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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – DCD Section 3.9 – RAI Numbers 3.9-106, 3.9-107, and 3.9-161 through 3.9-163**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

Reference:

1. MFN 06-378, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application,* October 10, 2006

Enclosure:

1. MFN 07-058 – Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – DCD Section 3.9 – RAI Numbers 3.9-106, 3.9-107, and 3.9-161 through 3.9-163

cc: AE Cubbage USNRC (with enclosures)
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eDRF 0000-0061-0410

Enclosure 1

MFN 07-058

Response to Portion of NRC Request for

Additional Information Letter No. 67

Related to ESBWR Design Certification Application

DCD Section 3.9

RAI Numbers 3.9-106, 3.9-107, and 3.9-161 through 3.9-163

NRC RAI 3.9-106

In DCD Tier 2, Section 3.9.3.5.2, provide a detailed description of the Dynamic Load Qualification that demonstrates the functionality and operability of a representative active valve.

GE Response

The detailed outline of dynamic load or seismic qualification by a process of analysis, test or a combination that is applicable to active valves is provided in DCD Tier 2, Chapter 3. However, some citation corrections and text revision will be incorporated for clarification.

DCD Impact

DCD Tier 2, Section 3.9, will be revised as noted in the attached markup.

NRC RAI 3.9-107

In DCD Tier 2, Section 3.9.3.5, provide a list of the Design Reports documenting the qualification of the safety-related valves. Confirm that the Design Reports meet the requirements stated in ASME Section III NCA 3550.

GE Response

The Design Reports required under the ASME Code, Section III, are specifically for the as-built materiel, fabricated components and systems supplied to and installed in or constructed for a specific plant or facility. Generally, the equity interest holder most responsible for the construction of a plant or facility, who is typically also the license applicant or license holder (licensee), is defined under the ASME Code as the Owner. The Owner has responsibilities as outlined under the ASME Code, Section III, Subarticle NCA-3200, which includes review of the Design Reports for conformance in accordance with Subsubarticle NCA-3260 requirements. Thus, this list of Design Reports are records of the plant's construction and remain on file in accordance with the licensee's records retention program established and maintained in accordance with the requirements of 10CFR Part 50, Appendix B.

DCD Impact

DCD Tier 2, Subsection 3.9.3, will be revised for clarification as noted in the attached markup.

NRC RAI 3.9-161

Section 3.9.6 -functional design and qualification test for POVs Describe the method for functional design and qualification for each power operated valve (POV) with safety-functions used in the ESBWR.

GE Response

Section 3.9.6, "In-Service Testing of Pumps and Valves," does not address design function qualification testing of active valves. The design function of each active safety-related valve is described under the corresponding system discussion within the DCD Tier 2 documentation. The qualification testing of active valves to demonstrate the capability to complete safety-related design functions under conditions imposed by dynamic and/or seismic loads is addressed in Subsections 3.9.2 and 3.9.3, especially 3.9.3.5.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 3.9-162

DCD Tier 2, Section 3.9.6.1 states that the COL holder will meet the ISTC provisions for inservice testing (IST) of motor-operated valves (MOVs) in the ESBWR. Discuss the requirements for supplementing the MOV stroke-time provisions in Section ISTC of the ASME OM Code with a program for periodic verification of the design-basis capability of safety-related MOVs as indicated in 10 CFR 50.55a.

GE Response

The referenced requirement comes from 10 CFR 50.55a, (b)(3)(ii) Motor-Operated Valve testing, which states that licensees "shall comply with the provisions for testing motor-operated valves in OM Code ISTC ..., and shall establish a program to ensure that motor-operated valves continue to be capable of performing their design basis safety functions." The requirement to develop and implement MOV periodic design function capability testing, initially ordered to licensees under GL 89-10 and subsequently under GL 96-05, is also incorporated in the NUREG-0800, Standard Review Plan 3.9.6, Revision 3-Draft." Analytic methods, test methods and testing procedures for periodic verification of MOV capability have been evolved by industry groups with participation by current licensees sufficiently that the NRC Commission closed Generic Safety Issue 158, "Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions" (Ref.: Regulatory Issue Summary 00-003). Thus, GE will incorporate a statement to include a program of periodic verification using appropriate testing and methods that demonstrates the performance capability is sufficient for each power-operated valve with active safety-related function(s) to complete its safety-related function(s) under design basis conditions.

