UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 9, 1994

Docket No. 52-004

Mr. Patrick W. Marriott, Manager
Licensing & Consulting Services
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 (Q435.1-Q435.108)

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 electric power systems described in Chapter 8 and other chapters of the SBWR standard safety analysis report (SSAR) is needed (Q435.1-Q435.108).* Please provide a written response to the enclosed questions within 90 days of the date of this letter.

This RAI also includes questions which address the electrical power systems material found in the SBWR Tier 1 Design Certification Document. The questions on the Tier 1 document should not be considered final. The staff intends to do a more detailed review of the document when you submit updated material that is based on the experience gained from the advanced boiling water reactor work on inspections, tests, analyses, and acceptance criteria. The staff will likely have additional questions on the SBWR Tier 1 document at that time.

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 Nuclear Energy the opportunity to verify the staff's conclusions. If, after that time, you do not request that all or portions of 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.

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

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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) 925-1125.

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

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NAME	PShea	MMalloy:tz	SNinh	JNWilson
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cc: Mr. Laurence S. Gifford
GE Nuclear Energy
12300 Twinbrook Parkway
Suite 315
Rockville, Maryland 20852

Director, Criteria & Standards Division
Office of Radiation Programs
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Mr. Sterling Franks
U.S. Department of Energy
NE-42
Washington, D.C. 20585

Mr. John E. Leatherman
SBWR Licensing Manager
GE Nuclear Energy
175 Curtner Avenue, MC-781
San Jose, California 95125

Mr. Steven A. Hucik
GE Nuclear Energy
175 Curtner Avenue, MC-780
San Jose, California 95125

Mr. Frank A. Ross
Program Manager, ALWR
Office of LWR Safety & Technology
U.S. Department of Energy
NE-42
19901 Germantown Road
Germantown, Maryland 20874

Mr. Victor G. Snell, Director
Safety and Licensing
AECL Technologies
9210 Corporate Boulevard
Suite 410
Rockville, Maryland 20850

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

Electric Power Systems

435.1 Throughout Chapter 8 of the standard safety analysis report (SSAR) and in Table 1.9-3, various Institute of Electrical and Electronic Engineers (IEEE) standards are referenced. If any standard referenced is a standard that had a previous version endorsed by a NRC regulatory guide (RG), identify the differences (changes, deletions, or additions) between the version that is referenced and the version endorsed by the RG. Describe the SBWR design in those areas that are related to the identified differences. In addition, IEEE Standard 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, should be added to SSAR Table 1.9-3 and used in the SBWR design for control of harmonic distortion from adjustable speed drives.

435.2 It is not always clear where the interface exists between the equipment that is within the SBWR scope and the equipment that is outside the SBWR scope. For instance, SSAR Section 8.2.4.3 states that the Normal Preferred Power interface occurs at the connection of the isolated phase bus to the main power transformer low voltage terminals. This implies that the unit auxiliary transformers are within the SBWR scope. However, the interface requirements in SSAR Section 8.2.3 state that the main and unit auxiliary transformers shall meet the requirements of American National Standards Institute (ANSI) Standard C57.12.00, which implies that the unit auxiliary transformers are outside the SBWR scope. Clearly define the areas that are within the SBWR scope and those that are not. This should be done by clearly identifying the interfaces on the drawings provided in the SSAR and by clearly identifying the equipment and systems outside the SBWR scope in the sections of Chapter 8 that address interface requirements and in Section 4 of the Tier 1 Design Certification Document.

435.3 SSAR Section 8.1.5.2.1 states that the SBWR unit's total safety-related load is divided into four physically separate and electrically independent divisions, and any two out of four divisions can safely shut down the unit and maintain it in a safe shutdown condition. Does this statement apply to isolation valves and other non-shutdown safety systems? Confirm that <u>any</u> two out of four divisions of safety-related power is all that is necessary for <u>all</u> safety-related equipment to accomplish their safety function. If this not accurate, identify the safety-related equipment that will not accomplish their safety function on a failure of any two of the four safety-related power divisions.

Enclosure

435.4 SSAR Section 8.1.5.2.1 states that redundant parts of the system are physically separated and electrically independent to the extent that for any design basis event, with any loss of equipment resulting from a single active failure, two divisions of dc power will be available to effect a safe plant shutdown for all allowable plant operating modes. If there are four separate and independent dc divisions, why would a single active failure fail two of the four divisions? Also, in the above statement and throughout SSAR Chapter 8, the terminology "single active failure" is used when talking about electrical systems. From a regulatory standpoint, the staff has not differentiated between active and passive failures when applying the single-failure criterion to electrical systems (as opposed to fluid systems for which failure have been differentiated). In the definitions to the General Design Criteria in 10 CFR Part 50, Appendix A, Footnote 2 states that single failures of passive components in electric systems should be assumed in designing against a single failure. Accordingly, all references to "single active failures" should be changed to "single failure of active and passive components."

435.5 SSAR Section 8.1.5.2.3 indicates that the SBWR is designed in accordance with General Design Criterion (GDC) 2 and GDC 4. In accordance with these criteria, explain what provisions have been taken in the SBWR design to protect the electrical systems against the disruptive effects of lightning on the offsite systems and the onsite systems. Highly inductive loads may also generate surges when de-energized that, if not suppressed, may impress voltage spikes on the electrical distribution systems. Describe the protection provided to suppress or protect against these surges.

435.6 In the sections of SSAR Chapter 8 that address combined operating license (COL) license information, it appears that some of the information includes interface requirements and should appear in those sections. For example, Section 8.2.4.3 under COL license information states:

> The Normal Preferred Power interface occurs at the connection of the isolated phase bus to the main power transformer low voltage terminals. The rated conditions for this interface are 780 MVA at a .9 power factor and 25 kV. It is a requirement that the utility provide sufficient impedance in the main power transformer and the high voltage circuit to limit the primary side maximum available fault current contribution from the system to no more than 275 kA symmetrical and 340 kA asymmetrical at 5 cycles from inception of the fault.

The above appears to be an interface requirement that the utility has to meet on the equipment they will be providing, rather than information they must provide at the COL licensing stage. It should, therefore, be included in the section on interface requirements. Include all the above similar kinds of requirements in the interface requirements sections so there is no misunderstanding of what requirements are placed on the utility's portion of the design. Identify where such changes are made.

435.7 SSAR Section 8.1.6.3 under COL license information addresses a matrix of regulatory requirements listed in Table 8.1-1 that is also in accordance with Table 8-1 in the NRC Standard Review Plan (SRP). Justify why this item is included under COL license information.

435.8 SSAR Section 8.2.1.2 states that the non-segregated bus ducts that are provided for the electrical interconnection between the unit auxiliary transformers and the 6.9 kV unit auxiliary switchgear buses associated with each power load group are physically separated to minimize the likelihood of simultaneous failure. It also states that the non-segregated bus duct that is provided for the electrical interconnection between the reserve transformer and the main circuit breakers of the 6.9 kV diesel generator (DG) switchgear buses is physically separated from the bus ducts (that are provided for the interconnection of the unit auxiliary transformers and the unit auxiliary switchgear buses to minimize the likelihood of simultaneous failure). Describe how much physical separation is maintained between these features and the rationale for the separation provided.

435.9 With regard to meeting GDC 18, SSAR Section 8.2.2 states that the generator breaker cannot be tested during normal operation of the plant. While it may not be feasible to test the tripping capability of the generator breaker during plant operation, the staff assumes that some inspections could be performed to provide confidence of its operability at power, such as verifying adequate operating air pressure. More comprehensive inspections and tests could also be performed during shutdown to verify its continued operability. Discuss what kinds of tests and inspections will be proposed for the generator breaker in the SBWR design.

