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MFN 08-761

Docket No. 52-010

October 16, 2008

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. 226, Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.5-92**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission Request for Additional Information (RAI) sent by NRC Letter 226, dated July 21, 2008 (Reference 1). The GEH response to RAI Number 9.5-92 is addressed in Enclosure 1.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 08-589, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 226 Related to ESBWR Design Certification Application*, July 21, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 226 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.5-92

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Enclosure 1

MFN 08-761

Response to Portion of NRC Request for

Additional Information Letter No. 226

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.5-92

NRC RAI 9.5-92

The GEH response to RAI 19.1-173 stated the correct assumption to apply to the evaluation of multiple spurious actuations caused by fire-induced damage to electrical circuits. In this RAI response, the stated assumption, that multiple spurious actuations would be assumed to occur simultaneously or in rapid succession, was applied to the bounding approach used for the fire PRA as described in NEDO-33201 and the response committed to revising NEDO-33201 to include this assumption.

The staff believes the importance of this assumption warrants its inclusion in the list of acceptance criteria for the fire hazards analysis provided in DCD Section 9A.2.4. A new acceptance criteria should be added similar to the following:

The post-fire safe-shutdown circuit analysis assumes that multiple spurious actuations associated with a postulated fire occur simultaneously or in rapid succession.

In addition, the final post-fire safe-shutdown circuit analysis that reflects the as-built and as-purchased plant, including circuit routing, should be performed using an approach similar to that described in the industry guidance document for circuit analyses, NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis". Since GEH has stated that the final circuit analysis will be performed by GEH for submittal by the individual licensees, the DCD should describe the methodology for performing this analysis. Reference to NEI 00-01 in Appendix 9A as the methodology used would be one acceptable approach. The NRC has accepted NEI 00-01, Revision 1, as described in RIS 2005-30 and is currently working with the industry on draft Revision 2. A commitment to the methodology provided in Revision 1 of NEI 00-01 in accordance with RIS 2005-30 would be acceptable for design certification.

GEH Response

The post-fire safe-shutdown circuit analysis will assume that any spurious actuations associated with a postulated fire occur simultaneously or in rapid succession; however, as noted in the response to RAI 19.1-150, Supplement 1 (MFN 07-455, Supplement 3, January 21, 2008), the ESBWR is designed to prevent spurious actuations that could adversely affect the capability to achieve and maintain safe shutdown.

The following was incorporated in NEDO-33201 R3 in response to RAI 19.1-150:

12.2.3 Task 2 Component Selection Assumptions:

(9) The ESBWR plant is designed to prevent spurious actuations induced by a fire in a single fire area that could adversely affect the capability to achieve and maintain safe shutdown.

a. The ESBWR design features as described in DCD Tier 2 Section 7.1.3 help minimize the adverse affect on safe shutdown from fire-induced spurious actuations. First, the ESBWR instrumentation and control system is digital. A spurious signal cannot be induced by fire damage in a fiber optic cable. The hard wires are minimized to limit the consequences of a postulated fire. The communication links between the main control room (MCR) and the DCIS rooms do not include any copper or other wire conductors that could potentially cause fire-induced spurious actuations that could adversely affect safe shutdown. From the DCIS rooms to the components, fiber optics will also be used up to the Remote Multiplexing Units (RMUs) in the plant. Hard wires then are used to control the subject components. The exposure of the distributed control and information system (DCIS) equipment to heat and smoke caused by a fire in a single fire area does not cause spurious actuations that could adversely affect safe shutdown.

b. ESBWR plant has a passive design that the safety systems do not have active components such as the high-pressure injection pumps in the traditional plant designs. For the high/low pressure interfaces, multiple check valves are included which prevent the opening of the path even if a spurious actuation should occur after a fire. DCD Tier 2 section 7.6.1 describes the HP/LP system interlock function.

As noted in the response to RAI 9.5-71 (MFN 08-634, August 13, 2008), the ESBWR is designed to prevent spurious actuations induced by smoke.

Appendix 9A, Subsection 9A.2.4 will be revised add a requirement stating that the post-fire safe-shutdown circuit analysis will assume that any spurious actuations associated with a postulated fire occur simultaneously or in rapid succession.

GEH will perform circuit routing using the EPM program which is similar to that described in the industry guidance document for circuit analyses, NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis. Appendix 9A, Subsection 9A.2.4 will be revised to add a requirement stating that circuit routing will conform to the methodology provided in Revision 1 of NEI 00-01 in accordance with RIS 2005-30.

DCD Impact

DCD Tier 2 Chapter 9, Appendix 9A, Subsection 9A.2.4 will be revised as noted in the attached markup to address spurious actuations and cable routing methodology.

