October 11, 2006

Mr. David H. Hinds, Manager, ESBWR
General Electric Company
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 79 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Hinds:

By letter dated August 24, 2005, General Electric Company (GE) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter. This RAI concerns Chapter 6, 16 and 17 of the ESBWR Design Control Document.

Chapter 6: 6.2-102 through 6.2-137

Chapter 16: 16.2-110

Chapter 17: 17.4-13 through 17.4-16

To support the review schedule, you are requested to respond to these RAI questions by November 22, 2006.

If you have questions or comments concerning this matter, please contact me at (301) 415-3207 or saw8@nrc.gov or you may contact Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Shawn A. Williams, Project Manager
ESBWR/ABWR Projects Branch
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosure: As stated

cc: See next page

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ACCESSION NO. ML062840401

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DATE	10/11/2006	10/11/06

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REQUESTS FOR ADDITIONAL INFORMATION (RAIs)
ESBWR DESIGN CONTROL DOCUMENT (DCD) TIER 2, Revision 1, Chapter 6, 16, and 17

RAI Number	Reviewer	Question Summary	Full Text
6.2-102	Pulsipher J	The PCCS has no CIVs; one per line is required.	DCD Tier 2, Revision 1, Sections 6.2.4.3.2.1 and 6.2.4.3.2.2, state that the passive containment cooling system (PCCS) has no containment isolation valves (CIVs). This is contrary to the explicit requirements of General Design Criterion (GDC) 56, which state that such lines require a CIV inside containment and another outside containment. It is also inconsistent with the guidance of Standard Review Plan (SRP), Section 6.2.4, Rev. 2, June 1996, Regulatory Guide (RG) 1.141 as well as the national standard ANS-56.2/ANSI N271-1976 on the implementation of the statement in GDC 56. This standard allows other isolation provisions if it can be demonstrated that the containment isolation provisions for a specific class of lines are acceptable on some other defined basis. The heat exchanger modules and piping of the PCCS outside containment, form closed systems. As the justification for having no CIVs, the DCD states that the heat exchanger modules and piping are designed as extensions of the safety-related containment, and that the design pressure of the PCCS is greater than twice the containment design pressure and the design temperature is the same as the drywell design temperature. This clearly does not satisfy the explicit requirements of GDC 56 of 10 CFR Part 50, Appendix A, for two CIVs per penetration. However, GDC 56 also allows other isolation provisions if it can be demonstrated that the containment isolation provisions for a specific class of lines are acceptable on some other defined basis. Regulatory guidance on the implementation of the “other defined basis” provision is found in SRP 6.2.4, Rev. 2, and RG 1.141, “Containment Isolation Provisions for Fluid Systems,” dated April 1978, which endorses ANS-56.2/ANSI N271-1976, “Containment Isolation Provisions for Fluid Systems.” These documents contain two pertinent discussions: 1) Necessary design provisions of a closed system outside containment, and 2) Allowable containment isolation provisions for a closed system outside containment.

RAI Number	Reviewer	Question Summary	Full Text
			(1) Necessary design provisions of a closed system outside containment SRP 6.2.4, Rev. 2, "Containment Isolation System," section II, "Acceptance Criteria," states, under heading e., that a closed system outside containment should have, among other things, "... a design temperature and pressure rating at least equal to that for the containment." ANS-56.2/ANSI N271-1976, section 3.6.7, "Criteria for Closed Systems Outside Containment," is consistent: "(3) Withstand temperature and internal pressure equal to the containment design conditions." Thus, the DCD's justification statement indicates only that the PCCS meets one of the criteria for a closed system outside containment. It is not sufficient to justify having no CIVs. **(2) Allowable containment isolation provisions for a closed system outside containment** SRP 6.2.4, Rev. 2, "Containment Isolation System," section II, "Acceptance Criteria," states, under heading e.: Containment isolation provisions for lines in engineered safety feature or engineered safety feature-related systems normally consist of two isolation valves in series. A single isolation valve will be acceptable if it can be shown that the system reliability is greater with only one isolation valve in the line, the system is closed outside containment, and a single active failure can be accommodated with only one isolation valve in the line. The closed system outside containment should be protected from missiles, designed to seismic Category I standards, classified Safety Class 2 (Ref. 9), and should have a design temperature and pressure rating at least equal to that for the containment. The closed system outside containment should be leak tested, unless it can be shown that the system integrity is being maintained during normal plant operations. For this type of isolation valve arrangement the valve is located outside containment, and the piping between the containment and the valve should be enclosed in a leak tight or controlled leakage housing. If, in lieu of a housing, conservative design of the piping and valve is assumed to preclude a breach of piping integrity, the design should conform to the requirements of SRP Section 3.6.2. Design

RAI Number	Reviewer	Question Summary	Full Text
			of the valve and/or the piping compartment should provide the capability to detect leakage from the valve shaft and/or bonnet seals and terminate the leakage. ANS-56.2/ANSI N271-1976, section 3.6.4, "Single Valve and Closed System Both Outside Containment," contains consistent criteria: For the isolation function of an engineered safety feature or system required to test an engineered safety feature, one barrier is required after the occurrence of a single active failure. Normally, this is accomplished by providing two isolation valves in series. If it is not practical to locate a valve inside containment and if it can be shown that a single active failure can be accommodated with only one valve in the line and that fluid system reliability is enhanced by the single valve over two valves in series while still maintaining at least a single mechanical barrier, and **if the closed system outside containment is treated as an extension of containment**, [emphasis added] then one valve is acceptable. The closed system shall be leak tested in accordance with 5.3 of this Standard unless it can be shown by inspection that system integrity is being maintained for those systems operating during normal plant operation at a pressure equal to or above the containment design pressure. The single valve and piping between the containment and the valve shall be enclosed in a protective leak tight or controlled leakage housing to prevent leakage to the atmosphere. In other words, if the PCCS satisfies the criteria for a closed system outside containment, it needs one CIV per penetration, located outside containment. The justification provided in the DCD that the closed system is treated as an extension of containment does not, per the ANS standard, eliminate the need for one CIV; it is, in fact, necessary to justify having only one CIV instead of two. Revise the DCD to provide a design which is consistent with the staff's regulatory position as detailed in SRP 6.2.4 and RG 1.141, or provide additional justification for maintaining the current design.

