VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

November 6, 1996

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

Serial No. 96-532
NL&OS/GSS
Docket Nos. 50-338
50-339
License Nos. NPF-4
NPF-7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
PROPOSED TECHNICAL SPECIFICATIONS CHANGE
REVISED LOOP STOP VALVE OPERATION

Pursuant to 10 CFR 50.90, Virginia Electric and Power Company requests amendments, in the form of changes to the Technical Specifications, to Facility Operating License Numbers NPF-4 and NPF-7 for North Anna Power Station Units 1 and 2, respectively. The proposed changes will modify the requirements for isolated loop startup to permit filling of a drained isolated loop via backfill from the Reactor Coolant System through partially opened loop stop valves.

A discussion of the proposed Technical Specifications changes is provided in Attachment 1. The proposed Technical Specifications changes are provided in Attachment 2. It has been determined that the proposed Technical Specifications changes do not involve an unreviewed safety question as defined in 10 CFR 50.59 or a significant hazards consideration as defined in 10 CFR 50.92. The basis for our determination that the changes do not involve a significant hazards consideration is provided in Attachment 3. The proposed Technical Specifications changes have been reviewed and approved by the Station Nuclear Safety and Operating Committee and the Management Safety Review Committee.

Should you have any questions or require additional information, please contact us.

Very truly yours,

James P. O'Hanlon

James P. O'Hanlon
Senior Vice President - Nuclear

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Attachments

130023

cc: U.S. Nuclear Regulatory Commission
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Mr. R. D. McWhorter
NRC Senior Resident Inspector
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Commissioner
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COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by J. P. O'Hanlon, who is Senior Vice President - Nuclear, of Virginia Electric and Power Company. He is duly authorized to execute and file the foregoing document in behalf of that Company, and the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 6TH day of November, 1996.

My Commission Expires: May 31, 1998.

Vicki L. Hull
Notary Public

(SEAL)

ATTACHMENT 1

DISCUSSION OF CHANGES

VIRGINIA ELECTRIC AND POWER COMPANY

DISCUSSION OF CHANGE

Introduction

The current North Anna Technical Specifications provide the following restrictions on returning an isolated reactor coolant loop to service:

> 4.4.1.4 The boron concentration of an isolated loop shall be determined to be greater than or equal to the boron concentration of the operating loops at least once per 24 hours and within 30 minutes prior to opening either the hot leg or cold leg stop valves of an isolated loop.
>
> 3.4.1.5 A reactor coolant loop cold leg stop valve shall remain closed until:
>
> a. The isolated loop has been operating on a recirculation flow of greater than or equal to 125 gpm for at least 90 minutes and the temperature of the cold leg of the isolated loop is within 20 F of the highest cold leg temperature of the operating loops.
>
> b. The reactor is subcritical by at least 1.77% delta k/k.

These requirements are imposed based on two considerations:

> a. The avoidance of inadvertent criticality during the process of bringing the loop into service, and
>
> b. The avoidance of reactor vessel thermal shock and the imposition of excessive thermal fatigue on vessel components, particularly on the cold leg nozzles.

In addition to the administrative controls imposed by the Technical Specifications, North Anna is equipped with a set of protective interlocks which prevent violation of the conditions established in Technical Specification 3.4.1.5.a, cited above. Interlocks are also provided to prevent startup of an idle pump under certain conditions.

The existence of these interlocks and the supporting Technical Specifications, which were originally addressed to restoration of a loop which had been isolated at power, can cause an unneeded administrative and operational burden during shutdown maintenance activities. Specifically, the requirement for 90 minutes of relief line flow means an extra 90 minutes of RCP run time, and requires additional pump starts, which reduces the useful life of the pumps. The requirement also results in additional outage time and associated replacement power cost.

The primary design consideration in developing the cold water interlocks was to prevent cold water accidents (unplanned criticality or power excursions) as a result of operation with a loop out of service in Modes 1-2 (power operation through hot standby). This type of operation is outside the current North Anna licensing basis. Therefore the potential concerns associated with a startup of an inactive loop at power are now significantly reduced.

The proposed Technical Specifications retain the current restrictions for returning a filled, isolated RCS loop to service in Modes 3-6. An additional option for unisolating a drained RCS loop by backfilling from the active portion of the RCS is added for cold shutdown and refueling shutdown (Modes 5 and 6). New controls ensure adequate reactivity and coolant inventory control during the loop backfill evolution. Therefore the proposed Technical Specification changes do not create an unreviewed safety question or significant hazards consideration.

