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SBN-371
T.F. B7.1.2

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. George W. Knighton, Chief
Licensing Branch 3
Division of Licensing

References: (a) Construction Permits CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444
(b) USNRC Letter, dated April 26, 1982, "Request for Additional Information - Seabrook Station, Units 1 and 2," F. J. Miraglia to W. C. Tallman

Subject: Response to RAI 440.133 and 440.134; (Reactor Systems Branch)

Dear Sir:

We have enclosed responses to the subject Requests for Additional Information (RAIs) which were forwarded in Reference (b). These responses will be included in OL Application Amendment 48.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

David A. Maidrand

J. DeVincentis for
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B001

ALL/fsf

Enclosure

cc: Atomic Safety and Licensing Board Service List

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440.133 Address each requirements of BTP RSB 5-1 and describe how Seabrook design will meet the requirement. Identify deviations if there are any, and provide justification to support the acceptability of the Seabrook design.

RESPONSE: Seabrook is a Class 2 plant (as defined by the Implementation section BTP RSB 5-1) and is, thus, subject to the technical requirements of RSB 5-1 only as they apply to Class 2 plants. Only partial compliance with the technical position is required where manual actions or repairs can be demonstrated to be an acceptable alternative to strict compliance. The safe shutdown design basis for Seabrook is hot standby. The functional requirements of RSB 5-1 impose the following assumptions on the system(s) used to go to cold shutdown: a loss of off-site power, the most limiting single failure, and that only safety-grade systems are available. Under these conditions, the plant is capable of being taken to cold shutdown within a reasonable amount of time, provided that limited manual actions, as allowed by the recommended implementation for Class 2 plants, are performed. Residual heat removal system operation conditions (350^{o}F, 400 psi) can be achieved in approximately 8-9 hours, including the time required to perform any necessary actions during a 4-hour period at hot standby.

In responding to this RAI, it will be shown that the Seabrook units can meet the requirements of BTP RSB 5-1. The following will respond to each of the BTP requirements:

BRANCH POSITION

A. Functional Requirements

The system(s) which can be used to take the reactor from normal operating conditions to cold shutdown* shall satisfy the functional requirements listed below:

1. The design shall be such that the reactor can be taken from normal operating conditions to cold shutdown using only safety-grade systems. These systems shall satisfy General Design Criteria 1 through 5.

2. The system(s) shall have suitable redundance in components and features, and suitable interconnections, leak detection, and isolation capabilities to assure that for on-site electrical power system operation (assuming off-site power is not available) and for off-site electrical power system operation (assuming on-site power is not available) the system function can be accomplished assuming a single failure.

*Processes involved in cooldown are heat removal, depressurization, flow circulation, and reactivity control. The cold shutdown condition, as described in the Standard Technical Specifications, refers to a subcritical reactor with a reactor coolant temperature no greater than 200^{o}F for a PWR and 212^{o}F for a BWR.

3. The system(s) shall be capable of being operated from the Control Room with either only on-site or only off-site power available. In demonstrating that the system can perform its function assuming a single failure, limited operator action outside of the Control Room would be considered acceptable if suitably justified.

4. The system(s) shall be capable of bringing the reactor to a cold shutdown condition, with only off-site or on-site power available, within a reasonable period of time following shutdown, assuming the most limiting single failure.

RESPONSE TO SECTION A

Four key processes described above, are required to achieve and maintain cold shutdown. Means for accomplishing these processes are described below.

A more detailed description of this operational evolution is provided as an attachment under the title "Cold Shutdown Scenario."

Heat Removal

Removal of residual heat can be accomplished first via the Emergency Feedwater System and then via the Residual Heat Removal System. Hot standby can be maintained by releasing steam via the steam generator code safety valves and/or the safety-grade, power-operated atmospheric relief valves. Cooldown to 350°F can be accomplished by venting steam via operation of the steam generator power-operated atmospheric relief valves in conjunction with secondary coolant makeup from the Emergency Feedwater System. A sufficient Seismic Category 1 supply of demineralized feedwater is provided in the Condensate Storage Tank for the cooldown to 350°F.

Reactor Coolant System Depressurization

Circulation of reactor coolant can be provided by natural convection created by the design of the Reactor Coolant System, i.e., the heat sinks (steam generators) are located at a higher elevation than the heat source (reactor core). It has been shown in tests and actual practice that the natural circulation flow induced in pressurized water reactors similar to Seabrook is more than adequate to remove core decay heat and cool down the plant.