9A.2.4 Acceptance Criteria

The following basic guidelines have been used as criteria for the fire hazard analysis, to be conducted in accordance with Regulatory Guide 1.189 and NFPA 804:

(1) The analysis is based on the existing design and on the currently specified, but not yet purchased, equipment. The analysis provides a basis for evaluating the fire protection characteristics and features of equipment as it is purchased.

(2) Automatic sprinkler systems are provided in the ESBWR design for areas in which either installed combustible loading is large enough to warrant the installation or a significant transient combustible loading is most likely to occur as a result of combustibles introduced by normal maintenance operations. The fire hazard analysis is based on the introduction of transient combustibles to any area of the plant, subject to administrative controls. Control of combustible transient materials is assumed to comply with Regulatory Guide 1.39 for housekeeping requirements.

As described in Appendix 9B, the combustible loading limit for electrical areas has been conservatively determined as 1400 MJ/m^2 (123,280 Btu/ft^2) and the combustible loading limit for all other indoor areas has been conservatively determined as 700 MJ/m^2 (61,640 Btu/ft^2) rooms that exceed these limits require automatic fire suppression. This approach conservatively assumes that all combustible material within a fire area instantaneously releases its net heat content upon ignition of the fire. Due to the considerable separation and fire barriers provided in the ESBWR plant layout, a detailed analysis or modeling of fire damage and plume temperatures resulting from any given fire was not considered necessary and has not been performed. This type of analysis could be performed later for an individual fire area if needed, but then could also include consideration of room height and volume, spatial location of combustibles and equipment, incomplete combustion, time-weighted heat release rates, thermal inertia of the structure, ventilation effects, response of installed automatic fire detection, response of installed fire suppression, and other relevant factors.

(3) The buildings are generally of reinforced concrete construction. The walls, floors, and ceilings have 3-hour fire resistance ratings where required based on high combustible loadings (lubrication oil tank, for example) in the room or where an adjacent room contains equipment or systems from a different Safety-Related division. Corridors and stairwells that do not communicate between areas of different Safety-Related divisions may have walls and doors with a 2-hour minimum fire rating for personnel protection during egress from the areas. Non-concrete interior walls are constructed of metal studs and gypsum wallboard to the required fire resistance rating.

(4) Doors penetrating rated fire barriers comply with NFPA ratings for that barrier. There are also doors that provide fire area separation that may not be labeled fire doors but do provide equivalent protection. Typically these are the doors for the personnel air lock into the reactor containment and the missile/tornado doors at the equipment access entrance to the reactor building. The term "doors," where used in the analysis means doors, frames, and hardware.

The use of 1.5-hour fire rated elevator doors in 3-hour fire-rated barriers does not compromise the fire barrier. Rather, section 6-1.2.2 of NFPA 804-1995 specifically allows 1.5-hour fire-rated doors in elevator shafts. No other applicable codes (IBC, NFPA 80, NFPA 101, NFPA 252, or ASME A17.1) require elevator doors to have a fire rating of more than 1.5 hours. None of the applicable codes address 3-hour fire-rated elevator shafts. It is not unusual for a door in a fire-rated wall to have a lower fire rating than the applicable firewall, because the area on both sides of the door is normally kept free of combustible material to ensure use of the door. Personnel evacuating from a fire are warned by signage at each elevator to use stairs (protected by 3-hour firewalls and doors) and not elevators during a fire.

(5) The fireproofing of structural steel members, where required by calculation based on combustible loading, is accomplished by application of an UL-listed or FM-approved cementitious or ablative material, or by an UL-listed or FM-approved boxing design. The required fire rating determines the fireproofing material thickness. Gypsum board is utilized for protection of fireproofing in high traffic or office areas.

(6) Surface finishes are specified to have a flame spread, fuel-contributed, and smoke-evolved index of 25 or less (Class A), determined by ASTM E84 (NFPA 255).

(7) The use of plastic materials, including electrical cable insulation, is minimized in the ESBWR design.

(8) Suspended ceilings are used in some areas of the plant. The ceilings, including the lighting fixtures, are of noncombustible construction.

(9) The electrical cable fire-stops are tested to demonstrate a fire rating equal to the rating of the barrier they penetrate. As a minimum the penetrations meet the requirements of NUREG-1552, including Supplement 1. The tests are performed or witnessed by a representative of a qualified, independent testing laboratory. The documented test results for the acceptable fire-stops are made a part of the plant design records.

(10) Electrical cable insulation in either solid metal enclosed raceways or concrete duct banks does not represent a combustible fire load and is excluded from the combustible loading analysis.

