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VPNPD-87-396
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September 18, 1987

U. S. NUCLEAR REGULATORY COMMISSION
Document Control Desk
Washington, D. C. 20555

Gentlemen:

DOCKETS 50-266 AND 50-301
RESPONSE TO LOSS OF RESIDUAL HEAT REMOVAL (RHR)
WHILE REACTOR COOLANT SYSTEM (RCS) IS PARTIALLY FILLED
GENERIC LETTER 87-12
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

On July 21, 1987, we received Generic Letter 87-12 from Mr. F. J. Miraglia of your staff requesting that we provide the NRC with a description of the operations performed at Point Beach Nuclear Plant during the approach to, and operation with, a partially filled RCS.

Attached is the requested response addressing Items 1 through 9 in the Generic Letter, which was based on the work of the Point Beach Nuclear Plant RHR System Task Force. The task force was established on December 27, 1985, by the Point Beach Plant Manager to address concerns related to the reliability of the RHR system at Point Beach Nuclear Plant which were brought to light by incidents at other plants in the nuclear power industry. The goal of this task force was to determine the "root cause" for various RHR incidents and to make recommendations aimed at preventing incidents in the future. The task force issued its findings and recommendations on July 28, 1986. We believe the actions taken in response to their recommendations address the concerns expressed in Generic Letter 87-12.

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If you have any questions regarding this matter, please contact us.

Very truly yours,

C. W. Fay
Vice President
Nuclear Power

Attachment

Copies to NRC Regional Administrator - Region III
NRC Resident Inspector
R. S. Cullen - PSCW

Subscribed and sworn to before me
this 18th day of September 1987.

Delores R Gruszkowski
Notary Public, State of Wisconsin

My Commission expires 5-27-90.

Response to Generic Letter 87-12
Loss of Residual Heat Removal While the RCS is Partially Filled
Point Beach Nuclear Plant, Units 1 and 2

Question 1 A detailed description of the circumstances (1A) and conditions (1B) under which your plant would be entered into and brought through a draindown process and operated with the RCS partially filled, including any interlocks that could cause a disturbance to the system (1C). Examples of the type of information required are the time between full-power operation and reaching a partially filled condition (used to determine decay heat loads) (1D); requirements for minimum steam generator (SG) levels (1E); changes in the status of equipment for maintenance and testing and coordination of such operations while the RCS is partially filled (1F); restrictions regarding testing, operations, and maintenance that could perturb the nuclear steam supply system (NSSS) (1G); ability of the RCS to withstand pressurization if the reactor vessel head and steam generator manway are in place (1H); requirements pertaining to isolation of containment (1I); the time required to replace the equipment hatch should replacement be necessary (1J); and requirements pertinent to reestablishing the integrity of the RCS pressure boundary (1K).

Response

1A On an annual basis, each unit is operated in a partially drained condition to permit preparation for and recovery from a core refueling operation. Scheduled maintenance and inspection of RCS components, such as RCP seals, SG tubes, and first-off valves, is interphased with the shutdown for refueling and requires short intervals (1-2 weeks) of 3/4 pipe operation.

Typical circumstances which would require the plant to enter into an unscheduled cooldown/draindown process and operate with the RCS partially drained (including 3/4 pipe operation) are:

1. Reactor vessel head leakage (CRDM, Conoseals, RV head seal(s), etc.)
2. Steam generator primary to secondary tube leakage.
3. Reactor Coolant Pump seal repair/replacement.
4. Primary side manway leakage (SG or pressurizer).
5. RTD manifold leak repair.
6. Unisolable RCS valve or mechanical joint leakage.
7. Seal table leak repair
8. Pressurizer heater repair/replacement

1B The major plant prerequisites for RCS draindown are:

1. RCS is solid, depressurized, and the Reactor Coolant Pumps are secured.
2. RCS temperature is less than the temperature limit for a cold shutdown, (200°F). Typically, it is maintained at 100-140°F.