435.10 SSAR Section 8.2.2 states that RG 1.32 is not applicable to the offsite system because the offsite system is non-Class 1E. Although the offsite system is non-Class 1E, IEEE Standard 308 (1974 and 1980 Editions) contains requirements for non-Class 1E interfaces, such as the preferred power supply. Correspondingly, RG 1.32 (which endorses the 1974 version of that standard) also addresses the preferred power supply interface in Regulatory Position C.1.a. Therefore, revise Section 8.2.2 accordingly and describe how the SBWR design complies with Regulatory Position C.1.a of RG 1.32.

435.11 SSAR Section 8.2.2 states that RG 1.47 is not applicable to the offsite system because the offsite system is non-Class 1E; however, SSAR Table 8.1-1 and Table 8-1 in the SRP indicate that it is applicable. As a minimum, status information should be available in the main control room to allow the operator to determine the status of the offsite system at all times. In addition, control of the switchyard breakers directly connected to the main and reserve offsite circuits should be provided in the main control room. Address this issue and provide an interface requirement in SSAR Section 8.2.3 for the above indicated control and monitoring instrumentation.

435.12 Section 4.2 of the Tier 1 Design Certification Document and the second bullet in SSAR Section 8.2.3 states that the main and reserve power circuits shall be connected to different transmission systems. Also stated is that they may use a common switchyard, provided adequate separation exists. The second statement seems to negate the first since "different transmission systems" would seem to require at least different switchyards. Define what is meant by "different transmission systems" and "common switchyard," and clarify whether or not it is intended that separate switchyards be used for the main and reserve power circuits.

435.13 Section 4.2 of the Tier 1 Design Certification Document and SSAR Section 8.2.3 state that it is required that the cables of the main and reserve power circuits be routed separately and in separate raceways apart from each other and onsite power system cables; however, they may share a common underground duct bank. Provide the rationale for allowing the cables associated with the main and reserve power circuits to share a common underground duct bank. This could make them susceptible to common cause failures such as flooding. Also, why is so much of the discussion of the separation of the main and reserve offsite circuits provided under these sections dealing with interface requirements? It appears that GE will be providing the entire reserve offsite circuit up through the reserve transformer and the main offsite circuit up to the main transformer, so the majority of this should be within the SBWR scope. (See also question Q435.2 with regard to clearly defining interfaces.)

435.14 SSAR Section 8.2.4.12 under COL license information states that the generator circuit breaker meets Appendix A to SRP Section 8.2. Is this a statement about the generator breaker or information the licensee must supply? Is the generator breaker intended to be inside or outside the GE portion of the SBWR design? The generator circuit breaker should be included in the SBWR Standard Plant scope.

435.15 SSAR Section 8.3.1.1.2 states that the 480 Vac motor control centers supply power to the Class 1E lighting system as discussed in SSAR Chapter 9. Chapter 9, however, indicates that the only Class 1E lighting system is the control room emergency lighting that is fed from the Class 1E 120 V vital ac power. Clarify this discrepancy.

435.16 SSAR Sections 8.3.1.1.2 and 8.3.1.1.6 indicate that each of the Class 1E motor control center (MCC) buses is provided with voltage and frequency monitoring and protection. The protection isolates the Class 1E system from the non-Class 1E system on loss of voltage, and on degraded voltage and frequency conditions, for a predetermined time period by opening the power supply circuit breaker located in the MCC. Provide more information on this feature such as the system logic, set points, and time delays used, as well as the compatibility of the set points and time delays with the rated values of the equipment they monitor. The voltage and frequency protection should trip the MCC circuit breakers located in the feeds from both the 480 V power center buses and the transportable ac generators (see Figure 21.8.3-4 Sheet 4). This will ensure that the safety-related equipment will not be damaged by an out-of-range voltage or frequency from the unqualified power sources and will remain available once the out-of-range condition is corrected. Verify that the equipment comprising the voltage and frequency protective functions are qualified as Class 1E.

435.17 With regard to the regulatory treatment of nonsafety systems (RTNSS) in passive advanced light water reactors (ALWRs), the NRC staff and the Electric Power Research Institute (EPRI) have agreed on an approach for resolving this issue on passive designs. Therefore, provide an analysis of the nonsafety electrical systems in the SBWR design in accordance with the process described in the EPRI letter to the NRC dated May 26, 1993.

435.18 Describe the analyses (including any industry standards or practices) used for voltage drop on the safety-related ac, dc, and vital ac electrical distribution systems which demonstrate that adequate voltages are maintained down to the terminals of all safety-related equipment over all plant normal and emergency modes of operation.

435.19 Describe the analyses (including any industry standards or practices) used for fault current on the safety-related ac, dc, and vital ac electrical distribution systems which demonstrate that the maximum available fault currents are within the ratings of all safety-related electrical distribution equipment over all plant normal and emergency modes of operation.

435.20 Describe the analyses (including any industry standards or practices) used for overcurrent protection and coordination that demonstrate that all safety-related electrical equipment are suitably protected from electrical faults and that the overcurrent protective devices are suitably coordinated to provide selective tripping of the device nearest to the fault over all plant normal and emergency modes of operation.

435.21 SSAR Section 8.3.1.1.2 states that the Class 1E motor control center emergency power main circuit breaker provided from the plug-in connections for a transportable ac generator is normally locked open and that an interlock is provided so that only one main breaker may be closed at any time. Do the interlocks referred to preclude the simultaneous connection of all four Class 1E MCCs to the transportable ac generator, or do they preclude the simultaneous closure of the emergency power main circuit breaker at an individual MCC and the normal supply breaker from the non-Class 1E power center at the same MCC? Also, is it planned to have individual transportable ac generators supply each of the four Class 1E MCCs, or will one supply all four MCCs simultaneously?

435.22 The SSAR Section 8.3.1.1.4 discussion of the non-Class 1E 120 Vac uninterruptible power supplies (UPSs) states that if the inverter fails, the ac static switch transfers to the regulating transformer without interruption, and if the ac source or rectifier fails, the dc thyristor switch transfers to the dc source without interruption. Figure 21.8.3-6, however, does not show a dc thyristor switch or rectifier. The subject statement seems to be describing a UPS design that is not used on the SBWR. Clarify this discrepancy and verify that the discrepancy has not been made on the Class 1E UPSs.

435.23 Under the heading, "Class 1E Electric Equipment Design Bases and Criteria," in SSAR Section 8.3.1.1.5, it is stated that plant design specifications for electrical equipment require such equipment be capable of accelerating their loads as required with a minimum of 80 percent rated terminal voltage. Sections 8.3.2.1.1 and 8.3.2.1.2 state that the dc system minimum discharge voltage at the end of the discharge period is 105 volts and that the operating voltage range of Class 1E dc loads is 100 to 140 V (135 V for non-Class 1E loads). The minimum specified operating voltage of 100 volts is 80 percent of the nominal 125 Vdc. At the minimum discharge voltage of 105 volts this would allow only a 5-volt drop from the battery terminals to the equipment terminals during motor starting transients at the end of the discharge period. Is a 5-volt drop from battery to motor sufficient to account for the large in-rush current that occurs during motor starting? Is it also sufficient to allow for the jumpering out of battery cells?