RAI Number	Reviewer	Question Summary	Full Text
6.2-103	Pulsipher J	Table 1.9-6 does not include the PCCS and Process Radiation Monitoring System as deviating from SRP 6.2.4.	DCD Tier 2, Revision 1, Table 1.9-6, “Summary of Differences from SRP Section 6,” in its entry for SRP 6.2.4, lists three systems for which the containment isolation provisions differ from the specific SRP acceptance criteria of one CIV inside and one CIV outside containment. However, the PCCS is not mentioned, even though it has no CIVs and does not conform to the provisions of SRP 6.2.4, as discussed in RAI 6.2-102. The Process Radiation Monitoring System is also not mentioned, even though it has both CIVs outside containment. Add the PCCS and the Process Radiation Monitoring System to Table 1.9-6 or change their designs to bring them into conformance with SRP 6.2.4.
6.2-104	Pulsipher J	Requirements from GDC 55-57 are quoted in an incomplete and misleading way. Also, the statement that the design meets these requirements is incorrect for several penetrations.	DCD Section 6.2.4, 2nd paragraph, states that the plant meets the relevant requirements of various GDC for containment isolation design. The staff questions three points of the discussion: (A) The 4th bullet quotes specific, detailed provisions from GDC 55 and 56 for number, position, and type of CIVs required per line, as follows: – One locked closed isolation valve inside and one locked closed isolation valve outside containment; or – One automatic isolation valve inside and one locked closed isolation valve outside containment; or – One locked closed isolation valve inside and one automatic isolation valve outside containment; or – One automatic isolation valve inside and one automatic isolation valve outside containment. However, despite this detail, the 3rd and 4th items are missing the sentences in the GDC that say that a simple check valve may not be used as the automatic isolation valve outside containment.

RAI Number	Reviewer	Question Summary	Full Text
			Detailed requirements reproduced from the regulations should not mislead the reader by leaving out significant restrictions. Provide a DCD revision which corrects this problem. (B) Contrary to the statement that the plant meets the relevant requirements of various GDC, at least four systems do not meet the specific requirements of GDC 55 and 56 listed in the 4th bullet. DCD Tier 2, Revision 1, Table 1.9-6 lists three of them, and the 4th is the PCCS. Clarify or correct this apparent discrepancy. (C) The 5th bullet, addressing GDC 57, has the same problem as the 4th bullet in that it does not say that a simple check valve may not be used as the automatic isolation valve. Provide a DCD revision which corrects this problem.
6.2-105	Pulsipher J	Clarify sentence in 6.2.4.1.	In DCD Tier 2, Revision 1, Section 6.2.4.1, "Design Bases," under the heading "Safety Design Bases," the 2nd bullet should be clarified: "Capability for rapid closure or isolation of all pipes or ducts that penetrate the containment **is performed means or devices** to limit leakage within permissible limits."
6.2-106	Pulsipher J	One of the safety design bases appears to be unacceptable. Revision, clarification, or further explanation is requested.	In DCD Tier 2, Revision 1, Section 6.2.4.1, "Design Bases," under the heading "Safety Design Bases," the 3rd bullet states: "The design of isolation valves for lines penetrating the containment follows the requirements of General Design Criteria 54 through 57 **to the greatest extent practicable consistent with safety and reliability**." [emphasis added]. The staff does not understand the intent of the highlighted phrase. Are you suggesting that an exemption is needed for this regulation? If not, please address how the ESBWR design is in full compliance with these regulations.
6.2-107	Pulsipher J	It appears that Class MC does not meet the guidelines for containment isolation system design.	In DCD Tier 2, Revision 1, Section 6.2.4.1, "Design Bases," under the heading "Safety Design Bases," the 7th bullet states: Containment isolation valves and associated piping and penetrations meet the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Class 1, 2, or MC, in accordance with their quality group classification. The approved guidance documents (SRP 6.2.4, Rev. 2, RG 1.141, and ANS-56.2/ANSI N271-1976) say that these components must be Class 2 or better.

