VIRGINIA ELECTRIC AND POWER COMPANY
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VICE PRESIDENT
NUCLEAR OPERATIONS

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
NORTH ANNA POWER STATION UNITS 1 AND 2
RESPONSE TO NRC GENERIC LETTER 87-12

Attached is a partial response to Generic Letter 87-12 "Loss of Residual Heat Removal (RHR) while the Reactor Coolant System (RCS) is Partially Filled". The responses have been formatted to address each area required by the Generic Letter for both Surry and North Anna Power Stations. In those instances where there are differences between station responses, they are addressed separately.

As indicated in the individual responses, the remaining items to be answered require further evaluation. Virginia Electric and Power Company is participating in the Westinghouse Owners Group efforts to develop the responses to these sections. It is expected that these responses will be completed by March, 1988.

If you have any questions, please contact us.

Very truly yours,

W. L. Stewart

Attachment

A061
1/1

cc: U. S. Nuclear Regulatory Commission
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Mr. W. E. Holland
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NRC Request

Description of your plant during the approach to a partially filled RCS condition and during operation with a partially filled RCS.

NRC Item 1

Detailed description of circumstances and conditions entering into and through draining and operation with the RCS partially filled.

Response

The Residual Heat Removal (RHR) system is designed to remove decay heat and sensible heat from the reactor core and the Reactor Coolant System (RCS) during the second phase of unit cooldown. The secondary purpose of the RHR system is to transfer water from the reactor refueling cavity and transfer canal to the refueling water storage tank following refueling. The RHR system consists of two heat exchangers cooled by the Component Cooling Water System, two residual heat removal pumps and associated piping, valves and instrumentation. The entire RHR system is located inside the containment, with the exception of the line that connects to the Refueling Water Storage Tank (RWST).

After the RCS temperature has been reduced to less than 350°F and the RCS pressure is less than 450 psig (SPS); 400 psig (NAPS), further RCS cooling is initiated by aligning the RHR pumps to take suction from the reactor outlet line and discharge through the heat exchangers into the reactor inlet line. The inlet line to the RHR system is located in the hot leg of reactor coolant loop A between the main loop stop valve and the reactor vessel. The return line connects to the cold leg of loops B and C between the loop stop valves and the reactor vessel. A portion of the heat exchanger outlet is directed to the chemical and volume control system (CVCS) for purification and volume control of the RCS. The RHR system suction line connects to the RCS loop below centerline.

Residual Heat Removal is a dedicated system and is <u>not</u> a part of the Low Head Safety Injection System.

Plant operating procedures provide detailed instructions for operating the plant from power operation to the cold shutdown, mid-nozzle condition. Actual draining of the RCS is performed after the overpressure mitigating system is placed in service, the RHR system is in service, and the RCS is cooled to less than 150°F (SPS); 140°F (NAPS).

Units at both Surry Power Station (SPS) and North Anna Power Station (NAPS) are equipped with loop stop valves that allow draining of the loops individually without draining the reactor vessel to mid-nozzle. Draining of the RCS to mid-nozzle is at times required in support of outage operations and whenever work must be performed on the loop stop valves or any component between the valves and the reactor vessel.

Mid-nozzle is exactly 11'-9 15/16" (SPS); 256'4" (NAPS). However, throughout this document and all Station Operating procedures, mid-nozzle refers to 12'6" (SPS); 257'2" (NAPS), which is the level that is maintained to ensure adequate RCS inventory to support the RHR pump operation. These elevations are based on sea level reference elevations.

The UFSAR states that the RCS temperature and pressure are presumed to be less than 350°F and 450 psig approximately four hours after reactor shutdown. The RHR system is designed to reduce the temperature of the RCS to 140°F within 16 hours after the RHR system is placed in operation. The UFSAR states that at 20 hours after a reactor shutdown, based on infinite core operation, residual heat generation is approximately 66.0×10^6 Btu/hr (SPS); 61.0×10^6 Btu/hr (NAPS).

NRC Item

1.a. Interlocks that could cause a disturbance to the system.

Response

The RHR inlet valves are interlocked to prevent opening these valves unless RCS pressure is less than 460 psig (SPS); 418 psig (NAPS). Each valve is interlocked with a separate RCS wide range pressure transmitter.

