HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 124 Related to ESBWR Design Certification Application - Mechanical Systems and Components - RAI Numbers 3.9-178, 3.9-180 through 3.9-196 and - Environmental Qualification of Mechanical and Electrical Equipment - RAI Number 3.11-19**

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) originally transmitted via the Reference 1 letter. The GEH response to RAI Numbers 3.9-178, 3.9-180 through 3.9-196 and 3.11-19 are addressed in Enclosure 1.

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

Reference:

1. MFN 08-029, Letter from U.S. Nuclear Regulatory Commission to Mr. Robert E. Brown, Senior Vice President, Regulatory Affairs, GE-Hitachi Nuclear Energy Americas, LLC, *Request For Additional Information Letter No. 124 Related To ESBWR Design Certification Application*, dated January 14, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 124 Related to ESBWR Design Certification Application - Mechanical Systems and Components - RAI Numbers 3.9-178, 3.9-180 through 3.9-196 and - Environmental Qualification of Mechanical and Electrical Equipment - RAI Number 3.11-19.

cc: AE Cubbage USNRC (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
eDRF 0000-0080-2205 and 0000-0080-2214

Enclosure 1

MFN 08-131

Response to Portion of NRC Request for

Additional Information Letter No. 124

Related to ESBWR Design Certification Application

Mechanical Systems and Components

RAI Numbers 3.9-178, 3.9-180 through 3.9-196

And

Environmental Qualification of Mechanical and Electrical Equipment

RAI Number 3.11-19

NRC RAI 3.9-178

NRC Summary:
Valve design-basis capability verification

NRC Full Text:
Section 3.9.3.5, "Valve Operability Assurance," discusses operability assurance of active Code valves, including the actuator, and states that safety-related valves are qualified by testing and analysis. The American Society of Mechanical Engineers (ASME) has prepared ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," to incorporate lessons learned from nuclear power plant operation and research programs for the design and qualification of the capability of valves (including power-operated valves, check valves, and pressure relief valves) to perform their design-basis functions. The NRC staff is proposing a revision to RG 1.100 to address ASME QME-1-2007. GEH is requested to revise the DCD to incorporate lessons learned for the functional qualification of valves used in nuclear power plants, such as through reference to ASME Standard QME-1-2007.

GEH Response

DCD Section 3.9.3.5 will be revised to discuss functional qualification of valves used in the ESBWR.

DCD Impact

DCD Tier 2, Section 3.9.3.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-180

NRC Summary:
MOV tests

NRC Full Text:
Paragraph a, Active Motor Operated Valve Tests, under Item (1), Power Operated Valve Exercise Tests, in Subsection 3.9.6.1.5, "Specific Valve Test Requirements," states that inservice operability testing of active MOVs relies on nonintrusive diagnostic techniques to permit periodic assessment of the valve's ability to perform its safety-related function during design-basis conditions. GEH is requested to discuss its intent regarding reference to "nonintrusive diagnostic techniques" and the justification for the use of such techniques.

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-181

NRC Summary:
Reference to ASME Code Case OMN-1 on MOV testing

NRC Full Text:
Paragraph a) under Item (1) in Subsection 3.9.6.1.5 states that ASME Code Case OMN-1, Revision 1, will be used to develop test frequencies. GEH is requested to revise the DCD to specify that the use of ASME Code Case OMN-1, Revision 1 will be subjected to relief request if necessary.

GEH Response

The text of paragraph a) will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-182

NRC Summary:
MOV risk ranking guidance

NRC Full Text:
The bullet titled "Risk Ranking" in Paragraph a under Item (1) in Subsection 3.9.6.1.5 states that guidance for MOV risk ranking is outlined in the Joint Owners' Group (JOG) MOV Periodic Verification Program Summary (MPR-2524-A). GEH is requested to revise the DCD to indicate that the NRC staff review of MPR-2524-A is described in a safety evaluation dated September 25, 2006.

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-183

NRC Summary:
Ambient temperature consideration in MOV functional margin

NRC Full Text:
The second paragraph under the bullet titled "Functional Margin" in Paragraph a) under Item (1) in Subsection 3.9.6.1.5 does not indicate that ambient temperature effects need to be considered in determining the motor actuator capability. GEH is requested to include ambient temperature in the list of considerations for MOV capability when determining functional margin.

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-184

NRC Summary:
Application of Generic Letter 96-05 and Joint Owners Group Program on MOV Periodic Verification

NRC Full Text:
The third paragraph under the bullet titled "Functional Margin" in Paragraph a under Item (1) in Subsection 3.9.6.1.5 states that the MOV Program utilizes guidance from GL 96-05 and the JOG MOV Periodic Verification study, MPR 2524-A. GEH is requested to revise the DCD to state that, the IST and MOV programs will implement GL 96-05 and the JOG program as discussed in the NRC safety evaluation dated September 25, 2006.

