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Subject: **Response to Portion of NRC Request for Additional Information Letters No. 103 and 126 Related to ESBWR Design Certification Application RAI Number 9.4-34 (Letter No. 103), and RAI Numbers 14.3-206 and 14.3-243 (Letter No. 126)**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letters dated July 23, 2007 (Reference 1) and December 20, 2007 (Reference 2).

Enclosure 1 contains the GEH response to each of the subject RAIs. The enclosed changes will be incorporated in the upcoming DCD Revision 5 submittal.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 07-414, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 103 Related To ESBWR Design Certification Application*, dated July 23, 2007

2. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to James C. Kinsey, GEH, *Request For Additional Information Letter No. 126 Related To ESBWR Design Certification Application*, dated December 20, 2007

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letters No. 103 and 126 Related to ESBWR Design Certification Application DCD Tier 1 RAI Number 9.4-34 (Letter No. 103), and RAI Numbers 14.3-206 and 14.3-243 (Letter No. 126)

cc:

AE Cubbage	USNRC (with enclosure)
GB Stramback	GEH/San Jose (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
eDRF Sections	0000-0082-9826 (RAI) 9.4-34
	0000-0080-3963 (RAI) 14.3-206
	0000-0080-7457 (RAI) 14.3-243

Enclosure 1

MFN 08-086, Supplement 42

Response to Portion of NRC Request for

Additional Information Letters No. 103 and 126

Related to ESBWR Design Certification Application

DCD Tier 1

RAI Number 9.4-34 (Letter No. 103), and

RAI Numbers 14.3-206 and 14.3-243 (Letter No. 126)

***Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.**

NRC RAI 9.4-34

Question Summary

Control room temperature questions during a design base accident.

Full Text

In DCD Tier 2, Revision 3, Section 9.4.1, it is stated that the temperature rise in the control room would be limited to 15 degrees F.

Is the temperature rise based on the highest temperature that could exist in the room at the time of the accident? Although room air temperature is important, the temperature of the air inside electrical cabinets is also important because it affects the proper functioning and potential failure of components important to safety. Is the air flow through electrical cabinets reduced during the 72-hour post-accident period? Are temperatures inside the cabinets higher since the room air used to cool the cabinets is higher? Is there any potential for component design temperatures to be exceeded with adverse effects on component performance or failure? Is there any adverse impact on control room temperatures or component operating temperatures if the winter design temperatures exist at the time of the accident?

GEH Response

The 15 degrees F temperature rise in the control room is the bounding worst case increase in ambient room temperature caused by the assumption of concurrent SBO and loss of nonsafety-related HVAC for all Design Basis Accidents (DBA) and Anticipated Operational Occurrences (AOO), as noted in DCD 26A6642AN Tier 2, Rev. 04, Appendix 3H, Table 3H-10.

The Equipment Qualification (EQ) program qualifies safety-related equipment for maximum and minimum temperature. The environmental qualification process is discussed in DCD 26A6642AN Tier 2, Subsection 3.11 "Environmental Qualification of Mechanical and Electrical Equipment."

DCD Tier 2 Subsection 3.11 will be changed to more fully explain the temperature qualification process.

The temperature inside of the cabinet is important and is accounted for in equipment qualification.

The airflow through electrical cabinets is assumed to be reduced during the 72-hour post accident period and the normal nonsafety-related HVAC is assumed to be off.

The EQ program ensures component performance for temperature, including if the event occurs during maximum summer design temperatures and minimum winter design temperatures.

DCD Impact

DCD Tier #2, Section 3.11.2.1 will be revised as noted in the attached markup. Subsection 3.11.2.1 is renumbered as new subsection 3.11.3.1 in the attached markup.

NRC RAI 14.3-206

NRC Summary:

Non-inclusion of equipment in ITAAC as required by 10 CFR 50.49 (b)(2) and (b)(3)

NRC Full Text:

GEH added ITAAC for Environmental Qualification of Mechanical and Electrical Equipment in DCD Tier 1 Section 3.8. ITAAC includes safety-related mechanical, electrical and digital I&C equipment. In DCD, Tier 2, Section 3.11.1, GEH stated that electrical equipment within the scope of this section includes all three categories of 10 CFR 50.49(b). The ITAAC did not include 10 CFR 50.49 (b)(2) and (b)(3) equipment. Please include 10 CFR 50.49(b)(2) and (b)(3) equipment in the ITAAC or provide justification for not including those equipment in ITAAC.

GEH Response

DCD Tier #1 Section 3.8 is consistent with SRP 14.3 and includes safety-related equipment in harsh environments and digital instrumentation and controls.

DCD Tier #2 Section 3.11 will be changed to more clearly identify that the EQ program includes all three categories of 10 CFR 50.49(b), (b)(1), (b) (2), and (b) (3).

DCD Tier #2 Section 3.11 will expand to more fully detail the EQ program including equipment included in the EQ program, qualification methods applicable to EQ equipment located in harsh and mild environments, relevant regulations, additional definitions, environmental conditions, and documentation.

DCD Impact

DCD Tier #2, Section 3.11 will be revised as noted in the attached markup.

NRC RAI 14.3-243

NRC Summary:

EMI qualification not in ITAAC

NRC Full Text:

The ITAAC should address EMI susceptibility and emissions qualifications.

GEH Response

EMI, RFI, and surge conditions are conditions to which safety-related and nonsafety-related equipment are qualified in the EQ program. The EQ program ITAAC is DCD Tier #1, Section 3.8 Rev 4. Since the EQ program addresses significant details, including EMI, RFI, and surge conditions, it is not necessary to include each detail in an ITAAC.

However, additional details for qualification to EMI, RFI, and surge conditions including envelopes will be added to DCD Tier #2, Section 3.11 to make it clear that the EQ program includes EMI, RFI, and surge conditions.

DCD Impact

DCD Tier #2, Subsection 3.11.2.1 will be revised per the attached markup. Subsection 3.11.2.1 is renumbered as new subsection 3.11.3.1 in the attached markup.

3.11 ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

Changes per Response to RAI 14.3-206, unless otherwise noted.

3.11.1 Description Requirements

This section describes the requirements for the environmental qualification elements of the ~~Environmental~~ Equipment Qualification (EQ) program as related to ~~of~~ electrical and mechanical equipment. The EQ program also includes dynamic and seismic qualification of safety-related electrical and mechanical equipment. Dynamic qualification is addressed in Sections 3.9 and 3.10 for Seismic Category I mechanical and electrical equipment, respectively, and the discussion in this section focuses on the environmental qualification elements of the EQ program.~~EQ is based on limiting design conditions for electrical equipment (including instrumentation and control components) and safety related mechanical equipment. EQ documentation describes methods and procedures used to demonstrate the capabilities of equipment to perform their required safety related functions when exposed to the environmental conditions in their respective locations as discussed in SRP 3.11 Draft 3 (Reference 3.11-1).~~

The EQ program includes safety-related electrical and mechanical equipment located in harsh and mild environments. Safety-related electrical equipment consists of all safety-related electrical power and instrumentation and control (I&C) equipment, which include all safety-related analog (non-digital) and digital instrumentation and control components.