The RHR inlet valves (North Anna only) have an automatic closure feature at 582 psig. Therefore, the testing or failure of the RCS wide range pressure channels can cause a simulated overpressure signal resulting in the automatic closure of the RHR inlet valves.

The degraded voltage/undervoltage protection signal automatically opens (but does not lock out) the RHR pump breaker, as well as its associated feeder (stub bus) supply breaker, if one of the following conditions occur on its emergency bus:

1. 90% of nominal voltage (60 sec. time delay)
2. 90% of nominal voltage concurrent with a SI signal (7 sec. time delay)
3. 75% (SPS); 71% (NAPS) of nominal voltage with a 2 sec. (SPS); 2.3 sec. (NAPS) time delay

The degraded voltage/undervoltage protection trips are functional only when the emergency bus is being supplied from its normal source. If only the EDG is supplying the emergency bus, the stub bus breaker and the RHR motor breaker may be closed regardless of bus voltages.

Containment depressurization actuation (North Anna only) causes the stub bus breaker to open and lock open. The testing of this circuit during shutdown conditions could cause the loss of RHR pumps.

NRC Item

1.b. Time between full power operation and reaching a partially filled condition (used to determine decay heat loads).

Response

SPS - A typical time from unit shutdown to the RCS being less than 200°F is 22.3 hours and at mid-nozzle in 84.6 hours. For 1986 data, the shortest time from power operations to CSD was 11.67 hours (9 shutdowns) and the shortest time from power operations to mid-nozzle was 74.8 hours (5 shutdowns).

NAPS - A typical time from power operation to mid-nozzle is 106 hours. The typical time to access the RCS for routine maintenance is about 40 hours.

NRC Item

1.c. Requirements for minimum steam generator (SG) levels.

Response

a. Operation with RCS $T_{ave} > 350°F$

A minimum of two steam generators in non-isolated loops are required to be operable when the average reactor coolant temperature is greater than 350°F. Inherent in the requirement for operability is maintaining a sufficient water level to allow the removal of core decay heat. By the governing operating procedure, the three steam generators are to remain in service to ensure a uniform cooldown with S/G water levels maintained in the narrow range by using Auxiliary Feedwater, Main Feedwater, or Condensate Pumps.

b. Operation with RCS $T_{ave} < 350°F$

When the reactor coolant average temperature is less than 350°F, at least two non-isolated loops, consisting of any combination of reactor coolant loops or residual heat removal loops, shall be operable. In this mode, the steam generators do not have any minimum water level specified. In the event that the two operable decay heat removal loops are the RHR system loops, there is no minimum water level requirement for the steam generators. In many instances, the RCS loops are isolated by closing the loop stop valves when RCS average temperature is less than 150°F (SPS); 140°F (NAPS). The unit is then operated in a partially filled condition using the RHR system loops to satisfy this Technical Specification Limiting Condition for Operation. This is typically done when the steam generators are to be opened for maintenance or inspection.

NRC Item

1.d. Changes in the status of equipment for maintenance and testing and coordination of such operations while the RCS is partially filled.

Response

Maintenance and testing progression is organized by the planning department to ensure that the Technical Specifications are satisfied, and to ensure that maintenance and testing tasks do not interfere with required OPERABLE equipment. Furthermore, maintenance, calibration, and testing must be approved by the Shift Supervisor or Assistant Shift Supervisor prior to starting these tasks. It is the Shift Supervisor's or Assistant Shift Supervisor's responsibility to ensure that these evolutions will not adversely affect the OPERABILITY of a required system.

To further ensure that the timing of the maintenance and testing evolutions is appropriate to prevent degradation of the safe operation of the units, an individual from the Operations Department that holds or has held a Senior Reactor Operator License is assigned to interface with the planning of such evolutions.

NRC Item

1.e. Restrictions regarding testing, operations, and maintenance that could perturb the nuclear steam supply system (NSSS).

Response

The responsibility for the testing, operations, and maintenance evolutions that could perturb the NSSS is assigned to the Shift Supervisor or Assistant Shift Supervisor. The specific restrictions that apply consist of the Technical Specification Limiting Conditions for Operation that are specified for particular systems and in particular unit conditions.

