Fort Calhoun Station Unit No. 1
OPERATING INSTRUCTIONS
OI-RC-3

Reactor Coolant System Startup

I. Purpose

This instruction describes the startup of the reactor coolant system from the cold shutdown condition to the hot standby condition.

II. Prerequisites

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A. Reactor coolant system has been vented and a leak test has been performed if required. _____/_____

B. Reactor coolant system initial conditions.

1. Reactor coolant temperature is between 82°F. and 210°F. with the shutdown cooling system in operation. _____/_____

or,

2. Reactor coolant pressure is being maintained at 600 psia if the leak test of OI-RC-2 was performed. _____/_____

NOTE: If this is the case, proceed directly to procedure, Step F.

C. Boron concentration is at a value to provide the shutdown margin as set in Tech. Spec. 2.10.2. Use the cold shutdown or hot shutdown condition boron concentration curve (whichever gives higher boron concentration) in the Technical Data Book for the required boron concentration. _____/_____

CAUTION: This is not intended to mean that a dilution can be performed if the Reactor Coolant is at a refueling boron concentration.

D. Reactor coolant and steam generator chemistry meet shutdown requirements. _____/_____

E. Steam generator water levels are in the normal operating range with the steam line vents positioned as required for the existing reactor coolant system temperature. _____/_____

F. Pressurizer and steam system safety valves are in conformance with Tech. Spec. 2.1.6. _____/_____

G. PPLS is blocked. _____

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II. Prerequisites (Continued)

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H. Containment integrity is established in accordance with OI-CO-5 if RCS temperature is equal to or greater than 210°F. _____/_____

I. Appropriate sections of OP-1 have been completed as required. _____/_____

J. If the RCS cold leg temperature is below 370°F, both PORV's shall be operable, at the low set-point. _____/_____

K. If PPLS is blocked all 3 HPSI pump control switches shall be CAUTION TAGGED in the PULL-STOP position. _____/_____

NOTE: Caution tagging the HPSI pump switches in PULL-STOP ensures that Technical Specification 2.3.(3) is satisfied.

III. Precautions

A. Observe the reactor coolant system temperature vs. pressure curves and heatup rate limitations specified in Tech. Spec. 2.1.2.

CAUTION: Whenever the RCS is in a water solid condition, an operator must be assigned full time to monitor and control RCS pressure to ensure pressure-temperature limits are not exceeded.

B. Trippable CEA's should not be above their lower electrical limit when RCS pressure is less than normal operating pressure. (This ensures that a "dry CEDM scram' will not occur.)

C. System pressure must be greater than the minimum required for reactor coolant pump operation (to satisfy NPSH requirements) and less than 265 psia for shutdown cooling system operation. The minimum RC pressure for RCP operation at different reactor coolant temperatures is specified in the Technical Data Book.

D. A reactor coolant system pressure of 2500 psig must not be exceeded for reactor coolant pump operation.

E. A reactor coolant system pressure of 2750 psig must not be exceeded with fuel in the reactor vessel.

F. Maximum pressure of 425 psia must be observed to prevent opening of the power operated relief valves when RCS temperature is less than 270°F; Maximum pressure of 575 psia must be observed when RCS temperature is less than 370°F. Normal or high setpoint on the PORV's is 2400 psia.

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III. Precautions (Continued)

G. Reactor coolant pump seal controlled bleedoff flow must be established whenever the reactor coolant system is pressurized.

H. Component cooling must be supplying the reactor coolant pumps whenever reactor coolant pumps are in operation or reactor coolant system temperature is greater than 130°F.

I. At least one reactor coolant pump or one shutdown cooling pump shall be in operation whenever a change is being made in the boron concentration.

J. Observe reactor coolant pump operation precautions as outlined in OI-RC-9.

K. Observe personnel safety around bare metal surfaces which exceed 120°F.

L. During heatup no boron dilution is permitted.

M. Criticality must be anticipated whenever CEA's are being withdrawn or whenever boron dilution or heatup operations are performed.

N. Whenever the pressurizer heaters are energized, the water level must be maintained above an actual level of 41.5%. Normal control band for actual pressurizer level should be between 48 and 60%.

NOTE: Use level correction curves for LI-106 and/or LI-101X/Y in the T.D.B. to obtain actual level from indicated level.

