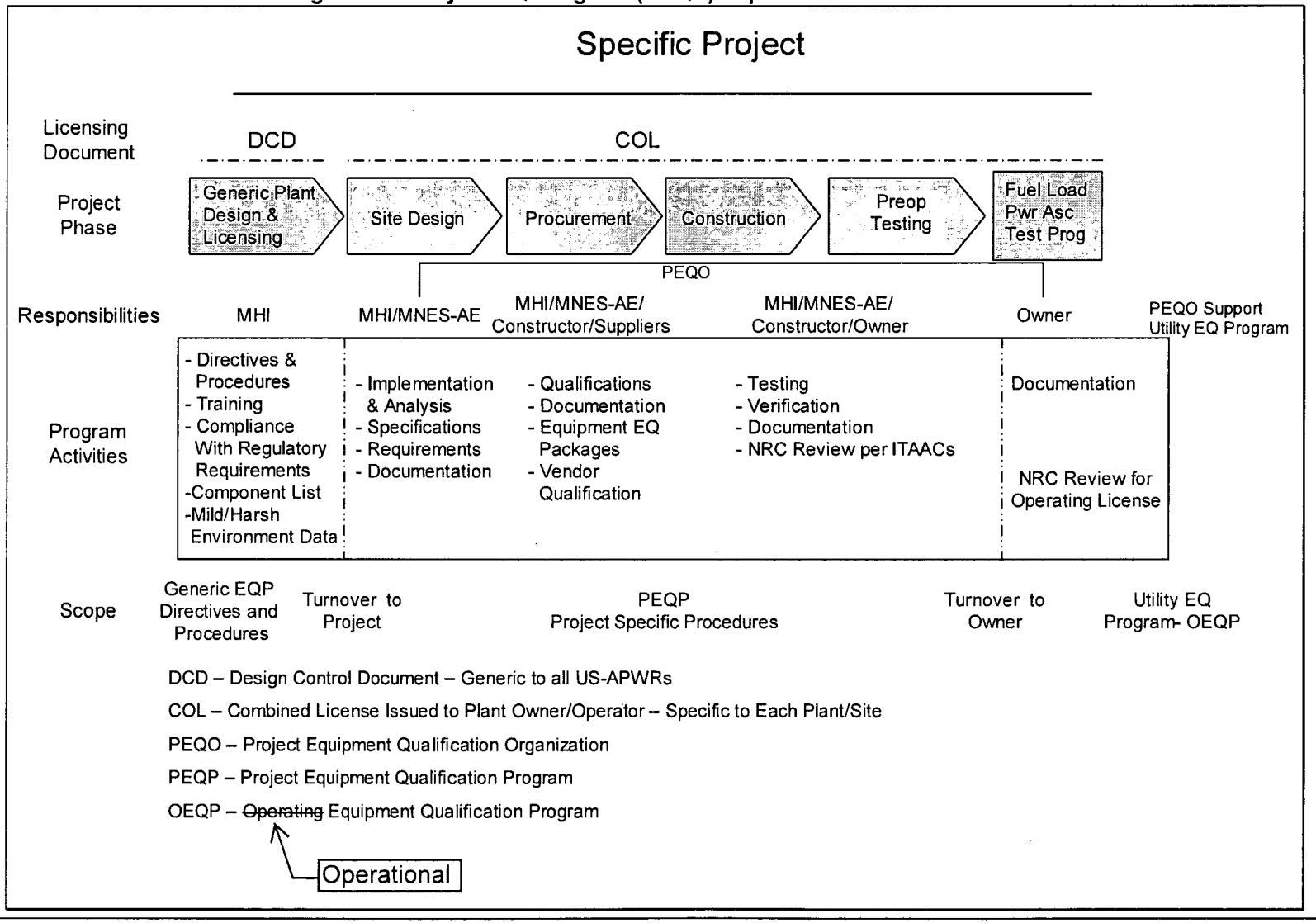
Operational

3. **Licensee's ~~Operating~~ Equipment Qualification Program (OEQP):** The plant owner's long-term ~~operating~~ EQP. The OEQP is based on the records and results of the PEQP. The transition from the PEQP to OEQP occurs at the time of initial plant licensure (OL or as a condition of licensure, e.g. at or before fuel load). The plant EQ Program covers the life of the plant (~60 yrs) and is discussed in the licensee's COL application (Ch 13 of the COL). Operational

DCD_03.
11-46

The Technical Report is primarily concerned with the generic US-APWR EQP and its implementation as a PEQP. The next section describes the statutory and regulatory basis for EQ.