Reactivity Control

Boration can be accomplished using portions of the Chemical and Volume Control System. Boric acid from the Boric Acid Tanks can be supplied to the suction of the centrifugal charging pumps by the boric acid transfer pumps or by direct gravity feed. The centrifugal charging pumps can inject the boric acid solution into the Reactor Coolant System via the boron injection portion of the Safety Injection System. Any additional makeup needed in excess of that needed for boration can be provided from the Refueling Water Storage Tank.

The systems identified above are all safety-grade systems and satisfy General Design Criteria 1 through 5.

These systems all contain suitable redundance in components and features, suitable interconnections and isolation capabilities to assure that the system safety function can be accomplished, assuming the availability of either only on-site power or only off-site power, and assuming a single failure. Leak detection from the described systems can be accomplished via Class 1E instruments for systems' level, pressure or flow rates in conjunction with various building sump level alarms and/or sump pump operation.

All systems are capable of being operated from the Control Room with either only on-site or only off-site power available. Should a single failure result in a loss of redundancy in the aforementioned systems, limited operation action outside the Control Room may be necessary.

One exception exists to the above statement relative to operability from the Control Room. The power supply breakers for the RHR suction valves (RH-V22, 23, 87, and 88) are maintained in the open position during normal operations. The purpose for this is to reduce the concerns relative to "interfacing LOCAs" during a postulated fire event.

Therefore, in order to establish residual heat removal system operation after the cooldown to 350°F, an operator will be dispatched to the Switchgear Rooms to close these four (4) breakers.

It should be noted that the Switchgear Rooms are located in the same building as the Control Room and, as such, share essentially the same environment. The Switchgear Rooms are located two floors below the Control Room and are directly accessible from the Control Room via a stairwell directly outside these rooms. The entire evolution would take 2-4 minutes to accomplish from the point of making the decision to close the breakers, until completion of the task.

Considering: 1) the simplicity of this operation, 2) the amount of time available to perform the operation (this can be performed anytime during the cooldown prior to establishing RHR), and 3) the overriding concerns requiring the breakers to be open - this limited operator action outside the Control Room is justified.

BRANCH POSITION

B. RHR System Isolation Requirements

The RHR shall satisfy the isolation requirements listed below:

1. The following shall be provided in the suction side of the RHR System to isolate it from the RCS.

   (a) Isolation shall be provided by at least two powεr-operated valves in series. The valve positions shall be indicated in the Control Room.

   (b) The valves shall have independent diverse interlocks to prevent the valves from being opened unless the RCS pressure is below the RHR System design pressure. Failure of a power supply shall not cause any valve to change position.

   (c) The valves shall have independent diverse interlocks to protect against one or both valves being open during an RCS increase above the design pressure of the RHR System.

2. One of the following shall be provided on he discharge side of the RHR System to isolate it from the RCS:

   (a) The valves, position indicators, and interlocks described in Items (a) through 1(c) above;

   (b) One or more check valves in series with a normally closed power-operated valve. The power-operated valve position shall be indicated in the Control Room. If the RHR System discharge line is used for an ECCS function, the power-operated valve is to be opened upon receipt of a safety injection signal once the reactor coolant pressure has decreased below the ECCS design pressure;

   (c) Three check valves in a series; or

   (d) Two check valves in series, provided that there are design provisions to permit periodic testing of the check valves for leak tightness and the testing is performed at least annually.

RESPONSE TO SECTION B

1. The Seabrook design relative to isolating the suction side of the Residual Heat Removal (RHR) System from the Reactor Coolant System meets the requirements of Section B.1 above by:

   (a) Providing two power-operated valves in series - RHR suction valves from Loop 1, RC-V22 and RC-V23 (see FSAR Figure 5.1-1, Sheet 2), and RHR suction valves from Loop 4, RC-V87 and RC-V88 (see FSAR Figure 5.1-1, Sheet 5). Valve position indication for all four valves is provided on the main control board.

(b) Independent, diverse, Train A and Train B interlock circuits are provided to prevent opening of the RHR suction valves until RCS pressure has been reduced to below approximately 425 psig. Valves RC-V23 (from Loop 1) and RC-V88 (from Loop 4) are prevented from opening by one pressure interlock, while valves RC-V22 (from Loop 1) and RC-V87 (from Loop 4) are prevented from opening by an independent, diverse pressure interlock. Valves RC-V23 and RC-V88 and their associated pressure interlock are all powered from Train A power sources, while valves RC-V22 and RC-V87 and their associated pressure interlock are all powered from Train B power sources.

