GE Nuclear Energy

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LEGEND OR DESCRIPTION OF GROUPS

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1.0 SCOPE/APPLICABILITY

This procedure provides detailed instructions for performing the operations required to achieve a safe and dependable reactor startup from a hot or cold shutdown condition to reactor criticality.

2.0 DISCUSSION

This procedure provides a means for organizing the many diversified activities associated with power plant operation for an efficient reactor startup to the point of reactor criticality. The approach to criticality will normally be integrated into an overall plant startup. Integrated Operating Procedures "Heatup and Pressurization"(IOP-2), "Turbine Startup and Generator Synchronization"(IOP-3), and "Power Ascension and Power Changes"(IOP-4) should be initiated in such a manner so as to provide an uninterrupted succession from one procedure to another.

3.0 PRECAUTIONS AND LIMITATIONS

3.1. Exercise caution when approaching criticality while the moderator temperature is decreasing, since increased moderation will result in comparatively shorter periods.

3.2. Do not achieve a stable reactor period shorter than [30] seconds.

3.3. During startup within 24 hours of previous high power operation, the reactor xenon inventory will be high and this condition may result in unusually high control rod worth in certain regions of the reactor. When at or near criticality, exercise additional caution when withdrawing control rods to avoid unexpectedly short periods.

3.4. If a sustained reactor period of less than [30] seconds is indicated, insert control rods until a reactor period of greater than [30] seconds is indicated. Obtain permission from the [Supervisor, Reactor Engineer?] prior to re-withdrawing the inserted rod(s).

3.5. If a reactor period less than [5] seconds occurs, take corrective actions per [later procedure for: Unexplained Change in Reactor Power or Reactivity].

3.6. No rods should be bypassed at the RC&IS when performing a reactor startup.

3.0 PRECAUTIONS AND LIMITATIONS(continued)

3.7. Rod coupling should be monitored by observing discernible nuclear instrument response during rod withdrawal. Rod coupling for each fully withdrawn control rod shall be verified.

3.8. Natural circulation startups are not permitted.

3.9. Reactor operation shall be within the RPV pressure and temperature limitations of [Technical Specifications later].

3.10. The flanges of both the reactor vessel and head must be maintained at or above [21 °C] when the reactor vessel head bolting studs are under tension.

4.0 PREREQUISITES

4.1 Enclosure 1, "Systems Status Checklist for Approach to Criticality," completed.

4.2 The drywell clear of personnel and locked.

4.3 Drywell, Primary and Secondary Containment integrity is established.

4.4 The following surveillance tests have been completed within their required times: [later]

4.5 A criticality prediction has been obtained from the [Core Predictor].

4.6 [Other administrative requirements, later].

5.0 PROCEDURE

Subsection 5.1 may be executed concurrently with Subsection 5.2.

5.1 Establishing Main Condenser Vacuum

5.1.1 Lineup the reactor head vent valves as follows:

Valve	Position
B21-F012, F013	CLOSED
B21-F014	OPEN

> CAUTION
>
> Do not supply sealing steam to the main turbine or the reactor feed pump turbine shaft seals if the turbine rotor is not running on the turning gear.

5.1.2 Verify that Turbine Lube Oil System is in operation and the main turbine and reactor feedpump turbines are on the turning gears in accordance with SOP–[later], "Turbine Lube Oil System".

5.1.3 Seal the turbine glands (both Main Turbine and Reactor Feedpump Turbines) with sealing steam supplied by the auxiliary boiler in accordance with SOP–[later].

5.1.4 Verify that the condenser LOW VACUUM BYPASS switches are in the BYPASS position in panels [later].

5.1.5 Close the condenser vacuum breakers [identity later] and start the mechanical vacuum pumps to draw a vacuum on the main condenser per SOP-[later].

5.1.6 When main condenser pressure decreases to [later], initiate preheat of the Off Gas System preheater with auxiliary steam and place the Off Gas System into operation in accordance with SOP–[later], "Off Gas System."

5.1.7 Place the startup SJAEs into operation and shutdown the mechanical vacuum pumps per SOP–[later].

5.1 Establishing Main Condenser Vacuum (continued):

5.1.8 When main condenser pressure decreases to less than [533 mm Hg A], position the DIV 1, 2, 3, and 4 CONDENSER LOW VACUUM BYPASS switches to NORMAL and verify their associated annunciators [Axxx,later] have cleared.

5.1.9 When main condenser pressure decreases to less than [later], reset the main turbine bypass valves low condenser pressure vacuum trip and verify the associated annunciator [Axxx, later] is clear.

5.10 Begin de–aerating and recycling the condensate demineralizers per SOP–[later].

5.1.11 Place the Hydrogen Analyzers for the Off-Gas System in service using the main condenser as the vacuum source.

5.2 Preparation for Control Rod Withdrawal

5.2.1 Verify that at least [three] SRNMS indicate ≥ [3 cps].

5.2.2 Select the approved rod sequence for rod pattern control.

5.2.3 The reactor coolant chemistry limits are within the following limits:

Chlorides	< 10 ppb
Conductivity at 25 °C	< 0.20 µS/cm
pH at 25 °C	6.4 – 7.8

5.2.4 Initiate recording of [designated variables].

*** NOTE ***

If a large amount of reactor decay heat is present, it is necessary to maintain temperature constant for reactor criticality prediction.

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5.2.5 Secure the Shutdown Cooling Mode of the RHR System if it is no longer required, flush, and line up RHR to Standby Readiness per SOP- E11.

5.2 Preparation for Control Rod Withdrawal(continued)

5.2.6 Perform the following surveillance tests as required:

[Later]

5.2.7 Place the Reactor Mode Switch to STARTUP/HOT STANDBY position.

5.2.8 Verify no rod blocks or rod motion inhibits exist.

5.2.9 Within [15] minutes prior to withdrawing control rods, verify reactor vessel temperature and pressure are within limits of Technical Specification [later].

5.3 Control Rod Withdrawal for Criticality

5.3.1 Commence control rod withdrawal for criticality in accordance with SOP–C11. Maintain reactor period longer than [50] seconds if manually withdrawing control rods. Verify control rod coupling when a rod is fully withdrawn.

5.3.2 When reactor is critical, initiate recording of [designated variables].

5.3.3 It is generally not desirable to withdraw any control rod after criticality has been established, until the heating range is reached. However, if necessary, continue to insert or withdraw control rods to maintain a reasonable reactor period, [60-150 seconds], until the heating range is reached, approximate [SRNMS indication, later].

5.3.4. Continue reactor heatup and pressurization in accordance with IOP–2, "Heatup and Pressurization".

6.0 REFERENCES

6.1 Water Quality Specification, 22A8479, Revision 2, PAE No. 1.A.9.