Background

The original North Anna plant design allowed power operation with less than three reactor coolant pumps running or with an isolated loop at reduced thermal power. However, this configuration has never been permitted by the plant operating license. Therefore restrictions on returning a previously isolated loop to service are not applicable for Modes 1 and 2.

In addition, an evaluation has shown that an alternative approach to returning an RCS loop to service, i.e. backfilling a previously drained and isolated loop from the RCS through a partially open stop valve, eliminates the need for boron and temperature surveillance of the isolated loop and the 90 minute operation of the loop (i.e., the reactor coolant pump) on recirculation flow. Therefore provision for using this method of returning a previously isolated and drained loop to service has been added for operational Modes 5 and 6.

Current Licensing Basis

Restrictions on returning an isolated loop to service were part of the original North Anna Technical Specifications. Amendment No. 32 for North Anna Unit 1 was issued in June 1981. Prior to Amendment 32, Unit 1's Specification 3.4.1.1 had provisions in the ACTION portion for power operation with one reactor coolant loop not in operation, with or without the loop stop valves closed. The ACTION statement imposed restrictions on thermal power for each operational condition. A number of protection channels associated with the loop not in operation were placed in the tripped condition and the overtemperature ΔT trip setpoint was reduced.

With Amendment 32, the provision for N-1 operation was eliminated and the Unit 1 Specification 3.4.1.1 was modified to its current form, i.e. all reactor coolant loops must be in operation with power removed from the loop stop valve operators in Modes 1 and 2. It should be noted that the N-1 provision was never used for Unit 1, in that other

portions of the Specifications (i.e. the Specification governing the emergency core cooling system) prohibited it. The N-1 provision was never in the Unit 2 Specifications.

The current specification governing opening a loop stop valve remains in its original form, i.e. the stop valve shall remain closed unless 1) the isolated loop has been operating on a recirculation flow of ≥ 125 gpm for at least 90 minutes; 2) the cold leg temperature of the isolated loop is within 20 F of the cold leg temperature of the highest cold leg temperature of the operating loops, and 3) the reactor is subcritical by at least 1.77% ΔK/k.

Current Design Basis

As currently configured, the cold water interlocks:

a. Prevent opening of a hot leg loop stop valve unless the cold leg stop valve in the same loop is fully closed.

b. Prevent starting a reactor coolant pump unless:

   1) The cold leg loop stop valve in the same loop is fully closed and the cold leg bypass relief line is available for bypass flow (bypass valve open), or

   2) Both the hot leg and cold leg loop stop valves are fully open.

c. Prevent opening of a cold leg loop stop valve unless:

   1) for a period of at least 90 minutes
      - the hot leg loop stop valve in the same loop has been open.
      - the cold leg bypass valve in the loop has been open.
      - flow has existed through the relief line.

   2) the cold leg temperature is within 20 F of the highest cold leg temperature in the other loops, and the hot leg temperature is within 20 F of the highest hot leg temperature in the other loops.

Further discussion of these interlocks may be found in Sections 7.6.3 and 15.2.6 of the North Anna UFSAR.

In order to implement the proposed technical specification to allow restoration of an isolated, drained loop via backfill from the RCS, the requirement for the temperature and relief line flow portion of the interlocks will be eliminated. For the case of restoration of a filled, isolated loop, the provisions for the 90 minutes of recirculation flow and the cold leg temperature differential limits will remain in the Technical Specifications and the associated operating procedures. The current Technical

Specification requirement to maintain the boron concentration in an isolated, undrained loop greater than or equal to the concentration of the operating loops will still apply.

Discussion

The Reactor Coolant System may be operated with one or more loops isolated in Modes 3-6 (subject to restrictions on operable heat removal paths) in order to perform maintenance. While operating with a loop isolated, restrictions must be placed on the subsequent return of the loop to service. If the loop is filled, sudden mixing of the contents of the loop with the contents of the operating loops must be avoided. This situation has the potential of causing a positive reactivity addition with a corresponding reduction in shutdown margin if:

a. The temperature in the isolated loop is lower than the temperature in the operating loops (cold water incident).

b. The boron concentration in the isolated loop is lower than the boron concentration in the operating loops (boron dilution incident).