This question was pursued with EPRI for Class 1E valve actuator motors. As a result, paragraph 2.6.2.3 in Volume 3, Chapter 11 of the ALWR Requirements Document specifies that the adequacy of the 80 percent starting voltage rating shall be demonstrated by calculations for each valve or a lower starting voltage shall be specified, as appropriate, based on the calculation results. Provide the results of these calculations.

435.24 Under the heading "Bus Protection" in SSAR Section 8.3.1.1.6, it is stated that the 6.9 kV feeders for power centers have instantaneous, inverse-time overload and ground fault protection. Describe how the instantaneous setting of the power center feeder breakers coordinates with downstream circuit protection?

435.25 SSAR Section 8.3.1.1.7 states that should the 6.9 kV plant investment protection bus voltage decay to below 70 percent of its nominal rated value for a predetermined time, a standard dead bus transfer is automatically initiated to the standby power source. It also states that as the bus voltage decays, large pump motor breakers are tripped and low voltage motor starters are opened because of undervoltage. Provide the time delay and type of redundant and coincident logic used for the 70 percent loss of preferred power function. Also, provide the undervoltage set point for the function that strips the buses. Is this function provided by individual undervoltage devices at the motor breakers and starters, or by common undervoltage sensing devices at the 6.9 kV buses?

Are the load sequencers designed to load shed and sequence the proper loads if a loss of offsite power or loss-of-coolant accident (LOCA) should occur during plant shutdown modes? If so, how are loads like the plant service water (PSW) system and reactor water cleanup/shutdown cooling (RWCU/SDC) system pumps handled since both divisions are shown connected to one diesel generator in SSAR Table 8.3-1? If manual action is relied upon, describe how the load sequencers are disabled and describe how any automatic actions (like auto DG start and separation from offsite system on degraded voltage or loss of offsite power) are integrated with required operator actions (like loading of the PSW pumps to support DG operation).

435.26 SSAR Section 8.3.1.1.7 describes the sequence of events for loss of preferred power (LOPP) following a LOCA and for loss of alternate preferred power (LAPP) following a LOCA. How are the load sequencing timers reset and the previously sequenced loads shed from the bus if the LOPP or LAPP occurs during the initial load sequencing of LOCA loads on offsite power? How is this done if the LOPP or LAPP occurs shortly after the initial load sequencing? Are the diesel generators started by the LOCA signal and run in standby when the LOCA occurs with offsite power available? If so, how is residual voltage allowed to decay prior to closing the DG breaker? Has consideration been given to the effects of deenergizing equipment and then reenergizing it shortly thereafter (such as motor overloading caused by pumps starting with valves fully opened, air conditioning compressors not fully depressurized, consecutive starts of continuous duty motors in excess of their specifications, or hydraulic problems such as water hammer caused by system drain back)?

435.27 SSAR Sections 8.3.1.1.7 and 19AE.15.4 indicate that if the normal preferred power supply is used for load testing the standby diesel generator and is lost during the standby diesel generator paralleling test, the normal preferred power supply breaker is automatically tripped and the standby DG continues to power the bus loads. Describe what signal trips the normal preferred power supply breaker since a loss of voltage signal may not be detected if the DG holds up the bus voltage. Section 8.3.1.1.7 also describes a similar scenario when the alternate preferred supply is used for load testing the standby DGs. Note 3A in Figure 21.8.3-1, however, seems to indicate that only the normal preferred power supply can be used for testing the DGs. Clarify this discrepancy.

435.28 SSAR Section 8.3.1.1.7 describes the degraded voltage protection provided for the plant investment protection buses. Describe the type of redundant and coincident logic that will be used, if any. Also, can the PIP loads tolerate a voltage of just above 70 percent (the set point of the loss-of-power logic) for the 5-minute time delay of the degraded voltage logic while the operator is attempting corrective action? In addition, does the 90 percent set point of the degraded voltage protection assure that rated voltages are maintained at the terminals of all equipment, including downstream equipment, taking into account voltage drop from the bus to the equipment?

435.29 Under "Cable Identification" in SSAR Section 8.3.1.3.1, it is stated that exceptions to color-coding of cables are permitted for individual conductors within cabinets or panels where all wiring is unique to a single division. This section also says that any non-divisional cable within such cabinets is appropriately marked to distinguish it from the divisional cables. Define "appropriately marked" and provide some examples of conductor markings that would meet this criteria.

435.30 Under "Sharing of cable trays" in SSAR Section 8.3.1.4.1, it is stated that all divisions of Class 1E ac and dc systems are provided with independent raceway systems. Are the cable trays containing Class 1E ac cables independent of cable trays containing Class 1E dc cables?

435.31 SSAR Section 8.3.1.4.2 refers to Table 8.3-1 in several places for information regarding the separation of various safety-related systems and equipment. The table, however, actually deals with the loads connected to the diesel generators which are primarily non-safety-related and does not provide any detailed information on safety-related equipment. Provide the information that was intended in those places where Table 8.3-1 is referenced.

435.32 SSAR Section 8.3.2.1 states that four independent Class 1E 125 Vdc power systems are provided. Is the separation of these four dc power systems the same as that described in Section 8.3.1.4.2 under the headings "General" and "Separation Techniques?" Is the separation criteria four way, that is, is each dc power system equally separate from each of the other three dc power systems?

435.33 SSAR Section 8.3.2.1.1 states that each divisional dc power system consists of two separate battery sets. One set supplies power to selected safety loads for at least 72 hours following a licensing basis event and the other set supplies power to other loads for a period of at least 2 hours without load shedding. During a 72-hour event, what will happen to the 2-hour loads and their batteries? Will the batteries be protected from a total discharge, and will the loads be protected from voltages lower than their rated values? If not, will not the battery cells be damaged from operating into cell reversal, and will not the loads be damaged or unintended equipment operations or anomalous instrument indications occur from operating under the low voltages? If the loads are damaged, would this complicate long-term recovery? (See Section 7.2.3, Chapter 11 of the NRC staff's Final Safety Evaluation Report for the EPRI Passive Requirements Document for additional information on this issue.)

435.34 SSAR Section 8.3.2.1.1 states that the 125-volt Class 1E batteries are rated 3000 ampere-hours for a 72-hour station blackout condition, and 1800 ampere-hours for 2-hour duty cycles. The ratings of the batteries are properly a GE responsibility, but SSAR Sections 8.3.4.8 and Section 1.1.17 state that the COL applicant should provide this information. Address this discrepancy.

435.35 Section 8.3.2.1.1 indicates that the Class 1E batteries are essentially divided into two sizing capabilities: those that are sized to supply the 72-hour loads and those that are sized to supply the 2-hour loads. Figure 21.8.3-2 shows two batteries in each of the four dc safety divisions. One 72-hour battery supplies the 72-hour load bus and one 2-hour battery supplies the 2-hour load bus. There is a bus tie breaker shown between the 72-hour bus and the 2-hour bus. There is also a battery charger shown connected to each of the two buses in each of the four divisions. Section 8.3.2.1.1 states that each battery charger is capable of supplying the maximum continuous load demand to its bus while recharging its battery from the design minimum charge to 95 percent of fully charged condition within 12 hours. From the preceding, it appears that the battery and its charger are sized to supply only their associated bus and no more. What then is the purpose of the bus tie shown between the 72-hour bus and the 2-hour bus? Is the bus tie intended to allow the batteries and chargers of the two buses to operate in parallel? If so, how is the division of load controlled and divided between the parallel chargers and batteries, and how is the 72-hour capability of the 72-hour battery assured without load shedding? Also, if the batteries and chargers are sized to power only their associated buses, there is no backup capability provided when a charger or battery must be removed from service. Comment on this lack of backup capability.