RAI Number	Reviewer	Question Summary	Full Text
			Explain how, and if, Class MC satisfies the guidelines, or revise the design in conformance with the guidelines.
6.2-108	Pulsipher J	Approach to CIV closure times differs from staff and industry standard position	DCD Tier 2, Revision 1, Section 6.2.4.2.1, "Containment Isolation Valve Closure Times," states: Containment isolation valve closure times are established by determining the isolation requirements necessary to keep radiological effects from exceeding guidelines in 10 CFR 100. For system lines, which can provide an open path from the containment to the environment, a discussion of valve closure time bases is provided in Chapter 15. This seems to suggest that any (long) closure time is acceptable as long as Part 100 guidelines are met. The staff's philosophy for selecting closure times, as expressed in SRP 6.2.4, Rev. 2, and RG 1.141, is more conservative. ANS-56.2/ANSI N271-1976, which is endorsed by RG 1.141, states in section 4.4.4, "Valve Closure Time," that: The objective in establishing valve closure times should be to limit as low as reasonably attainable the release of radioactivity from the containment... In general, power-operated valves 3-1/2 inches to 12 inches in diameter should be closed at least within a time determined by dividing the nominal valve diameter by 12 inches per minute... Valves 3 inches and less generally close within 15 seconds. This results in small valves closing faster than large valves. All valves larger than 12 inches in diameter should close within one minute unless an accident radiation dose calculation is performed to show that the longer closure time does not result in a significant increase in off-site dose. Shorter valve closure times may be required for purge, vent, or other valves which may be open during plant operation and which provide an open path from the containment atmosphere to the environment outside the containment... Provide a discussion which justifies the ESBWR approach (doses not exceeding Part 100 guidelines) when compared to the staff and industry standard position (doses as low as reasonably attainable). Alternately, revise the DCD to be consistent with the staff and industry standard position.

<table>
<tr><th>RAI Number</th><th>Reviewer</th><th>Question Summary</th><th>Full Text</th></tr>
<tr><td>6.2-109</td><td>Pulsipher J</td><td>Tabular listings of closure times are preliminary; when will they be finalized?</td><td>In the tables of CIVs (DCD Tier 2, Revision 1, Tables 6.2-16 through 6.2-42 and 6.2-47), for the entries for valve closure times, times are listed, but footnotes say “Closing Times are estimates and will be confirmed during detailed design stage.” DCD Tier 2, Revision 1, Section 6.2.8.4, “Containment Isolation Valve Information,” states “The COL Applicant shall provide the missing information indicated in Tables 6.2-16 through 6.2-42 and 6.2-47.”

Is it intended for the statement in Section 6.2.8.4 to include the closure times? If so, 6.2.8.4 should be clarified because the closure times are not exactly missing from the tables. If not, what is the meaning of the footnotes as to when the closure times will be confirmed; in other words, when is the “detailed design stage”? Is this intended to be a COL action item, ITAAC or both?</td></tr>
<tr><td>6.2-110</td><td>Pulsipher J</td><td>Conformance to RG 1.11, and identification and description of all instrument lines penetrating containment in the DCD tables of CIVs.</td><td>(A) DCD Tier 2, Revision 1, Section 6.2.4.2.2, “Instrument Lines Penetrating Containment,” and Section 6.2.4.3.2.5, “Evaluation Against Regulatory Guide 1.11,” state that sensing instrument lines penetrating the containment follow all the recommendations of RG 1.11, in that each line has a 1/4-inch orifice inside the containment and a manually-operated isolation valve just outside the containment.

This design does not conform to the guidelines of RG 1.11. RG 1.11, section C., “Regulatory Position,” subsection 1.c., states that the lines:

Should be provided with an isolation valve capable of automatic operation or remote operation from the control room or from another appropriate location...

In addition, there are other parts of the regulatory position which the DCD does not address, such as C.1.a., C.1.d., and C.1.e., and other details in C.1.c. and C.1.b. (orifice) which are also not addressed. Revise the DCD to provide a complete discussion which justifies the claim that the design follows all the recommendations of RG 1.11.

(B) Apparently no instrument lines are listed or described in the DCD tables of CIVs (DCD Tier 2, Revision 1, Tables 6.2-16 through 6.2-42 and 6.2-47). Identify and describe all instrument lines penetrating containment in the DCD tables of CIVs.</td></tr>
</table>

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6.2-111	Pulsipher J	GDC 57 and RG 1.141 not addressed along with GDC 54, 55, 56, and RG 1.11.	DCD Tier 2, Revision 1, Section 6.2.4.2.3, “Compliance with General Design Criteria and Regulatory Guides,” states, in part: In general, all requirements of General Design Criteria 54, 55, 56, and Regulatory Guide 1.11 are met in the design of the containment isolation function. Why were GDC 57 and RG 1.141 not addressed as part of this statement?
6.2-112	Pulsipher J	Explain compliance with Seismic Category I requirements.	DCD Tier 2, Revision 1, Section 6.2.4.2.4, “Operability Assurance, Codes and Standards, and Valve Qualification and Testing,” states, in part: The containment isolation function piping and valves are designed in accordance with Seismic Category I requirements as defined in Section 3.7 using the techniques of Subsection 3.9.3.2. The staff’s position (SRP 6.2.4, Rev. 2, and RG 1.141) is simply that they be designed in accordance with Seismic Category I requirements. The staff could infer from the qualifiers, “as defined in Section 3.7 using the techniques of Subsection 3.9.3.2,” that the simpler statement would not be correct. Ultimately, the design either does or does not conform to Seismic Category I requirements. Please explain.
6.2-113	Pulsipher J	Provide simpler statement regarding CIVs withstanding accident temperatures and pressures.	DCD Tier 2, Revision 1, Section 6.2.4.2.4, “Operability Assurance, Codes and Standards, and Valve Qualification and Testing,” states, in part, that DCD Section 3.11 presents a discussion of the environmental conditions for which the CIVs and pipe are designed. Provide a statement in this DCD Section as to whether the CIVs and associated pipes are designed to withstand the peak calculated temperatures and pressures of postulated accidents to which they would be exposed.
6.2-114	Pulsipher J	State whether CIVs and other containment isolation barriers meet Safety Class 2 and Quality Group B requirements.	DCD Tier 2, Revision 1, Section 6.2.4.2.4, “Operability Assurance, Codes and Standards, and Valve Qualification and Testing,” states, in part, that the CIVs are designed in accordance with the requirements of ASME Code, Section III. Does this mean that they are designed to safety class 2 requirements? SRP 6.2.4, Rev. 2, section II.p.1, states that components performing a

