GE Energy

David H. Hinds
Manager, ESBWR

PO Box 780 M/C L60
Wilmington, NC 28402-0780
USA

T 910 675 6363
F 910 362 6363
david.hinds@ge.com

MFN 06-452

Docket No. 52-010

November 14, 2006

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

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – Mechanical Systems and Components - RAI Numbers 3.9-127, 3.9-128, 3.9-130, 3.9-131 and 3.9-165**

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

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

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 06-452 – Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – Mechanical Systems and Components - RAI Numbers 3.9-127, 3.9-128, 3.9-130, 3.9-131 and 3.9-165

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRFs 0000-0060-5895, 0000-0060-8053

Enclosure 1

MFN 06-452

Response to Portion of NRC Request for

Additional Information Letter No. 67

Related to ESBWR Design Certification Application

Mechanical Systems and Components

RAI Numbers 3.9-127, 3.9-128, 3.9-130, 3.9-131 and 3.9-165

NRC RAI 3.9-127

The Hydraulic Control Unit (HCU) and subcomponents are identified as Quality Group D. However, consistent with SRP 3.2.2, Revision 1,July 1981, and Draft Revision 2, April 1996, and Regulatory Guide 1.26,Revision 3, February 1976, guidance regarding components designed for reactor shutdown, these should be Quality Group B components. It is the staff position that, because of the safety importance of the reactivity control function, all HCU assemblies and subcomponents, must be designated Quality Group B components. Please revise the DCD accordingly.

GE Response

This question was addressed previously. Please see the response to RAI 3.2-21 provided in the following letter:

MFN 06-308, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Response to NRC Request for Additional Information Letter No. 51 Related to ESBWR Design Certification Application – Classification of Structures, Systems and Components – RAI Numbers 3.2-1 through 3.2-62*, September 8, 2006.

DCD Impact

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

NRC RAI 3.9-128

Clarify design requirements for non-pressure retaining portions of FMCRD The pressure retaining portions of the Fine-Motion Control Rod Drive (FMCRD) are identified as Quality Group A components. FMCRD internals are not identified as either Quality Group A, B, or C. Please provide information on the quality group criteria, design criteria, and allowable stress criteria used for the FMCRD non-pressure retaining components.

GE Response

GE has not given the non-pressure retaining components of the FMCRD a Quality Group designation per RG 1.26 because this Regulatory Guide pertains to pressure retaining components as defined in DCD/Tier 2 Subsection 3.2.2. This is consistent with the ABWR DCD, which does not assign a specific Quality Group to the FMCRD non-pressure retaining components. However, GE has assigned a Safety Class 3 to the FMCRD non-pressure retaining components as noted in the markup of Table 3.2-1 provided in the following letter and incorporated in Revision 2 of DCD/Tier 2 Chapter 3:

MFN 06-308, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Response to NRC Request for Additional Information Letter No. 51 Related to ESBWR Design Certification Application – Classification of Structures, Systems and Components – RAI Numbers 3.2-1 through 3.2-62*, September 8, 2006.

The FMCRD supplier is required to demonstrate the design acceptability of the safety related non-pressure retaining FMCRD components by functional testing or analysis. For analysis, the ASME Code, Section III is used as a guide. The applicable stress criteria for these non-Code components are defined in attached Table 3.9-128-1. These criteria have been used in the design of the ABWR FMCRDs for the K-6/7 and Lungmen projects.

DCD Impact

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

Table 3.9-128-1 Stress Criteria for FMCRD Non-Coded Components

Operating Conditions	Stress Classification (See Note 3)	Stress Limits	Note
Design	P_m P_L $P_m(P_L) + P_b$ Special Stresses	0.9 S_y, 0.5 S_u 1.35 S_y, 0.75 S_u 1.35 S_y, 0.75 S_u *	1, 4, 5 1, 4, 5 1, 4, 5
Service Level A & B (Normal & Upset)	P_e $P_m(P_L) + P_b + P_e + Q$ $P_m(P_L) + P_b + P_e + Q + F$ Special Stresses	2.7 S_y, S_u 2.7 S_y, S_u $U < 1.0$ *	1, 4, 5 1, 4, 5
Service Level B (Upset)	P_m P_L $P_m(P_L) + P_b$	S_y, 0.55 S_u 1.49 S_y, 0.83 S_u 1.49 S_y, 0.83 S_u	1, 4, 5 1, 4, 5 1, 4, 5
Service Level C (Emergency)	P_m P_L $P_m(P_L) + P_b$ Special Stresses	1.08 S_y, 0.70 S_u 1.62 S_y, S_u 1.62 S_y, S_u *120% of Special Stresses	1, 4, 5 1, 4, 5 1, 4, 5
Service Level D (Faulted)	P_m P_L $P_m(P_L) + P_b$	2.16 S_y, 0.80 S_u 2.16 S_y, 1.1 S_u 2.16 S_y, 1.1 S_u	1, 4, 5 1, 4, 5 1, 4, 5
*Special Stresses	Pure Shear Bearing Progressive Distortion of Nonintegral Connections	0.6 S_y $S_y + D_F/D_L (0.5\ S_y)$ S_y	2, 4 4, 6 4

Notes to Table 3.9-128-1:

1. Use the lesser of the values identified.
2. Average pure shear stress limit for torsional shear, use 0.8 S_y. Shear stress other than these shall be included in other calculations.
3. Stress classification definitions are presented in ASME Boiler and Pressure Vessel Code Article NB-3000.
4. Yield strength values (S_y) taken at temperature.
5. Ultimate tensile strength (S_u) taken at temperature.
6. The average bearing stress shall be limited to $S_y + D_F/D_L\ (0.5S_y)$ where D_F is the distance to a free edge and D_L is the distance over which the bearing load is applied. The maximum distance ratio is limited to 1.0.