3. Letdown is from the RHR system and is aligned in a solid system configuration bypassing the Volume Control Tank.
4. An empty Chemical and Volume Control System (CVCS) Holdup Tank (HUT) is available to receive the reactor coolant.
5. The nitrogen supply system is available to backfill the Pressurizer and RCS with nitrogen at a slight positive pressure (1-3 psi) during draindown.
6. The containment purge supply and exhaust system is typically operating.
7. The reactor has been shutdown for >89 hours or the decay heat load has been demonstrated to be within the heat removal capability of a single train of RHR. Shutdown begins when the reactor is made subcritical, and could be initiated from a full power or low power condition. The decay heat calculations discussed later conservatively assume a shutdown from full power.
8. Isotopic chemical analysis of the RCS indicates that the concentration of radioisotopes is within an acceptable level for draindown and opening of the RCS.
9. Both RHR trains are operable when the RCS temperature is <200°F. One train at a time may be temporarily out of service when <140°F for surveillance requirements. This is a Technical Specification requirement (Section 15.3.1).
10. When the RCS is not open to the atmosphere and either cold leg temperature is $\leq$275°F, no more than one high head SI pump shall be operable. The second pump shall have its associated 4160 volt breaker racked out or its discharge valve shut and operator power removed. This is a Technical Specification requirement (Section 15.3.15.B.1).
11. Reactor vessel level instrument, LT-447, is calibrated prior to its use. The transmitter is thoroughly purged of liquid in the reference leg and air in the variable leg prior to placing it in service.
12. Whenever the RCS temperature is <354°F and the RCS is not open to the atmosphere, the Low Temperature Overpressure Protection System (LTOP) shall be operable. This is a Technical Specification Requirement (Section 15.3.15.A.1).

1C There are no interlocks that could cause a disturbance to the system during RCS draindown or to the operation of the RHR system when the RCS is partially drained.

1D Reference item #7 in response 1B.

1E Once the primary side of the steam generator is drained, the secondary side of the steam generator has no minimum level required because there is no heat removal capability.

1F. Maintenance activities require the implementation of the Equipment Isolation Procedure (Danger Tag Procedure) which is under the direct approval and authorization of the Duty Shift Superintendent (DSS). A segment of this procedure requires the DSS to assess the impact of each equipment isolation and the scope of the maintenance activity on the requirement to maintain redundant decay heat removal capability. If there is a potential problem with maintaining decay heat removal, the tag out must be evaluated further.

In addition, work is coordinated with the control room through the use of Maintenance Work Requests or Modification Requests.

Similarly, testing and inspection activities are performed with the guidance of preapproved procedures. The DSS authorizes the performance of these activities provided the plant status is not affected or is in accordance with the prerequisites of the procedure.

1G Reference response 1F.

1H Reference item #12 in response 1B.

1I Containment integrity or isolation is not required when RCS temperature is <200°F (<140°F when the reactor vessel head is removed).

1J The containment equipment hatch takes two hours to move into place and an additional six hours to bolt and torque (longer if ramps, rails or scaffolding need to be removed).

1K There are no specific requirements regarding reestablishing the integrity of the RCS pressure boundary.

Question 2 A detailed description of the instrumentation and alarms provided to the operators for controlling thermal and hydraulic aspects of the NSSS during operation with the RCS partially filled. You should describe temporary connections, piping, and instrumentation used for this RCS condition and the quality control process to ensure proper functioning of such connections, piping, and instrumentation, including assurance that they do not contribute to loss of RCS inventory or otherwise lead to perturbation of the NSSS while the RCS is partially filled. You should also provide a description of your ability to monitor RCS pressure, temperature, and level after the RHR function may be lost.

Response

During the normal draindown process, level indication is provided initially by the cold calibrated pressurizer level indicator LI-433, which has a range of 0 to 100% (0 to 275 inches). When pressurizer level is about to go off scale, the reactor vessel (RV) level transmitter LT-447 is placed in service. This provides level indication from about 1 foot above the reactor vessel flange down to the bottom of the hot leg nozzle (0 to 100 inches) (see attached Figure 1). In addition, the narrow range Reactor Vessel Level Indication System (RVLIS) indicator and recorder are operational for trending through the entire process. If draindown is continued to below the level where the primary coolant pipes are full, the level is also checked locally by a tygon tube. The tygon tube is mounted near a permanently installed scale, and level is checked after the RCS is vented to the atmosphere for verification of LT-447. These three methods of level indication remain operational with loss of RHR. LT-447 also provides a high level alarm function.