Mechanical, electrical, and I&C equipment associated with systems described below are reviewed to determine whether they are designed to meet the requirements described under the acceptance criteria as follows:

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.

The EQ program includes qualification of safety-related electrical and mechanical equipment for natural phenomena and external events, unless the adverse effects are precluded by design. For example, location of safety-related electrical and mechanical equipment within safety-related structures may preclude the adverse effects of flood, wind, tornados, and tornado missiles.

The EQ program includes safety-related electrical equipment, including I&C equipment in a mild environment. Safety-related Distributed Control and Information System (Q-DCIS) equipment located in areas characterized as mild environments, also meet Regulatory

Guide 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-based Instrumentation and Control Systems in Nuclear Power Plants," (Reference 3.11-4), and type testing is the preferred method of qualification.

Mild environments do not experience a loss-of-coolant accident (LOCA), high energy line break (HELB), or main steamline break (MSLB) and have the environmental limits shown in Table 3H-13.

Equipment supporting RTNSS functions that are located inside containment are included in the EQ program, and are qualified using the appropriate methods for their location. The remainder of the RTNSS equipment is qualified as outlined in Section 19A. Table 3.11-1 includes RTNSS equipment located inside containment.

3.11.1.1 Applicable Regulations and Standards

The environmental qualification of electrical and mechanical equipment meets the relevant requirements of the following regulations:

(1) Code Federal Regulations (CFR):

a. 10 CFR 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."

b. 10 CFR 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

c. 10 CFR 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."

d. 10 CFR 50, Appendix A, General Design Criterion 23, "Protection System Failure Modes."

e. 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."

f. 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Section III, "Design Control," Section XI, "Test Control," and Section XVII, Quality Assurance Records."

(2) Institute of Electrical and Electronic Engineers (IEEE):

a. IEEE-323-2003, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

b. IEEE-317-1983 (R2003), "Standard for Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations."

c. IEEE-383-2003, "Standard for Qualifying Class 1E Electric Cable and Field Splices for Nuclear Power Generating Stations."

d. IEEE-420-2001, "Standard for the Design and Qualification of Class 1E Control Boards, Panels and Racks Used in Nuclear Power Generating Stations".

e. IEEE-535-1986 (R1994), "Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations."

f. IEEE-603-1991~~1998~~, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations."

g. (Deleted)~~IEEE-627-1980 (R1996), "Standard for Design Qualification of Safety Systems Equipment Used in Nuclear Power Generating Stations."~~

h. IEEE-638-1992, "Standard for Qualification of Class 1E Transformers for Nuclear Power Generating Stations."

i. IEEE-649-1991 (R2004), "Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations."

j. IEEE-650-1990 (R1998), "Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations."

k. IEEE-382-1996 (R2004), "Standard for Qualification of Actuators for Power Operated Valve Assemblies with Safety-Related Functions for Nuclear Power Plants."

l. (Deleted)~~IEEE-381-1977 (R1984), "Standard Criteria for Type Tests of Class 1E Modules used in Nuclear Power Generating Stations."~~

m. IEEE-572-1985 (R2004), "Standard Qualification of Class 1E Connection Assemblies for Nuclear Power Generating Stations".

n. IEEE-634-2004, "Standard Cable-Penetration Fire Stop Qualification Test".

o. IEEE-323-1974, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

p. IEEE-334-1994 (R1999), "IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations."

q. IEEE-344-1987 (R1994), "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."

r. IEEE-497-2002, "IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations."

s. IEEE-7-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations."

t. IEEE-1202-2006, "IEEE Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies."

(3) American Society of Mechanical Engineers (ASME):

a. ASME B&PVC Section III-2001 "Rules for Construction of Nuclear Power Plant Components."

b. ASME NQA-1, Addenda NQA-1a-1999 "Quality Assurance Requirements for Nuclear Facility Applications."

(4) U.S. Nuclear Regulatory Commission (NRC) Regulatory Guides:

a. Regulatory Guide 1.63, ~~1987~~ "Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants."

b. Regulatory Guide 1.73, ~~1974~~ "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants."

c. Regulatory Guide 1.89, ~~1984~~ "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants."

d. Regulatory Guide 1.131, ~~1977~~ "Qualification Tests of Electric Cables, Field Splices and Connections for Light-Water-Cooled Nuclear Power Plants."

e. Regulatory Guide 1.153, ~~1996~~ "Criteria for Safety Systems."

f. Regulatory Guide 1.183, ~~2000~~ "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactor."

g. Regulatory Guide 1.97, ~~2006~~ "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants."

h. Regulatory Guide 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems."

i. Regulatory Guide 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer Based Instrumentation and Control Systems in Nuclear Power Plants."

j. Regulatory Guide 1.40, "Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants."

k. Regulatory Guide 1.100, "Seismic Qualification of Electrical and Mechanical Equipment for Nuclear Power Plants."

l. Regulatory Guide 1.156, "Environmental Qualification Connection Assemblies for Nuclear Power Plants."

m. Regulatory Guide 1.158, "Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants."

3.11.1.2 General Requirements

~~The general requirements for environmental~~Environmental design and qualification used to implement the relevant requirements of 10 CFR 50.49; General Design Criteria 1, 2, 4 and 23; and Quality Assurance Criteria III, XI, and XVII are as follows:

(1) The equipment is designed to have the capability of performing its design safety-related functions under all anticipated operational occurrences and normal, accident, and post-accident environments and for the length of time for which its function is required.

(2) The equipment environmental capability is demonstrated by appropriate testing and analyses.

(3) A quality assurance program meeting the requirements of 10 CFR Part 50, Appendix B, is established and implemented to provide assurance that all requirements have been satisfactorily accomplished.

A review is performed to assure conformance with the environmental design basis requirements of 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 4 which states, in part, that

"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."

~~The electrical and mechanical equipment within the scope of this section is defined in Subsection 3.11.1. Dynamic qualification is addressed in Sections 3.9 and 3.10 for Seismic Category I mechanical and electrical equipment, respectively.~~

~~Limiting design conditions include the following:~~

3.11.1.3 Definitions

Normal Operating Conditions — Planned, purposeful, ~~unrestricted~~ reactor operating ~~modes~~ conditions including startup, power range, hot standby (condenser available), shutdown, and refueling. ~~modes.~~

~~**Abnormal Operating Conditions** — any deviation from normal conditions anticipated to occur often enough that the design should include a capability to withstand the conditions without operational impairment.~~

Anticipated Operational Occurrences (AOOs) – Conditions or normal operation expected to occur one or more times during the life of the nuclear power unit and include, but are not limited to loss of the turbine generator set, isolation of the main condenser and loss of offsite power.

Test Conditions — Planned testing including pre-operational tests.

Accident Conditions — A single event not reasonably expected during the course of plant operation that has been hypothesized for analysis purposes or postulated from unlikely but possible situations or that has the potential to cause a release of radioactive material (a reactor coolant pressure boundary rupture may qualify as an accident; a fuel cladding defect does not).

Design Basis Event (DBE) or Design Basis Accident (DBA) – Postulated events used in the design to establish the acceptable performance requirements for structures, systems, and components.

