2-131C

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GEORGIA POWER
POWER GENERATION DEPARTMENT
VOGTLE ELECTRIC GENERATING PLANT

INSTRUCTIONAL UNIT

TITLE:	RESPOND TO LOSS OF RESIDUAL HEAT REMOVAL	NUMBER: LO-IU-60315-001-02
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REFERENCES:

VEGP PROCEDURE 18019-C, REV 6, LOSS OF RESIDUAL HEAT REMOVAL

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PERFORMANCE OBJECTIVE

Given indications of a loss or reduction of RHR capability, respond to loss of RHR.

The LO must restore the faulted/failed RHR train(s) to operable status. If a required RHR train cannot be restored, the LO must shut down the train, refer to Technical Specification for additional requirements, and initiate appropriate actions to restore the train. The LO must comply with all applicable Technical Specifications. All communication and activities must be performed in accordance with current, approved procedures.

INFORMATION

During a normal plant cooldown, the RHR system transfers heat from the RCS to the CCW system to reduce the temperature of the reactor coolant to cold shutdown temperature. A loss of RHR capability could result in an uncontrolled RCS temperature rise and, over the long term, any of the following conditions:

1. RCS pressure increase
2. Thermal stresses
3. Reactor coolant boiling

A rapid increase in RCS temperature is not expected if the reduction or loss of RHR capability occurs early in the fuel cycle. However, if the reduction or loss occurs late in the fuel cycle, an immediate, uncontrolled RCS temperature increase is probable because of the presence of a high rate of decay heat. The rate of decay heat is not only dependent on time and fuel cycle, but also on recent power history. The highest rate of decay heat will be present during a shutdown at the end of the fuel cycle after extended operation at high power.

Loss of RHR also means that a major component of the ECCS will not be available to provide emergency core cooling in the event of a loss of cooling accident.

The most likely causes of a reduction or loss of residual heat removal are:

1. RHR pump trip
2. Failure of pressure transmitters in a RHR train
3. RHR system breaks
4. Pump/flow problems due to
   a. Loss of/inadequate level
   b. Vortexing

c. Pump cavitation

An RHR pump trip is most likely to occur during operation in mode 5 with the RCS loops partially drained for maintenance, due to air/gas binding of the RHR pump(s). If this occurs, remotely-operated RHR pump suction vents (HV-10465, HV-10466) can be opened to release the air/gas.

Failure of pressure transmitters in a RHR train may cause suction isolation valves to close, thus, causing a loss of suction. This is a low probability cause of reduction or loss of RHR.

RHR System breaks are also unlikely; the following components are most susceptible to a break leading to a reduction or loss of RHR capability:

1. pump seals
2. valve packing glands
3. heat exchangers (tube leaks)
4. piping (failure)

The symptoms of reduction or loss of residual heat removal are:

- Unexplained decrease in RHR flow or discharge pressure
- Detected RHR system leakage
- An unexpected rise in RCS temperature while RHR is in operation
- Any observed loss of RHR capability while RHR is in operation

The following annunciators may be present on loss of RHR:

- RHR PMP OVERLOAD annunciator alarm
- CCW TRAIN A(B) RHR PMP SEAL LO FLOW annunciator alarm
- NSCW TRAIN A (B) RHR PMP MTR CLR LO FLOW annunciator alarm

RHR PMP OVERLOAD will occur only with an RHR pump trip. Symptoms 3 and 4 may also accompany a pump trip.

Plant Vogtle Procedure 18019-C, "Loss of Residual Heat Removal," is entered when the symptoms of reduction or loss of RHR capability are present. The goal of this procedure is to restore the faulted/failed RHR train(s) to operable status as quickly as possible.

The RHR system is one of the few plant systems that has Technical Specification requirements placed on it for all modes of operation. The response to loss or reduction of RHR capability in Procedure 18019-C is highly dependent upon the mode of operation and the limiting conditions of the applicable Technical Specifications:

MODE T.S.

