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U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

PLANT VOGTLE - UNITS 1, 2
NRC DOCKETS 50-424, 50-425
OPERATING LICENSE NPF-68, CONSTRUCTION PERMIT CPPR-109
RESPONSE TO NRC GENERIC LETTER 87-12:
"LOSS OF RESIDUAL HEAT REMOVAL (RHR) WHILE THE
REACTOR COOLANT SYSTEM (RCS) IS PARTIALLY FILLED"

Gentlemen:

Generic Letter 87-12 requested information to assess safe operation of pressurized water reactors (PWRs) when the reactor coolant system water level is below the top of the reactor pressure vessel. The specific issues addressed and the Georgia Power Company response are contained in the enclosure to this letter.

After thorough review, Georgia Power Company has determined that the Plant Vogtle RHR system meets all required licensing bases, including General Design Criterion 34 and Technical Specifications. Should you have any questions in this regard, please contact this office.

James P. O'Reilly states that he is a Senior Vice President of the Georgia Power Company and is authorized to execute this oath on behalf of Georgia Power Company, and that to the best of his knowledge and belief, the facts set forth in this letter and enclosure are true.

GEORGIA POWER COMPANY

by: James P. O'Reilly
James P. O'Reilly

Sworn to and subscribed before me this 18th day of September, 1987.

LTG:JPO:ju

c: (See next page)

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ENCLOSURE

GEORGIA POWER COMPANY RESPONSE TO
NRC GENERIC LETTER 87-12
"LOSS OF RESIDUAL HEAT REMOVAL (RHR) WHILE
THE REACTOR COOLANT SYSTEM (RCS) IS
PARTIALLY FILLED"

Generic Letter 87-12 requested a detailed description of the operation of Plant Vogtle during the approach to a partially filled RCS condition and during operation with a partially filled RCS condition to ensure that the licensing basis is met. The letter outlined, in nine paragraphs, specific information that should be included in the description.

This enclosure provides the requested information. Footnotes are included in the text and refer to the list of references in Table 3. An acronym list is provided in Table 4 and a comparison of RCS level versus elevation is provided in Table 5. Reactor Pressure Vessel (RPV) water level is referenced to mean sea level.

The majority of procedures referenced in our response, as well as plant specific data such as elevations, pump pressures, flow rates, and time estimates, are specific to Vogtle Unit 1. Our response, however, applies to both units; review of Vogtle Unit 2 procedures and Technical Specifications will be conducted in conjunction with scheduled activities prior to Unit 2 startup.

QUESTION NO. 1

> A detailed description of the circumstances and conditions under which your plant would be entered into and brought through a drain-down process and operated with the RCS partially filled, including any interlocks that could cause a disturbance to the system. 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); requirements for minimum steam generator (SG) levels; changes in the status of equipment for maintenance and testing and coordination of such operations while the RCS is partially filled; restrictions regarding testing, operations, and maintenance that could perturb the nuclear steam supply system (NSSS); ability of the RCS to withstand pressurization if the reactor vessel head and steam generator manway are in place; requirements pertaining to isolation of containment; the time required to replace the equipment hatch should replacement be necessary; and requirements pertinent to reestablishing the integrity of the RCS pressure boundary.

GPC RESPONSE

A. Circumstances

Plant Vogtle will drain-down and operate with the RCS partially filled under the following circumstances:

- Refueling - When establishing conditions for refueling, the RCS is drained to just below the vessel flange to allow removal of the head assembly.[1]

- Maintenance - Maintenance of various components in the RCS and connected systems may require drain-down. Examples are Reactor Coolant Pump (RCP) seal replacement, SG tube inspection, and repair of RCS pressure boundary valves.[2]

B. Conditions

Plant Vogtle will be drained down and operated with the RCS partially filled as described in Appendix A, "Normally Expected Initial Conditions," and Appendix B, "Sequence of Draining to Just Above Mid-Nozzle and Venting the RCS." [3, 4, 5, 6]

- Control Systems and Interlocks - Control systems and interlocks that could disturb the drain down process are listed in Appendix C, "Potential Disturbances to the Drain-Down Process."

- Drain-down Time - The shortest time required to take the unit from 100 percent power to partially filled is conservatively estimated to be 30.5 hours as delineated in Table 1.

- Minimum Steam Generator Levels - Minimum steam generator levels are specified in Technical Specifications[7] and apply only with the RCS loops filled.

- Equipment Status Change - Changes to the status of equipment for maintenance, testing, or operations that may affect plant conditions requires authorization of the shift supervisor. This is true in all modes of operation. Additional controls are not enacted when the RCS is partially filled.[8]

- RCS Overpressure Protection - The ability of the RCS to withstand overpressurization with the reactor vessel head in place is provided in Modes 4, 5, and 6 by means of the Cold Overpressure Protection System (COPS) and the relief valves in the RHR system. Protection from overpressurization events is described in the Final Safety Evaluation Report (FSAR).[9]

- Containment Isolation Protection - To replace the equipment hatch on the containment building is estimated to take three to four hours. An additional 11 hours is estimated to perform the local leak rate test on the hatch.[10]

- RCS Pressure Boundary Integrity - Requirements pertinent to reestablishing the integrity of the RCS pressure boundary are described in the Technical Specifications.[11]

QUESTION NO. 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.