The startup of an isolated, filled loop is controlled to prevent sudden reactivity additions due to cold water or boron dilution. The limiting conditions for operation and associated plant procedures require the following:

a. The boron concentration in the isolated loop is required to be maintained higher than the boron concentration in the operating loops, thus eliminating the potential for introducing coolant from the isolated loop that could dilute the boron concentration in the operating loops.

b. The reactor must be subcritical by at least 1.77% $\Delta k/k$ prior to opening a cold leg loop stop valve. This ensures that any minor reactivity changes associated with temperature gradients cannot result in inadvertent criticality.

c. Prior to opening a cold leg loop stop valve, the isolated loop must operate on a recirculation flow of greater than or equal to 125 gpm for at least 90 minutes. This ensures a slow,controlled mixing of the contents of the isolated and active loops.

d. The temperature of the cold leg of the isolated loop must be within 20 F of the highest cold leg temperature of the operating loops. This restriction limits the potential reactivity addition due to cooldown to a small amount which is readily accommodated by the available shutdown margin.

If an isolated loop is initially drained, the requirements listed above are not applicable. An initially isolated and drained loop may be returned to service by partially opening the loop stop valve and filling the loop in a controlled manner from the reactor coolant

system. The new LCO uses the words "...may be energized and/or opened" in recognition of the fact that partial opening of the valve can be accomplished manually without energizing the motor operator. The following controls will be placed on the backfill operation.

a. The isolated loop shall be drained prior to backfilling. This control eliminates the possibility of unsampled water at an indeterminate boron concentration diluting the water flowing in from the active portion of the RCS and subsequently being passed through the core.

b. Pressurizer water volume shall be at least 450 cubic feet during opening of the loop stop valves and during filling of the isolated loop. This control prevents excessive loss of reactor coolant inventory in the event of an inadvertent rapid full opening of the loop stop valve in the drained loop. This pressurizer water volume requirement is established such that, even if the three cold leg loop stop valves are suddenly opened with all three loops drained, one loop under vacuum and no makeup available, the Reactor Coolant System water level will not drop below mid-nozzle. Additionally, only one loop may be back-filled at a time.

c. The hot and cold leg stop valves shall be fully opened within 2 hours after completion of the loop fill evolution. This limitation eliminates the potential for an undetected change in the boron concentration or temperature in the affected loop resulting in an uncontrolled reactivity addition when the reactor coolant pump is started.

d. A source range neutron flux monitor shall be operable with a count rate of no more than a factor of 2 above the initial count rate during backfilling of the isolated loop. Because of requirement (b) above, makeup to the active portion of the Reactor Coolant System will be proceeding during the backfill evolution to maintain inventory. The source range monitor provides assurance that a boron dilution due to maladjustment of the Chemical and Volume Control System blender setting would be detected well in advance of inadvertent criticality.

Specific Changes

The following changes are applicable to both Units 1 and 2.

1. The Mode Applicability statement for Specification 3.4.1.4 is being changed from 'MODES 1, 2, 3, 4 and 5' to:

   APPLICABILITY: MODES 3, 4, and 5

   Specification 3.4.1.4 does not apply to Modes 1 and 2, since operation with an isolated loop is prohibited by Specification 3.4.1.1. This is

considered an editorial change. Similarly, the action to place the unit in at least HOT STANDBY has been removed since the loop stop valves cannot be closed in modes above HOT STANDBY.

2. The word 'undrained' is added to Surveillance Requirement 4.4.1.4 to clarify the condition for applicability of the surveillance:

4.4.1.4 The boron concentration of an isolated, undrained loop shall be determined to be greater than or equal to the boron concentration of the operating loops at least once per 24 hours and within 30 minutes prior to opening either the hot leg or cold leg stop valves of an isolated loop.

3. The title of Specification 3/4.4.1.5 is changed to read:

ISOLATED LOOP STARTUP - FILLED

4. The Limiting Condition For Operation for Specification 3.4.1.5 will be reworded to read as follows:

3.4.1.5 A reactor coolant loop cold leg stop valve on an undrained loop shall remain closed with AC power removed and its breakers locked open* unless:

a. The isolated loop has been operating on a recirculation flow of greater than or equal to 125 gpm for at least 90 minutes and the temperature at the cold leg of the isolated loop is within 20 °F of the highest cold leg temperature of the operating loops, AND

b. The reactor is subcritical by at least 1.77 percent Δk/k, OR

c. The loop is be ackfilled in accordance with Specification 3.4.1.6.

