September 20, 1988

Docket No. STN 50-605

Mr. Patrick W. Marriott, Manager
Licensing & Consulting Services
General Electric Company
Nuclear Energy Business Operations
Mail Code 682
275 Curtner Avenue
San Jose, California 95125

Dear Mr. Marriott:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING THE GENERAL ELECTRIC COMPANY APPLICATION FOR CERTIFICATION OF THE ABWR DESIGN

In our review of your application for certification of your Advanced Boiling Water Reactor Design, we have identified a need for additional information. Our request for additional information, contained in the enclosure, addresses the areas of SRP Chapter 5 reviewed by the Reactor Systems Branch. Questions related to the remainder of the review of Chapters 4, 5, 6 and 15 being carried out by the Reactor Systems Branch will be provided in the near future.

In order for us to maintain the ABWR review schedule, we request that you provide your responses to this request by November 21, 1988. If you have any concerns regarding this request please call me on (301) 492-1104.

Sincerely,

original signed by
Dino C. Scaletti, Project Manager
Standardization and Non-Power
Reactor Project Directorate
Division of Reactor Projects - III, IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosure:
As stated

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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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ADVANCED BOILING WATER REACTOR (ABWR)
SSAR CHAPTER 5.2.2 QUESTIONS

440.13 ODYNA and REDYA are the improved versions of NRC approved ODYN and REDY codes. Describe the changes made in the codes. The staff requires approval of these codes before the final design approval.

440.14 Information given in NEDE-24011-P-A is not sufficient to demonstrate compliance with the ASME code. The ASME Code Section III, Article NB-7200, requires that an overpressure protection report be prepared. Provide this report for the staff review.

Include the following items in the report:

(1) Provide all system and core parameter initial values assumed in the overpressure analyses. Include their nominal operating range with uncertainties and Technical Specification limits.

(2) Scram time characteristics.

(3) Safety/relief valve characteristics.

(4) Demonstrate available safety margin considering the most limiting transients.

(5) Peak vessel bottom pressure versus time for the limiting transients

(6) Provide graphical representation for peak vessel bottom pressure versus safety/relief valve capacity and number of safety/relief valves used for the most limiting transients.

(7) Identify conservatisms used in the overpressure transient analyses.

440.15 Confirm that the overpressure analysis includes the effects of the ATWS reactor recirculation pump trip on high reactor pressure.

440.16 Provide the sensitivity study which shows that increasing the initial operating pressure (up to the maximum permitted by the high pressure trip setpoint) will have a negligible effect on the peak transient pressure.

440.17 The performance of essentially all types of safety/relief valves has been less than expected for a safety component. Because of reportable events involving malfunctions of these valves on operating BWRs, the staff is of the opinion that significantly better safety/relief valves performance should be required of new plants. Provide a detailed description of improvements between your plant and presently operating plants in the areas listed below. In addition, explain why the noted differences will provide the required performance improvement.

(1) "Weeping" of SRVs is a generic problem. The following table explains the seriousness of the problem.

COMPARISON OF BWR/6s
"WEEPING" SRVs

PLANT	"WEEPING" SRVs/TOTAL NO.
Clinton	3/16
River Bend	12/19
Grand Gulf	11/20
Grand Gulf (after all valves changed during 1st refueling)	6/20
Perry	18/19

The continuous "weeping" of the SRV has the potential to degrade SRVs and increase the frequency of use of RHR heat exchangers.

How will the ABWR SRVs resolve the generic problem stated above?

(2) Valve and valve operator type and/or design Include discussion of improvements in the air actuator, especially materials used for components such as diaphragms and seals. Discuss the safety margins and confidence levels associated with the air accumulator design. Discuss the capability of the operator to detect low pressure in the accumulator(s). Provide detailed description of safety and relief mode of operation/function of the SRV.

(3) Specifications What new provisions have been employed to ensure that valve and valve actuator specifications include design requirements for operation under expected environmental conditions (esp. temperature, humidity, and vibration)?

(4) Testing Prior to installation, safety/relief valves should be proof tested under environmental conditions and for time period representative of the most severe operating conditions to which they may be subjected.

(5) Quality Assurance What new programs have been instituted to assure that valves are manufactured to specifications and will operate to specifications?

For example, what tests are performed by the applicant to assure that the blowdown capacity is correct?