DCD Impact

DCD Tier 2, Subsection 3.9.6.1, will be revised as noted in the attached markup.

NRC RAI 3.9-163

Discuss the requirements to provide for periodic verification of the design basis capability of POVs other than MOVs with safety functions in the ESBWR.

GE Response

Refer to response to RAI 3.9-162

DCD Impact

No DCD changes will be made in response to this RAI.

(RAI NO. 3.9-106) – DCD TIER 2, SUBSECTION 3.9.3.5.2 MARK-UP

3.9.3.5.2 Other Active Valves

Other safety-related active valves are ASME Class 1, 2 or 3 and are designed to perform their mechanical motion during dynamic loading conditions. The operability assurance program ensures that these valves operate during a dynamic seismic and other RBV event.

Procedures

Qualification tests accompanied by analyses are conducted for all active valves. Procedures for qualifying electrical and instrumentation components, which are depended upon to cause the valve to accomplish its intended function, are described in ~~Subsection 3.9.3.5~~**Section 3.10**.

Tests

Prior to installation of the safety-related valves, the following tests are performed: (1) shell hydrostatic test to the Code requirements; (2) back seat and main seat leakage tests; (3) disk hydrostatic test; (4) functional tests to verify that the valve opens and closes within the specified time limits when subject to the design differential pressure; and (5) operability qualification of valve actuators for the environmental conditions over the installed life. Environmental qualification procedures for operation follow those specified in Section 3.11. The results of all required tests are properly documented and included as a part of the operability acceptance documentation package.

Dynamic Load Qualification

The functionality of an active valve during and after a seismic and other RBV event may be demonstrated by an analysis or by a combination of analysis and test. The qualification of electrical and instrumentation components controlling valve actuation is discussed in ~~Subsection 3.9.3.5~~**Section 3.10**. The valves are designed using either stress analyses or the pressure temperature rating requirements based upon design conditions. An analysis of the extended structure is performed for static equivalent dynamic loads applied at the center of gravity of the extended structure. Refer to Subsection 3.9.2.2 for further details.

The maximum stress limits allowed in these analyses confirm structural integrity and are the limits developed and accepted by the ASME for the particular ASME Class of valve analyzed.

When qualification of mechanisms that must change position to complete their safety-related function is based on dynamic testing or equivalent static load testing, operability testing is performed for the loads defined by the applicable events and conditions per Subsection 3.9.1.1 and Table 3.9-1.

The dynamic qualification testing procedure for valve operability is outlined below. A subject valve assembly is mounted in a test stand or fixture in a manner that will conservatively represent typical valve installation(s). Each test valve assembly includes the actuator and accessories that are attached to an in-service valve. Additional discussion of test criteria and method is provided in Subsection 3.9.2.2, and also in the portions of Subsections 3.10.1 and 3.10.2 applicable to active valve assemblies.

Dynamic load qualification is accomplished in the following way:

(1) The active valves are designed to have a fundamental frequency that is greater than the high frequency asymptote (ZPA) of the dynamic event. This is shown by suitable test or analysis.

(2) The actuator and yoke of the valve system is statically loaded to an amount greater than that due to a dynamic event. The load is applied at the center of gravity to the actuator alone in the direction of the weakest axis of the yoke. The simulated operational differential pressure is simultaneously applied to the valve during the static deflection tests.

(3) The valve is then operated while in the deflected position (i.e., from the normal operating position to the safe position). The valve is verified to perform its safety-related function within the specified operating time limits.