* A cold leg stop valve in a reactor coolant loop may be closed for up to two hours for valve maintenance or testing. If the stop valve is not opened within two hours, AC power shall be removed from the valve and the breaker locked open.

The words 'on an undrained loop' are added to limit the applicability of the specification to RCS loops that are already filled. The case of unisolating a drained loop via backfill will be addressed in new Specification 3.4.1.6.

considered an editorial change. Similarly, the action to place the unit in at least HOT STANDBY has been removed since the loop stop valves cannot be closed in modes above HOT STANDBY.

2. The word 'undrained' is added to Surveillance Requirement 4.4.1.4 to clarify the condition for applicability of the surveillance:

4.4.1.4 The boron concentration of an isolated, undrained loop shall be determined to be greater than or equal to the boron concentration of the operating loops at least once per 24 hours and within 30 minutes prior to opening either the hot leg or cold leg stop valves of an isolated loop.

3. The title of Specification 3/4.4.1.5 is changed to read:

ISOLATED LOOP STARTUP - FILLED

4. The Limiting Condition For Operation for Specification 3.4.1.5 will be reworded to read as follows:

3.4.1.5 A reactor coolant loop cold leg stop valve on an undrained loop shall remained closed with AC power removed and its breakers locked open* unless:

a. The isolated loop has been operating on a recirculation flow of greater than or equal to 125 gpm for at least 90 minutes and the temperature at the cold leg of the isolated loop is within 20 °F of the highest cold leg temperature of the operating loops, AND

b. The reactor is subcritical by at least 1.77 percent $\Delta k/k$, OR

c. The loop is being backfilled in accordance with Specification 3.4.1.6.

* A cold leg stop valve in a reactor coolant loop may be closed for up to two hours for valve maintenance or testing. If the stop valve is not opened within two hours, AC power shall be removed from the valve and the breaker locked open.

The words 'on an undrained loop' are added to limit the applicability of the specification to RCS loops that are already filled. The case of unisolating a drained loop via backfill will be addressed in new Specification 3.4.1.6.

Removing power and locking the breakers to the valve provides added protection against inadvertent opening of the valves. Two hours are allowed to stroke the valve for maintenance or testing without the requirement to run the reactor coolant pump on bypass for 90 minutes prior to reopening the valve. The potential for an undetected change in the loop boron concentration or temperature is negligible during this period.

5. The Mode Applicability statement for Specification 3.4.1.5 is being changed from 'ALL MODES' to:

APPLICABILITY: MODES 3, 4, 5 and 6

Specification 3.4.1.5 does not apply to Modes 1 and 2, since operation with an isolated loop is prohibited by Specification 3.4.1.1. This is considered an editorial change.

6. The following statement is added to the Specification 3.4.1.5 ACTION:

AC power shall be removed from the valve and the breaker locked open within 2 hours.

This additional statement is consistent with and ensures adherence to the Limiting Condition for Operation.

7. New Limiting Condition for Operation 3.4.1.6 is added:

3.4.1.6 Whenever a reactor coolant loop is isolated and drained, AC power shall be removed from the loop stop valves and the associated breakers locked open.

a. The valves may be energized and/or opened to fill the loop from the active volume of the Reactor Coolant System, once the following conditions are met:

1. The isolated loop shall be drained.

2. Pressurizer water volume shall be at least 450 cubic feet.

3. A source range neutron flux monitor shall be operable.

b. During backfilling of the isolated loop,

1. Pressurizer water volume shall be maintained at or above 450 cubic feet.

2. The source range neutron flux count rate shall be no more than a factor of 2 above the initial count rate.

3. The hot and cold leg stop valves shall be fully opened within 2 hours after the backfill of the isolated loop has been completed.

APPLICABILITY: MODES 5 and 6.

ACTION:

a. If the isolated loop is not drained then it must be fully drained before initiating backfilling.

b. If the pressurizer water volume is not maintained at 450 cubic feet or greater, then the loop stop valves on the loop being filled shall be closed, AC power shall be removed from the valves and the breakers locked open.

c. If the loop stop valves are not fully open within 2 hours after the loop is filled, then the loop shall be isolated and drained or apply Specification 3.4.1.4 and 3.4.1.5.

d. If the source range count rate increases by a factor of two over the initial count rate, then the hot and cold leg loop stop valves shall be reclosed, power removed from the breakers and the breakers locked open. No attempt shall be made to reopen the loop stop valves until the reason for the count rate increase has been determined.