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-185

NRC Summary:
MOV design-basis capability verification

NRC Full Text:
The paragraph titled "Design Basis Verification Test" in Paragraph a under Item (1) in Subsection 3.9.6.1.5 states, prior to power operation, a design-basis verification test is performed upon each MOV to verify its capability to meet the safety-related design-basis requirements. The verification of design-basis capability needs to be accomplished for each safety-related MOV as part of the design and qualification process prior to installation of the MOV in the nuclear power plant. For example, ASME has prepared ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," to incorporate lessons learned from nuclear power plant operation and research programs for the design and qualification of the capability of power operated valves to perform their design-basis functions. The NRC staff is proposing a revision to RG 1.100 to address ASME QME-1-2007. GEH is requested to revise the DCD to indicate the need to verify the design basis capability of safety-related MOVs as part of the design and qualification process prior to installation (such as through application of ASME Standard QME-1-2007).

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-186

NRC Summary:
MOV design-basis capability testing

NRC Full Text:
The paragraph titled "Design Basis Verification Test" in Paragraph a under Item (1) in Subsection 3.9.6.1.5 states that the MOV test is performed at conditions that are as close to design-basis conditions as practicable. GEH is requested to revise the DCD to indicate that where design conditions cannot be achieved the design-basis capability of the MOV will need to be justified by analytical means based on the functional qualification program and extrapolation of test data.

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-187

NRC Summary:
Consideration of uncertainties in MOV functional margin and periodic test intervals

NRC Full Text:
The paragraph titled "Active MOV Test Frequency Determination" in Paragraph a) under Item (1) in Subsection 3.9.6.1.5 states that the ability of a valve to meet its design-basis functional requirements (i.e., required capability) is verified during the design-basis verification test and that the preservice test measures the valve's actual actuator output capability. This information is then used to determine a periodic test interval that is compared to the valve's historical data to verify that any potential valve degradation would not reduce the functional margin to less than zero. GEH is requested to revise the DCD to indicate that uncertainties need to be included in the output and required capabilities when determining functional margin. GEH is also requested to address the determination of potential valve degradation when historical data for the specific valve would not be available at initial plant operation. For example, the JOG Program on MOV Periodic Verification includes provisions for consideration of potential degradation for various valve types.

GEH Response

The text of paragraph a will be deleted since there are no motor-operated valves with an active safety function in the ESBWR design. DCD Revision 4, Tier 2, Table 3.9-8 listed four valves with motor-operators. The operator types on these four valves are being changed, as shown in the response to RAI 3.9-159 S01, which was submitted to the NRC on February 11, 2008 under MFN 08-109.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-188

NRC Summary:
Other power-operated valve (POV) testing

NRC Full Text:
Paragraph b, Other Power-Operated Valve Operability Tests, under Item (1) in Subsection 3.9.6.1.5 states that Power-Operated Valves other than active MOVs are exercised quarterly in accordance with ASME OM ISTC. GEH is requested to revise the DCD to address the implementation of Regulatory Issue Summary 2000-003, "Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions."

GEH Response

As discussed in the response to RAI 3.9-189, this paragraph will be deleted from the DCD since quarterly stroking of power-operated valves is covered in Section 3.9.6.1.4, paragraph (1), and design basis verification testing is covered by Section 3.9.3.5.2. Regulatory Issue Summary (RIS) 2000-003 informed the industry of the closure of Generic Safety Issue (GSI) 158, "Performance of Safety- Related Power-Operated Valves Under Design Basis Conditions," and of the NRC staff's intent to continue to monitor activities associated with verification of power-operated valve capability. The RIS also discusses some performance issues and industry initiatives related to air-operated valves (AOVs), and discusses a "voluntary initiative" to establish a program to ensure AOVs are designed and set up to perform their intended functions. The RIS mentions the Joint Owners' Group (JOG) AOV Program and the NRC's comments on the JOG AOV Program Document, and also provides a list of attributes of a successful AOV program. However, the RIS requires no actions or written responses.

AOVs in the ESBWR will be functionally qualified to perform their intended function(s) as discussed in the response to RAI 3.9-178. This functional qualification will address some of the successful program attributes in Attachment 1 of RIS 2000-003, for example, thrust/torque prediction methods will incorporate lessons learned from industry efforts, valve weak links will be determined and diagnostic testing will be performed. However, establishment of a voluntary AOV program in response to RIS 2000-003 is the decision and responsibility of the plant license holder. Since such a program is not a regulatory requirement, a COL holder item is not included in the DCD.