(6) Valve Operability Provide a summary of the surveillance program to be used to monitor the performance of the safety/relief valves. Identify the information that will be obtained and how these data will be utilized to improve the operability of the valves.

(7) Valve Inspection and Overhaul Operating experience has shown that safety/relief valve failure may be caused by exceeding the manufacturer's recommended service life for the internals of the safety/relief valve or air actuator. At what frequency do you intend to visually inspect and overhaul the safety/relief valve? For both safety/relief and ADS modes, what provisions exist to ensure that valve inspection and overhaul are in accordance with the manufacturer's recommendations and that the design service life would not be exceeded for any component of the safety/relief valve?

440.18 Address the following TMI-2 action items related to SRVs.

(a) II.K.3.16
(b) II.B.1
(c) II.D.3
(d) II.K.3.28
(e) II.D.1

440.19 Explain in detail how the spring and relief modes of the SRV works. Are they any different from the SRVs currently used in operating BWRs?

440.20 What ATWS considerations have you given for sizing SRVs?

440.21 In Section 5.2.2.2.2.3, the reclosure pressure setpoint (% of opening setpoint) for both modes are given as 98 and 93. Explain the significance of those numbers.

440.22 In Figure 5.1.3a the SRV solenoid valves are not shown as DC powered as they should be. Note 8 states that "valve motor operators and pilot solenoids are ac operated unless otherwise specified."

440.24 Confirm that SRVs are designed to meet seismic and quality standards consistent with the recommendations of Regulatory Guides 1.26 and 1.29.

440.28 In SSAR Table 1.8-19, it is stated that branch technical position RSB 5-2 is applicable for ABWR. How does the ABWR design comply with BTP RSB 5-2?

440.29 Describe the methods planned for performing hydrostatic tests on ABWR RPV vessel after the initial start-up. Can you perform hydrostatic tests and leak tests without using critical heat?

ADVANCED BOILING WATER REACTOR (ABWR)
SSAR CHAPTERS 4.6, 5.4.1 AND 5.4.6

440.30 In SSAR Section 7.7.1.2, Section 4, it is stated that: "The Rod Control and Information System (RC&IS) is not classified as a safety related system, it has a control design basis only and is not required for the safety and orderly shutdown of the plant. A failure of RC&IS will not result in fuel damage. The Rod Block Functions of the RC&IS, however, are important in limiting the consequences of a rod withdrawal error during normal plant operation. An abnormal operating transient that might result in local fuel damage is prevented by the rod block enforcement functions of the RC&IS."

If credit for RC&IS is assumed in the analysis of the rod withdrawal transient to meet the GDC 10 requirement that "specified acceptance fuel design limits (SAFDL) will not be exceeded," the staff requires that RC&IS satisfies GDC-1 which states that "structures, systems and components important to safety must be designed, fabricated, erected and tested to quality standards commensurate with the safety function to be performed."

440.31 Selected Control Rod Run In (SCRRI) is provided for thermal-hydraulic stability control. Describe in detail how SCRRI controls stability.

440.32 We understand that the control rod has no velocity limiter. Discuss in detail the reason for velocity limiter elimination.

440.33 In SSAR Chapter 7.7.1.3, Section 7, 3 trips are described in the RPT logic. Do these 3 trips include the ATWS RPT trip or is the ATWS RPT trip separate?

440.34 In SSAR Chapter 5.4.1.4, it is stated "During various moderately frequent transients and infrequent transients, various Reactor Internal Pumps (RIP) operating modes will be required such as: Bank of five RIPs runback to 30% speed; trip from current speed condition; or, runback to 30% speed and subsequent trip. These control actions are all produced through control actions of the Recirculation Flow Control System (RFCS)."

Even though credit is taken for RFCS to mitigate transients as stated above, RFCS is not classified as a safety grade system. (See SSAR Chapter 7.7.1.3 Section 2). The staff has the same concern as given in question No. 440.30.

440.35 In SSAR Chapter 5.4.1.5, it is stated "The recirculation system has sufficient flow coastdown characteristics to maintain fuel thermal margins during an abnormal operational transient." What are the coastdown characteristics? Explain in detail why they are sufficient.

440.36 RCIC is taken credit in the LOCA analysis. What "upgrade" has been made to the ABWR RCIC system which is different from the BWR/6 RCIC system?

