



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

April 7, 1994

Docket No. 52-004

Mr. Patrick W. Marriott, Manager
Advanced Plant Technologies
GE Nuclear Energy
175 Curtner Avenue
San Jose, California 95125

Dear Mr. Marriott:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING THE SIMPLIFIED
BOILING WATER REACTOR (SBWR) DESIGN (Q420.99-Q420.113)

The staff has determined that it needs additional information to support its review activities related to the SBWR design certification. Some additional information on the instrumentation and control (I&C) systems described in Chapter 7 of SBWR standard safety analysis report (SSAR) is needed (Q420.99-Q420.113). Please provide a written response to the enclosed questions within 90 days of the date of this letter.

The enclosed questions amplify the staff's earlier I&C RAIs, which were transmitted to GE on January 4, 1994. In particular, they should assist GE in responding to Q420.58, which concerns the SBWR digital I&C data communication system. The questions are based on work performed for the staff by Lawrence Livermore National Laboratory (LLNL) and documented in a report entitled "Analysis of GE SBWR Data Communications." LLNL identified concerns (Q420.99-Q420.110) regarding the vulnerabilities of the SBWR data communication systems based on its assessment of the SBWR design against the guidance proposed in NUREG/CR-6082, "Data Communications." Q420.111-Q420.113 are related to the data communication system design details that were not clear in the SSAR.

You have previously requested that portions of the information submitted in the August 1992, application for design certification of the SBWR plant, as supplemented in February 1993, be exempt from mandatory public disclosure. The staff has not completed its review of your request in accordance with the requirements of 10 CFR 2.790; therefore, that portion of the submitted information is being withheld from public disclosure pending the staff's final determination. The staff concludes that this RAI does not contain those portions of the information for which you are seeking exemption. However, the staff will withhold this letter from public disclosure for 30 calendar days from the date of this letter to allow GE the opportunity to verify the staff's conclusions. If, after that time, you do not request that all or portions of

*The numbers in parentheses designate the tracking numbers assigned to the questions.

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Mr. Patrick W. Marriott

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the information in the enclosure be withheld from public disclosure in accordance with 10 CFR 2.790, this letter will be placed in the NRC's Public Document Room.

This RAI affects nine or fewer respondents, and therefore, is not subject to review by the Office of Management and Budget under P.L. 96-511.

If you have any questions regarding this matter, please contact me at (301) 504-1178 or Mr. Son Ninh at (301) 504-1125.

Sincerely,

(Original signed by)

Melinda Malloy, Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of Nuclear Reactor Regulation

Enclosure:
RAI on the SBWR Design

cc w/enclosure:
See next page

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Mr. Patrick W. Marriott
GE Nuclear Energy

Docket No. 52-004

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REQUEST FOR ADDITIONAL INFORMATION (RAI) ON THE
SIMPLIFIED BOILING WATER REACTOR (SBWR) DESIGN

Instrumentation and Control (I&C)

- 420.99 Describe the type of communication system used by the essential multiplexing system (EMS). Is the communication system an event-based or a state-based system?
- 420.100 The standard safety analysis report (SSAR) does not provide sufficient information to accurately or completely describe the layout of the communication system used by the EMS. Provide a discussion of the total data rates on link, reliability, and error-recovery characteristics of the communication system. The discussion should explain (1) the length of each individual link, (2) the connection between separate networks, and (3) the detailed end-to-end traffic patterns of normal and reasonably expected degraded conditions. An accurate diagram of the layout of the communication architecture should also be provided.
- 420.101 Provide a discussion on the data rates between all nodes of the architecture for normal and error conditions. Page 7.3-31 of the SSAR states:
- [a]ll interconnections are fiber optic data links. Within each division, the system uses redundant links in a bi-directional, reconfigurable arrangement for greater reliability.
- Explain how the data rate performance is affected by the error recovery. Would the communication system have sufficient capability to handle the communication traffic generated during and after error recovery?
- 420.102 Data rates are usually specified in bulk bytes (or bits) per send. This description, however, does not include overhead (extra bits) incurred by various communication schemes, which is usually added to each data transmission. If the message consists of large overhead and a small data amount, the bulk data rate supported by the links and nodes may not provide a true capability of the data communication system. Provide a description of the data message, including the length and frequency of the message.
- 420.103 Provide a discussion of how the protection system performs its functions within its timing requirements. This should include a discussion of the minimum delay allowance that the protection system will have. In addition, explain why and how the protection functions are accomplished within the required time to meet their performance goals.

Enclosure

- 420.104 The SSAR states that the SBWR communication system is deterministic. However, it is possible that during error recovery, the system may exhibit non-deterministic characteristics. Provide a discussion of error-recovery-induced indeterminacy of the data communication system.
- 420.105 Is the data highway bandwidth specified in SSAR Section 7.3.5.2 the same as the peak medium bandwidth? If not, what is the peak medium bandwidth? (The peak medium bandwidth is determined by considering the node-to-node rate with operating systems, interfaces, protocol, and other inserted delays.) In addition, provide a discussion of the data communication capability of the local multiplexing units (LMUs) and control room multiplexing units (CMUs) to support their required data rates during normal and error-occurred conditions.
- 420.106 Provide the fault tolerance, raw bit error rate, and maintainability requirements of the data communication media. Is the fiber distributed data interface (FDDI) raw data rate of 100 megabits per second a requirement?
- 420.107 Are there any handshake or synchronization signals from outside of the safety system or between separate protection system divisions? If so, explain why.
- 420.108 Provide a discussion of the communication system error performance requirements. The discussion should address the following questions:
- (1) What undetected error rate is tolerable and how is this determined? Will there be full-scale testing to determine the actual error rate?
 - (2) What undetected error rates are expected during a plant upset when noise sources may be very active?
 - (3) What error-detection and correction system is to be used, and how much of the system traffic is dedicated to this task?
 - (4) What are the worst-case consequences of undetected errors? What can be done to mitigate these consequences?
 - (5) What does the system do when it encounters an unrecoverable error?
- 420.109 Provide a discussion of the protocol used by the communication system. This should include a description of the requirements of the protocol.
- 420.110 Provide a discussion of the compatibility among node processors, network controllers, operating system, and protocol stack. The discussion should indicate the measures taken in the design of the

architecture to ensure well-designed interfaces, well-defined and balanced allocation of functions and extra capacity in components to accommodate minor design errors, and future maintenance.

- 420.111 SSAR Section 7.3.5.1 (page 7.3-30, second bullet) states that the safety-related data signals are transmitted using the EMS. However, Figures 7.3-2b and 21.7.3-6 show direct serial communication links from each sensor local multiplexing unit to the division safety system logic and controls (SSLCs). Provide a discussion addressing this discrepancy.
- 420.112 Describe the protocol used for multiplexing on the non-highway serial links. In addition, describe how ISO 7498 will be applied to the design.
- 420.113 Explain why the fiber distributed data interface meets the reliability or maintainability required for nuclear power plants. In addition, describe how FDDI cable and components (particularly, connections and terminations) meet standards applicable to Class 1E equipment.