DCD Impact

No DCD changes will be made in response to this RAI. DCD Tier #2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the response to RAI 3.9-189.

NRC RAI 3.9-189

NRC Summary:
Other POV design basis capability verification

NRC Full Text:
The paragraph titled "Design Basis Verification Test" in Paragraph b under Item (1) in Subsection 3.9.6.1.5 states, prior to power operation, a design-basis verification test is performed upon each Power-Operated Valve (POV) to verify its capability to meet the safety-related design-basis requirements. As discussed with regard to MOVs, the verification of design-basis capability needs to be accomplished for each safety-related POV as part of the design and qualification process prior to installation of the POV in the nuclear power plant. GEH is requested to revise the DCD to indicate the need to verify the design-basis capability of safety-related POVs as part of the design and qualification process prior to installation (such as through application of ASME Standard QME-1-2007).

GEH Response

Paragraph b under Item (1) in Subsection 3.9.6.1.5 will be deleted. Quarterly stroking of power-operated valves is covered in Section 3.9.6.1.4, paragraph (1), and design basis verification testing is covered by Section 3.9.3.5.2. The response to RAI 3.9-178 revises DCD Tier 2, Section 3.9.3.5, to clarify that valves are functionally qualified to perform their required functions as part of "Valve Operability Assurance," using QME-1-2007 as guidance.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-190

NRC Summary:
POV design-basis capability test

NRC Full Text:
The paragraph titled "Design Basis Verification Test" in Paragraph b under Item (1) in Subsection 3.9.6.1.5 states that the POV test is performed at conditions that are as close to design-basis conditions as practicable. GEH is requested to revise the DCD to indicate, where design conditions cannot be achieved, the design-basis capability of the POV will need to be justified by analytical means based on the functional qualification program and extrapolation of test data.

GEH Response

Paragraph b under Item (1) in Subsection 3.9.6.1.5 will be deleted, as discussed in the response to RAI 3.9-189. Qualification of mechanical equipment, as discussed elsewhere in the DCD (e.g., Section 3.10) allows qualification by a combination of testing and analysis. Section 3.10.2.3 addresses extrapolation of dynamic loading conditions.

DCD Impact

DCD Tier # 2, Section 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-191

NRC Summary:
NRC RG 1.192 on ASME OM Code Cases

NRC Full Text:
The second paragraph in Section 3.9.6.6, "10 CFR 50.55a Relief Requests and Code Cases," refers to RG 1.147 with regard to NRC staff acceptance of ASME OM Code Case OMN-1. This reference should be to RG 1.192 for ASME OM Code Cases.

GEH Response

This paragraph will be deleted. OMN-1 is not utilized for the ESBWR since there are no motor-operated valves with an active safety function in the ESBWR design.

DCD Impact

DCD Tier # 2, Section 3.9.6.6 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-192

NRC Summary:
IST program 120-month interval

NRC Full Text:
Section 3.9.6.7, "Inservice Testing Program Implementation," states that the duration of each 120-month test interval may be modified by as much as one year as allowed by the Code. ISTA-3120, "Inservice Test Interval," in the ASME OM Code-2004 states in paragraph (d) states that adjustments shall not cause successive intervals to be altered by more than one year from the original pattern of intervals. Therefore, if the COL Holder extends an IST Program interval by one year, then successive intervals cannot exceed 10 years unless the interval is decreased to allow the original pattern of intervals to be achieved. GEH is requested to revise the DCD to include the additional Code provision with respect to modifying the IST Program interval.

GEH Response

DCD Tier #2, Section 3.9.6.7 will be revised to include the additional Code provision with respect to modifying the IST Program interval.

DCD Impact

DCD Tier # 2, Section 3.9.6.7 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-193

NRC Summary:
POV design-basis capability

NRC Full Text:
The first paragraph in Section 3.9.6.8, "Non-Code Power Testing of Other Operated Valve Testing," states that active POVs are tested to verify that the valve opens and closes under static and design conditions. Where design conditions cannot be achieved, Section 3.9.6.8 states that testing is performed at the maximum achievable dynamic conditions. GEH is requested to revise the DCD to indicate, where design conditions cannot be achieved, the design-basis capability of the POV will need to be justified by analytical means based on the functional qualification program and extrapolation of test data.

GEH Response

Section 3.9.6.8 will be revised to clarify the purpose and scope of power-operated valve pre-operational testing. Pre-operational testing is not intended to verify operator capability; verification of operator capability is performed as part of designing and qualifying the equipment. The pre-operational testing will verify the valve is set up properly, consistent with its documented qualification, and will typically be performed under static (no pressure or flow) conditions.