Pressure indication is provided at all times on RCS pressure indicator PI-493, a narrow range instrument calibrated for a range of 0-1000 psig, and this indication remains operational on loss of RHR. Pressure indicator PI-628 at the discharge of RHR pump P10A and PI-629 at the discharge of P10B are also available and have a range of 0-600 psi.

Temperature is monitored by the core exit thermocouples located in the upper internals which are available during the partial filled condition unless the reactor vessel head is removed. In addition, if RHR is operating, local and remote temperature indicators associated with TI-622 and TI-623 with a range of 50-350°F on the A and B RHR heat exchanger outlets are available. RCS temperature is also read and recorded by TR-630 with a range of 100-400°F located on the line from the loop A hot leg to the suction of the RHR pumps. Temperature indication is provided on the common leg for RHR return into loop B by TR-627 which has a range of 100-400°F. Wide range T_{hot} and T_{cold} indication (50-750°F) are provided from the loops and are read on the Auxiliary Safety Instrumentation Panel (ASIP). Indication of T_{hot}, T_{cold} and core exit thermocouples (if available) remain operational with loss of RHR.

Indication of normal charging flow is provided by the flow indicator/transmitter FIT-128 located on the discharge of the charging pumps. Separate local seal injection flow indication is provided for each RCP. Letdown flow is indicated by FI-134 which is located downstream of the letdown orifices. The difference between total charging (sum of normal charging flow and seal injection flow to each RCP) and letdown is the volumetric rate of reactor coolant that is being removed/added. Flow indication is provided on the RHR flow to the cold leg injection by FT-626. This transmitter also provides a low flow alarm if RHR flow is less than 800 gpm. The above flow indicators are all available upon loss of RHR.

All instrumentation, with the exception of the tygon tube level indicator, is permanently piped. The tygon tube is normally isolated from the RCS. It is unisolated only for level comparison/verification checks.

Question 3 — Identification of all pumps that can be used to control NSSS inventory. Include: (a) pumps you require to be operable or capable of operation (include information about such pumps that may be temporarily removed from service for testing or maintenance); (b) other pumps not included in item a (above); and (c) an evaluation of items a and b (above) with respect to applicable TS requirements.

Response

3A In accordance with Technical Specifications both RHR trains and associated pumps are required to be operable whenever RCS temperature is <200°F with the exception that one train at a time may be temporarily out of service when <140°F for surveillance requirements. The RHR pumps are capable of rapid makeup to the RCS from the RWST.

3B During normal draindown, inventory control is initially provided by the charging pumps (P2A, P2B, & P2C) which can take suction from the letdown system, the blender system, the Refueling Water Storage Tank, the Boric Acid Storage Tanks, or the Holdup Tanks. Safety Injection Pumps (P15A and P15B) are available for inventory addition from the Refueling Water Storage Tank or the Boric Acid Storage Tanks. In accordance with Technical Specifications, one safety injection pump must be tagged out to preclude overpressurization of the primary system when the RCS temperature is ≤275°F. The second pump is capable of being operated during the draindown process and while at a partially drained condition unless maintenance is being performed on both SI pumps. Holdup tank recirculation pump (P9) can be aligned to the suction of the charging pumps to provide makeup water from the holdup tanks. When the RCS is partially drained, the Refueling Water Storage Tank will be full of water, which allows the Refueling Water Storage Tank to be aligned to gravity feed the RCS via the RHR suction line. The difference in elevation between the top of the water level in the RWST and 3/4 pipe is about 40 feet.

3C Reference response 1B items 9 & 10.

Question 4 A description of the containment closure condition you require for the conduct of operations while the RCS is partially filled. Examples of areas of consideration are the equipment hatch, personnel hatches, containment purge valves, SG secondary-side condition upstream of the isolation valves (including the valves), piping penetrations, and electrical penetrations.

Response

Technical Specifications do not require containment integrity, if the primary system is in a cold shutdown or refueling shutdown condition (the conditions in which the RCS could be partially drained). Clearly there must be a time during which the containment can be "opened" so maintenance work and required testing can be done. The purge supply and exhaust ventilation system may be operating. Normally the radiation monitoring system, which initiates trips of the purge supply and exhaust system, is functional. The personnel hatches may be open and the equipment hatch may be off. Piping and electrical penetrations may be "open" for maintenance or testing.