(4) ~~Motor operators~~**Powered valve actuators** and other ~~electrical appurtenances~~ **accessory components directly attached onto the valve or actuator that are** necessary for operation are qualified as operable during a dynamic event by appropriate qualification tests prior to installation on the valve. The~~se motor operators~~**powered actuator assemblies** then have individual Seismic Category I supports attached to decouple the dynamic loads between the ~~operators~~ **actuators** and valves themselves.

The piping, stress analysis, and pipe support designs maintain the ~~motor operator~~**actuator assembly** accelerations below the qualification levels with adequate margin of safety.

If the fundamental frequency of the valve, by test or analysis, is less than that for the ZPA, a dynamic analysis of the valve is performed to determine the equivalent acceleration to be applied during the static test. The analysis provides the amplification of the input acceleration considering the natural frequency of the valve and the frequency content of the applicable plant floor response spectra. The adjusted accelerations have been determined using the same conservatism contained in the horizontal and vertical accelerations used for rigid valves. The adjusted acceleration is then used in the static analysis and the valve operability is assured by the methods outlined in Steps (2) through (4), using the modified acceleration input. Alternatively, the valve, including the actuator and all other accessories, is qualified by shake table test.

Valves that are safety-related but can be classified as not having an overhanging structure, such as check valves and pressure-relief valves, are considered as follows:

(RAI NO. 3.9-107) – DCD TIER 2, SUBSECTION 3.9.3 MARK-UP

3.9.3 ASME Code Class 1, 2 and 3 Components, Component Supports and Core Support Structures

This subsection discusses the structural integrity of pressure-retaining components, their supports, and core support structures which are designed in accordance with the rules of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Division 1 (hereinafter "the Code") and General Design Criteria 1, 2, 4, 14, and 15 as discussed in SRP 3.9.3 draft R2.

The plant design meets the relevant requirements of the following regulations:

(1) 10 CFR Part 50.55a and GDC1 as they relate to structures and components being designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed.

(2) GDC 2 as it relates to safety-related structures and components being designed to withstand the effects of earthquakes combined with the effects of normal or accident conditions.

(3) GDC 4 as it relates to safety-related structures and components being designed to accommodate the effects of and to be compatible with the environmental conditions of normal and accident conditions.

(4) GDC 14 as it relates to the reactor coolant pressure boundary being designed, fabricated, erected, and tested to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

(5) GDC 15 as it relates to the reactor coolant system being designed with sufficient margin to ensure that the design conditions are not exceeded.

The ASME Code, Section III, requires that a design specification be prepared for ASME Class 1, 2 and 3 components. The design specifications for ASME Class 1, 2 and 3 components, supports, and appurtenances are prepared under administrative procedures that meet the ASME Code rules. The specifications conform to and are certified to the requirements of the applicable subsection of the ASME Code, Section III. The ASME Code also requires design reports for Class 1, 2 or 3 components be prepared which demonstrate that the as-built components satisfy the requirements of the respective ASME design specification for each component and the applicable ASME Code. These design specifications and the design reports are completed by the license applicant, or the applicant's authorized agent, in accordance with the responsibilities outlined under the ASME Code, Section III. The ASME Code design reports include the record of as-built reconciliations, for example, the evaluations of changes to piping support locations, the pre-operational testing and results, and reported construction deviation resolutions, and also includes the small-bore piping analysis.

3.9.3.1 Loading Combinations, Design Transients and Stress Limits

(RAI NO. 3.9-162) – DCD TIER 2, SUBSECTION 3.9.6.1 MARK-UP

3.9.6.1 In-Service Testing of Safety-Related Valves

Check Valves

All safety-related piping systems incorporate provisions for testing to demonstrate the operability of the check valves under design conditions. In-service testing incorporates the use of advance non-intrusive techniques to periodically assess degradation and the performance characteristics of the check valves in accordance with the provisions of ISTC. The Subsection ISTC tests are performed, and check valves that fail to exhibit the required performance may be disassembled for evaluation. The Code provides criteria limits for the test parameters identified in Table 3.9-8. A program shall be developed by the COL holder referencing the ESBWR design, to establish the frequency and the extent of each disassembly. The program may be revised throughout the plant life to minimize disassembly based on past disassembly experience. (Refer to Subsection 3.9.9.3 (1) for COL information requirements.)