Equipment Qualification – The generation and maintenance of evidence to ensure equipment will operate on demand to meet system performance requirements during normal and AOO service conditions and postulated design basis events.

Harsh Environment – An environment resulting from a design basis event, i.e., LOCA, HELB, and MSLB.

Interfaces – Physical attachments, mounting, auxiliary components, and connectors (electrical and mechanical) to the equipment at the equipment boundary.

Margin – The difference between service conditions and the conditions used for equipment qualification.

Mild Environment – An environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including AOOs.

Post-Accident Conditions —The length of time after an accident condition that equipment must perform its safety-related function and must remain in a safe mode after the safety-related function is performed.

Qualified Life – The period of time, prior to the start of a design basis event, for which the equipment was demonstrated to meet the design requirements for the specified service conditions.

Service Conditions – Environmental, loading, power, and signal conditions expected as a result of normal operating requirements, expected extremes (abnormal) in operating requirements, and postulated conditions appropriate for the design basis events of the station.

Significant Aging Mechanism – An aging mechanism that, under normal and abnormal service conditions, causes degradation of equipment that progressively and appreciably renders the equipment vulnerable to failure to perform its safety-related function(s) during the design basis event conditions.

~~3.11.1~~ 3.11.2 Equipment Identification

~~Electrical equipment within the scope of this section includes all three categories of 10 CFR 50.49(b) (Reference 3.11-2). Safety-related mechanical equipment (e.g., pumps, motor-operated valves, solenoid-operated valves, safety-relief valves, and check valves) is as defined and identified in Section 3.2. Specific equipment to be included in the equipment qualification program is identified in Table 3.11-1. Electrical and mechanical equipment safety classifications are further defined on the system design drawings.~~The EQ program generates and maintains a list of safety-related electrical and mechanical equipment located in harsh and mild environments. The systems containing safety-related equipment are identified in Table 3.11-1.

~~Safety-related mechanical equipment and 10 CFR 50.49(b) electrical equipment located in a harsh environment must perform its proper safety-related function in environments during normal, abnormal, test accident and post-accident conditions as applicable. A list of all 10 CFR 50.49(b) electrical and safety-related mechanical equipment that is located in a harsh environment area is included in the Environmental Qualification Document (EQD) to be prepared as mentioned in Subsection 3.11.2.2.~~The Environmental Qualification Document (EQD) summarizes the qualification results for all safety-related electrical and mechanical equipment in the EQ program. The EQD is current and in an auditable form for the entire period during which the covered item is installed or is stored for future use to permit verification that each item of safety-related electrical and mechanical equipment meets the EQ requirements.

~~3.11.2~~ 3.11.3 Environmental Conditions

~~*3.11.2.1*~~ *3.11.3.1 General Requirements*

Environmental Design Bases: Analysis is performed to identify the environmental design bases including the definition of AOO and normal, accident, and post-accident environments. DBA and AOO define the temperature and pressure time-dependent information for areas subject to accidents and AOOs.

Safety-related equipment is qualified to the worst-case environmental conditions for the areas in which they are located for the duration that they are required to perform their safety-related function.

The environmental design basis includes the safety-related function for each item of safety-related equipment and its acceptance criteria; Electromagnetic interference/radio frequency

interference (EMI/RFI) and Voltage Surges; environmental conditions including temperature, equipment heating, Heating, Ventilation and Air Conditioning (HVAC) and lack of HVAC, inside and outside maximum and minimum temperatures, and time dependency of temperatures.

The safety-related functions are either functional performance requirements or fail-safe requirements. A fail-safe safety-related function consists of not failing in a manner detrimental to plant safety, accident mitigation, or prevention of a safety-related function. The basis for the safety-related function is included in the qualification documentation.

The following provides detailed information on each environment included in the environmental design basis.

RAI 9.4-34

Temperature

The temperature qualification for safety-related equipment in harsh environments is by test. Safety-related equipment is demonstrated to perform as intended while exposed to the qualification temperature. The qualification temperature is 10°C higher than the maximum temperature to which the equipment is exposed for the worst-case DBA, while the equipment is under its maximum loading, to comply with margin requirements.

For safety-related electrical equipment in mild environments, except for computer based I&C, the temperature qualification methods are test or analysis. The maximum qualification temperature is 10°C higher than the maximum temperature to which the equipment is exposed for the worst-case AOO, while the equipment is under its maximum loading, to comply with margin requirements. The minimum qualification temperature is 10°C lower than the minimum temperature to which the equipment is exposed for the worst-case AOO.

For safety-related computer based I&C equipment in mild environments, the temperature qualification method is by test. The maximum qualification temperature is 10°C higher than the maximum temperature to which the equipment is exposed for the worst-case AOO, while the equipment is under its maximum loading, to comply with margin requirements. The minimum qualification temperature is 10°C lower than the minimum temperature to which the equipment is exposed for the worst-case AOO.

Since HVAC is nonsafety-related, AOO, including Station Black Out (SBO), and DBA conditions assume no HVAC cooling and assume worst case highest ambient temperature caused by lack of HVAC, maximum outside temperature, and maximum heat rise from collocated and adjacent heat sources. Additionally, AOO, including SBO, conditions assume no HVAC heating and assume worst case lowest ambient temperature caused by lack of HVAC heating, minimum outside temperature, and minimum heat rise from collocated and adjacent heat sources. This ensures that safety-related equipment is qualified for the worst-case temperatures with margin per the requirements of IEEE 323.

Pressure

The pressure qualification for safety-related equipment in harsh environments is by test. The qualified pressure is 10% higher, to comply with margin requirements, than the maximum pressure to which the equipment is exposed for the worst-case DBA, while the equipment is under its maximum loading.

For safety-related electrical equipment in mild environments, including computer based I&C, the pressure qualification methods are by test or analysis. The qualified pressure is 10% higher, to

comply with margin requirements, than the maximum pressure to which the equipment is exposed for the worst-case AOO, while the equipment is under its maximum loading.

This ensures that safety-related equipment is qualified for the worst-case pressure with margin per the requirements of IEEE 323.

Humidity

Relative humidity requirements are defined for DBAs and AOOs, and safety-related equipment is qualified for the applicable relative humidity conditions. The qualification for steam exposure for safety-related equipment in harsh environments is by test. The qualified steam conditions are those identified in the DBA analysis.

For safety-related electrical equipment in mild environments, including computer based I&C, the qualification methods for humidity are by test or analysis. This ensures that safety-related equipment is qualified for the worst-case humidity conditions per the requirements of IEEE 323.

Chemical effects

The assumed composition of chemicals is at least as severe as that resulting from the most limiting mode of plant operation (e.g., normal operation and borated water from the Standby Liquid Control System (SLCS). There is no caustic containment spray in an ESBWR. The qualification for chemical exposure for safety-related equipment in harsh environments is by test. This chemical exposure test ensures that safety-related equipment is qualified for the worst-case chemical conditions per the requirements of IEEE 323. Safety-related electrical equipment, including computer based I&C, in mild environments is not exposed to chemicals.