GPC RESPONSE

A. Permanent Plant Instrumentation

During operation with the RCS partially filled, control and indication of RCS pressure, temperature, core flow and reactor vessel level may be obtained through use of the permanent plant instruments described in Table 2.

During operation of the RHR system to support RCS drain-down and mid-loop conditions, two alarms may be annunciated in the control room. The first alarm, "RHR Pump Motor Overload," is common to both trains and will annunciate on motor overcurrent or on manual tripping of motor breakers at the breakers. The second alarm, "RHR Pump Discharge High Pressure," is available for each train independently. There are no temperature alarms annunciated in the control room for use during drain-down or mid-loop operation.

B. Temporary Connections, Piping, and Instrumentation

Temporary instrumentation is installed to provide local indication of RCS level. The temporary instrumentation consists of 1 inch tygon tubing connected to the RCS at the loop one intermediate leg and the Pressurizer steam space sample line.[12] Although the Reactor Vessel Level Indicating System

(RVLIS) indicates reactor vessel level to the nearest percent, it is not accurate enough for use in controlling RCS level within the tight band (6 to 12 inches) required for half loop operation. Therefore, temporary instrumentation is installed to provide local indication of RCS level.

C. Quality Control

The quality control process to ensure proper functioning of temporary connections, piping and instrumentation, to ensure that they do not contribute to loss of RCS inventory or otherwise lead to perturbation of the NSSS while the RCS is partially filled is currently addressed as follows:

- o Physical installation of tubing and functional testing is accomplished through the work order process in accordance with administrative procedures.[13]
- o Operations department personnel are assigned to a continuous watch station at the tygon tubing installation while the RCS water level is at mid-loop, as required by the RCS drain-down procedure.[5]
- o Additional controls to ensure proper functioning of temporary connections, piping and instrumentation are discussed in the response to question 9.

D. Monitoring The RCS After A Loss of RHR

Should the RHR function be lost, limited instrumentation will still be available to monitor RCS parameters. Whenever the RHR loop suction valves are open, operators can obtain pressure indication from RHR suction and discharge instrumentation (see items 1, 2, and 4 in Table 2). Pressure indication can be obtained from RCS wide range instrumentation.[14] Level indication may be obtained from the RVLIS (if operable), or from the temporary tygon tubing as long as RCS pressure increase does not require tubing isolation. Core temperature may be obtained from the incore thermocouple system, but only if the reactor vessel head is on and the integrated head package is connected. Incore thermocouple system accuracy is within $\pm$ 5 to 10 percent of the reading with temperatures in the 100-200 degrees Fahrenheit range.

QUESTION NO. 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.

GPC RESPONSE

A. Pumps Required To Be Operable or Capable of Operation

The following pumps can be used to control RCS inventory during mid-loop operation:

- o Chemical and Volume Control System (CVCS) Charging Pumps 1-1208-P6-001, 002 or 003 - A minimum of one of these three pumps is required to be operable. One or two could be removed from service for testing or maintenance.

- o RHR Pumps 1-1205-P6-001 or 002 - Both pumps are required to be operable in Mode 6 with water level less than 23 feet above the reactor vessel flange or in Mode 5 with the RCS loops not filled.

B. Other Pumps Not Included Above

Safety injection pumps 1-1204-P6-003 and 1-1204-P6-004 are capable of controlling RCS inventory but are required by Technical Specifications[15] to be inoperable in Modes 4, 5 and 6 with the RPV head on.

C. Evaluation of Pumps With Respect To Technical specifications

Technical Specifications[16, 17] establish Mode 5 and 6 operability requirements for the charging pumps by stating that at least one shall be operable to inject boric acid for reactivity control. Compliance with these technical specifications ensure that a minimum of one charging pump is available during mid-loop operation for RCS inventory control.

With RCS loops not filled in Mode 5, two RHR trains will be operable with at least one train in operation for decay heat removal purposes per Technical Specifications.[18] Technical Specifications do provide allowances for one RHR train to be inoperable for up to two hours for surveillance testing provided the other RHR train is operable and in operation.

Additionally the RHR pumps may be de-energized for up to one hour provided dilution of the RCS boron concentration is not permitted and core outlet temperature is maintained at least 10 degrees Fahrenheit below saturation temperature.

Safety injection pumps are inoperable during mid-loop operation to preclude a mass addition pressure transient.

QUESTION NO. 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.

GPC RESPONSE

A. Containment Closure Conditions

During the periods described in the GPC response to Question No. 1, the containment closure conditions are dictated by the Technical Specifications[19] requirements for operating activities. Specifically, whenever the plant is in Mode 5 (cold shutdown), containment integrity is not required. While in Mode 6 (refueling), during periods of core alterations or movement of irradiated fuel within the containment, the containment building penetrations shall be as follows:

- The equipment door closed and held in place by a minimum of four bolts.

- A minimum of one door in each airlock (comprised of a personnel and an emergency airlock) is closed.