During normal power operations, the power supply circuit breakers for the RHR suction valves are locked in the open position. This action ensures protection against an interfacing LOCA under any circumstance, including fire induced multiple hot shorts. As stated in the response to Section A, these valves are repowered during a plant cooldown just before RHR System operation is initiated.

It should be noted that separate power supplies are utilized for valve position indication such that valve position indication is active regardless of valve power supply circuit breaker position.

The interlock circuitry is designed such that a power supply failure will cause the associated valve to close to prevent exposure of the RHR System to potentially high pressure. Although this type of failure is highly unlikely, should it occur, the RHR suction valves can be reopened using the local control switches located on the MCCs in the applicable Switchgear Room.

There is no power supply failure which would cause the RHR suction valves to open.

(c) Similar to the interlocks described above to prevent inadvertent opening of the RHR suction valves, independent diverse Train A and Train B interlock circuits are provided to protect against one or both valves being open at RCS pressures above the pressure retaining capability of the RHR system. At an RCS pressure of 750 psig increasing, the interlock circuits automatically close RHR suction valves, thus isolating the RHR System from the RCS.

FSAR Sections 5.4.7.1 and 5.4.7.2 contain additional information concerning RHR System valves and interlocks.

2. The Seabrook design, relative to provisions provided to isolate the discharge side of the RHR System from the RCS, meets the requirements of Section B.2 by utilizing option (d).

   Provisions are provided to check the leak tightness of the two series check valves in each RHR discharge line to the RCS. An installed test line upstream of each series check valve provides the ability to verify valve closure and proper seating.

   FSAR Figure 5.4-10 and Figure 6.3-1, Sheets 1 and 2 show the extensive nature of the test system used to verify proper closure and seating of high-low pressure system interface valves.

   Periodic testing of the check valves for leak tightness is performed in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Article IWV-3000.

BRANCH POSITION

C. Pressure Relief Requirements

The RHR shall satisfy the pressure relief requirements listed below:

1. To protect against accidental overpressurization when it is in operation (not isolated from the RCS), pressure relief in the RHR System shall be provided with relieving capability in accordance with the ASME Boiler and Pressure Vessel Code. The most limiting pressure transient during the plant operating condition when the RHR System is not isolated from the RCS shall be considered when selecting the pressure relieving capacity of the RHR System. For example, during shutdown cooling in a PWR with no steam bubble in the pressurizer, inadvertent operation of an additional charging pump or inadvertent opening of an ECCS accumulator valve should be considered in selection of the design bases.

2. Fluid discharged through the RHR System pressure relief valves must be collected and contained such that a stuck open relief valve will not:

   (a) Result in flooding of any safety-related equipment.

   (b) Reduce the capability of the ECCS below that needed to mitigate the consequences of a postulated LOCA.

(c) Result in a non-isolatable situation in which the water provided to the RCS to maintain the core in a safe condition is discharged outside of the containment.

3. If interlocks are provided to automatically close the isolation valves when the RCS pressure exceeds the RHR System design pressure, adequate relief capacity shall be provided during the time period while the valves are closing.

RESPONSE TO SECTION C

1. An RHR System overpressurization analysis has confirmed that one relief valve has the capability to maintain the maximum pressure within code limits for all credible events. A more detailed description is provided in FSAR Section 5.4.7.2(d).

2. Fluid discharged through the RHR System pressure relief valves is collected and contained. The pressure relief valve on each of the redundant RHR System suction lines is located inside the reactor containment. The fluid discharged from the suction line relief valves is routed to the pressurizer relief tank. Fluid from those pressure relief valves provided on RHR pump discharge piping are directed to the primary drain tank.

   (a) Flooding of safety-related equipment is prevented by containing discharged fluids. Remotely-operated valves are provided on the main control board which can be used to terminate flow through a stuck open relief valve.

   (b) During normal plant operation, the RHR System is aligned for ECCS functions to mitigate the consequences of a postulated LOCA. In this ECCS mode, the system stands ready to respond to an actuation signal that automatically starts the RHR pump for the ECCS function. Therefore, it remains inactive and unpressurized except for the head produced from the refueling water storage tank (the ECCS borated water supply). The only credible pressurization scenario for the system in this inactive condition would be backleakage from the RCS, which could cause the RHR System pressure relief valves to lift. Should this occur, it would be recognized by an increase in the RCS leak rate and an abnormal increase in level in either or both the pressurizer relief tank and the primary drain tank. In this case, appropriate action would be taken to correct this problem. However, this scenario is made less likely because the suction and discharged pressure interface valves between the RHR System and the RCS are subject to periodic leak tests in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Subarticle IWV-3000.