4 3.4.1.3
5 3.4.1.4.1 (reactor coolant loops filled)
5 3.4.1.4.2 (reactor coolant loops not filled)
6 3.9.8.1 (water level above the top of the reactor pressure vessel flange greater than or equal to 23 feet)
6 3.9.8.2 (water level above the top of the reactor pressure vessel flange less than 23 feet)

Tecanical Specifications should be consulted for complete operating requirements.

Technical Specification requirements will vary depending on the mode of operation. Generally, a minimum of one RHR train must be operable. Certain modes or plant conditions require two RHR trains to be operable. Every effort should be made in Plant Vogtle Procedure 18019-C to restore faulted/failed RHR trains to operable status as quickly as possible.

There has been many Loss of RHR events in the industry over the past several years. These events are significant because core voiding and overheating can occur rather quickly.

Refer to Figure 2 "Time to Boil", Figure 3, "Time for Core Uncovery", and Figure 4, "Heatup Rate" curves located in AOP 18019 for understanding of the urgency for recovery from loss of RHR event.

RESPOND TO LOSS OF RHR

This Instructional Unit is divided into two sections: Section A, Loss of RHR in Modes 4 or 5, and Section B, Loss of RHR in Mode 6.

SECTION A - LOSS OF RHR IN MODES 4 OR 5

CAUTION

During midloop operation with HL dams installed and inadequate RCS venting, a loss of RHR cooling will result in saturated RCS conditions within 10 minutes, subsequently resulting in core uncovery and requiring containment closure initiation.

Monitor/Maintain core cooling

This must be done continuously until you exit the procedure. To do this you will monitor the Core Exit TC less than 200°F and RHR cooling is restored

If Core Exit TC is greater than 200°F or RHR cooling is not restored, then initiate Procedure 91001-C, "Emergency Classification and Implementing Instructions". You must also evacuate non-essential personnel and initiate

containment isolation. Additionally verify the RCS is in tact and initiate charging flow to provide core cooling.

If core exist temperature is less than 200°F, then continue to monitor the TCs. Should you lose the TC indication while in midloop operation, then raise RCS level to the top of the hot leg (188 feet 3 inches) and monitor temperature using RCS wide range indication T_{hot}.

If no RHR Train is operating, then suspend any RCS boron reduction and if the steam generators are available maintain RCS temperature below 350°F by use of steam dump or atmospheric relief valves (one SG level should be filled and maintained in the narrow range).

Concurrently with these actions, you must monitor operating RHR pumps for cavitation. Cavitation would be indicated by the discharge flow being lower than normal for the RCS pressure or by an unstable discharge pressure. These indications are located on the QMCB.

PI-0614	Train A - Pressure
PI-0615	Train B - Pressure
FI-0618A	Train A - Flow
FI-0619	Train B - Flow

If at any time during performance of this procedure, cavitation occurs, then stop the running RHR pump, realign misaligned valves, vent the affected pump using HV-10465 Trn A or HV-10466 Trn B valves using the QMCB located hand switches. The valves are physically located in sealed rooms and cannot be observed locally. If HV-10465 is not closed when venting is complete, the contaminated water from the vent will overflow from the vent room down into the vestibule R-131 level C. Failure to close HV-10466 will result in contaminated water on the floor of the room containing the vent and the actuation of the room sump level switch light on the QPCP.

If Core Exit TCs are stable or lowing, then return to the appropriate UOP.

If the TCs are rising, verify the affected RHR and CCW flow normal. This may occur due to inadequate time from when the problem first occurred and the time that you are at this step. If the TCs do not stabilize or begin to lower with normal flows, then an inadequate RCS inventory may exist.

Monitor/Reestablish Adequate RCS Inventory

To have adequate inventory you should have greater than 72% indication on the RVLIS FR or local or remote level indication greater than 187 ft. elev. If this does not exist, then you will take actions to restore the level. In doing so, you will dispatch operators as necessary to locate and isolate any leaks, adjust charging flow to return level or, if no charging is available, gravity fill the RCS from the RWST.