- Each penetration providing direct access from the containment atmosphere to the outside atmosphere shall be either:

  - Closed by an isolation valve, blind flange, or manual valve, or
  - Be capable of being closed by an OPERABLE automatic containment ventilation isolation valve[20]

A Plant Vogtle procedure[21] addresses surveillance of applicable valves and flanges, and assures that the above requirements are met.

At times other than during core alterations, the containment penetration restrictions are relaxed to allow maintenance related activities to proceed during the outage.

A complete listing of containment penetrations and isolation valve information can be found in the FSAR.[22]

QUESTION NO. 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. Your response should include the analytic basis you used for procedures development. We are particularly interested in your treatment of draindown to the condition where the RCS is partially filled, treatment of minor variations from expected behavior such as caused by air entrainment and de-entrainment, treatment of boiling in the core with and without RCS pressure boundary integrity, calculations of approximate time from loss of RHR to core damage, level differences in the RCS and the effect upon instrumentation indications, treatment of air in the RCS/RHR system, including the impact of air upon NSSS and instrumentation response, and treatment of vortexing at the connection of the RHR suction line(s) to the RCS.

Explain how your analytic basis supports the following as pertaining to your facility: (a) procedural guidance pertinent to timing of operations, required instrumentation, cautions, and critical parameters; (b) 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; and (c) response to loss of RHR, including regaining control of RCS heat removal, operations involving the NSSS if RHR cannot be restored, control of effluent from the containment if containment was not in an isolated condition at the time of loss of RHR, and operations to provide containment isolation if containment was not isolated at the time of loss of RHR (guidance pertinent to timing of operations, cautions and warnings, critical parameters, and notification is to be clearly described).

GPC RESPONSE

A. Summary Description of Procedures

The following descriptions summarize procedures in the control room which direct operations while the RCS is partially filled.

- o Unit Operating Procedure "Unit Cooldown To Cold Shutdown"[3] - This procedure is the controlling document that directs plant operations from normal operating temperature and pressure to Mode 5 (cold shutdown) with RCS filled or partially drained and temperature less than 140°F. A step[23] directs drain-down to be accomplished in accordance with the system operating procedure "Reactor Coolant System Draining."

- <u>System Operating Procedure "Reactor Coolant System Draining"</u>[5] - The initial conditions of this procedure are the RHR system is in operation, communication has been established between the containment and the control room to ensure adequate RCS level monitoring during the draining operation, the Liquid Waste System is capable of receiving drains, nitrogen is available, and the Pressurizer Relief Tank (PRT) is in service with 3-5 psig nitrogen cover gas. This procedure also directs that the tygon tube be installed between the Pressurizer steam space vent and RCS intermediate leg drain valves.[12]

  - Nitrogen overpressure is provided in the Pressurizer and drain-down to 50 percent Pressurizer level commences. Instrumentation utilized during this initial drain-down is the Control Room Pressurizer level[24] and PRT pressure.[25] PRT pressure is monitored to ensure a positive pressure is maintained during the drain-down.

  - At 50 percent Pressurizer level, draining is stopped and a transition is made to the tygon hose.

  - Nitrogen is then supplied to the RPV head to maintain positive pressure during the remainder of the drain-down.

  - Draining is then recommenced to a level of 194 feet (top of RPV flange).

  - If it is intended to perform maintenance activities requiring level to be at mid-nozzle, then direction is given to lower the level to 187 feet 6 inches (which is 6 inches above mid-nozzle elevation).

  - Guidance is given to be aware of erratic level indication during Steam Generator tube draining.

  - If the RCS is to be opened to the containment atmosphere, then the RCS is vented at the Pressurizer and the RPV head.[26]

  - When the RCS level is at mid-nozzle, the tygon tube is continuously monitored.

- o Unit Operating Procedure "Refueling Entry"[4] - Integrated plant operations are then continued by this procedure which defines elevations that are recommended to be maintained during the outage. Examples are: (1) RCP seal package maintenance or SG primary side inspection; 187 feet 6 inches ± 6 inches and (2) preparation for RPV head removal; 193 feet 0 inches ± 6 inches.

- o System Operating Procedure "Residual Heat Removal System"[6] - RHR system operation is directed by this procedure. To minimize excess flow while at mid-nozzle, a precaution states the RHR System should be limited to single train operation whenever the RCS is at mid-nozzle level (187 feet 0 inches). This minimizes potential loss of RHR pump suction due to gas entrainment from vortexing.

B. Analytic Basis

The bases used for procedure guidance pertinent to sequencing of operations, required instrumentation, cautions, and critical parameters were Westinghouse general operating instructions[27, 28] Technical Specifications, FSAR, INPO SOER's, and other utility procedures and experience.

- o Air Entrainment Effect on Instrumentation - Evaluation of the available instrumentation provided to the operator during mid-nozzle operation and the required parameters has shown that the only instrument that can be subject to variance or error as a result of air entrainment is the tygon hose level indication.

- o Calculations of Instrument Response and Time to Core Damage - Calculations of approximate time from loss of RHR to core damage and level differences in the RCS due to pressure/hydraulic phenomenon are currently not available. See section 9 for further discussion on these calculations.