435.36 SSAR Sections 8.3.2.1.1 and 8.3.2.1.2 state that the Class 1E and non-Class 1E batteries are sized so that the required loads will not exceed 80 percent of nameplate rating or warranted capacity at end-of-installed-life with 100 percent design demand. Section 8.3.2.1.1 states that the Class 1E batteries are also sized for the dc load in accordance with IEEE Standard 485. IEEE Standard 485, however, requires that the batteries be sized using more than just the given criteria in Section 8.3.2.1.1. It requires that a temperature correction factor and a design margin of 10 to 15 percent be included in the sizing, together with the factor used to compensate for the age-related 80 percent replacement criteria. Provide the temperature correction factor and the design margin GE is specifying for the SBWR Class 1E batteries. The sizing of the non-Class 1E batteries should also include these parameters, therefore, provide them as well. Also, provide the battery sizing calculations and load duty cycles that are used in the sizing of the Class 1E and non-Class 1E batteries. The loading and sizing calculations for the Class 1E batteries should be provided for both the 72-hour and 2-hour batteries.

In addition to the above information, provide the most limiting discharge profile of the 2-hour batteries that will be used for heat calculation purposes during a 72-hour event. (See Section 7.2.3, Chapter 11 of the NRC staff's final safety evaluation report for the EPRI Passive Requirements Document for additional information on this particular item.)

435.37 SSAR Sections 8.3.2.1.1 and 8.3.2.1.2 state that the Class 1E and non-Class 1E battery banks are designed to permit replacement of individual cells without loss of availability or capability. How is this accomplished with the batteries on-line, and how is the loss of capability prevented during the transition?

435.38 With regard to the battery chargers, SSAR Section 8.3.2.1.1 states that the chargers are suitable for float charging the batteries. The chargers should also be suitable for performing an equalizing charge on the batteries. Indicate whether or not this is the case. If it is not, describe how the batteries will be given an equalizing charge.

435.39 Provide a list of all monitoring instrumentation provided on the Class 1E and non-Class 1E dc power supply systems. Identify instrumentation that is located in the main control room and that is located locally. A battery ampere-hour meter should be provided for the 72-hour batteries to assist the operator in determining remaining capacity on those batteries during a 72-hour event.

435.40 SSAR Sections 8.3.2.1.1 and 8.3.2.1.2 briefly address Class 1E and non-Class 1E battery room ventilation. Is the ventilation designed to limit hydrogen accumulation to less than 2 percent of the total volume of the battery area as required by IEEE Standard 484? Will the hydrogen concentration be limited to less than 2 percent during the course of a 72-hour event when ac power and ventilation is not available? Will it be limited to less than 2 percent during such an event near the end of the battery discharge when battery cells are going into cell reversal and gassing more heavily?

435.41 Under the heading "Non-Class 1E Batteries" SSAR Section 8.3.2.1.2 states that the 125-volt and 250-volt non-Class 1E batteries are sized for a 2-hour duty cycle. Later, under the same heading, it states that the non-Class 1E batteries have sufficient stored capacity without their chargers to independently supply their loads continuously for at least 8 hours. Clarify this discrepancy. Are the non-Class 1E batteries sized to be able to supply their loads continuously for 2 hours or for 8 hours?

435.42 SSAR Section 8.3.2.1.2 indicates that the maximum operating voltages of the 125-Vdc and 250-Vdc non-Class 1E loads are 135 volts and

275 volts, respectively. It also states that the maximum equalizing charge voltages for the 125-volt and 250-volt non-Class 1E batteries are 140 Vdc and 280 Vdc, respectively. Since the equalizing charge voltage is greater than the maximum operating voltage of the loads, are the nonsafety batteries intended to be equalize charged off line? If they are intended to be equalized off line, the non-Class 1E dc distribution system arrangement shown in SSAR Figure 21.8.3-3 would appear not to facilitate such a process, since there is no capability to connect any of the chargers to the batteries off line. If the batteries are intended to be equalized on line and the voltage drop between the battery and the loads is relied upon to keep the voltage at the load terminals to within maximum rated values, this will be very difficult to ensure for all loading conditions. The non-Class 1E 125 Vdc system will be especially troublesome since no more than a 5-volt drop to the loads can be tolerated during battery discharges and no less than a 5-volt drop can be tolerated during battery equalizing charges. Address the these comments.

435.43 SSAR Section 8.3.2.2.1 states that a ground detection system is employed for prompt detection of grounds. The ground detection system used should be a high impedance system to avoid problems seen in some existing plants that use lower impedance systems that have contributed to spurious component actuation. Indicate whether the high impedance system will be used in the SBWR design.

435.44 SSAR Section 8.3.2.2.2 discusses "dc safety-related standby lighting system circuits." SSAR Section 9.5.3 addresses the SBWR lighting systems, however, and seems to indicate that the standby lighting system is totally non-Class 1E. Address this apparent discrepancy.

435.45 SSAR Section 8.3.4.10 states that thermal overload protection for Class 1E motor-operated valves is active at all times except under LOCA conditions. Describe how the SBWR design accomplishes this. In addition, address RG 1.106 and list it as a pertinent regulatory requirement in Section 8.3.2.2.2.

435.46 SSAR Section 8.3.4.11 identifies a COL item to provide an emergency operating procedure that allows two divisions to be shut down during a station blackout event to reduce heat dissipation in the control room and conserve battery energy. Must two divisions be shut down in order to obtain 72-hour coping capability on the batteries and to maintain control room temperatures below limits?

435.47 SSAR Table 8.3-1 provides the diesel generator loading for various modes of operation. In many instances, it shows redundant loads that are normally connected to the redundant load groups being powered from a single DG. These cases are found scattered throughout all modes of operation, including LOCA and shutdown modes. How are the redundant loads connected to the DG in these cases? The only electrical connection shown between the redundant load groups is a possible bus tie between the 6.9 kV buses into which the alternate preferred supply is brought. Note 3A on Figure 21.8.3-1, however, indicates that the DG breaker and bus tie breaker in the load group are interlocked such that both breakers cannot be closed at the same time.

435.48 Based on the standby diesel generator rating (5000 kVA @ 0.8 p.f.) indicated on SSAR Figure 21.8.3-1, the continuous loading on the DGs shown in Table 8.3-1 is very near their continuous rating. In one case, it appears to exceed the continuous rating. The EPRI Passive Requirements Document specifies that the short-term rating of the standby sources include margin in the range of 10 to 15 percent to allow for possible load growth. It is not clear that this amount of margin will be available on the SBWR DGs with the loading indicated in Table 8.3-1. What is the SBWR's specified continuous and short-term rating of the DGs? This should be compared to the anticipated short-term loading of the DGs to determine the amount of margin available. In this regard, Table 8.3-1 should be modified to identify the short-term as well as the continuous loading on the DGs.

435.49 SSAR Table 8.3-2 identifies the loading sequence of the major loads on the standby diesel generators. It does not, however, provide the kilowatt loading of the individual loads or the total kilowatt loading of the individual load blocks. Table 8.3-2 should be revised to include this information.

435.50 On SSAR Figure 21.8.3-1, the Iso-Phase bus between the output of the generator breaker and Unit Auxiliary Transformer 1X10 is shown rated at 1200 amperes. The Iso-Phase bus between the generator breaker and Unit Auxiliary Transformers 1X100 (installed spare) and 1X20 is also shown rated at 1200 amperes. If the installed spare Unit Auxiliary Transformer 1X100 is used as a replacement for Unit Auxiliary Transformer 1X10, both the installed spare transformer 1X100 and transformer 1X20 will be fed from the 1200 amp rated Iso-Phase bus. Is the 1200 ampere rating of the Iso-Phase bus sufficient to carry the load of both transformers?