Question 5 Reference to and a summary description of procedures in the control room of your plant which describe operation while the RCS is partially filled (5A). Your response should include the analytic basis you used for procedures development (5B). We are particularly interested in your treatment of draindown to the condition where the RCS is partially filled (5C), treatment of minor variations from expected behavior such as caused by air entrainment (5D) and de-entrainment (5E), treatment of boiling in the core with and without RCS pressure boundary integrity (5F), calculations of approximate time from loss of RHR to core damage (5G), level differences in the RCS (5H) and the effect upon instrumentation indications (5I), treatment of air in the RCS/RHR system (5J), including the impact of air upon NSSS (5K), and instrumentation response (5L), and treatment of vortexing at the connection of the RHR suction line(s) to the RCS (5M).

Explain how your analytic basis supports the following as pertaining to your facility: (a) procedural guidance pertinent to timing of operations (5N), required instrumentation (5O), cautions (5P), and critical parameters (5Q); (b) operations control and communications requirements regarding operations that may perturb the NSSS (5R), including restrictions upon testing (5S), maintenance (5T), and coordination of operations that could upset the condition of the NSSS

(5U); and (c) response to loss of RHR including regaining control of RCS heat removal (5V), operations involving the NSSS if RHR cannot be restored (5W), control of effluent from the containment if containment was not in an isolated condition at the time of loss of RHR (5X), and operations to provide containment isolation if containment was not isolated at the time of loss of RHR (5Y) (guidance pertinent to timing of operations, cautions and warnings, critical parameters, and notifications is to be clearly described).

Response

5A There are four procedures in the control room at Point Beach which describe operation while the RCS is partially filled. Operating Procedure OP-4D, "Draining the Reactor Coolant System," provides the direction for draining the RCS to a partially filled condition. Operating Procedure OP-5A, "Reactor Coolant Volume Control," provides direction for maintaining proper reactor coolant inventory during the partially filled condition. Operating Procedure OP-4A, "Filling & Venting Reactor Coolant System," provides direction for filling the RCS from a partially filled condition. Finally, Abnormal Operating Procedure AOP-9C, "Degraded RHR System Capability," is used to evaluate and correct inadequate core cooling conditions during RHR system operation. These procedures are described in greater detail below.

OP-4D, Draining the Reactor Coolant System

Operating Procedure OP-4D is divided into two sections:

A. Draining the RCS to a Chemical and Volume Control System Holdup Tank
B. Pumping the refueling cavity/RCS to the RWST

Section A, titled "Draining the RCS to a CVCS HUT", details the required action to drain a closed RCS from a solid depressurized condition to any partially or fully drained condition. Fully drained is typically referred to as the "3/4 pipe" condition. In this procedure, reactor coolant is pumped via the RHR system and the letdown divert portion of the CVCS to a CVCS HUT. A nitrogen backfill of the RCS is employed to fill the voided areas in the RCS thus eliminating O_2 contact and as a controlled vacuum break of the coolant captive in each steam generator tube bundle.

Section B, titled "Pumping the Refueling Cavity/RCS to the RWST" details the required action to pump the upper level of the refueling cavity and the RCS to "3/4 pipe", if required, via the RHR system to the RWST. This procedure is primarily employed during a refueling shutdown when the reactor vessel head is removed in conjunction with RP-1B, "Recovery from Refueling."

OP-5A, Reactor Coolant Volume Control

Operating Procedure OP-5A defines the operations necessary to maintain proper reactor coolant inventory during different phases of plant operation. Section D of the procedure details the operation necessary to raise or lower the reactor vessel water level when the RCS is on RHR and drained to 3/4 pipe. This section is limited in scope to small adjustments to reactor vessel water level which may be necessary to maintain a 3/4 pipe condition.

Two methods for increasing reactor vessel water level are prescribed. The first uses makeup from the RWST via the emergency makeup flow path and a charging pump to the RCS. The second uses the blender system and a charging pump for makeup injection to the RCS.

Two methods for decreasing reactor vessel water level are prescribed. The first diverts reactor coolant to the RWST via a small locally operated RHR HX discharge bypass valve. The maximum diversion capability of this path is 200 gpm. The second method uses the normal letdown divert path to a selected CVCS holdup tank. The maximum diversion capability of this path is 60 gpm due to the reduced letdown pressure when cross-connected to the RHR pump discharge.