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			containment isolation function are to meet at least Group B quality standards, as defined in RG 1.26. Provide a statement in the DCD as to whether these SRP guidelines are met.
6.2-115	Pulsipher J	Design statement regarding redundancy is not conservative enough. Provide actual single failure evaluations.	(A) DCD Tier 2, Revision 1, Section 6.2.4.2.5, "Redundancy and Modes of Valve Actuations," states, in part: Redundancy is provided in all design aspects to satisfy the requirement that no active failure of a single valve or component prevents containment isolation. This is not quite as conservative as the guidelines expressed in SRP 6.2.4, Rev. 2 (section III, 4th paragraph), which is that no single active failure of any kind should prevent containment isolation. An example which illustrates the difference would be a penetration in which both CIVs are motor-operated and both receive emergency power from the same bus. The failure of one of the CIVs would not prevent containment isolation, but the loss of the single emergency bus would. Provide a discussion or statement in the DCD to indicate whether the ESBWR design meets the more conservative provision of SRP 6.2.4, Rev. 2. (B) DCD Tier 2, Revision 1, Section 6.2.4.3.3, "Evaluation of Single Failure," discusses, in general, the principles used to evaluate single failure. It implies that evaluations were performed for the containment isolation system, but does not provide the actual evaluations or even specific conclusions, other than an unsupported statement that "Electrical and mechanical systems are designed to meet the single failure criterion...." It refers to DCD Section 3.1 for more information, but 3.1 only is a general discussion of the ESBWR's compliance with the GDC. Provide the actual single failure evaluations performed for the containment isolation system, or at least a better discussion of the evaluations. Address particularly the example given in part 1 of this RAI.

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6.2-116	Pulsipher J	Incorrect or inadequate statement on CIV arrangements satisfying certain requirements and guidelines.	DCD Tier 2, Revision 1, Section 6.2.4.2.5, “Redundancy and Modes of Valve Actuations,” states, in part: Isolation valve arrangements satisfy all requirements specified in General Design Criteria 54, 55, 56 and 57, and Regulatory Guide 1.11. The staff notes two problems with this statement: 1. DCD Tier 2, Revision 1, Table 1.9-6, “Summary of Differences from SRP Section 6,” in its entry for SRP 6.2.4, lists several systems for which the containment isolation provisions differ from the GDC requirements (such as having both CIVs inside containment), and there may be more (e.g., PCCS). 2. It seems inappropriate to address RG 1.11, which addresses only instrument lines, and not RG 1.141, which addresses all lines. Resolve these apparent discrepancies.
6.2-117	Pulsipher J	Describe the administrative controls for sealed-closed CIVs.	DCD Tier 2, Revision 1, Section 6.2.4.2.5, “Redundancy and Modes of Valve Actuations,” states, in part: Functions for administrative controls and/or locks ensure that the position of all nonpowered isolation valves is maintained and known. In the DCD, describe the administrative controls.

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6.2-118	Pulsipher J	Provide more description of a spring-check valve's operation.	DCD Tier 2, Revision 1, Section 6.2.4.3.1.1, "Influent Lines," under the heading "Feedwater Line," describes the design of a spring-check valve as follows: The spring-check valve outside containment is provided with an air-opening, spring-closing operator, which, upon remote manual signal from the main control room, provides additional seating force on the valve disk to assist in long-term leakage protection. Should a break occur in the feedwater line, the check valves prevent significant loss of reactor coolant inventory and offer immediate isolation. The details of the spring-check valve's operation are unclear. For example, if the valve uses air to open, and remote-manual action provides additional seating force (from the spring, presumably), does this mean that the valve is normally held open by air? If so, how can the valve close immediately during an accident? Provide more description of the spring-check valve's operation, especially of its remote-manual operation.
6.2-119	Pulsipher J	Correct statements about meeting the "intent" of the regulations and regarding the implicit safety value of a closed loop outside containment.	DCD Tier 2, Revision 1, Section 6.2.4.3.1.1, "Influent Lines," under the heading "Isolation Condenser Condensate and Venting Lines," describes the isolation provisions for these lines and the isolation condenser purge line. (A) In this Section and in the tables of CIVs (Tables 6.2-23 through 6.2-30), there are discussions as to how the isolation provisions meet the intent of the "guidelines" of GDC 55 and GDC 56. It is not sufficient to meet the "intent" of the regulations; the ESBWR design must comply with the requirements of the regulations. The designs for these lines do not comply with the explicit requirements of GDC 55 and 56, which are that such lines require a CIV inside containment and another outside containment. As discussed in more detail in RAI 6.2-102, SRP 6.2.4, Rev. 2, RG 1.141, and national standard ANS-56.2/ANSI N271-1976 provide guidance on the implementation of the statements in GDC 55 and 56 which allow other isolation provisions if it can be demonstrated that the containment isolation provisions for a specific class of lines are acceptable on some other defined basis. Revise the DCD to discuss the conformance (or lack thereof) of the subject lines to the requirements of the GDC and the guidelines of the cited guidance documents.