If a postulated LOCA were to occur, the RHR pump would be automatically activated for ECCS functions. In this mode, pressure in all positions of the system is far below the pressure relief valve setpoints of 450 psig on the suction side and 600 psig on the discharge side. Shutoff head for the RHR pump is less than 200 psig. Refer to FSAR Figure 6.3-3.

When the plant is in hot shutdown, i.e., $\leq$ 350°F average coolant temperature, the RHR System is placed in operation for removal of core decay heat and continued plant cooldown. It is at this time that the highest operating pressures are experienced in the RHR System suction and discharge piping. When the RHR System is placed in service, RCS pressure must be $\leq$ 400 psig. This assures that pressure in the RHR suction line does not exceed the pressure relief valve setpoint of 450 psig. It also ensures that pressure in the RHR pump discharge line (RCS pressure plus the RHR pump discharge head) does not exceed the discharge line pressure relief valve setpoint of 600 psig.

Should a pressure relief valve open and stick open in this mode, the RHR loop can be isolated, thus terminating the leak. An adequate heat sink for core decay heat is ensured by the redundant RHR loop or the steam generators in conjunction with the Emergency Feedwater System.

(c) Isolation of one of the two redundant RHR Systems from the RCS would terminate all leakage from a stuck open relief valve in that system. Full ECCS capability would be retained by operation of the unaffected, redundant RHR System.

3. Adequate relief capability exists from any single RHR suction relief for all credible events.

BRANCH POSITION

D. Pump Protection Requirements

The design and operating procedures of any RHR System shall have provisions to prevent damage to the RHR System due to overheating, cavitation, or loss of adequate pump suction fluid.

RESPONSE TO SECTION D

RHR pump protection is provided as described in FSAR Section 5.4.7.2(b)(1).

In addition, alarms are provided in the Main Control Room to alert the operator that the RCS suction isolation valves are closing or are closed. Level instruments are also provided on RHR pump suction sources, i.e., the refueling water storage tank and the reactor vessel, with appropriate low level alarms. Pump motor current for each RHR pump is displayed on the main control board and is indicative of a loss of pump suction and cavitation.

BRANCH POSITION

E. Test Requirements

The isolation valve operability and interlock circuits must be designed so as to permit on-line testing when operating in the RHR mode. Testability shall meet the requirements of IEEE Standard 338 and Regulatory Guide 1.22.

The preoperational and initial startup test program shall be in conformance with Regulatory Guide 1.68. The programs for PWRs shall include tests with supporting analysis to (a) confirm that adequate mixing of borated water added prior to or during cooldown can be achieved under natural circulation conditions and permit estimation of the times required to achieve such mixing, and (b) confirm that the cooldown under natural circulation conditions can be achieved within the limits specified in the emergency operating procedures. Comparison with performance of previously tested plants of similar design may be substituted for these tests.

RESPONSE TO SECTION E

The capability to test RHR interlock circuits while in the RHR mode is provided.

Compliance with Regulatory Guide 1.68, Revision 2 is discussed in the FSAR Sections 1.8 and 14.2.7.

Seabrook will reference test data from other plants of similar design where applicable.

Verification of adequate mixing of borated water added to the RCS under natural circulation conditions, and confirmation of natural circulation cooldown ability will be accomplished either by reference or actual testing conducted as required by Regulatory Guide 1.68.2, Revision 1.

BRANCH POSITION

F. Operational Procedures

The operational procedures for bringing the plant from normal power operation to cold shutdown shall be in conformance with Regulatory Guide 1.33. For pressurized water reactors, the operational procedures shall include specific procedures and information required for cooldown under natural circulation conditions.

RESPONSE TO SECTION F

Operational procedures for bringing the plant from full power to cold shutdown will be prepared and will be available for review three months prior to fuel load. These procedures fully address natural circulation cooldown conditions in addition to normal plant shutdown and cooldown.

The quality assurance program for operation complies with the requirements of Regulatory Guide 1.33, Revision 2. For further discussion, refer to FSAR Section 17.2.