Radiation

The radiation environment is based on the type of radiation, the total dose expected during normal operation over the installed life of the equipment, and the radiation environment associated with the most severe design basis accident during or following which the equipment is required to remain functional, including the radiation resulting from recirculating fluids for equipment located near recirculating lines and including dose rate effects. Radiation exposure simulates radiation degradation for the total integrated dose applicable for the normal radiation dose. Accident dose may be added to the normal dose and a single radiation total dose applied by test. Equipment that has accident dose rate sensitivity is tested at the most degrading dose rate. Safety-related equipment is qualified for radiation. The qualification for radiation for safety-related equipment in harsh environments is by test. The qualification radiation total integrated accident dose is 10% higher, to comply with margin requirements, than the maximum accident total integrated dose to which the equipment is exposed for the worst-case DBA.

Electric and mechanical safety-related equipment that could be exposed to radiation is environmentally qualified to a radiation dose that simulates the calculated radiation environment (normal and accident) that the equipment should withstand prior to completion of its required safety-related functions. Such qualification considers that equipment damage is a function of total integrated dose and can be influenced by dose rate, energy spectrum, and particle type. The radiation qualification includes doses from all potential radiation sources at the equipment location. Plant-specific analysis is used to justify any reductions in dose or dose rate resulting from component location or shielding. The foregoing defines how the qualification environment at the equipment location is established.

Shielded components are qualified only to the gamma radiation environment provided it can be demonstrated that the sensitive portions of the component or equipment are not exposed to significant beta radiation dose rates or that the effects of beta radiation, including heating and secondary radiation, have no deleterious effects on component performance. If, after considering the appropriate shielding factors, the total beta radiation dose contribution to the equipment or component is calculated to be less than 10% of the total gamma radiation dose to which the equipment or component has been qualified, the equipment or component is considered qualified for the beta and gamma radiation environment, based only on gamma radiation testing.

Safety-related electrical and mechanical equipment located outside containment that is exposed to the radiation from a recirculating fluid is qualified to withstand the radiation penetrating the containment plus the radiation from the recirculating fluid.

For safety-related electrical equipment in mild environments, including computer based I&C, the qualification methods for radiation are by test or analysis. A mild radiation environment for electronic equipment is a total integrated dose less than 10 Gy (1.0E3 rad), and a mild radiation environment for other equipment is less than 100 Gy (1.0E4 rad). Safety-related electronic and electrical equipment is tested with the equipment energized and performing its safety-related function, if the required total integrated dose exceeds the mild environment level.

This ensures that the safety-related equipment is qualified for the worst-case radiation with DBA margin per the requirements of IEEE 323.

Operating Time

Safety-related equipment is qualified for its required operating time during DBA and post-accident conditions. Some mechanical and electrical equipment may be required to perform an intended function from within minutes of the occurrence of an event up to 10 hours into the event. Such equipment is shown to remain functional in the accident environment for a period of at least one hour in excess of the time assumed in the accident analysis unless a time margin of less than one hour can be justified. Such justification includes for each piece of equipment:

(1) Consideration of a spectrum of breaks;

(2) The potential need for the equipment later in the event or during recovery operations;

(3) Determination that failure of the equipment after performance of its safety-related function is not detrimental to plant safety nor misleads the operator; and

(4) Determination that the margin applied to the minimum operability time, when combined with other test margins, accounts for the uncertainties associated with the use of analytical techniques in the derivation of environmental parameters, the number of units tested, production tolerances, and test equipment inaccuracies.

For equipment with a required time of operation during accident and post-accident conditions of more than 10 hours, testing demonstrates that the safety-related equipment remains functional under such conditions for a period of time at least 10% longer than the required time of operation.

Aging

Safety-related equipment in harsh environments is analyzed for significant aging mechanisms. If the equipment is determined to have a significant aging mechanism, then the mechanism is

accounted for in the qualification program. Aging mechanisms include time-temperature degradation, cycle aging and normal radiation exposure. Artificial aging or natural aging simulate time-temperature degradation. Artificial aging is determined from the Arrhenius Equation. Cycle aging conservatively simulates the degradation during the required operating cycles. Use of synergistic effects is considered when these effects are believed to have a significant effect on equipment performance.

Age conditioning is not required for safety-related equipment without significant aging mechanisms, or for safety-related equipment in mild environments.

Equipment is reviewed in terms of design, function, materials, and environment for its specified application to identify potentially significant aging mechanisms. An aging mechanism is significant if subsequent to manufacture, while in storage, and/or in the normal and abnormal service environment, it results in degradation of the equipment that progressively and appreciably renders the equipment vulnerable to failure to perform its safety-related function(s) under DBE conditions.

Artificial accelerated aging simulates the significant aging mechanisms and a qualified life is established. For materials with a qualified life of less than 60 years, maintenance requirements are established to ensure that the material is replaced prior to the end of its qualified life. Alternatively, materials with a qualified life of less than 60 years may be evaluated with condition monitoring to ensure that the material degradation is less than the degradation, which was simulated in type tests, prior to the simulated DBA conditions.

Submergence

Safety-related equipment that is submerged during or after a design basis event is tested for the resulting worst-case submergence.

Synergistic effects

The age conditioning considers sequential, simultaneous, and synergistic effects in order to achieve the worst state of degradation. Synergistic effects are considered when they have a significant effect on equipment performance.

Electromagnetic interference (EMI)/radio frequency interference (RFI) and Voltage Surges

RAI 14.3-243

Safety-related equipment is qualified for EMI/RFI and voltage surge protection against the following:

- EMI
- RFI
- Electrostatic Discharge
- Electrical Surge

EMI qualifications follow the requirements defined in Mil Std. 461E and IEC 61000-4. The qualification for EMI/RFI and voltage surges for safety-related equipment in harsh and mild environments is by test, consistent with Regulatory Guide 1.180. Nonsafety-related electrical and digital I&C equipment is tested for Conducted Emission via power leads and Radiated Emission from electric fields to ensure that emissions from nonsafety-related electrical and I&C equipment do not exceed allowable limits and do not affect the safety-related equipment. This

ensures that safety-related equipment is qualified for EMI/RFI and voltage surges per the requirements of IEEE 323.

RAI 14.3-243

3.11.3.2 Environmental Requirements

Environmental conditions for the zones where safety-related equipment is located are calculated for normal, ~~abnormal~~AOO, test, accident and post-accident conditions and are documented in Appendix 3H, Equipment Qualification Environmental Design Criteria (EQEDC). Environmental conditions are tabulated by zones contained in the referenced building arrangements. Typical equipment in the noted zones is shown in the referenced system design schematics.

Environmental parameters include thermodynamic parameters (temperature, pressure and relative humidity), radiation parameters (radiation type, dose rates and total integrated doses ~~of neutron, gamma and beta exposure~~) and chemical spray parameters (chemical composition and the resulting pH). ~~Subsection 3.11.4 describes further the chemical and radiation environments.~~

~~The magnitude and 60-year frequency of occurrence of significant deviations from normal plant environments in the zones have insignificant effects on equipment total thermal normal aging or accident aging. Abnormal~~AOO and test condition environments are bounded by the normal or accident conditions according to the Appendix 3H tables.