435.51 Note 3D on SSAR Figure 21.8.3-1 states that the unit auxiliary switchgear buses may be supplied from the diesel generator bus for maintenance purposes in the event of an extended outage of their normal power supply. Is the intent of the note to allow the DGs to feed the unit auxiliary buses, or to allow the reserve transformer to feed these buses? The unit auxiliary buses are rated 3000 amps while the DG buses are only rated 1200 amps. How will overloading of the DG buses be prevented? Will the protection and coordination be set up for power flow in this direction?

435.52 Note 7 relative to unit auxiliary transformers on SSAR Figure 21.8.3-1 states that depending on the specific utility and plant system voltage operating requirements, the need for automatic load tap changer shall be determined on the project basis. It would seem that because of the inherent lower reliability of automatic load tap changers and problems associated with coordinating their operation with undervoltage protection systems, the use of these should be limited to only those cases where adequate voltage regulation could not be assured without them. Address this concern.

435.53 SSAR Figure 21.8.3-5 does not show any electrical protective assemblies (EPAs) connected between the reactor protective system (RPS) loads and their power sources. EPAs have been required in past BWR RPS designs to preclude non-fail-safe type single failures from failing the RPS system. The EPAs should be provided in the SBWR design, or justification should be given why they are not needed. In addition, discuss the susceptibility of the RPS loads to a distorted waveform on the output of the 120 Vac uninterruptible power supplies. Could a distorted waveform from the 120 Vac UPS supply create a non-fail-safe type failure of the RPS system, such that the RPS system would not scram the reactor when called upon to do so?

435.54 On SSAR Figure 21.8.3-3, emergency lighting loads are shown connected to 125 Vdc distribution panels 10D1033 and 10D1063. These are non-Class 1E distribution panels fed from a non-Class 1E dc power source. SSAR Section 9.5.3, however, does not identify any emergency lighting system loads fed from a non-Class 1E dc supply. It only identifies lighting fed from a Class 1E dc supply or that consists of self-contained battery-operated lighting units. Are distribution panels 10D1033 and 10D1063 feeding safety-related emergency lighting system loads? Clarify.

435.55 SSAR Figure 21.8.3-3 indicates that 125 Vdc distribution panel 10D1000 supplies dc control power for all Group C loads. Identify the Group C loads that are referred to.

435.56 SSAR Figure 21.8.3-3 shows a connection for a transportable ac diesel generator at non-Class 1E MCC 10B1192 and 10B2192. Are these connections intended to be made to the same transportable generator used to power the Class 1E motor control centers? If they are intended to be made to the same diesel generator, how will it be assured that the non-Class 1E loads do not degrade the input power to the Class 1E loads?

435.57 SSAR Figure 21.9A-21 identifies an adjustable speed drive as legend item 27. Will the electrical harmonics due to the adjustable speed motor drives be controlled to within the requirements specified in the EPRI Passive Requirements Document?

435.58 For SSAR Section 9.5.3.1.2, under the section, "Standby Lighting Design Bases," and Section 9.5.3.2, under the section, "Standby Lighting System Description," identify a number of areas that are served by the standby lighting system. The standby diesel generator rooms, pump rooms, and the spaces of other equipment that are powered from the standby DG buses should also be included in this list since they provide the first line response to design basis events and transients.

435.59 SSAR Section 9.5.3.2, under the section, "Standby Lighting System Description," states that the standby lighting system is limited to those areas of the plant where power can be supplied from a permanent nonsafety bus, insofar as practical, and which could be involved in emergencies, shutdown, or recovery operations. What does "insofar as practical" mean with respect to the areas of the plant that are served by the emergency lighting system? Also, it appears that the "permanent non-safety-related buses" referred to in Section 9.5.3.2 are the same as the "plant investment protection (PIP) non-safety-related buses" referred to in Section 8.3.1.1. For clarity purposes, only one designation should be used consistently throughout the SSAR for these buses.

435.60 SSAR Section 9.5.3.2, under the section, "DC Self-Contained Battery-Operated Lighting Units," states that the dc self-contained battery-operated lighting units provide the required minimum level of illumination for the time required with due consideration of the environment in which they are located. To what does the phrase "with due consideration of the environment in which they are located" refer? Explain.

435.61 SSAR Section 9.5.3.3 states: "The main control room emergency lighting system is safety-related and classified as Class 1E; the remaining lighting systems are not safety-related and are classified as non-Class 1E." The entire emergency lighting system should be Class 1E. Specifically, the remaining portion of the emergency lighting system that encompasses the dc self-contained battery-operated lighting units should also be qualified Class 1E. In the SBWR design, the standby lighting system cannot serve as the emergency lighting system because it is powered from a non-Class-1E-qualified ac distribution system and diesel generator. Therefore, it cannot be assumed to be available during design basis events (such as a seismic event). This is not the case on existing or evolutionary plant designs. Because the ac distribution system and DGs in the SBWR are non-Class 1E, the emergency lighting system is the only system that can be relied upon during design basis events. It would, therefore, have to be powered from the Class 1E dc system or utilize Class-1E-qualified self-contained battery-operated lighting units to assure its availability. Revise the SSAR accordingly.

435.62 Describe the SBWR lighting system design in the remote shutdown areas. What is the qualification of the lighting system? Discuss the duration of time that lighting will be available from a qualified lighting source relative to the amount of time needed to man these spaces for an event that makes the main control room uninhabitable.

435.63 SSAR Section 1.8.1 identifies COL applicant action items. Section 1.8.1.17 states that the COL applicant shall provide an analysis showing compliance with Branch Technical Position (BTP) PSB 1 (of SRP). In particular, it requires that the analysis include required starting voltages for Class 1E motors and compare these minimum required voltages to the voltages that will be supplied at the motor terminals during the starting transient when operating on off-site power and when operating on the standby diesel generators. The analysis should not be limited to only this information. It should identify the worst case voltages at the terminals of all electrical equipment (not only motors) for both steady state and transient conditions and should substantiate that the voltages are within equipment rated values. In addition, justify why this is identified as a COL applicant action item, since the onsite distribution system that it relates to is a part of the SBWR standard plant scope.

435.64 SSAR Table 3D-3 provides the thermodynamic environment conditions inside the safety envelope for normal operating conditions. The maximum and minimum temperatures indicated for the battery rooms, however, do not agree with those indicated in SSAR Section 9.4.5.1. Clarify this discrepancy. In addition, Table 3D-11a provides the thermodynamic environment conditions inside the safety envelope for accident conditions. The temperature listed in the electrical division rooms for those conditions is 135 °F. Verify that the equipment inside those rooms, including the batteries, will be designed and qualified for operation in that temperature. What is the minimum temperature inside the battery rooms for events releasing less energy than accident conditions, such as station blackout events? What minimum temperature is used to size the batteries?

435.65 SSAR Section 7.3.1.2.2 states that <u>two</u> dc power divisions and two logic divisions are required for each gravity-driven cooling system (GDCS) valve to open. It also states that <u>one</u> dc power division and two logic divisions are required for each deluge valve to open. Figure 21.7.3-2 sheets 6 and 16, however, show that the load driver actuation circuits for the GDCS and deluge valves are identically arranged. Therefore, it appears that the number of dc power divisions required to operate both groups of valves are identical. It appears that both groups of valves require two dc power divisions to open. Clarify.