DCD Impact

DCD Tier #2, Section 3.9.6.8 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-194

NRC Summary:
POV test parameters

NRC Full Text:
The first paragraph in Section 3.9.6.8 lists critical parameters to be measured during POV testing. If Section 3.9.6.8 only applies to POVs other than MOVs, GEH is requested to clarify the relationship between Section 3.9.6.8 and paragraph b under Item (1) in Subsection 3.9.6.1.5.

GEH Response

Paragraph b under Item (1) in Section 3.9.6.1.5 will be deleted as discussed in the response to RAI 3.9-189, and Section 3.9.6.8 will be revised as discussed in the response to RAI 3.9-193, to clarify the pre-operational testing that will be performed and to clarify the purpose and scope of the testing.

DCD Impact

DCD Tier #2, Sections 3.9.6.8 and 3.9.6.1.5 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-195

NRC Summary:
POV functional capability

NRC Full Text:
The second paragraph in Section 3.9.6.8 states that operating loads including uncertainties are compared to the structural capabilities of the POV. GEH is requested to revise the DCD to include the consideration of uncertainties in the determination of structural as well as functional capabilities of the POV.

GEH Response

DCD Tier #2, Section 3.9.6.8 will be revised to include the consideration of uncertainties in the determination of structural as well as functional capabilities of the POV.

DCD Impact

DCD Tier #2, Section 3.9.6.8 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.9-196

NRC Summary:
Inservice testing verification items

NRC Full Text:
The third paragraph in Section 3.9.6.8 provides a list of items that are verified to demonstrate the acceptability of the functional performance of POVs during pre-operational testing. GEH is requested to revise the DCD to indicate that these items are also applicable in demonstrating the acceptability of functional performance of POVs during inservice testing.

GEH Response

The list of items that are verified as part of the pre-operational testing included items that are verified by IST program testing and items that are verified by pre-operational testing, as discussed in the revised Section 3.9.6.8 and in the responses to RAIs 3.9-193, 3.9-194 and 3.9-195. Accordingly, this list of items in Section 3.9.6.8 will be deleted. Section 3.9.6.1 describes the scope and purpose of testing in the IST program, and the revised Section 3.9.6.8 describes the scope and purpose of the pre-operational testing.

DCD Impact

DCD Tier #2, Section 3.9.6.8 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.11-19

NRC Summary:
Revise Section 3.11.2.2 to reference qualified life of 60 years.

NRC Full Text:
Section 3.11.2.2, third paragraph states that "Qualified mechanical and electrical equipment has a design life of 60-years. The design life is verified using methods and procedures of qualification and documentation as stated in IEEE-323 and as addressed herein." The EQ program develops qualified life for mechanical and electrical equipment. Revise as follows: "The mechanical and electrical equipment has a qualified life of 60-years. The qualified life is verified using methods and procedures of qualification and documentation as stated in IEEE-323 and as addressed herein."

GEH Response

DCD Tier #2, Section 3.11.2.2 will be revised to state, "The mechanical and electrical equipment has a qualified life of 60-years. The qualified life is verified using methods and procedures of qualification and documentation as stated in IEEE-323 and as addressed herein."

DCD Impact

DCD Tier #2, Section 3.11.2.2 will be revised as noted in the attached markup.

3.9.3.5 Valve Operability Assurance

~~Active mechanical (with or without electrical operation) equipment designed to perform a mechanical motion for its safety-related function is Seismic Category I. Equipment with faulted condition functional requirements includes active pumps and valves in fluid systems such as the Residual Heat Removal (RHR) System, Emergency Core Cooling System (ECCS), and MS system.~~

This subsection discusses operability assurance of active Code valves, including ~~the~~ actuators ~~that is a part of the valve~~ (Subsection 3.9.2.2).

Valves that perform an active safety-related function are functionally qualified to perform their required functions. ASME QME-1-2007 is used as guidance in performing this qualification. Qualification specifications (e.g., design specifications) are prepared to ensure the operating conditions and safety functions for which the valves are to be qualified are communicated to the manufacturer or qualification facility. Qualification specifications are consistent with Appendices QV-I and QV-A of QME-1.

Functional qualification addresses key lessons learned from industry efforts, particularly on air- and motor-operated valves, many of which are discussed in Section QV-G of QME-1. For example:

- Evaluation of valve performance is based on a combination of testing and analysis, using design similarity to apply test results to specific valve designs.
- Testing to verify proper valve setup and acceptable operating margin is performed using diagnostic equipment to measure stem thrust and/or torque.
- Sliding friction coefficients used to evaluate valve performance (e.g. disk-to-seat friction coefficients for gate valves and bearing coefficients for butterfly valves) account for the effects of temperature, cycle history, load and internal parts.
- Actuator sizing allows margin for aging/degradation, test equipment accuracy and other uncertainties, as appropriate.
- Material combinations that may be susceptible to galling or other damage mechanisms under certain conditions are not used.