BRANCH POSITION

G. Auxiliary Feedwater Supply

The Seismic Category I water supply for the Auxiliary Feedwater System for a PWR shall have sufficient inventory to permit operation at hot shutdown for at least 4 hours, followed by cooldown to the conditions permitting operation of the RHR System. The inventory needed for cooldown shall be based on the longest cooldown time needed with either only on-site or only off-site power available with an assumed single failure.

RESPONSE TO SECTION G

Seabrook is a Class 2 plant and has a safe shutdown design basis of hot standby. However, it can be shown that the Seismic Category I condensate storage tank contains sufficient secondary coolant makeup volume to complete the cold shutdown scenario provided as Attachment A.

ATTACHMENT A

COLD SHUTDOWN SCENARIO

The safe shutdown design basis for Seabrook is hot standby. The cold shutdown capability of the plant has been evaluated in order to demonstrate how the plant can be brought to a cold shutdown condition using only safety-grade equipment following a safe shutdown earthquake, loss of off-site power and the most limiting single failure. Under such conditions, the plant is capable of achieving RHR System operating conditions (approximately 350°F and 400 psig) in approximately eight to nine hours, which includes remaining in hot standby for up to four hours.

The selected method of achieving the cold shutdown condition for Seabrook is natural circulation without RCS letdown. Core decay heat and cooldown energy is removed by a combination of steam generator atmospheric venting with secondary coolant makeup from the Condensate Storage Tank via the Emergency Feedwater System. Reactivity control is achieved by making up to the RCS from borated water sources, taking advantage of the reactor coolant's specific volume decrease as the RCS is cooled to $\leq$ 350°F. At this point, the RHR System is placed in service to complete the cooldown to cold shutdown conditions subsequent to RCS depressurization to approximately 400 psig.

This scenario is detailed more full as follows:

1. System Energy Removal

To maintain the RCS in hot standby (constant average temperature), core decay heat energy must be removed at a rate equivalent to fission product energy production. To cool down the RCS, the energy contained in the reactor coolant and all system components must also be removed.

The combination of decay heat energy and mass energy of the coolant and system components is initially removed by heat transfer to the steam generators. This heat transfer is made possible by natural convection with the reactor core as the heat source and the steam generators as the heat sink. Since the steam generators are located at a higher elevation than the reactor core, a natural thermosiphon is created. The resulting natural flow created for Seabrook is in the order of three to four percent of normal forced flow (reactor coolant pumps operating) and is more than adequate to transfer decay energy and mass energy to the steam generators. Simple analysis indicates that RCS loop ΔT valves are in the order of 15 - 30°F which are typical of power operation with forced convection. These values of natural circulation flow and loop ΔT's correspond well with actual natural circulation tests conducted at similar PWRs.

To ensure this natural circulation flow in the RCS, the steam generators must be maintained as a heat sink. To achieve this, the safety-grade steam generator power-operated atmospheric relief valves are used to vent vaporized secondary coolant. The rate of venting is adjusted by the operator to set the RCS cooldown rate to a value $\leq$ 50°F/hour. Secondary coolant makeup is provided via the Emergency Feedwater System from the Seismic Category I Condensate Storage Tank. The minimum volume which is available for this scenario is the 200,000 gallons which is dedicated solely for EFW use. The heat removal capability of this secondary coolant volume is determined by heating this coolant to saturation in the steam generators and removing the latent heat of vaporization by venting the steam generator. The total worth of the 200,000 gallons in the Condensate Storage Tank in terms of RCS heat removal is, on a BTU basis, sufficient to accommodate a four-hour period of hot standby plus a cooldown to ≤ 350°F.

Since it is recognized that continued mass addition to the RCS is desirable for reactor coolant pump seal injection and that the letdown system would be isolated, the RCS cooldown would normally commence without a four hour period at hot standby. This means that the portion of the Condensate Storage Tank volume allotted by design for a four-hour period at hot standby is not actually required for this scenario. This adds additional conservatism to the secondary coolant volume of 200,000 gallons provided for this cooldown.

Seabrook is classified as a T_{cold} plant by the NSSS vendor. This means that with normal forced convection (reactor coolant pumps running) the temperature of the coolant under the vessel head remains close to T_{cold} because a small portion of the vessel inlet flow is diverted into this region. Under natural circulation conditions, the coolant under the vessel head does not remain at T_{cold}. Vendor data shows that with a 50°F/hour RCS cooldown rate, the cooldown rate of the coolant under the head would be approximately 34°F/hour without the aid of the non-safety grade control rod drive mechanism fans. For a 50°F/hour cooldown rate, the RCS could be depressurized to 400 psig for RHR operation in about five hours. Although bulk coolant temperature under the head would be at a higher temperature, no steam voiding would occur based on a 34°F/hour cooldown rate.