If these actions do not result in level recovery, a leak may exist. To locate the leak you will isolate the RHR pump suction valves one at a time to isolate the leak. Additionally, you will be directed to AOP 18004-C "RCS Leakage" to restore the level.

After level is restored, then restore RHR.

Restore RHR

To restore RHR you will initiate procedure 8011 "RHR System". Also see LO-IU-12101-002, "Startup RHR". Once RHR is restored, check RCS intact and determine is alternate RCS cooling is required.

Determine/Establish Alternate RCS Cooling

The RCS temperature is the primary indicator of whether alternate cooling is required.

If RCS temperature is greater than 200°F, then alternate RCS cooling may be required.

If the SGs are available, then use the steam dumps or ARVs for cooling, and maintain at least two SG levels greater than 17%. Also start all CRDM fans which will also remove a significant amount of heat.

Start the containment cooling fans and maintain RCS pressure at 365 psig with PZR heaters and spray (if bubble in PZR) or charging and letdown (if solid).

Start an RCP is possible to provide forced flow for better heat transfer from the core to the steam generators.

Initiate Repairs

This may take considerable time depending on the cause of the event. Additionally Technical Specifications must now be consulted.

You will also return the system to normal operation. This will require consultation with the TSC for recovery actions.

SECTION B - LOSS OF RHR IN MODE 6

Check RCS level above RV flange with cavity filled. If not, go to Section A

Suspend all operations involving a reduction of RCS boron concentration.

Verify the loop suction valves are open.

Verify the following valves are open:

- HV-8701A Train A
- HV-8701B Train A
- HV-8702A Train B
- HV-8702B Train B

If any of these valves are closed, stop the affected RHR pump(s) and open the affected train suction valves.

Verify reactor cavity level is greater than 23 feet.
Use local Tygon tubing or remote indication to verify reactor level. If less than 23 feet, restore cavity level or fill the vessel to 98 percent RVLIS FR.

Suspend all fuel movement.

Determine if any leaks exist.
Check the Auxiliary Building and Containment Leak Detection System to determine if any leaks exist. Dispatch an PEO to locate and isolate any leaks. If a break occurs on the RHR System, stop the RHR pumps.

Attempt to place either train of RHR in operation.
Initiate 13011, "RHR System," to place one train of RHR in operation.

Initiate repairs and applicable Technical Specification requirements.
When the RHR System is in operation, return to the appropriate UOP.

Start all containment cooling fans.

Place both trains of the Spent Fuel Pool Cooling and Purification System in service.
Initiate 13719, "Spent Fuel Pool Cooling and Purification System," to place both RHR trains in service.

Place FHB HVAC in service.
Initiate 13320, "FHB HVAC System," to place FHB HVAC in service.

Ensure RCS temperature is greater than 185 degrees F.
If RCS temperature is less than 185 degrees F, return to the placing either train of RHR in service step (Procedure step 86).

Establish an RCS feed path from the RWST.
At least one CCP must be running. Verify valve alignments for the operating pumps. Manually start a CCP and align the valves as necessary. If feed from the RWST cannot be established, return to the placing either train of RHR in service step (Procedure step 86).

Establish an RCS bleed path.

Establish an RCS bleed path from at least one open loop. Dispatch a PEO to open the RCDT pump to RWST isolation valves 1901-U4-041 and 1204-U4-002 and the RCS drain loop to RCDT pump isolation valve 1901-U4-242. Operate the RCDT pumps as necessary to maintain the reactor cavity level at greater than 23 feet and the temperature at less than 185 degrees F.

Check RHR System status.

If the RHR System cannot be placed in operation, return to the placing either train of RHR in service step (Procedure step B6).

Terminate bleed and feed.