440.37 Traditionally, RCIC can be started with only reactor steam and D.C. power and it is independent of AC power for start-up. Is this true for the ABWR RCIC?

440.38 In SSAR Chapter 5.4.6.1, Section 5, it is stated that "should a complete Loss of AC power occur, RCIC is designed to operate for at least 30 minutes." Typically, in current operating BWRs, the batteries (DC power) are available for at least 4 hours after station blackout. If the batteries are available for at least 4 hours, why is RCIC designed to operate for only 30 minutes?

440.39 Some of the recent BWRs licensed to operate have gland seal compressor instead of the gland seal condenser. Why the switch now to gland seal condenser? Is the ABWR gland seal condenser design the same as the old design? Describe in detail the operation of condensate and vacuum pumps.

440.40 In SSAR Chapter 5.4.6.2.1.3, Section 2, it is stated that "the F031 limit switch activates when fully open and closes F022 and F059." This interlock is not applicable when the system is in the test mode. During test mode the RCIC pump takes suction from the suppression pool and returns to the pool. Therefore, all the 3 valves will be open simultaneously. Correct the interlock description for F031, F022 and F059.

440.41 In the ABWR design, RCIC is tested by taking suction from the pool and returning to the pool. This new testing, unlike current plants where RCIC is tested from the condensate storage tank (CST), is a requirement to take credit as an ECCS system. But from an operational point of view, it is better to provide the test flow path from CST and to the CST also. Normally, suppression pool water is a low quality water and hence, draining, flushing and filling of the system is required before putting the system back on standby after testing. (Normally, the system is lined up from CST.) This may add unnecessary radiation exposure to operations personnel. We suggest that you consider adding a test return line to CST also. Since a suction line from CST is already provided, addition of a new test return line to CST at the pump discharge should not be a major change.

440.42 Why are the power supply for valves F063, F064, F076, F077, and F078 standby A/C instead of DC?

440.43 Address the following TMI-2 action Items related to RCIC.

(a) II.K.1.22

(b) II.K.3.13

(c) II.K.3.15

(d) II.K.3.22

(e) II.K.3.24

440.44 Confirm that the RCIC system meets the guidelines of Regulatory Guide 1.1 regarding pump Net Positive Suction Head (NPSH).

440.45 SRP 5.4.6 identifies GDCs 5, 29, 33, 34 and 54 in the acceptance criteria. Confirm that the RCIC system, described in Chapter 5.4.6 of the SSAR, meets the requirements of the above GDCs.

440.46 In SSAR Chapter 5.4.6.3, it is stated "The analytical methods and assumptions in evaluating the RCIC system are presented in Chapter 15 and Appendix 15A." Identify the section in Chapter 15 where the analytical methods and assumptions evaluating the RCIC systems are given.

440.47 Normally the RCIC pump takes suction from the Condensate Storage Tank (CST). But the CST is not seismically qualified or safety related. Confirm that the system piping and level transmitters, which interface with CST, will be designed and installed such that the automatic switchover to the suppression pool takes place without failure.

440.48 The equipment and component description given in 5.4.6.2.2 is very brief. What type of turbi.. is used in the ABWR? Is it the same type as the Terry Turbines used in current BWRs? Is the turbine testing done by Terry Co. with water applicable to the ABWR? Describe in detail the components, especially the turbine and the pump.

440.49 To the best of our knowledge, the steam isolation valves F063 and F064 in currently operating BWRs are not tested with a steam pipe break downstream and with actual operating conditions (pressure 1000 psig and temperature 546°F). There is no guarantee that the steam isolation valves will close during a break. We require that a proper testing of the valves be performed before the final design approval. (Reference Generic Issue GI-87 "Failure of HPCI Steam Line Without Isolation.")

440.50 Steam isolation valves F063 and F064 are to be opened in sequence to reduce water hammer and for slow warm-up of the piping. F064 and F076 are opened first. The valves logic should prevent the operator from opening the valves out of sequence. Confirm that the valves control logic includes an interlock.

440.51 Describe how the system design reduces water hammer. Confirm that a condensing sparger will be provided at the turbine exhaust to reduce water hammer. Add a necessary note in the P&I-D to indicate that the steam supply and exhaust lines are to be sloped to reduce water hammer.

440.52 RCIC operation from the suppression pool may be limited by an increase in suppression pool temperature due to lube oil cooling done by suppression pool water. What is the maximum suppression pool temperature at which RCIC can be operated safely.