~~Safety-related valves are qualified by testing and analysis and by satisfying the stress and deformation criteria at the critical locations within the valves. Operability is assured by meeting the requirements of the programs defined in~~ Subsection 3.9.2.2 and~~,~~ Section 3.10 provide details on the seismic qualification of valves.~~,~~ Section 3.11 provides details on the ~~and the following subsections~~environmental qualification of valves.

Section 4.4 of GE's Environmental Qualification Program (Reference 3.9-3) applies to this subsection, and the seismic qualification methodology presented therein is applicable to mechanical as well as electrical equipment.

3.9.3.5.1 Major Active Valves

Some of the major safety-related active valves (Tables 6.2-21, 6.2-42 and 3.2-1) discussed in this subsection for illustration are the main steamline isolation valves and safety relief valves, and

3.9.6 In-Service Testing of Pumps and Valves

Inservice testing of certain ASME Code, Section III, Class 1, 2, and 3 pumps and valves is performed in accordance with the ASME Operations and Maintenance (OM) Code as required by 10 CFR 50.55a(f), including limitations and modifications set forth in 10 CFR 50.55a. ~~Operability testing as required by 10 CFR 50.55a(b)(3)(ii) is performed on motor-operated valves (MOVs) that are included in the ASME OM Code inservice testing program to demonstrate that the MOVs are capable of performing their design basis safety function(s).~~ The Inservice Testing Program does not include any non-Code Class valves.

In-service testing of pumps and valves is in conformance with the relevant requirements of 10 CFR Part 50, Appendix A, General Design Criteria 1, 37, 40, 43, 46, 54, and 10 CFR 50.55a(f). The relevant requirements are as follows:

(1) GDC 1, as it relates to testing safety-related components to quality standards commensurate with the importance of the safety-related functions to be performed.

(2) GDC 37, as it relates to periodic functional testing of the emergency core cooling system to ensure the leak tight integrity and performance of its active components.

(3) GDC 40, as it relates to periodic functional testing of the containment heat removal system to ensure the leak tight integrity and performance of its active components.

(4) GDC 43, as it relates to periodic functional testing of the containment atmospheric cleanup systems to ensure the leak tight integrity and the performance of the active components, such as pumps and valves.

(5) GDC 46, as it relates to periodic functional testing of the cooling water system to ensure the leak tight integrity and performance of the active components.

(6) GDC 54, as it relates to piping systems penetrating containment being designed with the capability to test periodically the operability of the isolation and determine valve leakage acceptability.

(7) Subsection 50.55a(f) of 10 CFR, as it relates to including pumps and valves whose function is required for safe operation in the in-service testing program to verify operational readiness by periodic testing.

The Inservice Testing Program includes periodic tests and inspections that demonstrate the operational readiness of safety-related components and their capability to perform their safety-related functions. The inservice testing program is based on the requirements of the ASME OM Code, Subsections ISTA, ISTB, ISTC and (mandatory) Appendix I. The specific ASME OM Code requirements for functional testing of pumps are found in the ASME OM Code, Subsection ISTB, requirements for inservice testing of valves are found in the ASME OM Code, Subsection ISTC, and requirements for inservice testing of pressure relief devices are found in ASME OM Code, (mandatory) Appendix I. General requirements for inservice testing are found in ASME OM Code, Subsection ISTA.

The requirements for system pressure testing are defined in ASME Code Section XI, Subsection IWA-5000; this testing, which verifies pressure boundary integrity, is included within the scope of the inservice inspection program described in Subsection 5.2.4 and Section 6.6.

The requirements for preservice and inservice examination and testing of dynamic restraints are defined in the ASME OM Code Subsection ISTD. This program is described in DCD Subsection 3.9.3.7.1.

Refer to Subsection 3.9.9 for COL information requirements. The COL applicant will provide milestones for implementation of the preservice and inservice testing programs and other ~~motor-operated~~ valve-related programs.

3.9.6.1 InService Testing Valves

Certain ASME Code Class 1, 2, and 3 valves and pressure relief devices are subject to inservice testing in accordance with the ASME OM Code Subsection ISTC and/or Appendix I, including the general requirements in ISTA. Inservice testing of valves assesses operational readiness including actuating and position-indicating systems. The valves that are subject to inservice testing include those valves that perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident. In addition, pressure relief devices used for protecting systems or portions of systems that perform a function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident, are subject to inservice testing.

The inservice testing program does not require testing of nonsafety-related valves. Any nonsafety-related valves included in the Inservice Testing Program as part of regulatory treatment of nonsafety-related systems (RTNSS, see Appendix 19A) are considered augmented components and tested commensurate with their functions.