Figure 2.1 Project EQ Program (PEQP) Implementation Framework



DCD_3.
11-46

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 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.

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 EQ Evaluation Parameters

Important to Safety and Safety-Related SSCs are 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:

- Aging
- Operating Time
- Temperature
- Pressure
- Humidity
- Chemical Effects
- Vibration
- Radiation
- Submergence
- Synergistic Effects ~~and EMI/RFI~~
- Seismic

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- Margins
- Other Parameters

EME/RFI

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4.2.1 Aging

Per 10 CFR 50.49 (d)(5), which reads: "Equipment qualified by test must be preconditioned by natural or artificial (accelerated) aging to its end-of-installed life condition." This regulation describes the considerations for the aging testing including preconditioning a given SSC before any further aging tests. This testing is used to help determine the service life of an SSC important to safety. Aging requirements are SSC specific and are implemented on a project specific basis. Aging analysis addresses concerns regarding a SSCs design life, shelf life, and qualified life for SSCs in harsh environments. Qualified Life addresses issues relative to in service thermal, radiation, vibration and chemical effects. IEEE 323 as well as other technical references, provide guidance in addressing Aging and Qualified Life analysis requirements.

4.2.2 Operability Time

Equipment operating times are determined by the individual piece of important to safety equipment's function, location, and safety class. This information is the result of engineering analysis for each piece of equipment. This equipment is evaluated for a time dependent safety function after a DBA. The time dependent safety functions are for tripping the reactor after a LOCA or other accident signal, engineered safeguards initiation, post-accident monitoring, or containment isolation. Post accident operating times are factored into equipment which must remain operational following a DBA such as post accident monitoring equipment. The results are tabulated in the US-APWR DCD.

4.2.2.1 Shorter Operability Times

Equipment that performs its safety function prior to significant changes in its environment may be qualified for shorter durations. Per RG 1.89, justification for shorter duration includes:

• The consideration of a spectrum of pipe break sizes.
• The potential need for the equipment later in an accident or during recovery operations.

Subsequent failure of the equipment is shown to not be detrimental to plant safety or to mislead the operator.

The determination that the margin applied to the minimum operability time, when combined with other test margins, accounts for uncertainties associated with the use of analytical techniques used to derive environmental parameters, the number of units tested, the production tolerances, and the test equipment inaccuracies.

4.2.3 Temperature and LOCA/MSLB Analysis

Normal Operating Temperature – This temperature is defined as that temperature seen by important to safety equipment during normal operation. This would include the effects of transient operation that could normally be expected over the US-APWR plant lifetime. This temperature is a function of the equipment's location, system function, and effects of any engineered ventilation. These are tabulated in the US-APWR DCD.

by accelerating aging, chemical effects, or other effects caused by differences in the as-installed environment over that of the as-design environment. Synergistic effects are identified by both analysis and physical inspection. A synergistic effects evaluation program will be implemented by the PEQO to evaluate important to safety SSCs during initial construction and pre-operational testing (including hot functional) as well as during power ascension testing. Long term synergistic effects may be detected by the plant operator ongoing surveillance, testing and inspection programs.

~~4.2.10.1 EMI/RFI Compatibility~~

~~The EQ process involves detailed testing during the procurement, construction, and startup phases. During construction, as electrical equipment is installed and tested, synergistic effects are to be evaluated to verify that these effects do not adversely impact the qualification of the electrical equipment. An example of this testing is the onsite testing for electromagnetic and radio frequency interference. This testing will comply with the guidance provided in RG 1.180, Guidelines for Evaluating Electromagnetic and Radio Frequency Interference in Safety-related Instrument and Control Systems. These various tests augment the EQ process and assist in meeting the intent of evaluating synergistic effects that could have an adverse impact on safety and important to safety equipment.~~

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4.2.11 Seismic Qualification of Important to Safety SSCs

Appendix B of this Technical Report provides a detailed description of the US-APWR Equipment Seismic Qualification Program. The Seismic Qualification Program is a subset of the Equipment Qualification Program.