O. Maximum pressurizer heatup rate is 100°F in any one hour period. Maximum pressurizer cooldown rate is 200°F.

P. During heatup of the system operation of RC-3A and RC-3B is preferred to provide adequate pressurizer spray.

Q. Flow through the core should be maintained at all times using a reactor coolant pump or the shutdown cooling system. A no flow condition is acceptable for some period of time provided the temperature difference between the cold legs of the idle loops and the average core temperature as read by the core exit thermocouples or temporary instrumentation shall not exceed 30°F. and no change in RCS boron concentration is being made.

R. One steam generator shall be operable and the other steam generator shall be filled above the low steam generator water level trip setpoint and available to remove decay heat whenever the average temperature of the reactor coolant is above 300°F.

III. Precautions (Continued)

S. The total specific radioactivity of the reactor coolant due to nuclides with half lives of more than 30 minutes shall not exceed $31/\bar{E}$ µci/gm whenever the average reactor coolant temperature is greater than 532°F. within the requirements of Tech. Spec. 2.1.3 and Table 3.4.

T. The reactor coolant dissolved oxygen concentration must be less than 0.10 ppm or a hydrazine residual must be established at 1.5 times the measured oxygen concentration before reactor loop water temperature is raised above 150°F.

U. The reactor coolant shall not be heated above 300°F unless the conditions stated in Tech. Spec. 2.5 and 2.7 are satisfied.

V. After a change in system boron concentration in excess of 50 ppm, the pressurizer spray valves should be operated at maximum spray, consistent with pressure requirements until the boron concentration differential between the pressurizer water and the loop water is less than 10 ppm.

W. Steam and feedwater flows should be carefully regulated to avoid rapid temperature changes to the reactor coolant and steam generator feedwater nozzles.

X. Maximum Reactor Coolant temperature with the Shutdown Cooling System valves in operation is 300°F.

Y. Before reactor coolant system temperature reaches 300°F, ensure that the emergency feedwater storage tank inventory is greater than 55,000 gallons.

IV. Procedure

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A. Terminate shutdown cooling, if not already done, as per OI-SC-2. _____/_____

B. Pressurize the RCS to the discharge head of the LPSI pump(s) (if not already accomplished by fill and vent procedure) by performing the following:

1. Check open LCV-383-1 and LCV-383-2.

2. Check open HCV-2947 and HCV-2937.

3. Check open LPSI pump mini-recirculator valves SI-124 and SI-132.

4. Open HCV-385 and HCV-386.

5. Start a LPSI pump.

6. Check open FCV-326 and open LPSI loop isolation valves to pressurize the RCS. _____/_____

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IV. Procedure (Continued)

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C. Ensure CVCS let down flow path available for RCS heat-up expansion and to limit RCS pressure. _____/_____

D. Commence RCS heat-up by starting one, two, or three RC pumps per OI-RC-9. _____/_____

CAUTION: A non-operating reactor coolant pump shall not be started unless at least one of the following conditions is met:

(a) A pressurizer steam space of 60% by volume or greater exists, or

(b) The steam generator secondary side temperature is less than 50°F above that of the reactor coolant system cold leg.

E. Prior to exceeding 150°F. ensure the RCS oxygen concentration is within specification. If it is within specification, proceed to the next step. If it is not within specification, proceed as follows:

1. Establish two Reactor Coolant Pump operations with one pump running in each loop. _____/_____

CAUTION: A non-operating reactor coolant pump shall not be started unless at least one of the following conditions is met:

(a) A pressurizer steam space of 60% by volume or greater exists, or

(b) The steam generator secondary side temperature is less than 50°F above that of the reactor coolant system cold leg.

2. Place CVCS in operation in accordance with OI-CH-1. _____/_____

3. Place S/D cooling system in operation to maintain less than 150°F. _____/_____

4. Add required hydrazine to CVCS system. _____/_____

5. When RCS O_2 concentration is less than 0.1 ppm, or a hydrazine residual at 1.5 times the measured oxygen concentration is established, proceed with the following steps. _____/_____

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IV. Procedure (Continued)

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E. 6. Terminate shutdown cooling system operation. _____/_____

7. Pressurize the RCS to the discharge head of the LPSI pump(s) by repeating Step B of this procedure. _____/_____

8. Restart one RC pump to commence heat-up of RC system. _____/_____

CAUTION: Prior to exceeding 300°F, ensure that the emergency feedwater tank inventory is greater than 55,000 gallons.