- o Coordination of Testing and Maintenance - Coordination of testing and maintenance is performed in the Planning, Scheduling and Work Controls Department by previously licensed personnel with operating experience. This group evaluates and schedules work to be performed daily, taking into consideration plant conditions and Technical Specification requirements. A plan of the day is generated and reviewed by the plant staff and Control Room personnel. Maintenance Work Orders to be performed are approved by the Shift Supervisor prior to commencement of work.

Maintenance and Surveillance procedures additionally contain notification requirements prior to initiation and close out. The Shift Supervisor is notified upon completion of maintenance or testing.

The basis for developing this procedural approach to testing and maintenance control is conformance to IEEE Standard[29], Technical Specifications, NRC Regulatory Guides[30], and industry practices.

- <u>Response to a Loss of Residual Heat Removal</u> - While operating the RHR System, the Loss of Residual Heat Removal Abnormal Operating Procedure[31] is immediately implemented if any of the following conditions occur:

  - Less than 3000 gpm RHR flow
  - Detected RHR system excessive leakage while RHR is in operation
  - Any unexplained rise in RCS temperature while RHR is in operation
  - Any observed loss of RHR system capability while RHR is in operation

  If any of the above occur, then action taken is to:

  - Suspend all operations involving a reduction of RCS boron concentration
  - Check loop suction valves open
  - Check RVLIS level greater than 75 percent or local vessel level greater than 193 feet.
  - If level is not greater than 193 feet, then the operating RHR pump is stopped, suction valves are closed, and makeup initiated with a charging pump supplied from the Refueling Water Storage Tank (RWST).
  - When level is restored, the RHR suction lines are vented from the control room and one train of RHR is placed back into service per the RHR system procedure.[6]

The abnormal procedure was developed using the same philosophy as the Westinghouse Owners Group Emergency Response Guidelines for a LOCA. Upon loss of RHR cooling capability: Immediately restore inventory, vent suction lines, restore forced circulation via one RHR train or establish a RCS feed and bleed path.

Other factors, such as RHR suction piping design that slopes downward toward the pump to allow self-venting and vents at the high points in the piping that are remotely operated from the control room, provide for rapid recovery if vortexing is observed. Currently however, there is no procedural guidance to the operators in order to assist them in recognizing parameters that indicate a vortex condition exists (eg., RPV level instrument or RHR flow instrument oscillations).

If level cannot be restored, then the action specified is to maintain RCS temperature until RHR can be restored by use of SG steam dumps/atmospheric relief valves or establishing SG feed and bleed with auxiliary feedwater.

Also, a RCS feed and bleed path is verified by either a Charging Pump or Safety Injection Pump and PORVS or RPV head vents. Guidance is given to maintain at least 10 degrees subcooling with RCS feed and bleed including required flow in gpm based on time from reactor shutdown.

Containment building penetration integrity and control of effluent from the containment if containment was not isolated at the time of loss of RHR is currently not addressed. Section 9 discusses proposed plans in this area.

QUESTION NO.6

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. We are particularly interested in such areas as maintenance personnel training regarding avoidance of perturbing the NSSS and response to loss of decay heat removal while the RCS is partially filled.

GPC RESPONSE

A. Licensed Operator Training

The lesson plan for the Residual Heat Removal System[32] addresses concerns and problems that can lead to a loss of RHR cooling when the RCS is in a partially drained condition. The potential for major core damage as a result of loss of RHR cooling and the potential for the release of airborne activity are stressed. The causes of a loss of RHR cooling capability discussed include losing RHR pumps due to air entrainment through vortexing and its possible effects on temporary level instrumentation, loss of RHR pumps for other reasons, and loss of RHR due to unwarranted suction valve closure. Industry events relating to loss of RHR cooling are reviewed. Methods for recovery from loss of RHR cooling situations are discussed.

The lesson plan for Loss of RHR[33] is specific to the Loss of RHR Abnormal Operating Procedure[31] and covers operator actions to recover from loss of RHR cooling. At the present time this procedure does not differentiate between full and partial fill situations and the lesson plan does not deviate from the procedure.

The lesson plan for level measurement[34] discusses industry events associated with RPV level indication including reasons for any symptoms of level instrumentation malfunctions.

B. Non-Licensed Operator Training

The lesson plan for the Residual Heat Removal System[35] discusses the use of tygon hoses for temporary local level measurement while the loops are partially filled. Included are discussions of proper methods for venting tygon hoses and the relationship of change of indicated level to other parameter changes. The significance of loss of cooling capability is stressed and industry events are reviewed.

The lesson plan for level measurement[36] discusses industry events associated with RPV level indication including reasons for and symptoms of level instrumentation malfunctions.

C. Maintenance Training

The lesson plan for Maintenance Operation Quality Assurance Program/MWO's[37] includes detailed training in the use of MWO's. In this lesson some of the major items stressed are proper adherence to MWO requirements and approvals as well as the importance of not working beyond the scope of the work authorized.