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			Further, in all the many other instances where DCD Tier 2, Revision 1, Section 6.2.4 and the CIV tables (Tables 6.2-16 through 6.2-42 and 6.2-47) make similar statements, revise them in like manner. (B) This DCD Section states, in part: ...the IC System outside the containment consists of a closed loop... which is a “passive” substitute for an open “active” valve outside the containment. This closed-loop substitute for an open isolation valve outside the containment **implicitly provides greater safety**. The combination of an **already isolated** loop outside the containment plus the two series automatic isolation valves inside the containment... [emphasis added] The staff disagrees with the highlighted words. A closed loop outside containment is not necessarily better or safer than a CIV. The standard of the GDC and the approved guidance documents is to have a CIV; a closed loop outside containment is sometimes allowed as an adequate, not superior, substitute for a CIV. Further, such a loop may be described as already closed, but not as “already isolated.” This distinction is important in Technical Specifications, where one acceptable response to an inoperable CIV is to isolate the affected containment penetration. The presence of a closed loop attached to the affected penetration is not sufficient to consider the penetration to be isolated; some other barrier (e.g., valve, blind flange) must be closed to isolate the penetration. Revise the DCD in light of the issues discussed above.
6.2-120	Pulsipher J	Verify that either gas pressure or spring force alone will close MSIVs under accident conditions.	DCD Section 6.2.4.3.1.2, “Effluent Lines,” under the heading “Main Steam and Drain Lines,” describes the power-operated main steam isolation valves (MSIVs) as closing under either spring force or gas pressure. It states, in part: The separate and independent action of either gas pressure or spring force is capable of closing an isolation valve. Considering that virtually every BWR MSIV in the U.S. needs <u>both</u> gas pressure and spring force to close under accident conditions, verify that the quoted sentence is correct.

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6.2-121	Pulsipher J	Revise Isolation Condenser Steam Supply Lines description per RAI 6.2-119	DCD Tier 2, Revision 1, Section 6.2.4.3.1.2, "Effluent Lines," under the heading "Isolation Condenser Steam Supply Lines," makes two notable statements: 1. Two isolation gate-valves are located in the containment where they are protected from outside environmental conditions, which may be caused by a failure outside the containment. 2. ...the IC System outside the containment consists of a closed loop... which is a "passive" substitute for an open "active" valve outside the containment. This closed-loop substitute for an open isolation valve outside the containment **implicitly provides greater safety**. The combination of an **already isolated** loop outside the containment plus the series automatic isolation valves inside the containment comply with the **intent** of... [emphasis added] Statement 1. If the only justification for having both CIVs inside containment is that they are thus protected from outside environmental conditions, it is inadequate. SRP 6.2.4, Rev. 2, RG 1.141, and national standard ANS-56.2/ANSI N271-1976 provide guidance on acceptable justifications for deviations from the explicit requirements of GDC 55 and 56. Statement 2. See RAI 6.2-119 Revise the two statements in light of the issues presented.
6.2-122	Pulsipher J	Put information from Section 9.1.3.3 into Section 6.2.4.3.2.1.	DCD Tier 2, Revision 1, Section 6.2.4.3.2.1, "Influent Lines to Containment," under the heading "Fuel and Auxiliary Pool Cooling System," states that subsection 9.1.3.3 contains additional information about the containment isolation design for the system including any justifications for deviation from the GDC 56 requirements. Provide this information in Section 6.2.4.3.2.1.
6.2-123	Pulsipher J	Need better justification for both CIVs being outside containment in each Containment Inerting System line.	DCD Tier 2, Revision 1, Section 6.2.4.3.2.1, "Influent Lines to Containment," under the heading "Containment Inerting System," states that all the CIVs on these lines are outside of the containment to provide accessibility to the valves. This justification is inadequate. SRP 6.2.4, Rev. 2 (section II.d.), RG 1.141, and national standard ANS-56.2/ANSI N271-1976 (sections 3.6.5 and 3.7) provide guidance on acceptable justifications for deviations from the explicit requirements of GDC 55 and 56, including additional requirements when both CIVs

RAI Number	Reviewer	Question Summary	Full Text
			are outside containment. Note in particular that the option of having both CIVs outside containment is available only for engineered safety feature (ESF) or ESF-related systems, or systems needed for safe shutdown of the plant. DCD Tier 2, Revision 1, Section 6.2.4.3.2.2, "Effluent Lines from Containment," under the heading "Containment Inerting System," also contains the same statement. Provide adequate justification as described.
6.2-124	Pulsipher J	Need diversity in the parameters sensed to initiate containment isolation of the High Pressure Nitrogen Supply System.	DCD Tier 2, Revision 1, Section 6.2.4.3.2.1, "Influent Lines to Containment," under the heading "High Pressure Nitrogen Supply System," states: Because the pressure in this system is higher than the containment pressure, it is only isolated on low pressure signal inside the High Pressure Nitrogen Supply System. The approved guidance is that there should be diversity in the parameters sensed to initiate containment isolation. The high pressure of this system does not relieve it from this guideline. Many of the systems which penetrate containment are high pressure systems; it has no bearing on this issue. Provide diversity in the parameters sensed to initiate containment isolation of this system, or provide additional justification in the DCD for not doing so.
6.2-125	Pulsipher J	Put information from Section 9.1.3.3 into Section 6.2.4.3.2.2, and address guidelines for a closed system outside containment	DCD Tier 2, Revision 1, Section 6.2.4.3.2.2, "Effluent Lines from Containment," under the heading "Fuel and Auxiliary Pools Cooling System Suction Lines," states that subsection 9.1.3.3 contains additional information about the containment isolation design for the system including any justifications for deviation from the GDC 56 requirements. Provide this information in Section 6.2.4.3.2.2. Further, the design takes credit for a closed system outside containment as the second containment isolation barrier. As detailed in RAI 6.2-102, there are a number of guidelines in SRP 6.2.4, Rev. 2, RG 1.141, and ANS-56.2/ANSI N271-1976 which govern the design of a closed system outside containment when used as a containment isolation barrier. Address these guidelines in the DCD.