~~Margin is defined as the difference between the most severe specified service conditions of the plant and the conditions used for qualification.~~ Margins are included in the qualification parameters to account for normal variations in commercial production of equipment and reasonable errors in defining satisfactory performance. The environmental conditions shown in the Appendix 3H tables do not include margins.

~~Some mechanical and electrical equipment may be required to perform an intended function from within minutes of the occurrence of an event up to 10 hours into the event. Such equipment is shown to remain functional in the accident environment for period of at least one hour in excess of the time assumed in the accident analysis unless a time margin of less than one hour can be justified. Such justification includes for each piece of equipment:~~

~~(1)consideration of a spectrum of breaks;~~

~~(2)the potential need for the equipment later in the event or during recovery operations;~~

~~(3)a determination that failure of the equipment after performance of its safety related function is not detrimental to plant safety or does not mislead the operator; and~~

~~(4)determination that the margin applied to the minimum operability time, when combined with other test margins, accounts for the uncertainties associated with the use of analytical techniques in the derivation of environmental parameters, the number of units tested, production tolerances, and test equipment inaccuracies.~~

~~For equipment with a required time of operation during accident and post accident conditons of more than 10 hours, it is demonstrated that it remains functional under such conditions for a period of time at least 10% longer than the required time of operation.~~

The environmental conditions shown in the Appendix 3H tables are upper-bound envelopes used to establish the environmental design and qualification bases for equipment. The upper bound

envelopes indicate that the zone data reflects the worse case expected environment produced by a compendium of accident conditions. ~~Estimated chemical environmental conditions are also reported in Appendix 3H.~~

~~Accident environmental profiles (i.e. Pressure, Temperature, Radiation) and operating service conditions are provided in Environmental Data Sheets per Appendix J, in Reference 3.11-3.~~

~~3.11.2.2~~ 3.11.4 Qualification Program, Methods and Documentation

3.11.4.1 Harsh Environment Qualification

Some safety-related equipment is located in a harsh environment. 10 CFR 50.49(b) electrical equipment that is located in a harsh environment is qualified by test or other methods as described in IEEE-323-1974 and permitted by 10 CFR 50.49(f) (Reference 3.11-2) or IEEE 323-2003, since both versions of IEEE 323 contain the same qualification methods and processes for harsh environment qualification. Equipment type test is the preferred method of qualification.

~~Safety-related mechanical equipment that is located in a harsh environment is qualified by analysis of materials data, which are generally based on test and operating experience.~~ A type test subjects a representative sample of equipment, including interfaces, to a series of tests, simulating the effects of significant aging mechanisms during normal operation. The sample is subsequently subjected to DBA testing that simulates and thereby establishes the tested configuration for installed equipment service, including mounting, orientation, interfaces, conduit sealing, and expected environments. A type test demonstrates that the equipment performs the intended safety-related function(s) for the required operating time before, during, and/or following the DBA, as appropriate.

Performance data from equipment of similar design that has successfully operated under known service conditions may be used in qualifying other equipment to equal or less severe conditions. Applicability of this data depends on the adequacy of documentation establishing past service conditions, equipment performance, and similarity to the equipment to be qualified and upon which operating experience exists. A demonstration of required operability during applicable DBA(s) is included in equipment qualification programs based on operating experience, when harsh environment design basis event qualification is required.

Qualification by analysis requires a logical assessment or a valid mathematical model of the equipment to be qualified. The bases for analysis typically include physical laws of nature, results of test data, operating experience, and condition indicators. Analysis of data and tests for material properties, equipment rating, and environmental tolerance can be used to demonstrate qualification. However, analysis alone is not used to demonstrate the initial qualification for safety-related electrical equipment in a harsh environment.

Safety-related mechanical equipment qualified by analysis is consistent with ASME Boiler and Pressure Vessel (B&PV) Code Section III-2001, "Rules for Construction of Nuclear Power Plant Components."

Active safety-related mechanical equipment is qualified by the qualification methods of IEEE 323.

Safety-related equipment located in harsh environments may be qualified by combinations of type test, operating experience, and analysis. For example, if a type test of a complete assembly is not possible, component testing supplemented by analysis may be used.

The ESBWR EQ program meets the requirements of Regulatory Guide 1.89 for safety-related electrical equipment in harsh environments. Regulatory Guide 1.89 endorses IEEE 323-1974. Safety-related equipment is qualified using the qualification methods of IEEE 323-1974 or IEEE 323-2003, since both contain the same qualification methods and processes. IEEE 323-2003 contains additional requirements such as EMI/RFI and surge testing requirements for electrical equipment, including lessons learned from NRC research.

However, equipment already qualified to IEEE 323-1974 need not be requalified to IEEE 323-2003, except that previously qualified electrical and electronic equipment are tested to supplemental EMI/RFI and surge testing, if applicable and not previously performed.

The effects of chemistry spray must be addressed. Containment spray, emergency core cooling initiation, and recirculation system operation are included in the qualification tests. The ESBWR SLCS injects borated water into the Reactor Pressure Vessel (RPV) during DBA LOCA. Containment spray is not caustic; therefore the effect of the demineralized water spray is included in the equipment qualification.

The EQ program includes safety-related mechanical equipment, in harsh environment areas and verifies that they are designed to be compatible with postulated environmental conditions, including those associated with LOCA. Active safety-related mechanical equipment is qualified using test, analysis, or a combination of test and analysis.

In some instances, mechanical equipment loading under normal service is more severe than loading under DBA. The loading under normal service is documented with test and/or analysis. The loading and capability under DBA conditions is analyzed in the EQ process to establish the suitability of materials, parts, and equipment needed for safety-related functions, and to verify that the design of such materials, parts, and equipment is adequate. The qualification of mechanical equipment includes materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms), required operating time, non-metallic subcomponents of such equipment; the environmental conditions and process parameters for which this equipment must be qualified; non-metallic material capabilities; and the evaluation of environmental effects.

~~Qualified~~The mechanical and electrical equipment has a ~~design~~ qualified life of 60-years. The ~~design~~qualified life is verified using methods and procedures of qualification and documentation as stated in IEEE-323 and as addressed herein.

~~The qualification program and methodology are described in detail in the NRC approved licensing Topical Report on GE's environmental qualification program (Reference 3.11-3). This report also addresses compliance with the applicable portions of the General Design Criteria of 10 CFR 50, Appendix A, and the Quality Assurance Criteria of 10 CFR 50, Appendix B. Additionally, the report describes conformance to Regulatory Guides and IEEE Standards referenced in SRP 3.11.~~

~~Safety-related equipment located in a mild environment, as defined by 10 CFR 50.49 paragraph (c), is qualified per IEEE . Safety-Related Distributed Control and Information~~

~~System (Q-DCIS) equipment located in areas characterized as mild environments, also meet RG 1.209, and type testing is the preferred method. Q-DCIS meets RG 1.180 for EMI/RFI and the documentation is consistent with the applicable elements of IEEE , Section 7.2.~~

3.11.4.2 Mild Environment Qualification

Safety-related equipment located in a mild environment is qualified as follows:

To assure safety-related equipment located in a mild environment meets its safety-related functional requirements during normal environmental conditions and AOOs, the environmental design basis for normal environmental conditions and AOO requirements is specified in the design/purchase specifications. A qualified life is not required for equipment located in a mild environment that has no significant aging mechanisms.