Valves subject to inservice testing in accordance with the ASME OM Code are indicated in DCD Table 3.9-8.

Active valve dynamic qualification and pre-installation testing requirements to assure valve operability are addressed in Subsection 3.9.3.5. Periodic operability (non-ASME Code) testing for power-operated valves ~~(other than motor-operated valves)~~ is described in Subsection 3.9.6.8.

3.9.6.1.1 Valve Exemptions

ASME OM Code ISTC-1200 provides exemptions from the inservice testing program for certain Code Class 1, 2, and 3 valves provided that they are not required to perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident. The following valves are exempt from Subsection ISTC:

(1) valves used only for operating convenience such as vent, test, drain and instrument valves

(2) valves used only for system control, such as pressure regulating valves

(3) valves used only for system or component maintenance

(4) skid-mounted valves provided they are justified and adequately tested

(5) valves used for external control and protection systems responsible for sensing plant conditions and providing signals for valve operation (e.g. solenoid valves on air operated valves).

accordance with ISTC-3560. These tests are performed in conjunction with the valve exercise test. Fail-safe test requirements are identified in Table 3.9-8.

- Category D explosively actuated valves are subject to periodic test firing of the explosive actuator charges. In accordance with ASME OM Code ISTC-5260, at least 20 percent of the charges installed in the plant in explosively actuated valves are fired and replaced at least once every 2 years. If a charge fails to fire, all charges within the same batch number are removed, discarded, and replaced with charges from a different batch. The firing of the explosive charge may be performed inside the valve or outside of the valve in a test fixture.

  The maintenance and review of the service life for charges for explosively actuated valves follows the requirements in the ASME OM Code ISTC-5260.

  Category D explosively actuated valves are identified in Table 3.9-8.

- Category D rupture disks are replaced on a 5 year frequency unless historical data indicates a requirement for more frequent replacement, in accordance with Mandatory Appendix I of the ASME OM Code.

  Category D rupture disks are identified in DCD Table 3.9-8.

3.9.6.1.5 Specific Valve Test Requirements

~~(1)Power Operated Valve Exercise Tests~~

~~a.Active Motor Operated Valve Tests~~

~~The inservice operability testing of active motor operated valves relies on nonintrusive diagnostic techniques to permit periodic assessment of the valve's ability to perform its safety-related function during design basis conditions. MOVs upon which inservice testing is performed are identified in Table 3.9-8. Test frequencies are developed in accordance with Generic Letter 96-05 and ASME Code Case OMN-1, Rev. 1 and will not exceed 10 years.~~

~~Inservice testing of active MOVs consists of both static and dynamic testing. The specific testing frequencies are based on the individual valve's risk ranking and functional margin. These factors are described below.~~

~~□Risk Ranking~~

~~The MOV's risk ranking is determined by review of the valve's individual Probabilistic Safety Assessment (PSA) which is documented on the individual component's ranking worksheet and reviewed and approved by an expert panel. Guidance for this process is outlined in the Joint Owners' Group (JOG) Motor Operated Valve Periodic Verification Program Summary [MPR-2524-A].~~

~~□Functional Margin~~

~~Functional margin is that increment by which the MOV's available capability exceeds the capability required to operate the MOV under design basis conditions. The required capability of the MOV is a known, calculated quantity, which is then compared to the valve's actual capability, a measured quantity.~~

~~Diagnostic equipment inaccuracies, degraded voltage, control switch repeatability, load-sensitive MOV behavior and margin for degradation are considered in the calculations used to determine the valve's capacity from the valves measured test values.~~

~~The MOV Program utilizes guidance from Generic Letter 96-05 and the Joint Owners Group (JOG) MOV Periodic Verification (PV) study, MPR 2524-A (November 2006).~~

~~**Design Basis Verification Test** – Prior to power operation a design basis verification test is performed upon each active motor-operated valve to verify the capability of each valve to meet its safety-related design basis requirements. The test is performed at conditions that are as close to design basis conditions as practicable. Results from this test are used along with the valves preservice test to develop the valve's initial (periodic verification) testing frequency.~~

~~**Active MOV Test Frequency Determination** – The ability of a valve to meet its design basis functional requirements (i.e. required capability) is verified during the valve's design basis verification test. The preservice test measures the valve's actual actuator output capability. The difference between the two capabilities is termed "functional margin." With the valves functional margin and risk ranking, a periodic verification test interval/frequency is determined. This determined test frequency is first compared to the valve's historical data to verify that any potential valve degradation during the test period would not reduce the functional margin to less than zero prior to the next scheduled periodic verification test. If the data shows that the functional margin may be reduced to less than zero, the frequency is reduced to ensure that the next periodic verification test is performed prior to a loss of functional margin. If there is not sufficient data to determine whether there will be a loss of functional margin prior to the next periodic verification test, the test frequency is limited to not exceed two (2) refueling cycles or three (3) years, whichever is longer, for high risk safety significant components, and is limited to not exceed three (3) refueling cycles or five (5) years, whichever is longer, for low risk safety significant components.~~