NRC RAI 3.9-130

The ESBWR FMCRD appears to be similar in design to the Advanced Boiling Water Reactor FMCRD. Please provide a description of the mechanical differences between the two FMCRDs. Please provide information on the design life of the ESBWR FMCRD and an overview of the FMCRD life cycle maintenance program.

GE Response

A description of the mechanical differences between the ABWR and ESBWR FMCRDs was addressed previously in the response to RAI 4.6-3 provided in the following letter:

MFN 06-078, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Response to NRC Request for Additional Information Letter No. 11 Related to ESBWR Design Certification Application – Control Rod Drive System – RAI Numbers 4.6-1 through 4.6-22*, March 16, 2006.

As with the ABWR FMCRD, the ESBWR FMCRD is designed to meet its specified design life (60 years for ESBWR) with appropriate provisions for maintenance, including periodic replacement of non-metallic components such as O-rings. Table 3.9-130-1 provides a general overview of the FMCRD life cycle maintenance program for the ABWR design. The ESBWR FMCRD program, while not yet established, will have similar elements specific to the basic components of the ESBWR drive design. The maintenance cycle for each component will ultimately be established based on the supplier's recommendations to support the equipment design life.

DCD Impact

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

Table 3.9-130-1. Overview of FMCRD Life Cycle Maintenance Program

No.	Component Name	Maintenance Cycle (Units to be maintained every year)
1	Upper Component	No specific maintenance required. (Disassembly and inspection of a sample of 5 to 6 units per year is recommended to confirm acceptability of the upper component.)
2	Lower Component	Every 10 years (20 to 21 units/year)
3	Position Indication Probe (PIP)	Every 10 years (20 to 21 units/year)
4	Motor Bracket	Every 10 years (20 to 21 units/year)
5	Motor Unit (consists of the motor, brake and position resolvers)	Every 10 years (20 to 21 units/year)
6	Separation Indication Probe (SIP)	Every 10 years (20 to 21 units/year)
7	Mounting Bolts and Couplings	Every 10 years (20 to 21 units/year)

NRC RAI 3.9-131

Please provide a description of the ESBWR FMCRD developmental process/tests that demonstrate ESBWR FMCRD performance under actual Boiling Water Reactor operating conditions.

GE Response

The ESBWR FMCRD developmental testing process will follow that of the ABWR FMCRD. This testing is designed to confirm drive performance under the full range of expected BWR operating conditions over its full design life. This includes, but is not limited to, the following types of tests.

Design Acceptance Testing

This testing confirms the performance of a prototypical FMCRD representing the design and materials to be used in the ESBWR. It forms the basis for design acceptance of the FMCRD. The scope of testing includes:

- Mechanical and electrical component testing (i.e., labyrinth seal, ball check valve, hollow piston latches, buffer, motor, magnetic coupling, brake, resolver, separation probe, position indication probe).
- Drive cycles/life testing for step/notch/continuous positioning.
- Scram performance testing, including:

  Testing under conditions of rated and peak transient reactor pressures with system conditions at the most conservative end of their range (e.g., maximum scram line friction loss, minimum HCU hydraulic pressure, maximum control rod weight, maximum drive line misalignment).

  Confirmation of seismic scram performance by testing/analysis with fuel channel deflections expected during seismic conditions.
- Structural adequacy testing under conditions generating the fastest scram velocity and end-of-stroke deceleration loads (e.g., minimum scram line friction loss, maximum HCU hydraulic pressure, maximum control rod weight, minimum drive line misalignment, atmospheric vessel pressure).
- Foreign material admixture test, in which quantities of materials such as sand and iron oxide are introduced into the drive to demonstrate reliable drive performance in the presence of foreign material.

Environmental and Seismic Qualification

The safety related mechanical and electrical components of the FMCRD are environmentally and dynamically qualified. Those parts that contain non-metallics undergo both environmental and

dynamic qualification. The safety related metallic parts are subject to dynamic qualification only.

Production Testing

This testing confirms that each new FMCRD satisfies performance requirements prior to shipment. The scope of this testing includes:

- Hydrostatic testing of pressure retaining components in accordance with Section III of the ASME Code.
- Scram performance testing.
- Special tests, such as demonstration of proper coupling/uncoupling to a prototypical control rod, confirmation of acceptable driveline friction, verification of hollow piston magnet performance, and proper operation of the hollow piston latches.
- Confirmation of motor torque and speed.
- Confirmation of brake performance (i.e., holding torque, release and engagement times).
- Verification that the resolver performance and electrical values are within design limits.
- Position indication and separation probe testing to confirm that position indication is within specified tolerance, switches actuate with minimum specified magnetic field strength, and insulation resistance is acceptable.

DCD Impact

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

NRC RAI 3.9-165

Provide information which demonstrates that the containment vacuum breaker valves and suppression pool vents have been designed, qualified, and capacity certified to meet ASME Section III requirements for Class 2 components. Verify that these devices are included in the IST program.

GE Response

DCD Tier 2, Table 3.9-8, under system T10, vacuum breaker and vacuum breaker isolation valve F002 and F001 respectively are included in the IST program. This Table also includes wetwell gas space discharge valves (or suppression pool gas space vent valves) as T31 system valves F012 and F011. As per this Table, these valves are ASME Section III, Class 2 components and are included in the IST program. The seismic, dynamic and environmental qualifications for these components are addressed DCD Tier 2 section 3.10 and 3.11. Being ASME Section III Class 2 components, their design (including capacity) certification and procurement will be done as required for ASME code components.

DCD Impact

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