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6.2-126	Pulsipher J	Describe in detail the Containment Inerting System's design provisions to compensate for having all CIVs outside containment.	DCD Tier 2, Revision1, Section 6.2.4.3.2.2, "Effluent Lines from Containment," under the heading "Containment Inerting System," states that all of the CIVs are outside containment and that the "piping to both valves is an extension of the containment boundary." This statement does not provide sufficient information. SRP 6.2.4, Rev. 2, section II.d., states, in part: ...the valve nearest the containment and the piping between the containment and the valve should be enclosed in a leak-tight or controlled leakage housing. If, in lieu of a housing, conservative design of the piping and valve is assumed to preclude a breach of piping integrity, the design should conform to the requirements of SRP Section 3.6.2. Design of the valve and/or the piping compartment should provide the capability to detect leakage from the valve shaft and/or bonnet seals and terminate the leakage. ANS-56.2/ANSI N271-1976, section 3.6.5, "Two Valve Outside Containment," states, in part: The valve nearest the containment wall and piping between the containment and that valve shall be enclosed in a protective leak tight or controlled leakage housing to prevent leakage to the atmosphere. The piping between the two isolation valves shall meet the requirements of 3.7. Section 3.7, "Criteria for Piping Outside Containment and Between the Containment and the Isolation Valve(s)," states: Piping which is outside the containment and is either between the containment and the outside isolation valve or between two outside isolation valves shall: (1) Meet Safety Class 2 design requirements (2) Withstand the containment design temperature (3) Withstand internal pressure from containment structural integrity test (4) Withstand loss-of-coolant accident transient and environment (5) Meet Seismic Category I design requirements (6) Be protected against a high energy line break outside of containment when needed for containment isolation.

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			Further, the DCD states that the first valve is located as close as practical to the containment. ANS-56.2/ANSI N271-1976, section 3.6.5, states that both valves are to be located as close as practical to the containment. Provide in the DCD a detailed description of the Containment Inerting System's conformance with these provisions.
6.2-127	Pulsipher J	Describe in detail the Process Radiation Monitoring System's justification for, and design provisions to compensate for, having all CIVs outside containment.	DCD Tier 2, Revision1, Section 6.2.4.3.2.2, "Effluent Lines from Containment," under the heading "Process Radiation Monitoring System," states that all of the CIVs are located outside containment "for easy access" and that the "piping to these valves is considered an extension of the containment boundary." These design statements are deficient, as discussed in RAIs 6.2-123 and 6.2-126. Provide in the DCD a detailed description of the Process Radiation Monitoring System's conformance with the guidelines discussed in RAIs 6.2-123 and 6.2-126.
6.2-128	Pulsipher J	Tables of isolation provisions for several systems are blank. How will the COL applicants' eventual design be consistent with the DCD text?	Although the containment isolation designs of the Chilled Water, High Pressure Nitrogen Supply, and Process Radiation Monitoring Systems are described in some detail in the text of DCD Tier 2, Revision 1, Section 6.2.4.3.2, the DCD tables which are meant to describe in more detail the isolation provisions for these systems are blank and say "COL applicant to provide" (Tables 6.2-39 through 6.2-42). Is it intended that the COL applicants will be restrained by the DCD text in their detailed design of the systems as described in the tables that they will provide? If not, is it intended that the COL applicants will design the systems' isolation provisions as they see fit, to be reviewed by the staff at the COL stage?
6.2-129	Pulsipher J	Clarify the apparent absence of GDC 57 penetrations.	DCD Tier 2, Revision 1, Section 6.2.4.3.2.4, "Evaluation Against General Design Criterion 57," states: "The ESBWR has no closed system lines penetrating the containment that require automatic isolation." Considering that, generally, closed systems inside containment do not require automatic isolation (e.g., remote-manual isolation is allowed), this is not very informative. Are there any closed systems inside containment whose lines penetrate the containment? If so, describe their containment isolation provisions in the DCD. If not, clarify the DCD statement.

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6.2-130	Pulsipher J	Will CIVs' automatic isolation function be tested?	DCD Tier 2, Revision 1, Section 6.2.4.4, "Test and Inspection," states that individual CIVs are functionally tested by remote-manual operation from the control room. Will their automatic function also be tested by the input of simulated containment isolation signals to the protection system? Revise the DCD to address this question.
6.2-131	Pulsipher J	Need discussions of 3 additional issues in DCD.	The DCD seems to lack discussions of the following issues. Provide discussions in the DCD. (A) The automatic isolation signals for CIVs and their diversity of parameters sensed, per item II.I. of SRP 6.2.4, Rev. 2. (B) Classification of systems as essential or non-essential and the automatic isolation of non-essential systems during an accident, per NUREG-0737, item II.E.4.2, and item II.h. of SRP 6.2.4, Rev. 2. (C) Reducing the containment setpoint pressure that initiates containment isolation for non-essential penetrations to the minimum compatible with normal operating conditions, per NUREG-0737, item II.E.4.2(5), and item II.k. of SRP 6.2.4, Rev. 2.
6.2-132	Pulsipher J	Explain the meaning of "Div. 1 / 2 " as a CIV power source.	In the DCD tables of CIVs, the power source for some CIVs is listed as "Div. 1/2." Does this mean power is available from both divisions 1 and 2, or something else?
6.2-133	Pulsipher J	The termination region for the inboard feedwater CIV seat leakage seems to be incorrect.	In DCD Tier 2, Revision 1, Tables 6.2-21 and -22, CIVs for Feedwater Lines A and B, the entries for "Leakage Past Seat" are "N/A" for the inboard CIVs but "(b_3)" (main condenser) for the outboard CIVs. Would not seat leakage from both inboard and outboard CIVs go to the main condenser?