The lesson plan for Safety and Administrative Controls[38] provides training in the proper use of administrative, maintenance, and health physics procedures. Items stressed include rules for performing procedures, Quality Assurance, Quality Control and Plant Communications.

The lesson plan for Equipment Clearance and Tagging[39] provides training which stresses plant personnel's responsibility according to the Equipment Clearance and Tagging Procedure.

Specific training is not provided to maintenance personnel regarding avoidance of perturbing the NSSS and response to a loss of decay heat removal while the RCS is partially filled.

QUESTION NO. 7

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.

GPC RESPONSE

An additional watch station is provided while the RCS is partially filled. A special watch is required at the tygon hose which measures water level in the RCS when the RCS is partially filled. This watch is manned continuously by a qualified plant equipment operator when water level is at mid-nozzle.[40]

QUESTION NO. 8

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.

GPC RESPONSE

The following additional requirements exist for Mode 5 operation when the RCS is partially filled:

A. Operability requirements of the RHR system per Technical Specification.[18]

B. Single train operation of the RHR system[41] when RCS level is at mid-nozzle.

C. Continuous monitoring of RCS level at the tygon hose[42] when RCS level is at mid-nozzle.

D. Removal of power from RCP's and Pressurizer heaters.[43]

E. Termination of seal injection flow to RCP seals.[44]

QUESTION NO. 9

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, described those changes and tell when they were made or are scheduled to be made.

GPC RESPONSE

A. Short Term Actions

The following short term actions intended to enhance RHR reliability during mid-nozzle operation are being considered and are tentatively scheduled for completion prior to the first refueling outage (currently scheduled for September 1, 1988):

- RPV Level Monitoring - Upgrading the RPV level monitoring capabilities during the drain-down mode of RCS operation. This includes a level indication (independent of the tygon tubing) being provided to allow redundant capability to monitor this safety related parameter. It also includes upgrading the administrative controls for installation and verification of the tygon tubing as a temporary level indication to provide assurance that it meets the quality requirements for its intended use.

  - Installing a temporary modification, using an existing instrument loop (e.g., SI Accumulator level or RCS flow) to provide RCS level indication and alarm in the Control Room (as a backup to the tygon tubing level indication during Modes 5 and 6 when reactor vessel level is less than 186 feet 6 inches). This instrument will monitor level using different sensing points than the tygon tubing.

  - Revising procedures to improve RPV level monitoring:

    Guidelines will be established in procedures 13005-1, "Reactor Coolant System Draining;" 12000-1, "Refueling Recovery;" and 12007-1, "Refueling Entry" to establish preferred loops to feed and drain from to minimize level error on loops that have level indication. Also, based on operating experience, the minimum elevation for mid-loop operation will be changed from 187 feet 6 inches to 188 feet to provide a 1 foot margin for level uncertainties after completion of SG tube draining.

Procedures 12006-1, "Unit Cooldown to Cold Shutdown" and 13005-1, "Reactor Coolant System Draining" will be revised to require continuous monitoring of tygon level indication during planned RCS inventory changes when below 17 percent (cold calibration) Pressurizer level. Whenever level is stable and the Control Room is monitoring reactor vessel level, the tygon tube will be monitored every 4 hours and compared to control room indication.

A procedure will be written to provide detailed installation instructions to control the actual installation and removal of the tygon tubing level indication which establishes a standard configuration for routing and provides an accurate level reference. The following items will be included based on industry experience:

(1) Calibrated elevation markings graduated in inches.

(2) Routing consistent with good practice and ALARA. These include (a) continuous slope so no air becomes trapped, (b) easy physical access by operators, (c) located in lowest possible radiation or contaminated area, (d) routed away from traffic areas and protected from damage, (e) no kinks, sharp bends or leaks, and (f) installation quality controlled and independently verified.

Plant Vogtle procedures 13005-1, "Reactor Coolant System Draining", and 13001-1, "RCS Fill And Vent", will be reviewed to ensure proper controls are in place for installation and removal of the tygon tubing.

- <u>Additional Procedural Controls</u> - Procedures will be upgraded to provide increased controls to prevent loss of RHR capability and to increase effectiveness of the response if a loss does occur. Specifically, procedures 12006-1, "Unit Cooldown to Cold Shutdown", and 12007-1, "Refueling Entry", will be revised to require at least two incore thermocouples be maintained operable during periods of RCS mid-loop operation. If the RPV head is removed, disconnection of these thermocouples will be delayed until the last possible moment and restored at the first opportunity after the head is replaced. Procedure 18019-1, "Loss of Residual Heat Removal", will be revised to provide specific instructions for loss of RHR during a partial fill condition. Also, if RHR cannot be immediately restored, containment closure will be verified.

Unit Operating Procedures will be upgraded to provide cautions to alert operators to the need for close scrutinization of ongoing work activities and to limit work that has the potential for reducing RCS inventory during periods of operation with the level below the RPV flange.

Administrative controls will be implemented to require an operable flow path (by manual realignment) from the RWST through RHR to the RCS in Modes 5 and 6 with RPV level below the flange.

Emergency Plan Implementing Procedures have been reviewed to ensure proper event classification for a loss of RHR. Currently, this event would be classified as an Alert.