OP-4A, Filling & Venting the Reactor Coolant System

Operating Procedure OP-4A, defines the operation for filling and venting of the RCS.

Primary system valve alignment is performed to establish an intact RCS boundary. A source of RCS makeup is selected from either the blender, CVCS holdup tank, or the RWST and is aligned to the suction of the charging pumps. The RCS is continuously vented at the reactor vessel head, pressurizer head, and the hot and cold leg of each steam generator channel head via a closed vent system to the Pressurizer Relief Tank (PRT) which is vented to the containment purge exhaust system. A slow fill rate of approximately 60 gpm is established via the charging system. This slow fill rate permits the free venting of RCS components (such as the SG channel heads) at near atmospheric pressure so that a minimum amount of air is entrapped once the RCS is solid. When the RCS is solid, the RCS vent valves are shut, the RCS is pressurized to 350 psig, and RCPs are alternately jogged to sweep air from the SG tube bundles. The air is selectively vented from the RCS high points (RV head and pressurizer head) via the steam space sample line to the primary sample sink and exhaust system.

AOP-9C, Degraded RHR System Capability

Abnormal Operating Procedure AOP-9C is used to evaluate and correct adverse conditions which have caused loss of residual heat removal system operation.

The procedure provides decay heat removal restoration guidelines for an intact RCS and for the condition where the RCS boundary is open to the containment atmosphere.

In the case where the RCS boundaries are intact, the RCS is filled solid, pressurized to obtain 35°F subcooling, and natural or forced SG cooling is initiated. In the case where the RCS boundary is not intact, the operator is directed to regain RHR capability by increasing RV water level with makeup from the RWST or the Spent Fuel Pool and restart of the RHR system. In the extreme case where RHR flow can not be regained, alternate core cooling is established (i.e., feed and bleed of the RCS).

5B Initial procedures were based on Westinghouse guidance provided in 1969 and 1970.

The current procedures are based on evaluating our own experience for more than 30 reactor-years of Point Beach operation and addressing industry experience, not only from NRC Information Notices, but also from industry initiatives such as INPO Significant Operating Experience Reports.

5C Draindown is accomplished by procedure OP-4D. For the following discussion refer to Figure 1. After the initial conditions have been met, the RCS is drained down to 60% indication on Reactor Vessel Level Transmitter LT-447. Draining volumes and rate are checked and a nitrogen purge is supplied to the system as it drains down. At 60% the Steam Generator Tube Bundle is drained by supplying N_2 to the steam generator cold leg vent. After draining both tube bundles, level is reduced to 40% on LT-447, which is approximately 7" above the top of the hot leg nozzle and approximately 14" above 3/4 pipe.

At this time the operator is provided with a series of procedural cautions regarding reducing level further, which tell him vortexing (air entrainment) may occur as evidenced by unsteady RHR flow and RHR pump discharge pressure fluctuation. If the RHR flow is at the normal 1500 gpm when evidence of vortexing (air entrainment) occurs, the flow is reduced to <1000 gpm and draining is secured. If RHR flow is lost, the operator follows AOP-9C. Once RHR system operation is returned to normal, the operator proceeds with draining down to 3/4 pipe.

5D Reference response 5C.

5E De-entrainment of air is covered in AOP-9C, which describes refilling the RHR pump suction using the P-33 pump to refill from either the RWST or the spent fuel pool. As a backup, water can be supplied from the spent fuel pool using the spent fuel pool cooling pumps P-12A or P-12B. It is noted that unstable RHR pump indications will occur for approximately one minute after starting an RHR pump. A short duration 1500 gpm flow is desired to accomplish an "air sweep" of the RHR system. In addition to filling the RHR pump suction, the operator is instructed to increase reactor vessel level by 5% or add 1000 gallons to the RCS prior to restart of a RHR pump.

5F The procedures are designed to restore cooling and inventory to the core as soon as possible. Boiling in the core with and without RCS pressure boundary integrity is not directly addressed in the procedures.

5G The shortest time from loss of RHR to core uncover and possible core damage was conservatively calculated to be approximately 55 minutes during cold shutdown (i.e., <200°F) and 64 minutes during refueling shutdown (i.e., <140°F). These times were calculated using the same methodology applied to Diablo Canyon as documented in NUREG-1269. The results are similar to those of Diablo Canyon.