~~A motor operated valve with an adequate functional margin is assured of being able to open and/or close under design basis conditions.~~

~~b.Other Power-Operated Valve Operability Tests~~

~~Power-operated valves other than active MOVs are exercised quarterly in accordance with ASME OM ISTC. Active and passive power-operated valves upon which operability testing is performed are identified in Table 3.9-8.~~

~~**Design Basis Verification Test** – Prior to power operation a Design Basis Verification Test will be performed upon each Power-Operated Valve so as to verify the capability of each valve to meet it's safety-related design requirements. The test will be performed at conditions that are as close to design basis conditions as practicable.~~

~~(2)~~(1) Manual Valve Exercise Tests

Active Category A and B manual valves are exercised once every two years in accordance with 10 CFR 50.55a(b)(3)(vi).

~~(3)~~(2) Check Valve Exercise Tests

Category C check valves are exercised to both the open and closed positions regardless of safety function position in accordance with ASME OM Code ISTC-5221.

During the exercise test, valve obturator position is verified by direct observation (position indicating lights) or by other positive means (i.e., changes in system pressure, temperature, flow rate, level, seat leakage or nonintrusive testing results).

Check valves are exercised open with flow to either the full open position or to the position required to perform its intended open safety function. Check valve closure tests are performed by verifying that the obturator travels to the seat upon cessation of flow or reverse flow. Check valves with only an open safety function may be verified closed by other direct observations such as pressure, level, temperature, or seat leakage. This methodology meets the exercise requirements of ISTC-5221.

Check valve exercise tests and frequencies are included in Table 3.9-8.

~~(4)~~(3) Vacuum Breaker Tests

Vacuum breakers must meet the test requirements for both a Category C check valve (ISTC-5220) and for a pressure relief device (Appendix I). Vacuum breaker tests and frequencies are included in Table 3.9-8.

~~(5)~~(4) Pressure Relief Valve Tests

Pressure relief devices that protect systems or portions of system that are required to perform a function in shutting down the reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident, are subject to periodic inservice testing. The inservice tests for these valves are identified in ASME OM Code (mandatory) Appendix I.

The periodic inservice testing includes visual inspection, seat tightness determination, set pressure determination, and operational determination of balancing devices, alarms, and position indication as appropriate. The frequency for this inservice test is every 5 years for ASME Class 1, and every 10 years for ASME Classes 2 and 3 devices. Pressure relief valves that require inservice testing are identified in Table 3.9-8.

3.9.6.2 Inservice Testing of Pumps

The ESBWR design does not require the use of pumps to mitigate the consequences of any design basis accident, or to achieve or maintain the safe shutdown condition. Therefore, there are no pumps required to be included in the Inservice Testing Program. Table 3.9-8 does not list any pumps in the Inservice Testing Program.

3.9.6.3 Preservice Testing of Valves

Category A, B, C (check valves), and D valves that are subject to periodic inservice testing are preservice tested in accordance with ASME OM Code Subsection ISTC-3100.

Category C pressure relief valves are preservice tested in accordance with ASME OM Code, Mandatory Appendix I.

3.9.6.4 Deferred Testing Justifications

In cases where it is not practicable to exercise category A, B or C (check) valves during normal power operations (quarterly), the valve is exercised during cold shutdown or refueling as permitted by ASME OM Code Subsections ISTC-3521 and ISTC-3522.

Valve exercise tests and associated frequencies are identified in Table 3.9-8. Justifications for deferred testing are detailed in the Inservice Testing Program.

3.9.6.5 Valve Replacement, Repair and Maintenance

Testing in accordance with ASME OM, ISTC-3310 and ISTC-5000 is performed after a valve is replaced, repaired, or has undergone maintenance that could affect the valve's performance.

3.9.6.6 10 CFR 50.55a Relief Requests and Code Cases

Inservice testing of ASME Code Class 1, 2, and 3 pumps and valves is performed in accordance with the ASME Operations and Maintenance (OM) Code except where specific relief has been granted by the NRC in accordance with 10 CFR 50.55a(f). Relief from the testing requirements of ASME OM Code is requested when compliance with requirements of the ASME OM Code is not practical. In such cases, specific information is provided which identifies the impractical code requirement, justification for the relief request, and the testing method to be used as an alternative. Demonstration of the impracticality of the testing required by the Code, and justification for alternative testing proposed is provided.