(11) Control, power, or instrument cables and equipment of redundant systems used for bringing the reactor to hot shutdown and maintaining safe shutdown, are separated from each other by 3-hour rated fire barriers, except within the containment and where the equipment of more than one division is required to be located within a single fire area. Where multiple divisions of cable or equipment are located in the same fire area, the acceptability of the configuration is evaluated in Section 9A.6.

(12) Certain areas of the plant have cable trays in stacked array. Where stacking of trays occurs, power cable, which is the most susceptible to internally generated fires, is routed in the uppermost tray to the greatest extent possible to provide isolation from other trays in the stack.

The fire loading of electrical cable in trays is based on flame-retardant, cross-linked polyethylene insulation having a maximum calorific value of 29.8 MJ/kg (12,834 Btu/lbm).

The cable trays are assumed to have the maximum (40%) design fill; actual cable fills may be lower.

The analysis uses 48.8 kilograms of insulation per square meter (10 lbm/ft^2) of tray. The combustible loading is based on maximum loading. As cables drop out of (exit) trays, the fire loading decreases. Cable insulation in completely enclosed (i.e., solid-bottom and solid-cover) trays or steel conduits is not considered to be a contributory, exposed combustible fire load to the area.

(13) Cables for local indication are included in the safe shutdown analysis where failure of the cable could cause failure of functionally associated circuits or where required to provide either diagnostic or process parameter information for recovery.

(14) Total reliance on a single fire suppression method is not used. At least two fire suppression methods are available to suppress a fire in each fire area. The plant design provides the following types of suppression methods and utilizes them in suitable combination for the fire hazard considered:

a. Automatic wet-pipe sprinkler system;

b. Automatic preaction sprinkler system;

c. Automatic dry-pipe sprinkler system;

d. Automatic preaction foam water sprinkler system;

e. Automatic foam water deluge system;

f. Automatic dry-pilot deluge system;

g. Internal manual water spray system;

h. Internal low pressure carbon dioxide flooding system;

i. Standpipe and hose racks;

j. Portable class ABC fire extinguishers;

k. Portable carbon dioxide class BC fire extinguishers; and

l. Portable class D fire extinguishers.

(15) The design of the water supply system ensures delivery of water to the standpipe and hose rack systems concurrent with a single active failure. The standpipe system and one diesel driven fire pump and one electric fire pump, their water supply, their suction piping, and their discharge piping throughout the Reactor, Fuel, and Control Buildings are designed to remain functional following an SSE. The standpipes which supply firewater to hose stations covering safet shutdown equipment are contained within the concrete stairwells or dedicated concrete chases, and thus, are protected from other phenomena of less severity and greater frequency.

(16) The effect of pipe breaks in fire suppression systems and protection methods for the effect of pipe breaks meet the criteria specified in Section 3.4 and Subsection 9.5.1.

(17) The floor drains are sized to handle both leakage from a crack in the standpipes or simultaneous operation of two fire hose streams. See Subsection 9.3.3 for details of the plant drainage system.

(18) Piping and cable tray penetrations are provided with fire-stops when penetrating fire rated barriers.

(19) HVAC penetrations through 2-hour or 3-hour rated fire barriers are provided with fire dampers compatible with the rating of the fire barrier.

(20) Spill control is provided to contain the contents of any above grade oil-filled vessel or tank larger than 208 liters (55 gallons) and all tanks containing chemicals used in water/wastewater treatment or quality control.

In accordance with NFPA 804 and RG 1.189, the following design criteria are used for fire containment sizing:

Drainage and any associated drainage facilities for a given area is sized to accommodate the volume of liquid produced by all the following:

a. The spill of the largest single container of any flammable or combustible liquids in the area.

b. Where automatic suppression is provided throughout, the credible volume of discharge (as determined by the fire hazards analysis) for the suppression systems operating for a period of 30 minutes.

c. Where automatic suppression is not provided throughout, the contents of piping systems and containers that are subject to failure in a fire.

d. Where the installation is outside, credible environmental factors such as rain and snow.

e. Where automatic suppression is not provided throughout, the volume is based on a manual fire-fighting flow rate of 500 gal/min (1892.5 L/min) for a duration of 30 minutes, unless the fire hazards analysis demonstrates a different flow rate and duration.

(21) The post-fire safe-shutdown circuit analysis will assume that any spurious actuations associated with a postulated fire occur simultaneously or in rapid succession.

(22) Circuit routing will conform to the methodology provided in Revision 1 of NEI 00-01 in accordance with RIS 2005-30.