When the steam generators are being used as the reactor heat sink during the cooldown to 350°F, a single failure of any active component does not render all steam generators ineffective as a heat sink. Either of the two Emergency Feedwater pumps has sufficient capacity to provide for all steam generator makeup requirements. The steam generator power-operated relief valves have manual loading stations should remote operation be lost. The Emergency Feedwater System and the steam generator power-operated relief valves are Seismic Category I subsystems.

The second stage of the cooldown is from 350°F to cold shutdown. During this stage, the RHR System is brought into operation. Circulation of the reactor coolant is provided by the RHR pumps, and the heat exchangers in the RHR System act as the means of heat removal from the RCS. In the RHR heat exchangers, the residual heat is transferred to the Component Cooling Water System which ultimately transfers the heat to the Service Water System.

The RHR System is a fully redundant system. Each RHR subsystem includes one RHR pump and one RHR heat exchanger. Each RHR pump is powered from different emergency power trains and each RHR heat exchanger is cooled by a different Component Cooling Water System loop. The Component Cooling Water and Service Water Systems are both designed to Seismic Category I.

If any component in one of the RHR subsystems were rendered inoperable as the result of a single failure, cooldown of the plant could still be continued.

At Seabrook, a single RHR cooling loop can be cut in under full flow conditions with all air-operated temperature control valves in their failed (maximum cooling) positions. The resulting maximum RCS cooldown rate would not exceed 50°F/hour; therefore, special control functions are not necessary.

2. Reactivity and Inventory Control

Core reactivity is controlled during the cooldown by adding borated water to the RCS in conjunction with the cooldown. As the cooldown progresses, the specific volume of the reactor coolant decreases. The resulting coolant contraction allows the addition of borated water to the RCS to maintain a constant pressurizer level during cooldown.

Boration is accomplished using portions of the Chemical and Volume Control Systems (CVCS). At the beginning of the cooldown, the operators align one of the two Boric Acid Tanks to the suction side of the centrifugal charging pumps. One of the two centrifugal charging pumps would inject borated water to the RCS through the reactor coolant pump seal injection flow path and/or the boron injection portion of the Safety Injection System. The capacity of one Boric Acid Tank is sufficient to make up for reactor coolant contraction down to and beyond the point of cutting in RHR. The concentration of boron in the Boric Acid Tank is maintained between 7000-7700 ppm H_3BO_3. At the minimum concentration of 7000 ppm, gross shutdown margin in the order of 2-5% Δ K/K is maintained during the cooldown considering most limiting conditions (end-of-life, most reactive rod stuck out).

Makeup in excess of that required for boration can be provided from the Refueling Water Storage Tank (RWST) using the centrifugal charging pumps and the same injection flow paths as described for boration. Two independent motor-operated valves, each powered from different emergency diesels, transfer the suction of the charging pumps to the RWST.

The two Boric Acid Tanks, two centrifugal charging pumps and the associated piping are of Seismic Category I design and are independently train associated.

Under natural circulation conditions, the RCS loop transport time is approximately five minutes and the coolant Reynolds' number is in the order of 25,000. Since either boration path distributes RCS makeup to all four loops, adequate mixing and distribution of boron can be assumed.

Provisions are provided to obtain RCS coolant samples to determine boron concentration during the cooldown. This can be done considering single failure and without the need for a containment entry. The on-shift chemistry technician would aid the operators in following boron concentration.

3. RCS Depressurization

For this scenario, RCS depressurization is accomplished by opening one of the two safety-grade pressurizer power-operated relief valves. The discharge is directed to the Pressurizer Relief Tank where it is condensed and cooled.

The depressurization process is integrated with the cooldown process to maintain the RCS within normal pressure-temperature limits. Just before cutting in an RHR cooling loop at 350°F, the RCS is depressurized to $\doteq$400 psig.

Analysis shows that the pressurizer relief tank can accommodate the RCS depressurization to the RHR cut in pressure of 400 psig without opening the rupture discs. Operation of Pressurizer Relief Tank Cooling System is not required.

Single failure of one pressurizer power-operated relief valve does not prevent RCS depressurization. Isolation valves are provided for each power-operated relief valve should it fail to properly reseat after depressurization.