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6.2-134	Pulsipher J	Describe the design logic used to assign power sources to the CIVs in the isolation condenser loops.	In DCD Tier 2, Revision 1, Tables 6.2-23 through 6.2-30, CIVs for Isolation Condenser Loops A-D, there are various combinations of power sources for the various CIVs in different loops. Although this is apparently done to protect from single failures in the power sources, the staff does not understand the choices made. For example, in Loop A, CIVs F011A and F012A are in series in a line, but both get power from division 1. Although they are described as normally closed, they are not locked or sealed closed, so may be open at the beginning of an accident. Both valves fail "as is," so it appears that a division 1 power failure could leave the line open (unisolated) during an accident. Although there is a closed system outside containment, the staff does not understand the choice to have two CIVs in series but with a single power source. Describe the design logic used to assign power sources to the CIVs in the isolation condenser loops.
6.2-135	Pulsipher J	Standby Liquid Control System has a simple check valve CIV outside containment, which GDC 55 specifically prohibits.	DCD Tier 2, Revision1, Section 6.2.4.3.1.1, "Influent Lines," discusses the Standby Liquid Control System Line. It seems to say that the outboard CIVs are a check valve in series with two parallel squib valves. However, Table 6.2-32 indicates that the only outboard CIV is a simple check valve. GDC 55 specifically prohibits the use of a simple check valve outside containment as a CIV. Provide justification for this design or bring the design into compliance with GDC 55.
6.2-136	Pulsipher J	Additional information requested regarding hydrogen monitors.	DCD Tier 2, Revision 1, Section 6.2.5.3 describes the containment hydrogen monitors as safety-related and Seismic Category I, with two redundant, physically and electrically independent monitoring divisions. 10 CFR 50.44(c)(4)(ii) states: Equipment for monitoring hydrogen must be functional, reliable, and capable of continuously measuring the concentration of hydrogen in the containment atmosphere following a significant beyond design-basis accident for accident management, including emergency planning. Draft Regulatory Guide 1.7, Rev. 3 (RG 1.7), states that safety-related hydrogen monitoring systems installed and approved by the NRC prior to October 16, 2003, are sufficient to meet these criteria. However, the ESBWR does not meet that requirement. The staff requires additional information:

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			(A) Per the guidelines of NUREG-0737, "Clarification of TMI Action Plan Requirements," item II.F.1, attachment 6, "Containment Hydrogen Monitor:" a) To satisfy the requirement of being capable of continuously measuring the concentration of hydrogen in the containment atmosphere following a significant beyond design-basis accident, are the hydrogen monitors capable of measurement over a range of 0 to 10% hydrogen concentration under both positive and negative ambient pressure? b) To satisfy the requirement of being functional and reliable, provide the accuracy of the hydrogen monitors and the placement of their sampling points, and justify that they are adequate for their intended function. (B) Hydrogen monitors are not required to function during normal plant operation. RG 1.7, section C.2.1, provides guidance on meeting the functional requirements of the rule in terms of how soon the monitors should be functioning after initiation of safety injection during an accident. The guidelines are detailed, but generally result in the monitors needing to be functional within 90 minutes after the initiation of safety injection. This period of time includes equipment warm-up but not equipment calibration. Do the ESBWR hydrogen monitors comply with these guidelines? (C) Although the hydrogen monitors are outside of the containment, will the system remain functional and reliable when exposed internally to the temperature, pressure, humidity, and radioactivity of containment atmosphere during a significant beyond design-basis accident?
6.2-137	Pulsipher J	Additional information requested regarding oxygen monitors.	DCD subsection 6.2.5.3 describes the containment oxygen monitors as safety-related and Seismic Category I, with two redundant, physically and electrically independent monitoring divisions. 10CFR 50.44(c)(4)(I) states: Equipment for monitoring oxygen must be functional, reliable, and capable of continuously measuring the concentration of oxygen in the containment atmosphere following a significant beyond design-basis accident for combustible gas control and accident

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			management, including emergency planning. RG 1.7 states that existing oxygen monitoring systems approved by the NRC prior to October 16, 2003, are sufficient to meet these criteria. However, the ESBWR does not meet that requirement. The staff requires additional information: 1) To satisfy the requirement of being capable of continuously measuring the concentration of oxygen in the containment atmosphere following a significant beyond design-basis accident, provide the range of measurement capability of the oxygen monitors. 2) To satisfy the requirement of being functional and reliable, provide the accuracy of the oxygen monitors and the placement of their sampling points, and justify that they are adequate for their intended function. 3) Although the oxygen monitors are outside of the containment, will the system remain functional and reliable when exposed internally to the temperature, pressure, humidity, and radioactivity of containment atmosphere during a significant beyond design-basis accident?
16.2-110	Pulsipher J	Add a TS limiting containment oxygen concentration to less than 4% by volume.	Proposed Technical Specification (TS) Section 3.6, Containment Systems, apparently does not have a TS for containment oxygen concentration. GE's response to RAI 16.0-1, dated August 8, 2006, in Enclosure 1, Attachment 2, item 27, asserts that an operating restriction on oxygen concentration (to less than 4% by volume) is not required as an initial condition in the analysis of any design-basis event, so it does not meet Criterion 2 of 10 CFR 50.36 and is not included in the proposed Technical Specifications. However, both the NRC staff and the nuclear industry's Technical Specification Task Force have stated that such a TS is required. (A) When 10 CFR 50.44, "Combustible Gas Control in Containment," was revised in 2003, the staff issued a model safety evaluation (SE) for implementation of the revised rule through the Consolidated Line Item Improvement Process (ADAMS Accession No. ML032600597, September 12, 2003). The model SE states, on page 13, that