- Training - To bridge the gap between the implementation of these recommendations and the long term implementation of upgraded training through the normal requalification cycle, training will be provided to licensed operators and supervisors in Operations, Maintenance, Engineering, and Work Planning prior to the next refueling outage. The presentation will include a study of loss of RHR events and changes to Plant Vogtle policies and procedures.

B. Long Term Actions

Plant Vogtle is considering the following long term corrective actions. An evaluation of the safest, most cost effective solution must be performed before a determination of the scope and schedule can be provided.

- Design Change - The temporary modification described under "Short Term Actions" will be evaluated to determine if a permanent design change needs to be made. In addition, alternatives by which permanent plant equipment can be dedicated to this use, or for providing adaptation of an existing capability for shutdown reactor level monitoring, will be evaluated.

  A design change will be evaluated to remove the auto-closure interlocks to the RHR suction isolation valves. This design change is currently being evaluated by the Westinghouse Owners Group.

- o <u>Containment Closure</u> - A design change will be evaluated to install a structure around the existing containment equipment hatch to allow placement of a polyethylene curtain over the opening. Additionally, the Heating, Ventilation and Air Conditioning (HVAC) system will be used to establish flow from the containment, through the charcoal filters, and discharge to the plant vent.

- o <u>Westinghouse Involvement</u> - The Westinghouse Owners Group is preparing a program to address the thermal hydraulic and fluid flow analyses which would apply to issues raised in question 5. To supplement the WOG work, a plant work request has been submitted for an engineering analysis as follows:

  - An analysis of expected pressure, temperature and boil-off for a loss of RHR while at mid-loop. This will allow prediction of conservative times to core boiling, time to core uncovery, and the expected mass boil-off as a function of time since shutdown.

  - An analysis of the plant specific potential for vortex information and the possible consequences of vortex information.

  - An analysis to determine the sensitivity of RCS loop water elevation to critical submergence depth as a function of RHR flow during mid-loop operation. This calculation should include calculations to evaluate RHR reduced flow operation consistent with existing decay heat removal capabilities and potential for boron stratification.

  The results of this analysis will be evaluated and incorporated into station procedures as appropriate. In addition the option of allowing RHR total flow rates of less than 3000 gpm during mid-loop operation will be addressed and needed FSAR and Technical Specification changes will be pursued.

- o <u>Technical Specifications</u> - A Technical Specification clarification will be written to state that the 3000 gpm minimum RHR flow requirement in Mode 6 can be met by operating two RHR trains with a flow of 1500 gpm in each as stated in the FSAR (Question 440.43).

APPENDIX A

NORMALLY EXPECTED INITIAL CONDITIONS

1. The temperature of the RCS is less than 200 degrees Fahrenheit.
2. A steam bubble is in the Pressurizer and level is maintained between 17 percent and 80 percent using the cold calibrated level channel.
3. Pressurizer pressure is 250 ± 25 psig.
4. One or two RCP's are in operation to equalize temperatures.
5. One or both trains of RHR are in operation maintaining RCS temperature. Flow in each operating RHR loop is 3000 gpm.
6. Charging and letdown are in operation and one train of RHR is cross connected to the letdown system.
7. Both trains of the COPS are armed.
8. SG's are at their normal level (45-55% narrow range) with a nitrogen blanket at 2 to 5 psig.
9. Safety injection signals from low steam line pressure and low pressurizer pressure are blocked.
10. Both Safety Injection Pumps have their power removed and all Safety Injection accumulators are isolated.
11. Both motor driven Auxiliary Feedwater Pumps have their control switches in PULL-TO-LOCK.

APPENDIX B

SEQUENCE OF DRAINING TO JUST ABOVE MID-NOZZLE AND VENTING THE RCS

1. Adjust one or both RHR heat exchanger outlet valves to establish a 50 degrees Fahrenheit per hour cooldown while maintaining pressurizer pressure and level constant.

2. When below 140 degrees Fahrenheit place SG's in wet layup if the unit is to remain below 200 degrees Fahrenheit for more than 4 days.

3. When below 110 degrees Fahrenheit and temperatures have equalized, stop all RCP's.

4. Collapse the Pressurizer bubble by raising charging flow and/or lowering letdown flow.

5. Cooldown the Pressurizer to below 190 degrees Fahrenheit using auxiliary spray.

6. Maintain RCS temperature between 80 and 130 degrees Fahrenheit.

7. Depressurize the RCS to 50 psig by adjusting charging and letdown flows.

8. Isolate safety injection cold legs to prevent gravity fill of the RCS from the RWST.

9. Isolate potential RCS dilution paths by closing, locking, and tagging manual valves.

10. Remove power from RCP's and Pressurizer heaters.

11. Install a tygon hose between the loop 1 drain line and Pressurizer steam space sample line for measuring water level in the RCS.

12. Align nitrogen from the PRT to the Pressurizer steam space.

13. Ensure only one RHR train is in operation (a precaution).

14. Drain to a Pressurizer level of 50 percent on the cold calibrated channel while maintaining a positive nitrogen pressure in the PRT. Drain from the four loop drain valves to the Reactor Coolant Drain Tank or via RHR letdown.