Further administrative controls have been implemented to restrict these evolutions. These controls are in the form of precaution or limitation statements in procedures, standing orders or shift orders to address particular unusual evolutions and the control of temporary modifications through the safety analysis and Station Nuclear Safety and Operating Committee approval.

The removal of systems or portions of systems from service is controlled by a tagging system. As in other evolutions, the Shift Supervisor or Assistant Shift Supervisor approves the hanging or clearance of tags and ensures that operability testing of systems is conducted following maintenance.

If the tagging of systems impacts the operability of safety related equipment or equipment important to safety, the evolution is independently verified by an individual qualified on the affected system.

The removal of systems from service or restoration of systems to service is conducted only by qualified Operations Department Personnel under the cognizance of a Senior Reactor Operator. Maintenance or testing personnel are not permitted to hang or remove tags or to operate systems.

NRC Item

1.f. Ability of the RCS to withstand pressurization if the reactor vessel head and steam generator manways are in place.

Response

The overpressurization of the reactor coolant system is prevented by the strategic placement of relief valves in the design of the shutdown cooling systems and the cold overpressure protection (NDTT) mode of the Pressurizer Power Operated Relief Valves (PORV). These relief valves will provide overpressure protection whether the RCS is water solid, partially filled or during any possible alignment of systems in these modes.

In the event that residual heat (decay heat) removal capability is lost with the reactor vessel head and the steam generator manways still in place, overpressurization is prevented by the following system relief valves:

1) Residual Heat Removal System Relief Valves
2) Letdown Line Relief Valve
3) RCS Pressurizer Power Operated Relief Valve in the NDTT Protect Mode.

By procedure, when the RCS is partially filled with the reactor vessel head and steam generator manways in place, at least one Pressurizer PORV connects the RCS to the pressurizer relief tank (PRT). Normally, both PORV's are maintained open. At North Anna, mechanical blocks are normally installed on at least one PORV. The PRT is also protected from overpressurization by two 100 psi rupture discs.

NRC Item

1.g. Requirements pertaining to isolation of containment.

Response

Containment integrity is required to be maintained unless the unit is in a cold shutdown (Mode 5) condition.

The Technical Specification definitions of containment integrity are slightly different between Surry and North Anna as follows:

Surry:

Containment integrity is defined to exist when:

1. All non-automatic containment isolation valves, except those required for intermittent operation in the performance of normal operational activities, are locked closed and under administrative control. Non-automatic containment isolation valves may be opened intermittently for operational activities provided that they are under administrative control and are capable of being closed immediately if required.

2. Blind flanges are installed where required.

3. The equipment access hatch is properly closed and sealed.

4. At least one door in the personnel air lock is properly closed and sealed.

5. All automatic containment isolation valves are operable or are locked closed under administrative control.

6. The uncontrolled containment leakage T.S. limits are satisfied.

North Anna:

Containment integrity shall exist when:

1. All penetrations required to be closed during accident conditions are either:

   a. Capable of being closed by an OPERABLE containment automatic isolation valve system, or

   b. Closed by manual valves, blind flanges, or deactivated automatic valves secured in their closed positions, except as provided for in subsequent T.S. limitations,

2. All equipment hatches are closed and sealed,

3. Each air lock is OPERABLE pursuant to T.S. limitations,

4. The containment leakage rates are within the limits of T.S.

5. The sealing mechanism associated with each penetration (e.g. welds, bellows or O-rings) is OPERABLE.

There are additional operational restrictions that are in place when containment integrity is not met. These concern positive reactivity changes, shutdown margin requirements and containment purge operations.

Containment integrity during outage operations will be addressed in a supplemental response.

NRC Item

1.h. Time required to replace the equipment hatch should replacement be necessary.

Response

During outages that require the opening of containment, the equipment hatch missile shields, the equipment hatch and the emergency escape lock (which is integral to the hatch) are removed by a crane and placed into temporary storage locations in the yard area. In order to facilitate the reestablishing of containment boundaries for refueling operations, as required by the Technical Specifications, a barrier that encloses the equipment hatch(SPS); escape hatch (NAPS) opening has been provided. It is estimated that it would take 2 to 4 hours to install the equipment hatch and escape lock. However, if containment boundary is required in a shorter time, a temporary barrier could be installed.