New LCO 3.4.1.6 is supported by the following surveillance requirements:

4.4.1.6.1 The isolated loop shall be verified drained within 2 hours prior to opening the loop stop valve for backfilling the loop from the RCS.

4.4.1.6.2 The pressurizer water volume shall be verified to be $\geq$ 450 cubic feet at least once per 15 minutes during filling of the isolated loop.

4.4.1.6.3 The source range neutron flux monitor shall be demonstrated OPERABLE by performance of

a. A CHANNEL FUNCTIONAL TEST within 8 hours prior to commencing isolated loop backfill, and

b. A CHANNEL CHECK at least once per 15 minutes during backfilling of an isolated loop.

8. The following shall be added to the BASIS section to support new Specifications 3/4.4.1.6:

3/4.4.1.6

An initially isolated and drained reactor coolant loop may be returned to service by partially opening the loop stop valves and filling the loop in a controlled manner from the Reactor Coolant System. Prior to partially opening the loop stop valves, the following measures are required to ensure no sudden positive reactivity addition or loss of Reactor Coolant System inventory occurs:

a. The isolated loop is verified to be drained, thus preventing the dilution of Reactor Coolant System boron concentration by liquid present in the loop.

b. Pressurizer level is verified to be greater than or equal to 450 cubic feet to ensure Reactor Coolant System inventory is maintained for decay heat removal. Pressurizer level is required to be maintained greater than or equal to 450 cubic feet during the backfill evolution. In addition, the backfill evolution is limited to one isolated loop at a time.

c. A source range neutron flux monitor channel is required to monitored to detect any unexpected positive reactivity addition due to an inadvertent mismatch between RCS and blended makeup concentration.

After an initially drained loop is filled from the Reactor Coolant System by partially opening the loop stop valves, the loop is no longer considered to be isolated. Thus, the requirements for returning an isolated and filled loop to service are not applicable and the loop stop valves may be fully opened without restriction within two hours of completing the loop backfill evolution.

The initial pressurizer level requirement has been established such that, even if the stop valves are suddenly opened on all three loops with all of them drained, one of them under vacuum and no makeup available, the Reactor Coolant System water level will not drop below the middle of the reactor vessel nozzles. This ensures continued adequate suction conditions for the residual heat removal pumps.

The safety analysis assumes a minimum shutdown margin as an initial condition. Violation of the limiting conditions for loop stop valve operation could result in the shutdown margin being reduced to less than that assumed in the safety analysis. In addition, violation of the limiting conditions could cause a loss of shutdown decay heat removal.

Safety Significance

The proposed changes were evaluated against the station design and licensing basis for the prevention of reactivity addition events during restoration of an isolated reactor coolant loop.

Implementation of the proposed Technical Specification changes will require elimination of a portion of the current loop stop valve interlocks in order to utilize the option of loop backfill. However, the restrictions previously imposed by the interlocks will be retained for the case of restoring an isolated and filled loop via Specification 3.4.1.5 and the associated operating procedures. These procedures will continue to ensure that restoration of a filled, isolated loop is a controlled evolution involving gradual and limited reactivity changes. This will be done, as is currently done, via strict controls on the temperature and boron differential between the isolated loop and the active portion of the RCS and by requiring 90 minutes of recirculation flow of at least 125 gpm. In addition, the precondition of shutdown margin in excess of 1.77% prior to restoring the isolated loop will still apply. Therefore the potential for inadvertent criticality during restoration of a filled, idle loop has not been increased.

For the option of backfill of an isolated and drained loop via the RCS, the restrictions imposed by new Specification 3.4.1.6 ensure that 1) no potential is created for the introduction of unsampled water from the loop to the core after the evolution; 2) adequate RCS inventory for core cooling is maintained throughout the evolution; 3) no potential for reactivity transients due to undetected changes in the boron concentration or temperature in the backfilled loop is created; and 4) no potential for an undetected boron dilution as a result of mismatch between the boron concentration of the makeup stream and the RCS is created. Therefore operation under the proposed new Specification 3.4.1.6 will not increase the potential for an inadvertent criticality.

As such, no new accident types or sequences are created by these proposed changes. The probability of a boron dilution or cold water accident is not increased, and the consequences of the accidents associated with loop stop valve misoperation remain bounded by those assessed in the UFSAR. The margin of safety described in the basis for the existing Technical Specifications is not decreased.