APPENDIX B (Cont'd.)

SEQUENCE OF DRAINING TO JUST ABOVE
MID-NOZZLE AND VENTING THE RCS

15. Place the tygon hose in service to measure water level.
16. Align nitrogen from the PRT to the reactor vessel head.
17. Drain as before to the level of the RPV flange (194 feet as read on the tygon hose).
18. Drain as before to just above mid-nozzle (187 1/2 feet as read on the tygon hose).
19. Maintain continuous water level monitoring at the tygon hose.
20. Isolate nitrogen from the PRT to the Pressurizer steam space and the RPV head.
21. Vent the Pressurizer steam space and the RPV head to the containment purge ventilation exhaust.

APPENDIX C

POTENTIAL DISTURBANCES TO THE DRAIN-DOWN PROCESS

System	Potential Cause
1. Automatic closure of RHR suction valves from RCS hot legs	Instrument failure, error during maintenance or testing
2. Automatic opening of Pressurizer PORV's from COPS	Instrument failure, error during maintenance or testing
3. Automatic initiation of Emergency Core Cooling System	Instrument failure, error during maintenance or testing
4. Automatic initiation of Auxiliary Feedwater System	Error during maintenance or testing
5. Automatic energization of Pressurizer heaters	Error during maintenance or testing
6. Closure or opening of letdown pressure control valve	Instrument failure, loss of instrument air, error during maintenance or testing
7. Closure or opening of RHR heat exchanger outlet valves	Control failure, loss of instrument air, error during maintenance or testing
8. Closure or opening of RHR heat exchanger bypass valves	Instrument failure, loss of instrument air, error during maintenance or testing
9. Change in charging flow	Instrument failure, loss of instrument air, error during maintenance or testing

TABLE 1
ESTIMATE OF TIME FROM 100% POWER TO MID-NOZZLE

ACTIVITY	DURATION
1. 100% Power to 0% Power	45 30 minutes
2. 557 to 350 Degrees Fahrenheit	46 4 hours
3. 350 to 140 Degrees Fahrenheit	46 16 hours
4. Drain to Mid-Nozzle	45 10 hours
TOTAL	30.5 hours

TABLE 2
PERMANENT PLANT INSTRUMENTATION AVAILABLE DURING PARTIAL FILL

	TRAIN A	TRAIN B	DESCRIPTION	LOCATION	RANGE
1	PI-0601	PI-0602	RHR pump suction pressure	Local	0- 800 psig
2	PI-10614		RHR pump discharge pressure	Local	0-1000 psig
3		PI-10615	RHR pump discharge pressure	Local	0- 800 psig
4	FIS-0610	FIS-0611	RHR pump discharge flow	Local	0-1500 gpm
5	PI-403	PI-405	RCS wide range pressure	QMCB	0-3000 psig
6	PI-408	PI-418	Reactor vessel pressure	QMCB	0-3000 psig
7	PI-438	PI-428	Reactor vessel pressure	QMCB	0-3000 psig
8	PI-0614	PI-0615	RHR pump discharge pressure	QMCB	0- 800 psig
9	FI-618A	FI-619A	RHR to RCS cold leg flow	QMCB	0-5000 gpm
10	FIC-618A	FIC-619A	M/A station for RHR heat exchanger bypass valve	QMCB	0- 100 %
11	HIC-606A	HIC-607A	M/A station for RHR heat exchanger outlet valve	QMCB	0- 100 %
12	TR-0612	TR-0613	Pen recorder for RHR heat exchanger inlet & outlet temperatures	QMCB	0- 400 degF
13	FI-618B	FI-619B	same as 5	PSDA,PSDB	0-5000 gpm
14	FIC-618B	FIC-619B	same as 6	PSDA,PSDB	0- 100 %
15	HIC-606B	HIC-607B	same as 7	PSDA,PSDB	0- 100 %
16	TI-604B	TI-605B	RHR heat exchanger outlet temperature	PSDA,PSDB	50-400 degF
17	LT-1311	LT-1321	Reactor vessel level	QMCB	0- 120 %
18	(various)	(various)	Core Exit Thermocouples 25 per train - 50 total	ERF computer	0-2300 degF
19	LI-0462		Pressurizer level (cold)	QMCB	0- 100%
20	PI-0469		PRT pressure	QMCB	0- 100 psig

TABLE 3
TABLE OF REFERENCES

1. Unit Operating Procedure 12007-1, Revision 3, "Refueling Entry", Step 4.1.3

2. Unit Operating Procedure 12007-1, Revision 3, "Refueling Entry", Step 4.1.2

3. Unit Operating Procedure 12006-1, Revision 5, "Unit Cooldown to Cold Shutdown"

4. Unit Operation Procedure 12007-1, Revision 3, "Refueling Entry"

5. System Operating Procedure 13005-1, Revision 2, "Reactor Coolant System Draining"

6. System Operating Procedure 13011-1, Revision 5, "Residual Heat Removal System"

7. Plant Vogtle Unit 1 Technical Specification 3.4.1.4.1

8. Administrative/Safety Procedure 10000-C, Revision 4, "Conduct of Operations", Step 2.7.d

9. Plant Vogtle FSAR, Paragraph 5.2.2

10. Work Planning Estimate

11. Plant Vogtle Unit 1 Technical Specification 3.4.10

12. The temporary instrumentation consists of 1 inch tygon tubing connected to the RCS at the following points:

    (1) RCS loop 1 intermediate leg, 3/4 inch valve 1-1201-X4-003
    (2) Pressurizer steam space sample line, 3/4 inch valve 1-1201-U4-100