NRC Item

1.i. Requirements pertinent to reestablishing the integrity of the RCS pressure boundary.

Response

At least two RCS loops must be operable and at least one loop in operation if RCS average temperature is greater than 350°F but less than Mode 2 for NAPS and startup for SPS. If RCS average temperature is less than 350°F, at least two decay heat removal loops are required to be operable with one in operation.

If both RHR system loops are operable with at least one loop in operation and RCS average temperature is less than 350°F, then there is no restriction by the Technical Specification, to closing more than one of the RCS loop stop valves, draining the loops and opening the RCS loops for access.

The reactor vessel head portion of the RCS pressure boundary cannot be removed unless the unit is in cold shutdown for SPS or Mode 6 for NAPS. Once the head is detensioned, the unit is in Mode 6. In addition, the movement of core components is restricted until the reactor has been subcritical for at least 100 hours (SPS); 150 hours (NAPS).

In the event of a loss of decay heat removal capability, the abnormal procedure directs the operator to reestablish the RHR system or to evaluate and initiate alternate cooling paths.

NRC Item 2

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.

Response

A listing of instrumentation and alarms that are available during operation with the RCS partially filled will be provided in a supplemental response.

NRC Item

2.a. Temporary connections, piping and instrumentation used for this 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.

Response

A temporary standpipe is used during partially filled conditions to monitor water level in the reactor vessel. This standpipe (3/4 inch tygon tubing) is installed between the vent valve on the pressurizer spray line and a drain valve on the RCS C loop cold leg located between the loop stop valve and the reactor vessel.

During partially filled conditions and with the reactor vessel head removed, the level indication must be monitored locally. At Surry, a design change has been developed to install a level sensing system with remote indication.

At North Anna, a remote visual sensing system (eg. camera and CRT) is normally installed when the standpipe is in place. This allows the Control Room Operator to monitor the reactor vessel level remotely whenever required. The standpipe installation is determined to be satisfactory by local operator observation during the drain down process.

At Surry, the standpipe installation is inspected by a Senior Reactor Operator to verify proper connection, the quality of the connection and proper installation with no kinks or trapped air bubbles. The water level in the reactor vessel is determined by comparing the water levels in the standpipe to elevation markings on the cubicle wall.

NRC Item

2.b. Description of the ability to monitor RCS pressure, temperature, and level after RHR function may be lost.

Response

The principle indications of pressure and level are not affected by the operation of the RHR system. However, continued temperature indication cannot be assured in all cases.

1) RCS Pressure - Wide range indication of RCS pressure (0-3000 psig) is provided on two RCS loops. The transmitter penetration to the loop is between the RCS loop stop valves and the reactor vessel. If the stop valves are closed, the wide range pressure transmitters are not affected. Similarily, if the RHR system isolation valves are closed or the RHR pumps fail, the pressure indication will be unaffected. These indications are electrically independent and are powered from vital (safety related) power sources.

2) RCS Temperature - Indication may be lost depending on the system alignments that are in place. The principle temperature indicators that are in use during a partially filled condition are in the RHR system. In the event of a closure of the RHR isolation valves or a loss of RHR forced circulation, these temperature indicators would not be indicative of the core temperature.

   The core exit thermocouples (CET) may be operable during partially filled conditions. At Surry, the CETs are withdrawn prior to fuel shuffle since they are inserted through the bottom of the reactor vessel in the incore instrumentation thimble tubes. At North Anna, the CETs are inserted through the reactor vessel head and are not available when the head is removed.

   The RCS loop wide range temperature indicators may be isolated during cold shutdown operation due to the closure of the RCS loop stop valves.

   The best method for providing continued temperature indication during all phases of operation will be evaluated and addressed in the final response.

3) RCS Level - During partially filled conditions the RCS level is monitored by the reactor vessel level indicating system (RVLIS) if the head is still in place and/or the installation of the temporary standpipe system. These level indications are not affected by the operation of the RHR system. However, the standpipe may read abnormally high if the RHR return is to C RCS loop.