440.53 How is thermal shock prevented at the feedwater line injection point?

440-54 What is the minimum quantity of water required in the condensate storage tank (CST) for RCIC operation? Give the basis for the required quantitiy of water in the CST.

440.55 In the LOCA analysis (SSAR Table 6.3) 800 gpm is taken credit for the RCIC system. Due to pump degradation and flow controller measurement inaccuracies, the system may not deliver 800 gpm. The required system flow should be increased, accounting for uncertainties, to meet the LOCA analysis required flow.

440.56 In SSAR Chapter 5.4.6.2.1.3, Section 1, it is stated "there are two key-locked valves (F068 and F069) and two key-locked isolation resets." Change the description to state that the valves F068 and F069 are key-locked open.

440.57 What is the closing time of test return valves F022 and F059? They should close earlier than 15 seconds to prevent any flow diversion to the suppression pool during a LOCA.

440.58 Since RCIC is part of the ECCS network, the RCIC pump minimum flow line should be designed to operate for a reasonable length of time. How long can RCIC run in minimum flow mode?

ADVANCED BOILING WATER REACTOR (ABWR)

SSAR CHAPTER 5.4.7

440.59 What is the difference between Low Pressure Flooder System and Low Pressure Core Spray System? Describe in detail why "flooder" system is better than core spray. Submit detailed drawing showing the "flooder" inside the vessel.

440.60 In SSAR Table 1.3.2, it is stated that the RHR heat exchanger duty for suppression pool cooling is based on assuming they are placed in operation 20 hrs after reactor shutdown.

This statement is not consistent with the normal assumption that suppression pool cooling is stated within ten minutes after a LOCA. What is the basis for sizing the RHR Hx? In SSAR Chapter 5.4.7.3.2, it is stated that ATWS was considered for RHR heat exchanger sizing. But a Feedwater Line Break (FWLB) is the most limiting event. Describe in detail why FWLB is the limiting event and not ATWS.

440.61 IN SSAR Chapter 5.4.7.3.2, Section 2, it is stated "because it takes 4 to 6 hrs to reach the peak pool temperature, shutdown cooling will be initiated before peak pool temperature. The energy release from the reactor will be controlled by the shutdown cooling system, and there is no need to release the reactor energy to the pool."

Which scenerios are postulated for the assumption stated above? For most scenerios, suppression pool cooling is started within a short time. Shutdown cooling is started at a much later stage. Describe in detail the assumptions made for sizing the RHR heat exchangers.

440.62 SRP 5.4.7 identifies GDCs 2, 5, 19 and 34 in the acceptance criteria. Confirm that the RHR system, described in Chapter 5.4.7 of the SSAR, meets the requirements of the above GDCs.

440.63 Confirm that the RHR system satisfies the requirements of TMI-2 Action item III.D.1.1.

440.64 Confirm that the RHR system meets the guidelines of Regulatory Guide 1.1 regarding pump Net Positive Suction Head.

440.65 In Section 5.4.7.2.3.1(3) it is stated that "redundant interlocks prevent opening the shutdown connections to and from the vessel whenever the pressure is above the shutdown range."

RSB 5-1 requires that the suction and discharge valves interfacing with the RCS shall have independent diverse interlocks to prevent the valves from being opened unless the RCS pressure is below the RHR design pressure.

Confirm that the high/low pressure interface with RCS satisfies the requirements of RSB 5-1.

440.72 NRC Bulletin 88-04 dated May 5, 1988, discusses the potential safety related pump loss. The first concern involves the potential for the dead-heading of one or more pumps in safety related systems that have a miniflow line common to two or more pumps or other configurations that do not preclude pump-to-pump interaction during miniflow operation. A second concern is whether or not the installed miniflow capacity is adequate for even a single pump in operation.

In the ABWR design, HPCS pump miniflow lines and test return lines to the suppression pool are routed through the RHR "c" loop test and minimum flow lines. How does the ABWR design satisfy the concerns given in NRC Bulletin No. 88-04?

440.73 In RHR process diagram 5.4-11b, RHR heat exchanger heat removal capacity for different modes is not given. Revise the process diagram to include the heat removal capacity.

440.74 In Figure 5.4-10b, (I-12) flammability system (T-49) is cross-tied to the RHR system. What is the purpose of this cross-tie to the RHR system?