5H Procedure OP-4D requires all hot and cold leg vents to be opened prior to draining the vessel level to less than 60% as indicated on LT-447. The pressurizer spray valves are opened prior to draining and provide two 3" diameter vent paths between the cold legs and the pressurizer which is connected to the hot leg. Also, when drained to 3/4 pipe, the RCS is vented through the PRT to the containment purge exhaust.

Based on the venting provided from procedure OP-4D, allowable temperatures, and decay heat rates for draining to 3/4 pipe condition, three scenerios were examined which could lead to unequal levels between the hot legs/core and the cold legs following a loss of RHR cooling. The first case assumed the hot leg was vented through a primary side manway. For this condition, the 3" pressurizer spray lines provide sufficient vent capacity to minimize hot and cold leg level differences. The second case is analyzed with the RCS pressure boundary intact on both the hot and cold leg sides. Again, the pressurizer spray lines provide adequate venting. The final case examined assumed the RCS hot leg intact and the cold leg pressure boundary opened. For this case, the RCS hot leg pressurizes, forcing water out of the hot legs/core, into the cold leg and out of the opening. In response to the vessel level decrease the operator is directed in AOP-9C to increase the RCS level from the RWST using any available means.

5I There is no effect on instrumentation. Because the LT-447 variable and reference legs tap directly off the bottom of the reactor vessel and the top of the pressurizer, respectively, no error is introduced due to level fluctuations between the hot leg and cold leg.

5J Reference response 5C, 5E and 5F.

5K The procedure for pressurizer spray valve opening equilizes hot and cold leg pressures via the pressurizer. Therefore any noncondensible gases admitted to the RCS will have no impact on the NSSS.

5L Reference response 5I and 5K.

5M Reference response 5C.

5N The timing for the start of the draindown procedure was calculated assuming the maximum decay heat available in the core and of one RHR train to remove decay heat. Operating procedures do not allow draining the RCS to a partially drained condition until >89 hours have elapsed since shutdown, or a single RHR train is verified to be able to remove all of the decay heat.

5O The required instrumentation for draindown of the RCS is identified by the parameters used in the calculation of the time to uncover the core. This calculation identifies the key parameters as reactor vessel level, RCS temperature, and RCS pressure, which are used in the procedures. See Response 2 for a detailed description of the instruments used to measure these parameters.

5P The operator is cautioned against draining more than 3,000 gallons during the time the pressurizer level is off scale until LT-447 is on scale without investigating the discrepancy. This volume has been determined to be about 2,000 gallons. In procedure OP-4D the volume of the steam generator tubes is identified as about 7,000 gallons. The operator is instructed to compare this volume with the drain rate volume and selected holdup tank volume change to ensure proper steam generator tube draining.

5Q See response 5O.

5R Procedure OP-4D, Section B, "Pumping the Refueling Cavity/RCS to the RWST," requires communications be established between the control room, refueling cavity and the RHR discharge valves to the RWST prior to commencing this draindown.

5S Testing is controlled and coordinated by the Duty Shift Superintendent (DSS). The DSS must authorize testing to proceed.

5T Reference response 1F.

5U Coordination of operations that could upset the condition of the NSSS is provided through the DSS.

5V Operating Procedure OP-4D, "Draining the Reactor Coolant System," directs the operator to proceed to AOP-9C, "Degraded RHR System Capability," upon loss of RHR flow. If the RCS pressure boundary is intact, the operator is instructed to shut the RHR loop suction valve, establish RCS subcooling based on core exit thermocouples by raising the RCS pressure or increasing steam generator cooling, and initiate RHR cooling per OP-7A, "Placing Residual Heat Removal System in Operation." This response is supported by the Westinghouse Owner's Group Emergency Response Guidelines and the PBNP EOP Setpoint Document.

If the RCS pressure boundary is not intact the operator is instructed to fill the RHR pump suction from the RWST or the Spent Fuel Pool, and increase Reactor Vessel Level by 5% or add 1,000 gallons to the RCS. He is then directed to restart one RHR pump to reestablish cooling. This response is supported by operating experience and testing.

5W If the RHR system does not provide adequate RCS cooling, the operator is instructed to implement alternate core cooling means such as feed and bleed to the RCS and to continue efforts to restore RHR as directed by AOP-9C.