   The RVLIS is not operable during conditions where the reactor vessel head is removed. During the time where the head is removed and the refueling cavity is flooded for refueling, the level indications that are available require local monitoring. In order to improve the monitoring of reactor vessel level under any condition, a design modification is being installed at Surry to provide remote continuous indication in the main control room. (See response to part 2.a).

NRC Item 3

Identification of all pumps that can be used to control NSSS inventory.

Response

The pumps that could be aligned to supply cooling water to the core or control the RCS inventory during partially filled conditions are:

1. Three Charging/SI pumps per unit - These pumps take suction from the refueling water storage tank (RWST), volume control tank (VCT) or the discharge of the low head SI pumps. The charging/SI pumps are powered from the 4160V emergency buses.

2. Two Low Head SI pumps per unit - These pumps take suction from the RWST or from the containment sump. The LHSI pumps are powered from the 4160V emergency buses.

3. Two Boric Acid Transfer pumps per unit - These pumps take suction from the boric acid storage tank (BAST).

Additional information will be provided in a supplemental response.

NRC Item

3.a. Pumps required to be operable or capable of operation.

Response

Surry:

When at cold shutdown or refueling, one charging/SI pump is required to be available* for the other (operating) unit. This pump may be inoperable provided immediate attention is directed to making repairs. Additionally, the operating unit will have two charging/HHSI pumps, 2 LHSI pumps and two boric acid transfer pumps (BATP) operable. One of two LHSI pumps, three of four BATPs, or two of three charging/HHSI pumps may be inoperable provided immediate attention is directed to making repairs and the pump(s) is (are) returned to service within the time frame specified in the T.S. LCO.

Whenever fuel is in the reactor vessel, at least one flow path to the core is required to be maintained. This can be (for a partially filled core) gravity flow from the RWST.

*Available is defined to be: (1) operable except for automatic initiation instrumentation, (2) offsite or emergency power source may be inoperable in cold shutdown, and (3) it is capable of being used for alternate shutdown with the opening of the charging pump cross-connect.

If both units are at cold shutdown or refueling, then there are no requirements for charging/HHSI, LHSI, or BATP to be operable or available.

The provisions that are required to provide for continued make-up capability in every mode of operation is under evaluation and will be addressed in the final response.

North Anna:

RCS inventory make-up requirements for a shutdown unit (Mode 5 & 6).

T.S. 3.1.2.7: Borated Water Sources

One of the following:

a) Boric Acid Storage Tank (BAST), with

1. ≥ 1398 gallons
2. between 12,950 and 15,950 ppm C_B
3. ≥ 115°F

b) Refueling Water Storage Tank (RWST), with

1. ≥ 51,000 gallons
2. between 2300 and 2400 ppm C_B
3. ≥ 35°F

T.S. 3.1.2.1: Boron Injection Flowpaths

One of the following:

a) BAST to Boric Acid Transfer Pump to Charging Pump to RCS if only BAST is operable.

b) RWST to Charging Pump to RCS if only RWST is operable.

T.S. 3.1.2.5: Boric Acid Transfer Pumps

At least one (1) pump operable if only BAST flowpath is operable. (Unit 1 only).

T.S. 3.1.2.3: Charging Pumps

At least one (1) charging pump in the required Boron Injection Flowpath shall be operable.

Should any of the above requirements not be met, then suspension of core alterations and positive reactivity changes is required.

Additionally, though not required to be operable in Modes 5 or 6, the Low Head Safety Injection Pump(s) (LHSI) is available to provide make-up to the RCS in Mode 6. The water supply to the LHSI pumps would be from the RWST or the containment sump, if required.

NRC Item

3.b. Information about pumps that may be temporarily removed from service for testing or maintenance.

Response

See the response to item 3.a.

NRC Item

3.c. Other pumps not included in item a.

Response

No other pumps available.

NRC Item

3.d. An evaluation of items a and c with respect to applicable T. S. requirements

Response

See response to item 3.a.

NRC Item 4

Description of the containment closure condition you require for the conduct of operations while the RCS is partially filled.