435.66 The second bullet in SSAR Section 7.3.3.1 indicates that fail-safe design concepts shall be utilized in the leak detection and isolation system logic design to allow containment isolation on loss of power to the plant. Does this statement apply to loss of all dc power on all isolation valves? That is, will all isolation valves go to their isolated state on loss of all dc power?

435.67 With regard to the safety system logic and control, SSAR Section 7.3.4.2 indicates that trip signals are transmitted via load drivers to the actuators for protective action. It further states that the load drivers are solid-state power switches which direct appropriate currents to various devices, such as scram pilot valve solenoids, air-operated valves, explosive-actuated squib valves, and motor control centers. Describe the devices in the motor control centers that are actuated by the load drivers. Provide schematics of the load driver actuation circuits in the motor control centers; or, if they are shown on schematics that have already been provided, indicate where these can be found.

435.68 SSAR Section 7.3.1.1.4 states that the continuity of the safety-relief valve pilot solenoids and the bridge wires within the depressurization valve (DPV) squib valve actuating circuitry are tested continuously by a low amperage current, causing an alarm if the circuit is interrupted. Discuss the potential for the low amperage test current to fire the squib valve or operate the solenoid during various shorts or grounds on the circuit. Trip coils of circuit breakers have historically been monitored with a low amperage current that circulates through a breaker indicating light, and accidental shorting of the indicating light bulb socket during replacement of the bulb has caused the unintended opening of the associated breaker. (See also Q435.43 with regard to the ground detection system employed on the dc power systems to create the potential for spurious component actuation.)

435.69 SSAR Section 6.3.3.2 states that two initiator-boosters (squibs), singly or jointly, actuate the shearing plunger of an automatic depressurization system depressurization valve and open the valve. It states that one initiator-booster has two pairs of pins connected through a wire bridge and that the other has one pair of pins connected through a bridge wire. SSAR Figure 7.3-5 shows that the initiator-booster with two pair of pins has a different safety-related dc division connected to each pair of pins. The two pairs of pins are not electrically interconnected, but they are located in a common squib and would both undergo the same firing shock and thermal burn. Describe the separation between the three dc power circuits (especially the two that are connected to a common squib) that fire the squibs to open the DPV. Also, discuss the potential for the explosive action of the squibs to short the pins and put a fault on the safety-related dc power divisions to which they are connected, or short one division to the other in the two circuits that fire a common squib.

435.70 In numerous places in SSAR Section 9A.5, a room or fire zone that is identified as being associated with one division is described as having fire loading from a cable tray of an opposite division, and no fire loading is identified from a cable tray of the same division. Some examples of this are in Sections 9A.5.1.4.11, 9A.5.1.5.11, 9A.5.1.5.12, 9A.5.1.5.15, 9A.5.1.5.16, 9A.5.1.7.13, and 9A.5.1.7.16. Explain why cables of an opposite division are located in these spaces and no cables of the same division are located in these spaces.

435.71 SSAR Section 9A.6.4.1, regarding the reactor protective system scram circuits, states that a fire that causes a hot short on the cables feeding power to the scram solenoids may cause the associated fuses in the scram solenoid fuse panel to blow. It would appear that if the separation of the scram circuits is as described earlier, a hot short of the scram solenoid circuits should not occur in that section. Clarify.

435.72 SSAR Table 9A.7-1 is a compilation of the components that could be required to safely shutdown the plant. The fire hazard analysis was performed using the data documented in this database. A great deal of electrical equipment is listed in Table 9A.7-1, but there is no listing for the safety-related batteries even though dc electrical components such as battery chargers, battery buses, and load centers are listed. Explain why the batteries are not listed.

435.73 SSAR Section 19.2.4, which discusses the methodology used in the SBWR probabilistic risk assessment (PRA), states that for nonsafety-related systems components, a higher maintenance unavailability is used compared to that used for safety-related systems. Specifically, with regard to electrical system components, has a different non-maintenance-related unavailability or failure rate been used for safety-related components as compared to nonsafety-related components? If not, why not? Is there any basis for assuming that the failure rates of nonsafety-related electrical components are no different than those of safety-related components?

435.74 SSAR Section 19AD.3.2.3 on loss of offsite power states that the loss of offsite power initiating event frequency of 0.11 events/year used in the SBWR PRA was obtained from Appendix A to Chapter 1 of Volume 3 of the ALWR Requirements Document. The latest revision of the ALWR Requirements Document gives the total loss of normal offsite power for a plant without full load rejection capability as 0.12 events/year. Clarify this discrepancy. Also, in this SSAR section, it is stated that the loss of offsite power recovery probabilities were adopted from the ALWR Requirements Document as well. Provide the recovery probabilities that were used.

435.75 SSAR Section 19AB.3.4.4, which addresses common cause failures of batteries, states that there are six banks of batteries, four <u>banks</u> that are essential and two that are non-essential. In what sense is the term "banks" being used? Figures 21.8.3-2 and 21.8.3-3 show a total of twelve batteries, eight of which are safety-related (Class 1E) and four that are nonsafety-related (non-Class 1E). The eight Class 1E batteries are configured in four pairs with one pair in each of the four divisions. One of the batteries in each pair supplies loads required for 72 hours, while the other battery supplies non-72-hour loads. Is this the battery configuration used in the common cause failure analysis? Clarify.

435.76 SSAR Table 19AB-3, "CCF Numerical Evaluation," indicates in items CCX-BY-## and CCX-BY-PN that the batteries are tested on a 24-month staggered basis. What is meant by a "staggered 24 months test?" If the SBWR will operate on a 24-month fuel cycle, the battery service discharge tests will be required every 24 months on the safety-related batteries. All the safety-related battery service discharge tests would have to be performed during the refueling outage, although not simultaneously, because the SBWR has no provisions for testing the batteries offline without rendering the batteries inoperable. The safety-related batteries could be tested between refueling cycle outages, but this is unlikely because it would require shutting down the plant.

435.77 SSAR Table 19AD-15, "Description of Basic Events," lists a point estimate frequency of 1.1E-003 for loss of all offsite electrical power event MANMOD16. Describe how this frequency was obtained.

435.78 SSAR Section 19AE.1.3.1 indicates that for the evaluation of their unavailability, nonsafety standby components that are redundant to normal operating components are assumed to be rotated every three months. Was this assumption used for the installed spare main step-up transformer and the installed spare unit auxiliary transformer? If so, how is this communicated to the COL applicant?

435.79 SSAR Table 19AE.1-1, which is a listing of the data used for random failures in the SBWR PRA, does not list a failure rate for the main step-up transformer that is reported in the ALWR Requirements Document as 5.4E-6/hr. Was that failure rate used for the main step-up transformer in the SBWR PRA? Why is the failure rate not listed in Table 19AE.1-1?

435.80 SSAR Table 19AE.1-1 gives the failure rate for the battery power system as 2.0E-7/hr. Note (ff) to that table states:

> The condition of the batteries is continually controlled by a monitoring system during the plant normal operation. We assume that the monitoring system can detect 90% of the battery failures that could lead to the "Failure to provide proper output." These failures are alarmed in the control room and repaired within approximately 10 hours. The remaining 10% of the failures are detected only when the battery discharge test is performed, i.e., every refueling. Therefore, a failure rate of 2E-6/hr x 0.1 = 2E-7/hr was used.