~~Motor-Operated~~Power-Operated Valves

The ~~motor-operated valve (MOV)~~ **power-operated valve (POV)** equipment specifications**, including those for the pneumatic-operated (air or nitrogen), pneumatic-motor operated, hydraulic-operated, solenoid-operated, motor-operated and pyrotechnic-operated valves,** require the incorporation of the results of either in-situ or prototype testing with full flow and pressure or full differential pressure to verify the proper **actuator** sizing and correct ~~switch~~ **controls** settings of the valves.

Guidelines to justify prototype testing **of MOVs** are contained in Generic Letter 89-10, Supplement 1, Questions 22 and 24 through 28. **These guidelines are appropriately applied to prototype testing of other power-operated valves.** The COL holder referencing the ESBWR design shall perform a study to determine the optimal frequency for **power-operated** valve stroking during in-service testing such that unnecessary ~~testing~~ **cycling** and damage ~~is not done~~ to the valve **does not occur** as a result of the testing. (Refer to Subsection 3.9.9.3 (1) for COL information requirements).

The concerns and issues identified in Generic Letter 89-10 for MOVs shall be addressed prior to plant startup. The method of assessing the loads, the method of sizing the actuators, and the setting of the torque and limit switches, are specifically addressed. **The methods for assessing loads, sizing valve actuators and determining controls settings for AOVs shall consider the guidance developed by the Joint Owners Group on Air-Operated Valves. The guidance from these two sources should also be used to address these same issues for other power-operated valves.** (Refer to Subsection 3.9.9.3 (1) for COL information requirements.)

Generic Letter 96-05 provides guidance for a program of periodic verification of MOV design basis capability. A program for periodic AOV capability testing should follow the guidelines established by the Joint Owners Group on Air-Operated Valves. The intent of guidance from these two sources should be used to develop a periodic test program for other power-operated valves. The COL holder referencing the ESBWR design shall address the program for periodic verification of design basis capability for all power-operated valves.

The in-service testing of ~~MOVs~~ **POVs** relies on diagnostic techniques that are consistent with the state of the art and which permit an assessment of the performance of the valve under actual loading. Periodic testing per Subsection ISTC is conducted under adequate differential pressure and flow conditions that allow a justifiable demonstration of continuing ~~MOV~~ capability for design basis conditions, including recovery from inadvertent valve positioning. ~~MOVs~~ **POVs** that fail the acceptance criteria, and are "declared inoperable," for stroke tests and leakage rate can be disassembled for evaluation. The Code provides criteria limits for the test parameters identified in Table 3.9-8. A program shall be developed by the COL holder referencing the ESBWR design to establish the frequency and the extent of disassembly and inspection based on suspected degradation of all safety-related ~~MOVs~~**POVs**, including the basis for the frequency and the extent of each disassembly. The program may be revised throughout the plant life based on past disassembly experience. (Refer to Subsection 3.9.9.3 (1) for COL information requirements.)

Isolation Valve Leak Tests

The leaktight integrity is verified for each valve relied upon to provide a leaktight function. These valves include:

(1) Pressure Isolation Valves — valves that provide isolation of pressure differential from one part of a system from another or between systems.

(2) Temperature Isolation Valves — whose leakage may cause unacceptable thermal loading on supports or stratification in the piping and thermal loading on supports or whose leakage may cause steam binding of pumps.