Response

See response to item 1.g. Further evaluations are being conducted in association with the Westinghouse Owners Group (WOG) and will be addressed in the final response.

NRC Item

4.a. Areas of consideration are the equipment hatch, personnel hatches, containment purge valves, S/G secondary-side condition upstream of the isolation valves (including the valves), piping penetration and electrical penetrations.

Response

See response to item 1.g. Further evaluations are being conducted in association with the Westinghouse Owners Group (WOG) and will be addressed in the final response.

NRC Item 5

Reference to and summary description of procedures in the Control Room which describe operation while the RCS is partially drained.

Response

1. For Surry - OP-3.3 Unit Cooldown From 350/450 to CSD provides guidance for draining the RCS to mid-nozzle after the RHR system is in service and the RCS is cooled to less than 150°F. This procedure references RVLIS as a guide but requires the use of the standpipe to accurately monitor the vessel level after the pressurizer is voided. "Fallout", the draining of the RCS water from the S/G U-tubes, and its effect on the standpipe, is addressed.

   The operator is also instructed to monitor the RHR Motor current. Fluctuating current is an indication of impending loss of RHR.

2. For North Anna - OP-3.4, unit shutdown from cold shutdown less than or equal to 200°F to cold shutdown less than or equal to 140°F, initiates OP-5.4, draining the reactor coolant system to mid-nozzle after the RHR system is in service and the RCS has been cooled to less than 140°F.

NRC Item

5.a. Analytic basis used for procedure development.

Response

Further evaluations are being conducted in association with the Westinghouse Owners Group (WOG) and will be addressed in the final response.

NRC Item

5.b. Treatment of draindown to the condition where the RCS is partially filled.

Response

1. For Surry:

   1-OP-14.3 - RHR System De-Watering the Reactor Cavity or Reactor Vessel.

   This procedure is used to lower the water level in the reactor cavity or the reactor vessel by using the RHR pumps to transfer water to the RWST.

   1-OP-5.8.1 - Raising the Reactor Vessel Level Using LHSI.
   1-OP-5.8.2 - Raising the Reactor Vessel Level Using CVCS.

   These two procedures provide guidance when raising the water level in the reactor vessel.

1-OP-14.4 - Shifting RHR Pumps.

This procedure provides guidance for starting the standby RHR pump and stopping the operating pump. When the pressurizer is voided, the standby pump is vented and RHR flow is reduced to approximately 1000 gpm prior to starting the idle pump.

1-MOP-5.3 - Draining A Reactor Coolant Loop.

1-MOP-5.4 - Draining B Reactor Coolant Loop.

1-MOP-5.5 - Draining C Reactor Coolant Loop.

These procedures address draining the indicated loops after the RCS is drained to 12'6".

2. For North Anna:

1(2)-OP-14.2 - Pumping the Reactor Cavity to the RWST using the RHR system.

This procedure is not normally utilized and is administratively controlled.

1(2)-OP-14.3 - Swapping or Restarting Residual Heat Removal Pumps.

This procedure provides detailed instructions for stopping and restarting RHR pumps including steps for venting the idle pump and recording RCS level (level hose and RVLIS) in the event the RCS is partially drained.

1(2)-OP-16.3 - Pumping the Reactor Cavity to the RWST.

This procedure provides instructions for pumping the reactor cavity to the RWST following refueling utilizing the refueling purification pump(s) and purification system.

1(2)-LOG-4A - CRO Surveillance Sheets (Mode 5 & 6).

This surveillance sheet records the following information during mid-loop operations:

1. "A" RHR pump vented once per 8 hours.
2. "B" RHR pump vented once per 8 hours.
3. RVLIS Train A upper range level once per 4 hours.
4. RVLIS Train B upper range level once per 4 hours.
5. Level hose at greater than or equal to 10" above centerline once per 4 hours.

1(2)-MOP-5.90 - Removing One or More Loops From Service for Maintenance.

Provides instructions for draining any isolated reactor coolant loop.

1(2)-MOP-14.01 - Removing Residual Heat Removal Pump 1(2)A from Service for Maintenance.