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			"...requirements for primary containment oxygen concentration will be retained in TS for plant designs with an inerted containment." Furthermore, the current standard TS for BWR/4 plants (NUREG-1433, Rev. 3.1) includes TS 3.6.3.2, Primary Containment Oxygen Concentration, which states that "The primary containment oxygen concentration shall be < 4.0 volume percent." (B) Technical Specification Task Force Traveler TSTF-447, Rev. 1, dated July 18, 2003, "Elimination of Hydrogen Recombiners and Change to Hydrogen and Oxygen Monitors," which has been accepted by the staff, states: "For plant designs with an inerted containment, the requirement for primary containment oxygen concentration will be retained in Technical Specifications." In light of these positions, add a TS limiting containment oxygen concentration to less than 4% by volume.

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17.4-13	Alexander S	Address how O-RAP will be incorporated into operational programs	SECY 95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety System (RTNSS) in Passive Plant Designs (SECY 94-084)," Item E, Reliability Assurance Program, states in part, that "the NRC disapproved the staff's proposal that an O-RAP be continued for the life of the COL. The staff should assure that the objectives of O-RAP are incorporated into existing programs for maintenance and quality assurance." Thus, in SECY 95-132 and SRP Section 17.4, Revision 0, the staff incorporated the O-RAP process into existing programs to implement the maintenance rule and the quality assurance program. The applicant should state in DCD Tier 2, Section 17.4.9, "Operational Reliability Assurance Activities," whether, and if so, how, O-RAP process will be implemented through existing operational programs, including the maintenance and surveillance program(s), the quality assurance program, and the Maintenance Rule program. The applicant should also add a reference to SECY 95-132 in DCD Tier 2, Section 17.4.14, References.
17.4-14	Alexander S	Include reliability data from test results collected from TS surveillance tests and other relevant testing and from IOE for both safety related and RTNSS SSCs as available	The applicant should include reliability monitoring information collected from Technical Specification (TS) surveillance test data, from other relevant testing and from industry Operating Data (IOE) for safety-related equipment as available. This information can be used in determining ORAP/Maintenance Rule reliability goals or performance criteria. The applicant should also include similar reliability data for RTNSS structures, systems, or components (SSCs) which are within the scope of the RAP as available. This information can also be collected from reliability estimates used in basic event fault trees for risk-significant (i.e., high-safety-significant) systems and components modeled in ESBWR PRA. A reference to these sources for reliability estimates and monitoring information should be added to DCD Tier 2, Section 17.4.9, "Operational Reliability Assurance Activities."

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17.4-15	Alexander S	The COL applicant should reference the guidance documents used to implement its O-RAP in DCD Section 17.4.9, "Operational Reliability Assurance Activities."	The staff determined that a COL applicant referencing the ESBWR should reference the guidance documents used to implement its O-RAP in DCD Tier 2, Section 17.4.9, "Operational Reliability Assurance Activities." For the Maintenance Rule element of the O-RAP, these documents include RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," which endorses NUMARC 93-01, "Industry Guidance for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." In addition, if still effective at the time of the COL application, RG 1.182, "Assessing and Managing the Risk Before Maintenance at Nuclear Power Plants," which endorsed the revised NUMARC 93-01, Section 11, "Assessment of Risk Resulting from the Performance of Maintenance Activities," should be referenced. This information should also be added to DCD Tier 2, Section 17.4.14, 'References."
17.4-16	Alexander S	The staff determined that four COL applicant/holder action items related to O-RAP should be added to DCD Section 17.4.13.	The staff determined that the following COL action items should be added to DCD Tier 2, Section 17.4.13: • The COL applicant is responsible for integrating the objectives of O-RAP into the QA program developed to implement 10 CFR 50, Appendix B. This program should also address failures of non-safety-related, risk-significant SSCs that result from design and operational errors in accordance with SECY 95-132, Item E. • The COL applicant is responsible for performing the tasks necessary to maintain the reliability of risk-significant SSCs as identified in the D-RAP. The applicant may cite, for example, cost-effective maintenance enhancements, such as condition monitoring and using condition-directed maintenance as well as time-directed or planned periodic maintenance. • The COL applicant's Maintenance Rule (10 CFR 50.65) program is required for monitoring the effectiveness of the COL applicant's maintenance activities needed for operational reliability assurance. As such it is an important element of O-RAP. • If the COL applicant proposes to use its Maintenance Rule program in O-RAP implementation, the SSCs in the scope of the Maintenance Rule program that are classified as high-safety-significant (HSS) should encompass all SSCs in the scope of the D-RAP. • In addition to the specific tasks necessary to maintain SSC reliability at its required

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			level cited above, the O-RAP activities should include: - Reliability data base - Historical data on equipment performance as available. The compilation and reduction of this data provides the plant with source of component reliability information. Data used in PRA fault-tree analyses may also be a viable initial source. - Surveillance and testing-establishes the level of performance or condition being maintained for SSCs within the scope of the RAP and identifies declining trends in between surveillances prior to performance or condition degrading to unacceptable levels undetected (or failure) to the extent possible. - Maintenance Plan - This plan describes the nature and frequency of maintenance activities to be performed on plant equipment. The plan includes the selected SSCs identified in the D-RAP.

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