For all safety-related equipment, excluding safety-related computer-based I&C systems, a Certificate of Conformance from the vendor of the safety-related equipment to be located in a mild environment needs to certify performance to the environmental design basis for normal environmental conditions and AOO requirements for the equipment location for the time that the safety-related function is required.

3.11.4.3 Computer-based I&C Systems

Safety-related computer-based I&C systems comply with Regulatory Guide 1.209. For all safety-related computer-based I&C systems, located in a mild environment, type testing is the preferred qualification method to demonstrate performance to the environmental design basis for normal environmental conditions and AOO requirements for the equipment location for the time that the safety-related function is required.

Type tests may be separate laboratory or manufacturer's tests that document performance to the applicable service conditions with due consideration for synergistic effects, if applicable.

When computer-based I&C systems type testing is performed:

- The system under test functions and performs with safety-related software that has been validated and verified and is representative of the software to be installed in the nuclear power plant.
- Testing demonstrates performance of safety-related functions at the specified environmental service conditions, including AOOs.
- Testing exercises all portions of the system under test that are necessary to accomplish the safety-related functions and those portions whose operation or failure could impair the safety-related functions.
- Testing confirms the response of digital interfaces and verifies that the design accommodates the potential impact of environmental effects on the overall response of the system.
- Testing of a complete system is preferred.
- When testing of a complete system is not practical, confirmation of the dynamic response to the most limiting environmental and operational conditions is based on type testing of the individual modules and analysis of the cumulative effects of environmental and

operational stress on the entire system to demonstrate required safety-related performance.

- The evidence of qualification in a mild environment is consistent with the guidance given in IEEE 323-2003 Section 7.2.

3.11.4.4 EQ Documentation

The procedures and results of qualification by tests, analyses or other methods are documented, maintained, and reported in accordance with requirements of 10 CFR 50.49(j), Regulatory Guide 1.209, and IEEE 323-2003 Section 7.2. The Environmental Qualification Document (EQD) summarizes the qualification results for all equipment identified in Subsection 3.11.~~1~~2. The EQD is developed during program implementation and includes the following:

- The ~~test~~ environmental parameters and the methodology used to qualify the equipment for~~located in~~ harsh and mild environments.
- The System Component Evaluation Work (SCEW) sheets which include a summary of environmental conditions and qualified conditions. ~~for the equipment located in a harsh environment zone as described in Table I-1 of GE's Environmental Qualification Program (Reference 3.11-3).~~

The compliance with the applicable portions of the General Design Criteria of 10 CFR 50, Appendix A, and the Quality Assurance Criteria of 10 CFR 50, Appendix B are described in the NRC approved Licensing Topical Report on GE's environmental qualification program (Reference 3.11-3).

The COL Applicant will provide a milestone for implementation of the environmental qualification program that includes completion of the plant specific EQD. (Refer to Subsection 3.11.7, Item 3.11-1-A).

3.11.5 Loss of Heating, Ventilating and Air Conditioning

~~The ESBWR needs no safety-related Heating, Ventilating and Air Conditioning (HVAC) system.~~ Sections 6.4 and 9.4 ~~describes~~describe the HVAC systems including their design evaluations. The loss of ventilation conditions are considered in Appendix 3H and the calculations are based on maximum heat loads assuming operation of all operable equipment regardless of safety-related classification.

~~3.11.4~~ 3.11.6 Estimated Chemical and Radiation Environment

Chemical Environment

Equipment in the lower portions of the containment is potentially subject to submergence. The chemical composition and resulting pH to which safety-related equipment is exposed during normal operating and accident conditions is reported in Appendix 3H.

Sampling stations are provided for periodic analysis of reactor water, refueling and fuel storage pool water, and suppression pool water to assure compliance with operational limits of the plant technical specifications.

Radiation Environment

Safety-related systems and components are designed to perform their safety-related function when exposed to the normal operational radiation levels and accident radiation levels.

The normal operational exposure is based on the radiation sources provided in Chapter 12.

The radiation sources associated with the Design Basis Accident (DBA) and developed in accordance with NUREG-1465 are used. Dose rates and integrated doses of radiation that are associated with normal plant operation and the DBA condition for various plant compartments are presented in Appendix 3H; these parameters are presented in terms of time-based profiles where applicable.

~~3.11.5~~ 3.11.7 COL~~Combined Operating License~~ Information

3.11-1-A Environmental Qualification Document (EQD)

The COL Applicant will provide a full description and a milestone for program implementation ~~milestone for implementation~~ of the environmental qualification program that includes completion of the plant-specific EQD per Subsection 3.11.~~3~~4.4.

3.11-2-H Environmental Qualification Records (Deleted)

~~3.11.6~~ 3.11.8 References

3.11-1 USNRC, ~~SRP 3.11 Draft 3 (04/1996),~~ "Environmental Qualification of Mechanical and Electrical Equipment," NUREG-0800, SRP 3.11.

3.11-2 USNRC, Code of Federal Regulations, Title 10, Chapter I, Part 50, Paragraph 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plant."

3.11-3 General Electric Co., "General Electric Environmental Qualification Program," NEDE-24326-1-P, Proprietary Document, January 1983.

3.11-4 Regulatory Guide 1.209, "Guidelines for Environmental Qualification of Safety-related Computer Based Instrumentation and Control Systems in Nuclear Power Plants."

3.11-5 NUREG 0588, USNRC, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," December 1979.