This procedure provides detailed instructions for the removal of the "A" RHR pump for electrical or mechanical maintenance. Steps are included to insure that at least one alternate method of core heat removal is available (opposite train LHSI pump or at least one operable steam generator.

1(2)-MOP-14.02 - Removing Residual Heat Removal Pump 1(2)B from Service for Maintenance.

This procedure is similar to 1(2)-MOP-14.01.

NRC Item

5.c. Treatment of minor variations from expected behavior such as caused by air entrainment or off-gasing.

Response

This question will be addressed in our supplemental response.

NRC Item

5.d. Treatment of boiling in the core with and without RCS pressure boundary integrity.

Response

This question will be addressed in our supplemental response.

NRC Item

5.e. Calculations of approximate time from loss of RHR to core damage.

Response

This area is under evaluation.

NRC Item

5.f. Level differences in the RCS and the effect upon instrumentation indications.

Response

This area is under evaluation.

NRC Item

5.g. Treatment of air in the RCS/RHR system including impact of air upon NSSS and instrumentation response.

Response

This area is under evaluation.

NRC Item

5.h. Treatment of vortexing at the connection of the RHR suction line to the RCS.

Response

Vortexing has occurred at both Surry and North Anna in the RHR suction penetration from the RCS. The response to vortexing is to restore the RCS water level, vent and start the standby pump, vent and restore the operability of the pump that experienced vortexing.

Vortexing is prevented by ensuring that the RCS water level does not drop below the minimum level below which vortexing may occur. The events that have occurred have been the result of the failure to maintain at least this minimum water level.

Further reevaluations are underway in this area.

NRC Item

5.i. Explain how the analytic basis supports:

1) procedure guidance pertinent to timing of operations, required instrumentation, cautions and critical parameters.

2) operations control and communications requirements regarding operations that may perturb the NSSS including restrictions upon testing, maintenance, and coordination of operations that could upset the condition of the NSSS.

3) response to the loss of RHR including:

   a. regaining control of RCS heat removal

   b. operations involving the NSSS if RHR cannot be restored

   c. control of effluents from containment if the containment was not isolated.

d. operations required to provide containment isolation if the containment was not isolated.

e. guidance clearly described for timing of operations, cautions and warnings, critical parameters and notifications.

Response

This area is under evaluation.

NRC Item 6

6.a. Brief description of training provided to Operators and other affected personnel specific to the issue of operation while the RCS is drained.

Response

1) NON-LICENSED OPERATOR TRAINING

In addition to other RHR system training, Non-Licensed Operators receive training associated with partially filled RCS operations as follows:

* INPO SOER #85-4; outline of events and underlying causes

* Surry RHR event in SER 60-83; outline of event and underlying causes

* INPO SOER #82-2; outline of event

* Conditions which could create the loss of RHR

* Identification of hazards associated with loss of shutdown core cooling

* Consequences of a loss of RHR

2) LICENSED OPERATOR TRAINING

In addition to other RHR system training, Licensed operators receive training associated with partially filled RCS operations as follows:

* Local & control room indications for monitoring system performance

* Controls and interlocks associated with pump and valve controls

* Administrative and Technical Specification Limitations

* Drain-down evolution to mid-nozzle, including vortexing phenomenon, indications and basic corrective actions

* Abnormal Procedure AP-27 (SPS); AP-11 (NAPS), Loss of Decay Heat Removal:

  - Diablo Canyon event and lessons learned,
  - Effects of loss of RHR and possible time to core uncovery based on INPO analysis,
  - Procedural synopsis and study,
  - INPO SOER #85-4 and lessons learned

3) SHIFT TECHNICAL ADVISOR TRAINING

The STAs receive the same instruction as Licensed Operator Training.

NRC Item

6.b. Maintenance personnel training regarding avoidance of perturbing the NSSS.

Response

1) MECHANICAL TRAINING

No specific training regarding avoidance of perturbing the NSSS while partially filled. However, trainees are presented RHR system purpose, flowpaths, major component descriptions, and RHR interconnections with other systems.

2) ELECTRICAL TRAINING

Receive the same basic instruction as described in the Mechanical Training Section.