~~The IST program described herein utilizes Code Case OMN-1, Revision 1, "Alternative Rules for the Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants." Code Case OMN-1 establishes alternate rules and requirements for preservice and inservice testing to assess the operational readiness of certain motor operated valves in lieu of the requirements set forth in ASME OM Code Subsection ISTC. Implementation of the program described will require request for relief, unless Code Case OMN-1, Revision 1 is approved by NRC in Regulatory Guide 1.147, or the case has been incorporated into the OM Code on which the IST program is based, and that code is approved in 10 CFR 50.55a(b).~~

The IST program does not invoke the use of any ~~other~~ ASME Code Cases for inservice testing.

3.9.6.7 Inservice Testing Program Implementation

ASME OM Code inservice test intervals are as required by ISTA-3120; the initial 120-month test interval beginning following the start of commercial service. The duration of each 120-month test interval may be modified by as much as one year as allowed by the Code, provided these adjustments do not cause successive intervals to be altered by more than one year from the original pattern of intervals.

3.9.6.8 Non-Code ~~Power Testing of Other Power-Operated Valves Testing~~

Although the design basis capability of power-operated valves is verified as part of the design and qualification process, power-operated valves that perform an active safety function are tested again after installation in the plant, as required, to ensure valve setup is acceptable to perform their required functions, consistent with valve qualification. These tests, which are typically

performed under static (no flow or pressure) conditions, also document the "baseline" performance of the valves to support future maintenance and trending programs performed by the COL holder. ~~Active safety-related power-operated valve assemblies are tested to verify that the valve opens and closes under static and design conditions. Where design conditions cannot be achieved, testing is performed at the maximum achievable dynamic conditions.~~ During the testing, critical parameters needed to ensure proper valve setup are ~~determine the required closing and opening loads are~~ measured. Depending on the valve and actuator type, ~~T~~these parameters may include seat load, running torque or thrust, valve travel, actuator spring rate, benchset and ~~differential pressure, system pressure, fluid flow, temperature, power supply, operating time and minimum~~ regulator supply pressure. Uncertainties associated with performance of these tests and use of the test results (including those associated with measurement equipment and potential degradation mechanisms) are considered appropriately. Uncertainties may be considered in the specification of acceptable valve setup parameters or in the interpretation of the test results (or a combination of both). Uncertainties affecting both valve function and structural limits are considered.

Additional valve testing may be performed by the COL holder, for example, as part of the plant's AOV Program in response to Regulatory Issue Summary 2000-003 or as part of the plant's preventive maintenance program.

~~The data collected during the testing on the parameters is used to determine the required operating loads for the design operating conditions in conjunction with the diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads or decrease in operating output capability. The resulting operating loads including uncertainties are then compared to the structural capabilities of the power-operated valve.~~

~~During pre-operational testing the following are verified to demonstrate the acceptability of the functional performance.~~

- ~~Valves are verified to open and close as applicable at a range of conditions up to the design conditions to perform its safety function.~~
- ~~For air-operated valves and hydraulically-operated valves the operator capability at minimum supply pressure, power supply or loss of motive force exceed the required operating loads including diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads or decrease in operator output capability.~~
- ~~Solenoid-operated valves must be capable of opening or closing at the minimum power supply voltage.~~
- ~~Air-operated valves and hydraulically-operated valves maximum operating loads including diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads are verified not to exceed the allowable structural capability limits of the power-operated valve components.~~
- ~~Stroke time measurements during opening and closing must be within the design requirements for safety-related functions.~~
- ~~Remote position indication is verified against the local position indication.~~
- ~~Valve seat leakage when fully closed is within established limits, as applicable.~~

~~During the operational inservice testing period the following are verified to demonstrate the acceptability of the functional performance of air-operated and hydraulic-operated valves.~~

~~Periodically assess the diagnostic methods used in the verification of valve function.~~

- ~~Evaluation of lessons learned through other related programs such as the MOV Generic Letter (GL) 89-10 and (GL) 96-05 Programs.~~

3.11.2.2 Qualification Program, Methods and Documentation

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 and permitted by 10 CFR 50.49(f) (Reference 3.11-2). 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.

The mechanical and electrical equipment has a qualified life of 60-years. The qualified life is verified using methods and procedures of qualification and documentation as stated in IEEE-323 and as addressed herein. ~~Qualified mechanical and electrical equipment has a design life of 60-years. The design 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 323. 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 323, Section 7.2.

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). The Environmental Qualification Document (EQD) summarizes the qualification results for all equipment identified in Subsection 3.11.1. The EQD is developed during program implementation and includes the following:

- The test environmental parameters and the methodology used to qualify the equipment located in harsh 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).