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
B21 Nuclear Boiling System					
Depressurization Valves	~~10~~8	CV	ESF	72 hr	MH
Safety Relief Valves	~~8~~10	CV	ESF	72 hr	MH
Temperature element in DPV/SRV Discharge	12	CV	ESF	72 hr	EH
MSIV - Inboard	4	CV	PB	~~72 hr~~100 Days	MH
MSIV - Outboard	4	RB	PB	~~72 hr~~100 Days	MH
MSIV Drain Bypass Valve	2	ST	ESF	72 hr	MH
Steam Line Lowpoint Drain Bypass Valve	1	TB	ESF	72 hr	MH
Feedwater isolation valve	4	ST/CV	PB	~~72 hr~~100 Days	MH
RPV Level Transmitters	24	RB	ESF	~~72 hr~~100 Days	EH
RPV Temperature Elements	12	CV	ESF	~~72 hr~~100 Days	EH
RPV Temperature Elements	12	RB	ESF	~~72 hr~~100Days	EH
RPV Pressure Transmitter	20	RB	ESF	~~72 hr~~100 Days	EH
Electrical Modules and Cable	All	CV, RB, ST, TB	ESF	100 Days	EH
B32 Isolation Condenser System					
Isolation Valves	16	CV	PB	~~72 hr~~100 Days	MH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
Isolation Valves ~~Nitrogen Motor~~ Operator	16	CV	ESF	~~72 hr~~100 Days	MH
Condensate Return Valves	4	CV	ESF	~~72 hr~~100 Days	MH
Condensate Return Valves ~~Nitrogen~~ Operator	4	CV	ESF	~~72 hr~~100 Days	MH
Condensate Return Bypass Valve	4	CV	ESF	~~72 hr~~100 Days	MH
Condensate Return Bypass Valve ~~pneumatic~~ Operator	4	CV	ESF	~~72 hr~~100 Days	MH
Upper Header Vent Valve	8	CV	ESF	~~72 hr~~100 Days	MH
Upper Header Vent Valve ~~Solenoid~~ Actuator	8	CV	ESF	~~72 hr~~100 Days	MH
Lower Header Vent Valve	16	CV	ESF	~~72 hr~~100 Days	MH
Lower Header Vent Valve ~~Solenoid~~ Actuator	16	CV	ESF	~~72 hr~~100 Days	MH
~~Dryer/Separator~~Equipment Storage Pool Connections	4	RB	ESF	~~72~~ 100 Days ~~hr~~	MH
Vent Line Temperature Element	8	CV	ESF	~~72 hr~~100 Days	EH
Condensate Drain Temperature Element	12	CV	ESF	~~72 hr~~100 Days	EH
Steam Piping Diff Pressure Transmitter	8	CV	ESF	~~72 hr~~100 Days	EH
Condensate Drain Diff Pressure Transmitter	8	CV	ESF	~~72 hr~~100 Days	EH
Electrical Modules and Cable	All	CV, RB	ESF	100 Days	EH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
C12 Control ~~Road~~ Rod Drive System					
HCU Scram Solenoid Pilot Valve	135	RB	ESF	72 hr	MH
FMCRD Brake	269	CV	ESF	72 hr	MH
FMCRD Separation Indication Probe	269	CV	ESF	72 hr	EH
FMCRD Reed Switch	269	CV	ESF	72 hr	EH
Charging Water Header Pressure Transmitter	4	RB	ESF	72 hr	EH
Electrical Modules and Cable	All	CV, RB	ESF	72 hr	EH
C21 Leak Detection and Isolation System					
Pressure Transmitters	All~~Multiple~~	CV, RB, CB	ESF	~~72 hr~~100 Days	EH
Temperature Sensors	All~~Multiple~~	CV, RB, CB	ESF	~~72 hr~~100 Days	EH
Electrical Modules and Cable	All	CV, RB, CB	ESF	100 Days	EH
C51 Neutron Monitoring System					
Detector and Tube Assembly	81	CV	ESF	72 hr	MH
Electrical Modules and Cable	All~~Multiple~~	CV, RB, CB	ESF	~~72 hr~~100 Days	EH
C61 Remote Shutdown Panel					
Electrical Panels, Modules and Cable	All~~Multiple~~	RB	ESF	~~72 hr~~100 Days	~~EH~~E
C63 Safety-Related DCIS					
Electrical Modules and Cable	All~~Multiple~~	RB, CB	ESF	~~72 hr~~100 Days	~~EH~~E