13. Administrative Procedure 00350-C, Revision 9, "Maintenance Program"

14. Reactor Coolant System Wide Range Pressure Instrumentation PI-403, PI-405, PI-408, PI-418, PI-428 or PI-438 (0-3000 psig range)

15. Plant Vogtle Unit 1 Technical Specification 3.5.3.2

16. Plant Vogtle Unit 1 Technical Specification 3.1.2.1

17. Plant Vogtle Unit 1 Technical Specification 3.1.2.3

18. Plant Vogtle Unit 1 Technical Specification 3.4.1.4.2

19. Plant Vogtle Unit 1 Technical Specifications 3.9.4

TABLE 3 (Cont'd.)
TABLE OF REFERENCES

20. Automatic containment ventilation isolation valves HV-2626 A&B, HV-2627 A&B, HV-2628 A&B, and HV-2629 A&B

21. Surveillance Procedure 14210-1, Revision 2, "Containment Building Penetrations Verification - Refueling"

22. Plant Vogtle FSAR, Table 6.2.4-1

23. Unit Operating Procedure 12006-1, Revision 5, "Unit Cooldown to Cold Shutdown" Step D4.2.13

24. Pressurizer level instrument LI-0462

25. Pressurizer Relief Tank (PRT) pressure instrument PI-0469

26. If the RCS is to be opened to the containment atmosphere, then the RCS is vented at the pressurizer vent valve 1-1201-U4-106 and reactor head vent valve 1-1201-U4-086.

27. Westinghouse general operating instruction M-1, "Draining the Reactor Coolant System"

28. Westinghouse general operating instruction O-2, "Plant Shutdown from Minimum Load to Cold Shutdown"

29. IEEE-338-1977, "IEEE Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems"

30. NRC Regulatory Guides listed in Plant Vogtle FSAR, Chapter 1.9

31. Abnormal Operating Procedure 18019-1, Revision 2, "Loss of Residual Heat Removal"

32. Lesson plan LO-LP-12101, "Residual Heat Removal System"

33. Lesson plan LO-LP-60310, "Loss of RHR"

34. Lesson plan LO-LP-65104, "Level Measurement"

35. Lesson plan NL-LP-150, "Residual Heat Removal System"

36. Lesson plan NL-LP-65140, "Level Measurement"

37. Lesson plan GE-LP-27101-01-C, "Maintenance Operation Quality Assurance Program/MWO's"

38. Lesson plan GE-LP-27201-01-C, "Safety and Administrative Controls"

39. Lesson plan GE-LP-00261-00, "Equipment Clearance and Tagging"

TABLE 3 (Cont'd.)
TABLE OF REFERENCES

40. Plant Vogtle FSAR, Paragraph 5.4.7 (also see Question & Response 440.43)

41. System Operating Procedure 13011-1, Revision 5, "Residual Heat Removal System", Precaution 2.1.6

42. System Operating Procedure 13005-1, Revision 2, "Reactor Coolant System Draining", Steps 4.1.19 and 4.2.20

43. System Operating Procedure 13005-1, Revision 2, "Reactor Coolant System Draining", Steps 4.1.1 and 4.2.1

44. System Operating Procedure 13005-1, Revision 2, "Reactor Coolant System Draining", Step 2.1.4

45. Operations Estimate

46. Plant Vogtle FSAR, Paragraph 5.4.7

TABLE 4
ACRONYM LIST

COPS	Cold Overpressure Protection System
FSAR	Final Safety Analysis Report
MWO	Maintenance Work Order
NSSS	Nuclear Steam Supply System
PORV	Power Operated Relief Valve
PRT	Pressurizer Relief Tank
PSDA	Shutdown Panel - Train A
PSDB	Shutdown Panel - Train B
QMCB	Main Control Board
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RPV	Reactor Pressure Vessel
RVLIS	Reactor Vessel Level Indication System
RWST	Refueling Water Storage Tank
SG	Steam Generator

TABLE 5
RCS LEVEL VERSUS ELEVATION

281'	MINIMUM RWST LEVEL
223'	RWST OUTLET NOZZLE LEVEL
221'	TOP OF STEAM GENERATOR U-TUBES
196'	PRESSURIZER SURGE LINE NOZZLE LEVEL
193'	TOP OF RCP SEAL PACKAGE
190'	BOTTOM OF RCP SEAL PACKAGE
188'	NORMAL RCS LEVEL (1/2 LOOP FULL)
187'	CENTERLINE OF RCP DISCHARGE PIPING
184'	PRT INLET PIPING
124'	CENTERLINE RHR PUMP DISCHARGE PIPING