This note indicates that the battery failure rate provided in the ALWR Requirements Document (2E-6/hr) has been reduced an order of magnitude due to the use of the monitoring system. This seems excessive. For such a reduction in the failure rate, the subject monitoring system would have to be a substantial improvement over what EPRI has specified in the Requirements Document and what has been used in the plants from which the failure rate was derived. Chapter 8 of the SBWR SSAR does not describe such a monitoring system.

Provide a description of the battery monitoring system that is intended to be used in the SBWR design. This description should also be included in Chapter 8 of the SBWR SSAR and in Section 2.12 of the Tier 1 Design Certification Document. Compare the SBWR monitoring system to that specified in the ALWR Requirements Document and to those systems used on existing plants. Also provide a failure modes and effects analysis that supports the assumption in Note (ff) of Table 19AE.1-1 that the monitoring system can detect 90% of the battery failures that could lead to the "failure to provide proper output."

435.81 The second part of Note (dd) to SSAR Table 19AE.1-1 is confusing. It states that the short to ground failure rate is used for 150 kVac, 480 Vac, and 120 Vac, because they are isolated from the ground and the short to ground is supposed to be alarmed and does not cause a direct failure. The rationale provided, i.e., they are isolated from the ground, appears to be a reason for not assuming that a disabling failure to ground is probable rather than assuming it is. Also, Figure 21.8.3-1 indicates that the 480 Vac load center transformers are solidly grounded rather than isolated from ground. Clarify.

435.82 SSAR Section 19AE.15.2 identifies the assumptions made in the SBWR PRA relative to the design of the 6.9 kVac and 480 Vac distribution systems. It states that circuit breakers upstream of motor control centers require load drivers and 125 Vdc power to change position (i.e., open or close). It also states that circuit breakers associated with MCCs require load drivers and 125 Vdc power to close and to remain closed. Explain this final statement. Is the statement referring to MCC circuit breakers or motor starters?

This section also states that loss of ventilation or room cooling will not significantly affect the failure rates of ac electrical equipment. Explain the basis for this assumption. Is this the reason no electrical system dependency on heating, ventilation, and air conditioning or service water has been identified in SSAR Chapter 19?

435.83 SSAR Section 19AE.15.3.1 states that four motor control centers are safety-related because they function as electrical isolators between the non-safety ac system and the safety-related portions of the 125 Vdc power system. Explain the basis for this statement. The MCCs are more than just electrical isolators. They are also the normal source of electrical power to the safety-related dc loads through the battery chargers, as well as the source of power to the battery room exhaust fans and alternate source of power to the safety-related 120 Vac loads through regulating transformers (Figure 21.8.3-4 Sheet 4).

435.84 SSAR Table 19AE.15-2 identifies the dependencies of the power center circuit breakers feeding the non-Class 1E motor control centers, but it does not identify the dependencies of the power center circuit breakers (MC1CR001, MC2CR001, MC3CR001, MC4CR001) that feed the Class 1E MCCs. Identify their dependencies. Were their dependencies factored into the SBWR analysis?

435.85 SSAR Table 19AE.15-4 provides diesel generator maintenance information used in the SBWR PRA. It indicates that there are no DG components aligned away from the emergency position without automatic return logic. How can this be possible if the diesel is torn down for maintenance? The table also indicates that the expected outage time for maintenance of the DG is 168 hours (7 days). Is this the total outage time per year or the outage time per the 5-month maintenance interval indicated in the table? The ALWR Requirements Document indicates approximately two weeks per year for maintenance or 4.6E-2 maintenance unavailability of the DGs.

SSAR Table 19.AE.16-5, which identifies modeling assumptions and simplifications, states that because of the staggered type of the test, the battery common-cause failure (CCF) unavailability has been evaluated on a four-month basis. Explain what kind of battery test is being referred to and what type of staggered testing is being assumed? If the battery tests referred to are discharge tests, refer also to Q435.76.

435.87 SSAR Section 19AF.3, relative to shutdown risk, states that in all cases, the minimum type and number of systems required by technical specifications (TS) plus systems normally operating during shutdown (e.g., control rod drive and fire water) are sufficient to maintain adequate shutdown safety margins. Sections 19AF.4.4 and 19AF.11 also state that the SBWR electrical system design features, in conjunction with appropriate TS and other administrative controls, result in an electrical distribution system that is able to maintain an adequate level of redundancy and capacity even with equipment out for maintenance or testing. What TS are being referred to, existing standard shutdown TS or the new shutdown risk standard technical specifications on which the NRC staff and the industry are currently working? What specific complement of electrical equipment is assumed to be required by the TS referred to?

With regard to the statement in Section 19AF.3 referenced above, Section 19AF.3 also states that many such combinations are possible, but certain specific combinations of minimum sets of systems have been identified to provide guidance to the COL applicant. Identify the "certain specific combinations of minimum sets of systems" that will be provided as guidance to the COL applicant and indicate where in the SBWR SSAR they are listed and how they will be identified to the COL applicant.

435.88 SSAR Section 19AF.4.1 states that the SBWR utilizes passive decay heat removal (DHR) systems such as the isolation condensers (ICs) in

Modes 3 and 4 which do not rely on ac power, and that this is the first line of defense in maintaining DHR. Is it intended that the ICs will be available at all times in Modes 3 and 4? If so, when will maintenance be performed on them?

435.89 SSAR Section 19AF.4.1 discusses the isolation of shutdown cooling (SDC). It states that it takes an actual need for completion of a safety function, not simply a loss of power, in order for the SBWR safety system logic to cause actuation of safety systems (e.g., isolation of SDC). Section 7.3.3.3, however, states that the leak detection and isolation system's four redundant divisional channels are designed to be fail safe. It states that the isolation logic is energized under normal conditions and will de-energize to trip to initiate the isolation function on indication of abnormal leakage. Reconcile what appears to be two contradictory descriptions of the SBWR isolation logic. Will loss of one or more power sources cause initiation of the isolation function?

435.90 SSAR Section 19AF.6 states that the SBWR has four independent safety-related electrical divisions, any <u>one</u> of which is capable of maintaining the reactor in a safe shutdown condition. Table 19AF-2a, in regard to a Vermont Yankee shutdown event, states that the SBWR has four safety-related dc power buses, any one of which can be taken out of service for maintenance, with the other three buses providing <u>two</u>-out-of-three redundancy. Section 19H.2.51 states that any <u>two</u> of four onsite electrical safety-related divisions can safely shut down the unit and maintain it in a safe shutdown condition. Reconcile these apparently contradictory statements and explain how many safety-related divisions are required to safely shutdown the SBWR and maintain it in a safe shutdown condition. Identify the minimum complement of shutdown equipment and their power sources that are necessary to safely shutdown the SBWR and maintain it in a safe shutdown condition.

435.91 SSAR Section 19AE.15.7 states that diesel generators can be maintained during plant operation. Section 19AF.7.10.5 indicates that the minimum set for the loss of offsite power initiator during shutdown assumes both of the DGs are available. Table 19AF-2a, in regard to a Nine Mile Point shutdown event, states that the SBWR is designed to allow all DG maintenance to be performed during power operation and both should be available during shutdown. From this it appears that all DG maintenance is intended to be conducted during power operation on the SBWR. Provide the rationale for conducting <u>all</u> diesel generator maintenance at power. Is this approach supported by the results of the power operation and shutdown risk analyses? What controls will be implemented to ensure all maintenance is conducted at power? How will GE communicate this assumption to a prospective SBWR licensee?