A special test was performed with the core defueled. The RHR suction piping (including the RHR pump casing) was completely drained. RHR suction piping and the reactor vessel were backfilled via P-33 and the spent fuel pool until a 5% increase in reactor vessel indicated level was observed, and the associated RHR pump was restarted and verified operable. An objective of the test was to determine the time required to backfill and restore the RHR to operating conditions. Based on the test results, RHR operability can be reestablished within 20 minutes.

5X Reference response 4. If RCS temperature increases above 200°F (above 140°F if the reactor vessel head is removed), containment integrity will be reestablished as required by the Technical Specifications. When drained down to 3/4 pipe, the RCS is vented through the PRT to the containment purge exhaust. The analytic basis for the above is provided by Technical Specification Basis 15.3.6.

5Y Operations to provide containment isolation would include:

1. Closure of all non-automatic containment isolation valves and installation of blank flanges as required.
2. Closure of the equipment hatch.
3. Closure of at least one door in each personnel air lock.
4. All automatic containment isolation valves are made operable or are closed.
5. Closure of all other openings in the containment resulting from maintenance activities.

Question 6 Provide a brief description of training provided to operators and other affected personnel that is specific to the issue of operation while the RCS is partially filled. Particular interest should be paid to maintenance personnel training regarding avoidance of perturbing the NSSS and response to loss of decay heat removal while the RCS is partially filled.

Response

Licensed operator training regarding this condition is provided via Lesson Plan LP1308, "Draining the RCS and Degraded RHR Capability." The lesson has five sections. First, it explains how RCS pressure and level are controlled before the RCS is drained down to the 3/4 pipe level. Second, the lesson reviews the procedure to accomplish RCS draindown. The third topic is an explanation of how RCS pressure and level are controlled after the RCS is drained to the 3/4 pipe level. The objective of the fourth section is to teach operators how to recognize symptoms of degraded RHR capability. The final section describes recovery from a loss of RHR flow. This is essentially the same as the training provided for the Duty Technical Advisor in Lesson Plan LP1307, "Draining the RCS & Degraded RHR Capability."

The auxiliary operators are trained under Lesson Plan LP0252, "Draining the Reactor Coolant System." The auxiliary operators are provided the initial conditions which must be present for RCS draindown to commence and the minimum reactor vessel level for RHR operation. The precautions which pertain to using the tygon tube method of level indication and the reason for red tagging the pressurizer heaters are provided. The auxiliary operators are taught the basic flow path for draining the RCS to the HUT or RWST. The lesson identifies situations which can cause level indicator LT-447 to read incorrectly, provides how the RCS is backfilled with nitrogen while draining, describes the procedures for venting the steam generators after draining the RCS and explains the reasons for red tagging shut the valves which connect the RCDT to the waste gas vent header.

Maintenance personnel receive no formal training on the RCS partially filled condition. The Point Beach Nuclear Plant Equipment Isolation procedure requires a danger tag out form to be completed. One of the questions on this form asks if redundant decay heat removal will be maintained. This question must be answered by the Duty Shift Superintendent who has received formal training in degraded RHR operation. If there is a potential problem with maintaining decay heat removal, the tag out must be evaluated further.

In addition, work is coordinated with the control room through the use of Maintenance Work Requests or Modification Requests.

<u>Question 7</u> Identification of additional resources provided to the operators while the RCS is partially filled, such as assignment of additional personnel with specialized knowledge involving the phenomena and instrumentation.

<u>Response</u>

Consistent with our philosophy of providing adequate staffing under all operating conditions, in addition to the required minimum shift complement, the Duty Technical Advisor (DTA) who has received training in loss of RHR cooling or RCS inventory and the Duty and Call Superintendent are resources available to the operators. Additional human resources are provided to the operators upon implementation of the Emergency Plan.

<u>Question 8</u> Comparison of the requirements implemented while the RCS is partially filled and requirements used in other Mode 5 operations. Some requirements and procedures followed while the RCS is partially filled may not appear in the other modes. An example of such differences is operation with a reduced RHR flow rate to minimize the likelihood of vortexing and air ingestion.