4.2.12 Margin

The term "margin" refers to the extent by which this equipment meets and exceeds the required EQ parameter values defined in this Section. Margin is defined in 10 CFR 50.49(e)(8), which states:

> 8) *Margins.* Margins must be applied to account for unquantified uncertainty, such as the effects of production variations and inaccuracies in test instruments. These margins are in addition to any conservatisms applied during the derivation of local environmental conditions of the equipment unless these conservatisms can be quantified and shown to contain appropriate margins.

Thus selected equipment will have the qualified margins in EQ parameters to assure that there is adequate conservatism in the equipment. It is not possible to quantify the amount of margin for a given environmental parameter with exact certainty, since in most cases these are commercial transactions and the selected equipment will be evaluated by the PEQO to verify that the margins are acceptable. This means that the procurement process will evaluate the margins and coordinate with the PEQO where appropriate. Table 4-2 lists margin requirements applied to the designated environmental parameters.

4.2.12.1 Normal and Accident Environmental Parameters

component. EQP implementation includes provisions to monitor storage conditions during construction and to maintain important to safety equipment in controlled environmental conditions prior to and after installation where appropriate.

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4.3 Equipment Failures

4.2.14 EMI/RFI

The EMI/RFI qualification is specified to comply with the guidance provided in RG 1.180, Guidelines for Evaluating Electromagnetic and Radio Frequency Interference in Safety-Related Instrument and Control Systems.

Equipment qualification is a to safety SSCs will be capable of fulf onmental and seismic conditions. The ety trains for all major safety functions. erage for random single failures. Pe rovide a proven mechanism to identi es. The plant OEQP provides assurances that individual failures are identified and corrected. The OEQP is described in Section 11 of this Technical Report.

4.4 Summary

The EQ parameters used to qualify important to safety SSCs were discussed in this section. The EQ parameters that are used in the equipment qualification process are consistent with regulatory and industry standards. The selection and use of these parameters involves a number of considerations and these are factored into the overall EQP as described in the following sections. The following sections start with the EQ process and methods and continue into a description of the EQ Program. The EQ Program description includes a more formal approach to EQ qualification of SSCs for the US-APWR.

Table 4-2 US-APWR EQP Margin Values

Condition	Parameter	Required Margin	Notes
NORMAL:	Aging	+10%	+10% time margin, +10% radiation and/or selection of conservative test parameters.
ABNORMAL:	Temperature/ Humidity		Margin is in "time" at abnormal test extremes.
	Pressure	None	Nominally atmospheric.
	Radiation	+10%	Include in aging doses, if applicable.
	Chemical Effects	+10%	In alkalinity of adjusted sump pH. Not applicable outside containment.
	Voltage & Frequency	+/- 10% +/- 5%	Simulated during temperature/humidity test.
	Submergence	Note 1	Generally, precluded by design.
ACCIDENT:	Transient Temperature and Pressure	Location Dependent	Temperature (+15°F) and pressure (+10 psig peak) margins added to transient profile.
	Chemical Effects	+10%	In alkalinity of adjusted sump pH. Not applicable outside containment.
	Radiation	+10%	Added to calculated total integrated dose.
	Submergence	Note 1	Generally, precluded by design.
	Seismic/ Vibration	+10%	Of acceleration at equipment mounting point for either SSE or line-mounted equipment vibration. (See subsection 4.5.4.)
	Post-accident Aging	+10%	In time demonstrated via Arrhenius time/temperature relationship calculation.

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Note:
1. Margin in submergence conditions is achieved by increases in temperature (+15°F), pressure (+10%), and chemistry (+10% in alkalinity of adjusted sump pH). Also, accident conditions submergence testing envelops abnormal conditions submergence conditions.