F. As soon as the RCS temperature is above that required to pressurize the RCS to 2545 psia, perform the following:

1. Establish a minimum of one RC pump in operation.

CAUTION: A non-operating reactor coolant pump shall not be started unless at least one of the following conditions is met:

(a) A pressurizer steam space of 60% by volume or greater exists, or

(b) The steam generator secondary side temperature is less than 50°F above that of the reactor coolant system cold leg.

2. Clear all caution tags on HPSI pumps, charging pumps, and pressurizer heaters.

3. Establish charging and let down flow and adjust RCS pressure as required to ensure NPSH requirements on RC pumps are satisfied.

NOTE: Maintain approximately 600 psia pressure until a pressurizer steam bubble has been formed.

4. Energize pressurizer heaters and raise and maintain pressurizer temperature at least 30°F greater than RCS temperature.

NOTE: It is preferred to maintain pressurizer temperature 80 to 200°F greater than RCS temperature in preparation for drawing a bubble.

5. Re-adjust charging pump accumulator pressures per OI-CH-1 as RCS pressure increases. _____/_____

IV. Procedure (Continued)

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G. When steam issues from the main steam line vents, close the vent valves and commence main steam line heatup in accordance with OI-MS-2. _____/_____

NOTE: Ensure MS vents/drains in containment as well as in Room 81 are checked.

H. Maintain steam generator water level by the use of blowdown and the motor driven auxiliary feedwater pump in accordance with OI-FW-5 and OI-FW-4 respectively. Feed steam generators via the main feedwater bypass valves. _____/_____

I. When pressurizer temperature indicator (TI-107) reaches approximately 486°F. and T-113 or T-123 indicates greater than 286°F. but less than 406°F., form the steam bubble.

1. Shut both pressurizer spray valves.

2. Decrease the setpoint of PIC-210 controller to obtain maximum letdown flow.

NOTE: Both letdown valves should be in operation to aid in drawing bubble.

CAUTION: Excessive letdown should be terminated if pressurizer level indication is not in evidence within approximately 1/2 hour.

3. Pressurizer pressure will decrease to the saturation pressure of the pressurizer steam phase temperature.

4. Continue to operate one charging pump with maximum letdown flow until LI-101X or LI-101Y indicates 48%. Place letdown control in Auto per OI-RC-8.

5. Operate PCV-103-1 and/or PCV-103-2 to control pressure and equalize boron concentrations between pressurizer and the system. Utilize the letdown control valves to control pressurizer level at 48% (LI-101X or LI-101Y).

6. Re-adjust PIC-210 setpoint to approximately 350 psig. _____/_____

J. Lock open the Safety Injection Tank Isolation Valves (HCV-2954, 2974, 2934, 2914 and lock open the power supply breakers to the motor operators for the valves after RCS pressure exceeds 600 psia. _____/_____

NOTE: Do not unisolate SI Tanks until after a pressurizer steam bubble is formed.

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IV. Procedure (Continued)

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K. Align the ECCS per OP-1 after a steam bubble is formed in the pressurizer. _____/_____

L. Continue heatup of the system with pressurizer heaters and reactor coolant pumps. _____/_____

NOTE 1: Main steam system warm-up must be complete by the time reactor coolant system temperature is at 532°F. so that the steam dump and bypass system can be used.

NOTE 2: Reactor coolant system heat-up rate will deminish as main steam warm-up is initiated. When reactor coolant system temperature reaches 500°F. all reactor coolant pumps may be operated.

M. As pressure in the reactor coolant system and in the steam generators increases, verify the following:

1. Steam Generator Low Pressure Trip Bypasses are automatically removed. Then place the Steam Generator Low Pressure Trip Bypass Switch on each RPS cabinet in the OFF position.

2. PPLS Block and SGLS Block are unblocked automatically. _____/_____

N. When reactor coolant system pressure reaches 2100 psia, place pressurizer pressure control in automatic as per OI-RC-7. _____/_____

O. When system temperature reaches 532°F $^{+3°F}_{-12°F}$, stabilize temperature with the MSIV's open. _____/_____

P. Ensure automatic pressurizer level control for zero power program level as per OI-RC-8 with one letdown valve. _____/_____

Q. Place the boronometer and process radiation monitor in operation in accordance with OI-CH-1. _____/_____

R. Place a purification ion exchanger as directed by the C/RP Supervisor into service in accordance with OI-CH-2. _____/_____

S. The reactor coolant system is now at a condition to perform a reactor start-up in accordance with OP-7. _____/_____

T. Return Reactor Coolant Gas Vent System to stand-by mode (See OI-RC-10).

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