<u>Response</u>

Mode 5 in the Standard Technical Specifications is defined as $K_{eff}<.99$, and RCS temperature $\leq 200^{\circ}F$. This corresponds to the cold shutdown condition defined in the Point Beach Technical Specifications.

The requirements which are implemented while the RCS is partially filled and which are not required in other cold shutdown operations at Point Beach are:

1. The Reactor Coolant Pumps are off.
2. The Pressurizer Heaters must have their breakers racked out and red tagged.
3. The Volume Control Tank (VCT) volume control switch is in the fill mode thereby defeating an automatic or unplanned letdown divert.
4. Vent paths identified in response 5H are open.

<u>Question 9</u> As a result of your consideration of these issues, you may have made changes to your current program related to these issues. If such changes have strengthened your ability to operate safely during a partially filled situation, describe those changes and tell when they were made or are scheduled to be made.

<u>Response</u>

In response to NUREG 1154 the Davis-Besse Report, Action Item 6, Recommendation No. 4 a task force was established on December 27, 1985 to address concerns related to the reliability of the RHR system at PBNP. Incidents at other plants in the nuclear power industry had brought these concerns to light. The goal of this task force was to determine what the "root cause" had been for loss of RHR incidents and to make recommendations aimed at preventing similar incidents at Point Beach. Based primarily on the recommendations of the task force, the following actions have been recently taken:

1. Modification has been performed on Unit 1 and is scheduled to be performed during the upcoming Unit 2 refueling which changes the connections for LT-447 (Reactor Vessel Level Transmitter). On Unit 1 the measurement leg had been connected to the section of RCS piping between the steam generator and the reactor coolant pump. The problem with this connection was that at the low level end (<3/4 pipe) system accuracy and response was diminished. As a result, the draindown had to proceed slowly to give levels time to equalize. If the draindown was too fast, the indicated level would lag the actual level. The new connection taps into a thimble guide tube which comes from the bottom of the reactor vessel. The new reference leg connection is located closer to the pressurizer than the old connection. This was done to enable the reference leg to respond more quickly to changes in RCS pressure. The old connection lagged the RCS pressure because of line losses from the pressurizer to the connection.

2. A recent modification of the VCT control switch permits the fill mode for the VCT to be maintained, thereby defeating an automatic or unplanned letdown divert to a HUT when the RCS is at 3/4 pipe.

3. A recent modification installed a new bypass valve around the 8" valve from the RHR discharge to the RWST which is used for draining the RCS to the RWST. The smaller bypass valve provides better control than the larger valve during the draindown process.

4. AOP-9C was issued on 08-01-86, and describes operator actions required for degraded RHR system capability.

5. Operating Procedure OP-4D "Draining the Reactor Coolant System," was revised on 04-01-87 to eliminate several potential problem areas. The VCT was eliminated from the flowpath, thus making the charging and letdown sections of the system solid. Therefore system input equals system output plus or minus draindown or filling. OP-4D was also revised to reflect the change in philosophy that operating level should not go below 3/4 pipe instead of the previously specified 1/2 pipe condition. This considerably reduces the probability of loss of RHR due to vortexing (air entrainment). Use of the RVLIS was added to the procedure to provide a trending function for the system water level.

6. Operating Procedure OP-5A, "Reactor Coolant Volume Control," was revised on 07-01-87 by adding a section to the procedure which provides instructions for maintaining and changing reactor coolant system level in a partially drained condition.

7. Training in operation of the RCS during a partially filled condition has been upgraded. Lesson Plan LP1307, "Draining the RCS and Degraded RHR Capability," which is used in training Duty Technical Advisors was issued on 06-26-87. Lesson Plan LP1308, "Draining the RCS and Degraded RHR Capability," used in training licensed operators was issued on 07-17-87. Lesson Plan LP0252, "Draining the Reactor Coolant System," used in the training of auxiliary operators was issued on 07-17-87.

8. AOP-9C will be reviewed to determine if the procedure should be clarified to emphasize the use of upper plenum injection paths for continuing decreasing reactor vessel water level following a loss of RHR flow in the partially drained condition.

We believe the above recent actions have significantly enhanced our ability to prevent the loss of RHR cooling during the partially drained condition at Point Beach, as well as cope with the loss of RHR, should it occur.

Figure 1.
Point Beach Nuclear Plant
Reactor Coolant System
Elevations of Major Components