Pro-03, *US-APWR Project Specific EQ Program Organization Management Structure*
Pro-05, *US-APWR EQ Program Documentation and Records Retention*
Pro-07, *US-APWR EQ Program Quality Assurance Program*
Pro-22, *US-APWR EQ Program Project Records Management*
Pro-25, *US-APWR EQ Program Personnel Qualifications*

9.14 ~~Operating~~ EQP (OEQP)

Operational

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At the time the Licensee's fuel load is authorized by the NRC (OL licensure), the PEQP is transferred to the Licensee and becomes the OEQP. The OEQP will remain in place for the life of the plant.

9.15 Summary

This section has briefly described how the generic US-APWR EQP would be implemented for a specific US-APWR project. The actual details of the implementation of a project-specific EQP have been left to the PEQO. There are numerous options in providing the support to deliver a US-APWR to a licensee and thus the actual framework and organizational structure of a Project Organization cannot be fully defined at this time. The US-APWR EQP has been designed to provide implementation flexibility, while at the same time providing the necessary guidance to a PEQO to allow the detailed formulization of a PEQP.

10.3 Inspections, Tests, Analysis, and Acceptance Criteria (ITAAC)

Completion of Inspections, Tests, Analyses and Acceptance Criteria (ITAAC), and the NRC approval of ITAAC closure are a constraint on fuel load for combined license holders. Therefore, the EQP implementation must be integrated with the ITAAC closure process in order to assure effective identification and closure of program-related ITAAC activities.

10.3.1 Electrical Equipment

To ensure that the seismic design requirements of GDC 2 and the EQ requirements of 10 CFR 50.49 are addressed, ITAAC are established for the applicable systems to verify the design aspects of Class 1E electrical equipment and important to safety equipment. The design specifications and other descriptions for this equipment identify the seismic qualifications and environmental qualifications for equipment located in a harsh environment. ITAAC verify the qualification of systems and components for seismic and harsh environments.

environmental and seismic

Electrical and I&C equipment located in a mild environment are specified to meet the ~~temperature~~ conditions of their respective as-built locations. ~~ITAAC verifies the HVAC systems' ability to maintain area temperature limits within design conditions.~~ DCD_03.11-45

10.3.2 Mechanical Equipment

Active Mechanical Equipment whose function is required to ensure the safe operation or safe shutdown of a nuclear power plant is qualified following the guidance of ASME QME-1. ITAAC includes verification of component operation (e.g., pump and valve tests) seismic qualification and compliance with ASME Code, Section III requirements under design loading conditions where appropriate.

10.3.3 Pipe Break

To ensure that the applicable requirements of GDC 4 have been adequately addressed, ITAAC are established to verify that the safety-related SSCs have been designed to the dynamic effects of pipe breaks. In addition, ITAAC are established to verify by as-built inspections of as-built, high-energy pipe break mitigation features and of the pipe break analysis report that safety-related SSCs are protected against the dynamic and environmental effects associated with postulated high-energy pipe breaks.

10.3.4 As-built Reconciliation

To ensure that the final as-built plant structures are built in accordance with the certified design as required by 10 CFR Part 52, structural analyses are performed which reconcile the as-built configuration of the plant structures with the structural design bases of the certified design via ITAAC.

For the reactor vessel (RV), the key dimensions of the RV system are verified in conjunction with the basic configuration check of the system. The key dimensions of the RV system and the acceptable variations of the key dimensions are provided in the certified design description. Alternatively, acceptable variations and the bases for them is provided and a final analysis of the dimensions is performed.

11.0 GENERAL DESCRIPTION OF UTILITY (LICENSEE) ~~OPERATING~~ EQUIPMENT QUALIFICATION PROGRAM

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This Technical Report provides a brief description of the Utility (Licensee) ~~Operating~~ EQP (OEQP). The OEQP implementation represents the final step of the PEQO transferring all responsibility for EQ to the Utility operating the US-APWR commercial nuclear power plant. This process is done over several steps, commencing prior to fuel load and prior to the commercial operation of the US-APWR. The OEQP is responsible for all aspects of the continuing EQ program such as:

- Spare part inventory
- Procurement of replacement parts
- Addressing programmatic aspects of OEQP such as aging of non-metallic parts
- Evaluating engineering and design questions as they arise such as Synergistic effects during long term power operations while allowing for considerations like available operating life with a margin for fulfilling important to safety functions during a DBA or other analyzed accident
- Establishing or contributing to a establishment of a In Service Inspection Program (ISI) and a In Service Testing Program (IST) as described in Chapter 13 of the Licensee's COLA
- Implementing the ISI and IST programs described above to verify components important to safety such as the dynamic restraints (snubbers) remain capable of fulfilling their intended safety function
- Providing a commercial grade dedication program and engineering staff to implement the program

The above items are not a comprehensive listing but illustrate the activities the Utility shall have in place prior to fuel load. These programs are implemented, documented and controlled by appropriate plant operating and maintenance procedures. These programs are administered by the plant staff. The plant operating and maintenance procedures are outside of the scope of the reactor vendor (MHI) and thus are not directly a part of this EQP Technical Report. This section of the Technical Report is included to describe the continuity of the EQ process after the plant is constructed and tested. . (See NRC direction in SECY 05-00197 regarding implementation and descriptions of licensee ~~Operating~~ Programs).

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Operational

11.1 Summary Description Of US-APWR Plant Procedures Relating To OEQP

As indicated in the appropriate COLA, all equipment qualification activities for a specific US-APWR project that that affect important to safety SSCs will be conducted by detailed, written, and approved procedures and instructions. These procedures and instructions include the OEQP in the Operation, Emergency Response, Maintenance, Test, Inspection, and Surveillance activities in the plant

The plant licnesee develops and implements written administrative procedures that assign the responsibilities and authorities of the plant staff. These administrative procedures also provide the control measures for the preparation, review, approval, revision, and use of all station procedures and instructions that govern OEQP or quality

EQ Program Procedure Pro- 17 "EQ Program Qualification Processes"

This procedure provides direction to the PEQO, on qualification methods that can be used for EQ.

This procedure establishes the EQ methods to be used by the Project EQP (PEQP) and provides direction on which methods to use. These methods apply to all mechanical and electrical equipment that is required to be qualified by thePEQP, and apply to important to safety structures, systems and components (SSC) during the licensing, design, procurement, construction, test, startup and turnover to the utility phases of a US-APWR project.

EQ Program Procedure Pro- 18 "EQ Program Qualification by Testing"

This procedure provides direction and guidance to the PEQO, for preparation of project specific implementing procedures to address EQ by testing.

The project specific PEQO procedures shall be developed to ensure that the applicable EQ requirements as delineated in 10CFR50.49, RG 1.89, IEEE Std 323, IEEE Std 344, ASME QME-1 and other equipment specific IEEE qualification standards are met. Type testing as described in IEEE Std 323, clause 5.1~~.1~~ is one of the acceptable methods for qualifying equipment important to safety for a US-APWR project. The selection of the method for qualification of particular equipment shall be agreed upon by the PEQO and the equipment vendor. DCD_03. 11-47

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EQ Program Procedure Pro- 19 "EQ Program Qualification by Vendor Certification"

This procedure provides direction and guidance to the PEQO, for preparation of project specific implementing procedures to address EQ by testing.

The project specific PEQO procedures shall be developed to ensure that the applicable EQ requirements as delineated in 10CFR50.49, RG 1.89, IEEE Std 323, IEEE Std 344, ASME QME-1 and other equipment specific IEEE qualification standards are met. Type testing as described in IEEE Std 323, clause 5.1~~.1~~ is one of the acceptable methods for qualifying equipment important to safety for a US-APWR project. The selection of the method for qualification of particular equipment shall be agreed upon by the PEQO and the equipment vendor. DCD_03. 11-47

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EQ Program Procedure Pro- 20 "EQ Program Qualification by Analysis"

This procedure provides direction and guidelines to the Project EQ Organization (PEQO) for preparation of project specific implementing procedure(s) to address EQ by analysis.

The scope of this procedure covers qualification by analysis for important to safety structures, systems and components (SSC) installed in a US-APWR nuclear power plant.

It should be noted that analysis alone cannot be used to demonstrate qualification. When an analysis method is used by a vendor for qualifying a piece of equipment, the analysis report should include a logical assessment, similarity evaluations, or a valid mathematical model to establish that the equipment to be qualified can perform its