435.92 As stated in Q435.91, SSAR Section 19AF.7.10.5 indicates that both diesel generators are assumed to be available during shutdown. Section 19AF.10, under the heading "Electrical Power Availability" also states: "Availability of normal and alternate power sources should be ensured especially during periods of higher risk evolutions (e.g., RPV cavity flooding prior to refueling)." In addition, Section 19AF.13.2 identifies the control rod drive (CRD) pump (which requires non-safety ac power) as an important contributor to the low level of risk associated with shutdown. Finally, Section 19AF.13.4 identifies very small unavailabilities for the CRD and offsite power (1E-3 and 4E-3 per reactor year, respectively) which are determined to be important in minimizing shutdown risk.

The conclusion that the staff draws from the above is that the non-safety ac power systems and their power sources are important contributors to the low level of risk associated with shutdown and they are assumed to be available during shutdown modes in the SBWR shutdown risk analysis. Section 16B.3.8 (the electrical power systems technical specifications (TS) for the SBWR), however, does not identify a category for these systems. Does GE intend to include the non-safety ac electrical power systems in the SBWR shutdown TS? If not, why not? (See also Q435.87 relative to this issue.)

435.93 SSAR Table 19AF-1 states that the reactor water cleanup/shutdown cooling system is a dedicated system that combines the RWCU and SDC functions into two independent 50-percent trains. What does "50% trains" mean in regard to the SDC function of the RWCU/SDC system? Is more than one train required to bring the plant to a shutdown condition and maintain it there? Must both diesel generators be available during shutdown modes in the event of a total loss of offsite power in order to support both trains of SDC and maintain the plant in a safe state?

435.94 SSAR Table 19AF-2a, relative to a Vermont Yankee event, states that the SBWR has four safety-related dc power buses, and at least two divisions are required to be operable during shutdown. What requirement is being referred to that requires at least two divisions of safety-related dc power be available during shutdown?

435.95 SSAR Figures 19AF-9 and 19AF-10 are the event trees for the loss of offsite power (LOOP) event in Modes 3, 4, and 5. Provide the numbers that were used for the branches E34 (LOOP), E5 (LOOP), REC3 (recovery of LOOP), and P (two diesel generators available) in the event trees. Provide the basis and rationale for the numbers used. Also, the title (Loss of Offsite Power Mode 3 and 4) for the initiating event (E5) in Figure 19AF-10 appears to be wrong.

435.96 With regard to Section 2.12, Station Electrical System, in the Tier 1 Design Certification Document, compare the design description and inspections, tests, analyses, and acceptance criteria (ITAAC) related to the station electrical system of the ABWR to that of the SBWR provided in Section 2.12. Identify the differences and provide rationale and basis for those differences.

435.97 Figures 2.12.1-1, 2.12.3-1a, and 2.12.3-1b in the SBWR Tier 1 Design Certification Document should be revised, consistent with SSAR Figure 21.8.3-4 Sheet 4, to show the Class 1E motor control center circuit breakers in the feeds to the Class 1E MCCs from the 480-volt power center circuit breakers.

435.98 Based on the staff's understanding of the SSAR, the following revisions should be made to Section 2.12.3 in the SBWR Tier 1 Design Certification Document:

> Each of the four divisions of Class 1E dc power is physically separate and electrically independent from each other and from non-Class 1E equipment. The dc systems operate . . .
>
> . . . by the Class 1E batteries. One battery in each division is sized to power all necessary safety-related loads needed to keep the plant in a safe condition for a 72-hour period. The other battery in each division is sized to power selected safety-related loads for a 2-hour period.
>
> Each Class 1E battery charger is sized to supply the maximum continuous load demand of its bus while simultaneously recharging its battery.
>
> The Class 1E dc power supply is designed to . . .

435.99 Certified Design Commitment 1)b) and Inspections, Tests, Analyses 1)b) in ITAAC Table 2.12.5-1 should be revised as follows:

> . . . panels are electrically independent and physically separate from each other and from non-Class 1E equipment.

In addition, an electrical separation ITAAC similar to this should be added to ITAAC Table 2.12.3-1 (ITAAC for the Direct Current Power Supply).

435.100 Section 2.12.4 in the Tier 1 Design Certification Document provides a design description for the standby ac power supply but does not provide a corresponding ITAAC for it. An ITAAC should be provided for the standby ac power supply.

435.101 The following revision should be made to Section 2.12.5 in the Tier 1 Design Certification Document:

Each of the four divisions of this Class 1E vital ac power is physically separate and electrically independent from each other and from non-Class 1E equipment. Each division is powered from . . .

435.102 Section 2.12.6 in the Tier 1 Design Certification Document provides a design description for the 120 V non-Class 1E instrument and control power supply but does not provide a corresponding ITAAC for it. An ITAAC should be provided for this instrument and control power supply if it is needed to support the standby ac power supply, the offsite power supply, or the distribution system that is a source of power to the Class 1E motor control centers.

435.103 Section 2.12.8 in the Tier 1 Design Certification Document states that the emergency lighting system is comprised of safety-related control room emergency and non-safety-related self-contained dc battery-operated units for emergency operations, exit, and stair lighting. The entire emergency lighting system, including the self-contained dc battery-operated units, should be safety-related and qualified Class 1E. (See Q435.61 for a discussion of this issue.)

435.104 Section 3.4.4.1, Chapter 1, Volume III of the ALWR Utility Requirements Document for passive plant designs specifies that passive plants shall be designed to continue supplying the grid under off-normal frequency conditions for a significant time period. It further states that during the frequency excursions, it shall be permissible for the voltage at the terminals of auxiliary equipment to vary from 100 percent to 90 percent of rated. The staff has not found any discussion of this topic in the SBWR SSAR. Is the SBWR designed with this capability? If so, provide analyses that demonstrate that the operating conditions of all plant loads have been evaluated and found acceptable for all relevant grid conditions. Also provide a discussion of the effect of the grid voltage and frequency excursions on operation of the undervoltage and underfrequency protection provided in the SBWR electrical distribution systems. (See Q435.16 which is relevant to this issue. See also Section 3.2.4, Chapter 11 of the NRC staff's Final Safety Evaluation Report for the EPRI Passive Requirements Document for additional information on this topic.)

435.105 Most of the uninterruptible power supply vendors comply with specification requirements for total harmonic distortion (THD) with the provision that these requirements are met for linear loads. The loads used for digital control power supplies and computers in the SBWR are inherently non-linear in nature. Also, variable-speed drive systems and fluorescent lighting ballasts introduce harmonics into the plant distribution system. Indicate the protective measures taken so that the THD due to non-linear loads on power system will not affect the current and voltage waveform of the UPS system.

435.106 Provide a listing of all dc or ac motor-operated valves within the SBWR design that require removing power in order to meet the single failure criterion and provide the details of the design which accomplish this requirement (see BTP ICSB-18 in the SRP).

435.107 With regard to the safety-related electrical and control drawings and diagrams, provide the physical layout and cable interconnecting drawings to assist in the staff's review and evaluation of the design with respect to the physical separation criteria for Class 1E systems, components, and penetrations in the plant. Include how physical separation and electrical independence of the channels/divisions are maintained in distributed logic systems utilizing multiplexing techniques.

435.108 10 CFR 52.47, "Contents of Applications," states that an application for design certification must contain "a representative conceptual design for those portions of the plant for which the application does not seek certification." In the electrical area, this applies to the portion of the offsite system which interfaces with the SBWR electrical system. Therefore, provide a conceptual design for this portion of the plant. It should show how the interfaces are met, as well as describe a conceptual design for the portion of the offsite system not in the SBWR scope.