4. Instrumentation

Class 1E instrumentation is available in the Control Room to monitor the key functions associated with achieving cold shutdown and includes the following:

a. RCS wide-range temperature, T_H and T_C

b. RCS wide range pressure

c. Pressurizer water level

d. Steam generator water level (per steam generator, narrow and wide range)

e. Steam line pressure (per steam line)

f. Condensate Storage Tank level

g. RWST level

h. Boric Acid Tank level (per Boric Acid Tank)

i. Emergency Feedwater flow

This instrumentation is sufficient to monitor the key functions associated with cold shutdown and to maintain the RCS within the designed pressure, temperature, and inventory relationships.

5. Summary of Manual Actions

This scenario can be easily accomplished with the normal on-shift complement without the need to call in additional personnel.

Depending on the nature of any single failure that may or may not be present, the following manual actions could be required outside the Main Control Room:

a. Manual valve alignment to feed Boric Acid Tank contents to the suction of the operating centrifugal charging pump prior to cooldown. This would only be necessary if the normal feed path was inoperable or if direct gravity feed from the Boric Acid Tank to the centrifugal charging pump was desired. This task is simple and would take less than ten minutes. The backup borated water source (RWST) can be lined up from the Control Room until this task is complete.

b. Prior to cutting in an RHR cooling loop when RCS temperature and pressure are reduced to $\leq 350^{o}$F and 400 psig, the operator must manually close the power supply breakers for the RHR suction valves (RH-V22, 23, 87, and 88). As stated in the responses to BTP RSB 5-1,this task would take 2-4 minutes to complete, although there is no real need to do this quickly. The RHR suction valve power supply breakers are left open during normal plant operation to reduce concerns relating to "interfacing LOCAs" during a postulated fire event.

   Should either Train A or Train B power sources be unavailable, the associated RHR suction valve in each RHR System would be inoperable. In this case, provisions are made to power the affected valve from the opposite train power source. Here again, the time to complete this task does not seriously hamper transition to RHR System cooling. The on-shift maintenance electrician would aid operators in completing this task.

c. Provisions for local operation of steam generator power-operated relief valves are provided should control at the main control board become inoperable for any train associated valves. The worst single failure would involve two of the four power-operated relief valves. However, only two of the four relief valves need to be operable for core energy removal. In this case, manual positioning of the affected valves would restore normal cooldown.

440.134 Your response to Item II.B.1 of NUREG-0737 is not sufficient. Provide the following:

1) Provide Schematic Diagrams of the Reactor Coolant System high point vents. The figure referenced (5.1-1) did not show a vent path from either the reactor vessel or pressurizer.

2) What size orifice is used in the Vent System? What are flow rates of the Vent System for gases, liquid, and steam under anticipated operating conditions?

3) Provide the design temperature and pressure of the piping, valves and components in the Vent System. Describe the materials of construction up to and including the second isolation valve, and verify that they are compatible with the reactor coolant chemistry and will be fabricated and tested in accordance with SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials".

4) Verify that the following RCS Vent System failures have been analyzed and found not to prevent the essential operation of safety-related systems required for safe reactor shutdown or mitigation of the consequences of a design basis accident.

   a. Seismic failure of RCS Vent System components that are not designed to withstand the safe shutdown earthquake.

   b. Postulated missiles generated by failure of RCS Vent System components.

   c. Dynamic effects associated with the postulated rupture of RCS vent piping greater than one inch nominal size.

   d. Fluid sprays from RCS Vent System component failures. Sprays from normally unpressurized portions of the RCS Vent System that are Seismic Category I and Safety Class 1, 2, or 3 and have instrumentation for detection of leakage from upstream isolation valves need not be considered.

5) Provide a reliability analysis consisting of a Failure Mode and Effects Analysis (FMEA) or equivalent qualitative analysis that shows no single active component failure, human error, or test and maintenance action could result in inadvertent opening or failure to close after intentional opening of an RCS vent path. Include in the analysis components in the associated power, instrumentation, and control systems as well as the electric and mechanical components of the RCS Vent System (reference NUREG-0737, Item II.B.1, Clarification A.(7) and (8)).

6) Demonstrate, using design description and engineering drawings, that the RCS vent path to the containment will provide good mixing with containment air to prevent the accumulation or pocketing of high concentration of hydrogen,

and that nearby structures, systems and components essential for safe shutdown or accident mitigation are capable of withstanding the anticipated discharges from the Vent System.

7) Verify that operability testing of the RCS Vent System valves will be performed in accordance with Subsection IWV of Section XI of the ASME Code for Category B valves (reference NUREG-0737, Item II.B.1, Clarification A.(11)).