(3) Containment Isolation Valves — valves that perform a containment isolation function in accordance with Evaluation Against Criterion 54, Subsection 3.1.2.5.5.2, including valves that may be exempted from Appendix J, Type C testing but whose leakage may cause loss of suppression pool water inventory.

Leakage rate testing of valves is in accordance with Subsection ISTC, Paragraph ISTC-3600.

NOTE:

Additional DCD Tier 2 Chapter 3 markups affected by the above markup are found on the following pages

Abbreviations And Acronyms

Term	Definition
PABX	Private Automatic Branch (Telephone) Exchange
PAM	Post Accident Monitoring
PAR	Passive Autocatalytic Recombiner
PAS	Plant Automation System
PASS	Post Accident Sampling Subsystem of Containment Monitoring System
PCC	Passive Containment Cooling
PCCS	Passive Containment Cooling System
PCT	Peak cladding temperature
PCV	Primary Containment Vessel
PFD	Process Flow Diagram
PGA	Peak Ground Acceleration
PGCS	Power Generation and Control Subsystem of Plant Automation System
PH	Pump House
PL	Parking Lot
PM	Preventive Maintenance
PMCS	Performance Monitoring and Control Subsystem of NE-DCIS
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
POV	**Power-Operated Valve**
PQCL	Product Quality Check List
PRA	Probabilistic Risk Assessment
PRMS	Process Radiation Monitoring System
PRNM	Power Range Neutron Monitoring
PS	Plant Stack
PSD	Power Spectra Density
PSS	Process Sampling System
PSWS	Plant Service Water System
PT	Pressure Transmitter
PWR	Pressurized Water Reactor
QA	Quality Assurance
RACS	Rod Action Control Subsystem
RAM	Reliability, Availability and Maintainability
RAPI	Rod Action and Position Information
RAT	Reserve Auxiliary Transformer
RB	Reactor Building
RBC	Rod Brake Controller
RBCC	Rod Brake Controller Cabinet
RBCWS	Reactor Building Chilled Water Subsystem

SUBSECTION 3.9.1

Subsequent COL holders need only provide the information on the schedules in accordance with the applicable portions of position C.3 of Regulatory Guide 1.20 for non-prototype internals (Subsection 3.9.2.4).

3.9.1.1 ASME Class 2 or 3 or Quality Group D Components with 60 Year Design Life

COL holders shall identify ASME Class 2 or 3 Quality Group D components that are subjected to loadings, which could result in thermal or dynamic fatigue and provide the analyses required by the Code, Subsection NB.

3.9.1.2 Pump and Valve In-Service Testing Program

COL holders shall provide a plan for the detailed pump and valve in-service testing and inspection program. This plan:

(1) Includes baseline pre-service testing to support the periodic in-service testing of the components required by technical specifications. Provisions are included to test the pumps, valves, and ~~MOVs~~ **POVs** in accordance with the O&M Code (Reference 3.9-5) and safety-related classification as necessary, depending on test results.

(2) Provides a study to determine the optimal frequency for valve stroking during in-service testing.

(3) Address the concerns and issues identified in Generic Letter 89-10; specifically, the method of assessment of the loads, the method of sizing the actuators, and the setting of the torque and limit switches.

3.9.1.3 Audit of Design Specification and Design Reports

COL holders shall make available to the NRC staff design specification and design reports required by the Code for vessels, pumps, valves and piping systems for the purpose of audit (Subsection 3.9.3).

SUBSECTION 3.9.1.

(1) The equipment is designed to have the capability of performing its design safety 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.

The electrical 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:

Normal Operating Conditions — planned, purposeful, unrestricted reactor operating modes 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.

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).

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

3.9.2 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. Electrical and mechanical equipment safety classifications are further defined on the system design drawings.

Safety-related mechanical equipment and 10 CFR 50.49(b) electrical equipment located in a harsh environment must perform its proper safety function in environments during normal, abnormal, test, design basis 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 shall be included in the Environmental Qualification Document (EQD) to be prepared as mentioned in Subsection 3.11.5.