3) INSTRUMENT TECHNICIAN TRAINING

Same as Mechanical Training Section.

4) TECHNICAL STAFF AND MANAGER TRAINING

Same as Mechanical Training Section.

5) HEALTH PHYSICS TECHNICIAN TRAINING

No specific training regarding avoidance of perturbing the NSSS while partially filled is required. Employees are presented RHR system purpose, flowpaths, major component descriptions, and RHR interconnections with other systems.

Employees are also trained to note any primary leaks or off-normal conditions and report these to the Health Physics Shift Supervisor, who will report these to the Operations Shift Supervisor.

NRC Item

6.c. Response to loss of decay heat removal while RCS is drained.

Response

1) NON-LICENSED OPERATOR TRAINING

No specific training regarding response to loss of decay heat removal while partially filled.

2) LICENSED OPERATOR TRAINING

Licensed Operators are trained in the response to a loss of decay heat removal while partially filled as follows:

* Local and control room indications for monitoring system performance

* Mid-nozzle operations, including vortexing phenomenon, indications and basic corrective actions.

* Abnormal Procedure AP-27 (SPS); AP-11 (NAPS), Loss of Decay Heat Removal:

  - Diablo Canyon event and lessons learned,

  - Effects of loss of RHR and possible time to core uncovery based on INPO analyses,

  - Procedural synopsis and study,

  - INPO SOER #85-4 and lessons learned

3) SHIFT TECHNICAL ADVISOR TRAINING

Same as Licensed Operator Training

4) MECHANICAL TRAINING

No specific training regarding response to loss of decay heat removal while partially filled.

5) ELECTRICAL TRAINING

No specific training regarding response to loss of decay heat removal while partially filled.

6) INSTRUMENT TECHNICIAN TRAINING

No specific training regarding response to loss of decay heat removal while partially filled.

7) TECHNICAL STAFF AND MANAGER TRAINING

No specific training regarding response to loss of decay heat removal while partially filled.

8) HEALTH PHYSICS TECHNICIAN TRAINING

No specific training regarding response to loss of decay heat removal while partially filled.

NRC Item 7

Identify additional resources provided to operators while the RCS is drained such as personnel with specialized knowledge involving phenomena and instrumentation.

Response

A Shift Technical Advisor (STA), with a bachelor's degree or equivalent in a scientific or engineering discipline and specific training in plant design and response and analysis of the plant for transients and accidents is assigned to each operating shift. Technical Specifications require that the STA position be manned whenever either unit is above the cold shutdown condition. However, North Anna requires by administrative procedure that a STA is available for any operating condition.

NRC Item 8

8.a. Comparison of the requirements implemented while the RCS is partially filled and the requirements in other Mode 5 operations.

Response

For those periods when the RCS is partially drained, a standpipe is connected between loop C and the top of the pressurizer. Periodic monitoring of the standpipe is required to assure the appropriate level is maintained.

During operation when the RCS is partially drained, additional precautions and guidance for operation are provided in the governing operating procedures, Surveillance logsheets and in Shift/Standing Orders. These include the following:

1. The use and comparison of multiple indications to base operational decisions, such as:

   a. Standpipe Level
   b. RVLIS Indication
   c. Pressurizer Level (cold calibration)
   d. Volume Control Tank Level
   e. Mass Balance (NAPS only)

2. Installation of spool pieces, level hoses (standpipe) and vacuum breaker to provide actual indication of level including specific steps for installation and verification.

3. Surveillance of the RHR pump, standpipe level, RVLIS, and RHR flow via shift logsheets.

4. Restrictions on RHR pump operation

   a. minimum flow/maximum flow
   b. pump venting
   c. standpipe level (minimum)

5. Opening of PORV's to provide overpressure protection and to prevent a formation of a vacuum in the RCS.

NRC Item

8.b. Requirements and procedures followed while the RCS is partially filled that may not appear in the other modes. (Example: operation with reduced RHR flow to minimize the likelihood of vortexing and air ingestion).

Response

This area is under evaluation.

NRC Item 9

After consideration of these items, any changes that are to be made, including schedule for completion to strengthen the current program.

Response

Any changes that are required as a result of this review will be described in the final response.