8) Provide proposed Technical Specifications to the RCS Vent System including RCS Vent System limiting conditions for operation and surveillance requirements as appropriate (reference NUREG-0737, Item II.B.1, Documentation Required (3)).

9) Submit guidelines for reactor operator use of the RCS Vent System. The operating guidelines shall include:

   a. Procedures to determine when the operator should and should not manually initiate venting and information and instrumentation required for this determination (reference NUREG-0737, Item II.B.1, Clarification A.(2)). The procedures to determine whether or not to vent should cover a variety of Reactor Coolant System conditions (e.g., pressure and temperature). The effect of the containment hydrogen concentration on the decision to vent or to continue venting should also be addressed considering the balance between the need for increased core cooling and decreased containment integrity due to elevated hydrogen levels.

   b. Detailed methods for determining the size and location of a noncondensible gas bubble (reference Position (2) and Clarification A.(2)).

   c. Procedures for operator use of the vents, including information and instrumentation available to the operator for initiating or terminating vent usage (reference Position (2)).

   d. Required operator actions in the event of inadvertent opening, or failure to close after opening, of the RCS vents including a description of the provisions and instrumentation necessary to detect and correct these fault conditions (reference Position (2) and Clarification A.(2)).

   e. Methods which in lieu of venting will assure that sufficient liquid or steam will flow through the steam generator U-tube region so that decay heat can be effectively removed from the RCS.

10) Verify that all displays (including alarms) and controls, added to the Control Room as a result of the TMI Action Plan requirement for Reactor Coolant System vents, have been or will be considered in the human factors analysis required by NUREG-0737, Item I.D.I, "Control Room Design Reviews".

RESPONSE: 1) Refer to revised FSAR Figure 5.1-1, Sheet 1, provided in Amendment 44.

2) The orifice size is 3/8" diameter. Liquid flow is 50 gpm and gas flow is 57 cfm referenced to normal plant operating conditions.

3) Design temperature and pressure is the same as the Reactor Coolant System, i.e., 650°F and 2485 psig. Piping and valve material is stainless steel, Type 316. All material is compatible with the reactor coolant chemistry and will be fabricated and tested in accordance with SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials".

4) a. All RCS Vent System components which are designated Safety Classes 1 or 2 are designed to withstand the safe shutdown earthquake. Pipe supports for that portion of the system piping which is NNS are designed to withstand the safe shutdown earthquake.

b. Refer to FSAR Subsections 3.5.1.2.

c. RCS vent piping does not exceed one inch nominal size.

d. The RCS vessel head vent piping and valves are Safety Class 1 and 2, Seismic Category 1 up to, and including, the second isolation valve. A temperature detector is located immediately downstream of the second isolation valve for leakage detection. The pipe supports for the non-nuclear piping downstream of the second valve are designed to withstand the safe shutdown earthquake. In addition, there is no piping which might be affected by spray from a postulated break in the NNS portion of the piping (which is routed to the pressurizer relief tank).

5) No single active component failure, human error, or test and maintenance action could result in inadvertent opening or failure to close after an intentional opening of the Reactor Vessel Head Vent System. The system consists of a solenoid valve (fail closed) and a motor-operated valve power supply, therefore each must be opened individually and no single failure will result in inadvertent opening or failure to close.

6) As discussed in FSAR Section 5.2.6, the reactor vessel head vent is routed to the pressurizer relief tank to prevent the accumulation of high hydrogen concentrations. Provisions exist for drawing off hydrogen from the tank via a sample connection to the tank vent piping.

7) The RCS Vent System valves, discussed in response to RAI 210.53 referring to FSAR Table 3.9(B)-23 (Sheet 17 of 57), will be operability tested in accordance with subsection IWV of Section XI of the ASME Code for Category B valves.

8) The Technical Specifications for the RCS Vent System will be provided and will include RCS Vent System limiting conditions for operation as well as surveillance requirements.

9) The Seabrook Station procedures concerning operation of the RCS Vent System will be prepared using the Westinghouse Owners Group Generic Emergency Response Guidelines, the plant-specific features of the Seabrook systems, including this new RCS Vent System, and considerations such as those noted in this RAI question. Such procedures and guidelines will be completed and available for review three months prior to fuel load.

10) Any displays (including alarms) and controls, added to the Control Room as a result of the TMI Action Plan requirement for Reactor Coolant System vents, will be considered in the human factors analysis.