Return to the UOP in effect.

PERFORMANCE GUIDE

The following steps are required to respond to loss of RHR:

SECTION A - LOSS OF RHR IN MODES 4 OR 5

1. Monitor/maintain core cooling
2. Monitor/reestablish adequate RCS inventory
3. Restore RHR
4. Determine/establish alternate RCS cooling
5. Initiate repairs

SECTION B - LOSS OF RHR IN MODE 6

1. Check RCS level above RV flange with cavity filled. If not, go to Section A.
2. Suspend all operations involving a reduction of RCS boron concentration.
3. Verify the loop suction valves are open.
4. Verify reactor cavity level is greater than 23 feet.
5. Suspend all fuel movement.
6. Determine if any leaks exist.
7. Attempt to place either train of RHR in operation.
8. Initiate repairs and applicable Technical Specification requirements.
9. Start all containment cooling fans.
10. Place both trains of the Spent Fuel Pool Cooling and Purification System in service.
11. Place FHB HVAC in service.
12. Ensure RCS temperature is greater than 185 degrees F.
13. Establish an RCS feed path from the RWST.
14. Establish an RCS bleed path.
15. Check RHR System status.
16. Terminate bleed and feed.
17. Return to the UOP in effect.

SELF-TEST

Before proceeding to the Task Practice, answer the following questions as completely as possible.

1. List the symptoms of loss of RHR.

2. List three annunciators which may be present on loss of RHR.

3. If a feed path is to be established during Mode 4, the ECCS pumps will provide feed. State the feed path during Mode 6.

4. Briefly state the implications of loss of RHR early in core life versus late in core life.

5. State the most likely causes of a reduction or loss of residual heat removal.

ANSWERS

1. - Unexplained damage in RHR flow or discharge pressure
   - Detected RHR system leakage
   - An unexpected rise in RCS temperature while RHR is in operation
   - Any observed loss of RHR capability while RHR is in operation

2. - RHR PMP OVERLOAD annunciator alarm
   - CCW TRAIN A(B) RHR PMP SEAL LO FLOW annunciator alarm
   - NSCW TRAIN A (B) RHR PMP MTR CLR LO FLOW annunciator alarm

3. The RCDT pumps provide feed flow, as required, through the RWST via the CCPs back to the reactor vessel.

4. A rapid increase in RCS temperature is not expected if the reduction or loss of RHR capability occurs early in fuel cycle. However, if the reduction or loss occurs late in fuel cycle, an immediate, uncontrolled RCS temperature increase is probable because of the presence of a high rate of decay heat. The rate of decay heat is not only dependent on time and fuel cycle, but also on recent power history. The highest rate of decay heat will be present during a shutdown at the end of fuel cycle after extended operation at high power.

5. - RHR pump trip
   - Failure of pressure transmitters in a RHR train
   - RHR system breaks
   - Pump/flow problems due to loss of/inadequate level, vortexing or pump cavitation

TASK PRACTICE

1. Review Procedure 18019-C, "Loss of RHR." Be sure that you understand all precautions, limitations, and steps associated with responding to loss of RHR.

2. Take this instructional unit and Procedure 18019-C, "Loss of RHR" to the control room or simulator. Be sure that you can locate all instrumentation associated with responding to loss of RHR.

3. In the control room or simulator, simulate responding to loss of RHR. If possible, have a fellow trainee evaluate your performance using Procedure 18019-C, "Loss of RHR" and this instructional unit.

FEEDBACK ON TASK PRACTICE

1. If you have any questions about the precautions, limitations, or steps in Procedure 18019-C, "Loss of RHR", ask your instructor.

2. You should have been able to locate all instrumentation associated with responding to loss of RHR. If you had any difficulty, ask your instructor for help.

3. You should have simulated the steps necessary to respond to loss of RHR. If you had any difficulty, re-read the pertinent sections of this instructional unit and the procedure. Resolve any questions with your instructor.