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
C71 Reactor Protection System					
Electrical Modules and Cable	All~~Multiple~~	CB, RB	ESF	~~72 hr~~100 Days	EH
C74 Safety System Logic and Control					
Electrical Modules and Cable	All~~Multiple~~	CB, RB	ESF	~~72 hr~~100 Days	EH
C41 Standby Liquid Control System					
RPV Isolation Valve	2	CV	PB	72 hr	MH
Isolation Check Valves	4	CV/RB	PB	72 hr	MH
Squib Injection Valves	4	RB	ESF	72 hr	MH
Injection Shut Off Valves Actuator	4	RB	ESF	~~72 hr~~100 Days	EH
Nitrogen Charging Globe Valve	2	RB	ESF	~~72 hr~~100 Days	MH
Nitrogen Charging Globe Valve Actuator	2	RB	ESF	~~72 hr~~100 Days	EH
Nitrogen Charging Check Valve	2	RB	ESF	72 hr	MH
Accumulator Depressurization Valves	4	RB	ESF	~~72 hr~~100 Days	MH
Accumulator Depressurization Valves Actuator	4	RB	ESF	~~72 hr~~100 Days	EH
Accumulator Relief Valve	2	RB	PB	72 hr	MH
Injection Shut Off Valves	4	RB	ESF	72 hr	MH
Accumulator Level Instrumentation	8	RB	ESF	~~72hr~~100 Days	EH
Accumulator Pressure Instrumentation	2	RB	ESF	~~72hr~~100 Days	EH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
Electrical Modules and Cable	All	CV/RB	ESF	100 Days	EH
D11 Process Radiation Monitoring System					
Isolation Valves	4	CV, RB, CB	ESF	~~72 hr~~100 Days	MH
Radiation Monitors, sensors, Electrical Modules and Cable	All~~Multiple~~	CV, RB, CB	ESF	~~72 hr~~100 Days	EH
E50 Gravity Driven Cooling System					
GDCS Pool Level Instrumentation	6	CV	ESF	~~72 hr~~100 Days	EH
GDCS Squib Valve to GDCS Pool	8	CV	ESF	72 hr	MH
GDCS Check Valve to GDCS Pool	8	CV	ESF	72 hr	MH
GDCS Squib Valve to Suppression Pool	4	CV	ESF	72 hr	MH
GDCS Check Valve to Suppression Pool	4	CV	ESF	72 hr	MH
GDCS Squib Valve to Lower DW	12	CV	ESF	72 hr	MH
Electrical Modules and Cable	All	CV, RB, CB	ESF	100 Days	EH
G21 Fuel and Auxiliary Pools Cooling System					
CIV - Drywell Spray - Outboard	1	RB	PB	72 hr	MH
CIV - Drywell Spray - Inboard	1	CV	PB	72 hr	MH
CIV - SPC Suction - Outboard	4	RB	PB	72 hr	MH
CIV - SPC Return - Outboard	2	RB	PB	72 hr	MH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
CIV - SPC Return - Inboard	2	CV	PB	72 hr	MH
CIV - GDCS Suction - Outboard	1	RB	PB	72 hr	MH
CIV - GDCS Suction - Inboard	1	CV	PB	72 hr	MH
CIV - GDCS Return - Outboard	1	RB	PB	72 hr	MH
CIV - GDCS Return - Inboard	1	CV	PB	72 hr	MH
LPCI Isolation	4	FB/RB	PB	72 hr	MH
IC/PCC Pool Level Instrumentation	4	RB	ESF	~~72 hr~~100 Days	EH
Fuel Pool Level Instruments	2	FB	ESF	~~72 hr~~100 Days	EH
Electrical Modules and Cable	All	CV, FB, RB, CB	ESF	100 Days	EH
G31 Reactor Water Cleanup/Shutdown Cooling System					
CIV - Mid Vessel - Inboard	2	CV	PB	72 hr	MH
CIV - Mid Vessel - Outboard	2	RB	PB	72 hr	MH
CIV - Mid Vessel - Inboard Operator	2	CV	PB	72 hr	EH
CIV - Mid Vessel - Outboard Operator	2	RB	PB	72 hr	EH
CIV - Bottom Drain Inboard	2	CV	PB	72 hr	MH
CIV - Bottom Drain Outboard	2	RB	PB	72 hr	MH
CIV - Bottom Drain Inboard Operator	2	CV	PB	72 hr	EH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
CIV - Bottom Drain Outboard Operator	2	RB	PB	72 hr	EH
CIV - Process Sampling Line -Inboard	2	CV	PB/PAMS	~~72 hr~~100 Days	MH
CIV - Process Sampling Line -Outboard	2	RB	PB/PAMS	~~72 hr~~100 Days	MH
CIV - Process Sampling Line -Inboard Operator	2	CV	PB/PAMS	~~72 hr~~100 Days	EH
CIV - Process Sampling Line -Outboard Operator	2	RB	PB/PAMS	~~72 hr~~100 Days	EH
Return Line Shutoff Valve	2	RB	ISOL	72 hr	MH
Check Valve to Feedwater	4	RB	ISOL	72 hr	MH
Mid-vessel Flow Instrumentation	2	CV	ISOL	~~72 hr~~100 Days	EH
Mid-vessel Temperature Instrumentation	4	CV	ISOL	~~72 hr~~100 Days	EH
Bottom Drain Flow Instrumentation	2	CV	ISOL	~~72 hr~~100 Days	EH
Bottom Drain Temperature Instrumentation	4	CV	ISOL	~~72 hr~~100 Days	EH
Return Line Flow Instrumentation	2	RB	ISOL	~~72 hr~~100 Days	EH
Return Line Temperature Instrumentation	4	RB	ISOL	~~72 hr~~100 Days	EH
Overboard Flow Instrumentation	2	RB	ISOL	~~72 hr~~100 Days	EH
Overboard Temperature Instrumentation	4	RB	ISOL	~~72 hr~~100 Days	EH
Electrical Modules and Cables	All	CV, RB	ESF	100 Days	EH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
H11 Main Control Room Panels					
Panels, ~~and~~ Modules and Cables	All~~Multiple~~	CB	ESF	~~72hr~~100 Days	E
H12 MCR Back Room Panels					
Panels, ~~and~~ Modules and Cable	All~~Multiple~~	CB	ESF	~~72hr~~100 Days	E
H21 Local Panels and Racks					
Panels, ~~and~~ Modules and Cable	All~~Multiple~~	ALL	ESF	~~72hr~~100 Days	EH
P10 Makeup Water System					
Isolation Valves	All~~Multiple~~	CV, RB	ISOL	72hr	MH
P25 Chilled Water System					
Isolation Valves	8	CV, RB	ISOL	72hr	MH
P51 Service Air System					
Isolation Valves	4	CV, RB	ISOL	72hr	MH
P54 High Pressure Nitrogen Supply System					
Isolation Valves	4	CV, RB	ISOL	72hr	MH
R10 Electrical Power Distribution System (EPDS)					
Cable and Supports	All	CB, FB, RB	ESF	100 Days	EH
R11 Medium Voltage Distribution System					
Medium Voltage Components	All	TB	ESF	100 Days	E
R13 Uninterruptible AC Power Supply					
Electrical Modules and Cable	All	CV, CB, RB	ESF	100 Days	EH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
R16 Direct Current Power Supply					
Division 250 VDC Battery	8	RB	ESF	100 Days	E
Division 250 VDC Normal/Standby Battery Charger	12	RB	ESF	100 Days	E
Division 250 VDC Power Center	8	RB	ESF	100 Days	E
Division 250 VDC Transfer Switch Box	8	RB	ESF	100 Days	E
Isolation Power Center Normal Main Circuit Breaker	4	RB	ISOL	100 Days	E
Isolation Power Center Alternate Main Circuit Breaker	4	RB	ISOL	100 Days	E
Isolation Power Center Supply Breaker to Division 250 VDC Normal Battery Charger	12	RB	ISOL	100 Days	E
Electrical Modules and Cable	All	CV, CB, RB, TB	ESF	100 Days	E
R31 Raceway System					
Electrical Penetrations	All	CV	PB	100 Days	EH
Conduit, Cable Trays and Supports	All	CV, CB, RB, TB	ESF	100 Days	EH
R41 Plant Grounding System					
Plant Grounding System	All	OO	ESF	100 Days	E
T10 Containment System					
Vacuum Breakers	3	CV	ESF	~~72hr~~100 Days	MH

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
Vacuum Breaker Isolation Valves	3	CV	ESF	72hr	MH
Instrumentation and Cables	All	CV	ESF	100 Days	EH
T15 Passive Containment Cooling System					
Vent Fan Ball Check Valves	6	CV	ESF	100 Days	MH
PCCS Vent Fan	6	CV	ESF	100 Days	EH
T31 Containment Inerting System					
Isolation Valve	10	CV, RB	ISOL	~~72 hr~~100 Days	MH
Electrical Modules and Cable	All	CB, RB	ESF	100 Days	EH
T62 Containment Monitoring System					
Electrical Modules and Cable	All	CB, CV, RB	ESF	100 Days	EH
U40 Reactor Building HVAC					
Building Isolation Dampers	All	RB	ESF	100 Days	EH
Electrical Modules and Cable	All	RB	ESF	100 Days	EH
U77 Control Building HVAC					
CRHA Supply Air Isolation Dampers	All	CB	ESF	100 Days	E
EFU Downstream Isolation Dampers	All	CB	ESF	100 Days	E
CRHA Restroom Exhaust Isolation Dampers	All	CB	ESF	100 Days	E
CRHA Smoke Exhaust Intake Isolation Dampers	All	CB	ESF	100 Days	E
CRHA Smoke Exhaust Output Isolation Dampers	All	CB	ESF	100 Days	E
Emergency Filter Unit (EFU)	All	CB	ESF	100 Days	E

Table 3.11-1

Electrical and Mechanical Equipment for Environmental Qualification

Components	Quantity	Location (note 1)	Function (note 2)	Required Operation Time (note 3)	Qualification Program (note 4)
Electrical Modules and Cable	All	CB	ESF	100 Days	E
U98 Fuel Building HVAC					
FBGAVS Building Supply Air Isolation Dampers	All	FB	ESF	100 Days	EH
FBGAVS Building Exhaust Air Isolation Dampers	All	FB	ESF	100 Days	EH
FBFPVS Building Supply Air Isolation Dampers	All	FB	ESF	100 Days	EH
FBFPVS Building Exhaust Air Isolation Dampers	All	FB	ESF	100 Days	EH
Electrical Modules and Cable	All	FB	ESF	100 Days	EH

Note 1: CV – Containment Vessel
ST – Steam Tunnel
RB – Reactor Building
FB – Fuel Building
CB – Control Building
TB – Turbine Building
OO – Outdoors Onsite

Note 2: ESF – Engineered Safeguard Feature
PAMS – Post Accident Monitoring
ISOL – Isolation
PB – Pressure Boundary

Note 3: The period of time which the equipment must remain available or operational.

Note 4: E – Electrical Equipment Program
M – Mechanical Equipment Program
H – Harsh Environment