VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

March 30, 1994

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

Serial No. 94-190
NL&P/MAE: R2
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 CHANGES
HIGH HEAD SAFETY INJECTION FLOW BALANCING

Pursuant to 10 CFR 50.90, the Virginia Electric and Power Company (Virginia Power) requests amendments, in the form of changes to the Technical Specifications, to Facility Operating License Nos. NPF-4 and NPF-7 for North Anna Power Station Units 1 and 2, respectively. The proposed changes will revise the High Head Safety Injection (HHSI) flow balance surveillance requirements by removing specific numerical values and replacing them with a broader requirement to ensure that the HHSI flow rates meet the loss of coolant accident (LOCA) analysis acceptance criteria and pump runout limits.

Virginia Power had previously been granted two license amendments (on August 4, 1993 and November 23, 1993) involving the HHSI flow balance surveillance requirements. Those amendments first expanded the acceptance range, then subsequently deleted a specified value for the simulated reactor coolant pump seal injection flow rate when unexpected difficulties were encountered in meeting the amended requirement. In each instance, system performance was evaluated and demonstrated to be within the limits of the applicable safety analysis. However, as a result of detailed engineering investigations, it was recognized that the margins relied on in those evaluations could be better utilized by directly incorporating them in the Technical Specification surveillance requirements. Thus, the proposed amendments take full advantage of existing margins in both the LOCA analysis acceptance criteria and pump runout limits and provide the flexibility necessary to support future surveillance testing. Approval of this proposed Technical Specification change is requested to support planned HHSI flow balance surveillance testing during the upcoming North Anna Unit 1 refueling outage, currently scheduled to begin on September 9, 1994.

A discussion of the proposed changes is provided in Attachment 1. The proposed changes are presented in Attachment 2.

A001

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 these 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,

RF Saunders for

W. L. Stewart
Senior Vice President - Nuclear

Attachments

cc: U.S. Nuclear Regulatory Commission
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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 R. F. Saunders, who is Assistant Vice President - Nuclear Operations, for W. L. Stewart 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 30TH day of March, 1994.

My Commission Expires: May 31, 1994.

Vicki L. Hull
Notary Public

(SEAL)

Attachment 1

Discussion of Changes

DISCUSSION OF CHANGES

INTRODUCTION

North Anna Units 1 and 2 Technical Specification 4.5.2.h requires a surveillance test of the high head safety injection (HHSI) system following the completion of any modification to the Emergency Core Cooling System (ECCS) subsystems that could alter the subsystem flow characteristics. The current surveillance criteria specify values for the sum of the injection line flow rates, excluding the highest flow rate, and the total pump flow rate. These correspond to requirements for the safety analysis flow input and the HHSI pump runout limit, respectively.

The proposed changes would remove specific numerical values and replace them with requirements to ensure that HHSI flow rates meet the loss of coolant accident (LOCA) analysis acceptance criteria and pump runout limits. A discussion of the constraints that affect the HHSI flow balance will also be added to the Bases of the Technical Specifications. These proposed changes are similar in concept to NUREG-1431, Standard Technical Specifications (STS), Westinghouse Plants, dated September 1992.

The HHSI test acceptance criteria in the current Technical Specifications are very narrow because of the various system physical and technical constraints that need to be considered in the flow balance testing. These acceptance criteria may also be more restrictive than required by either the LOCA analysis or the actual pump runout requirements. For example, the LOCA analysis contains input conservatisms that could be used to offset a reduction in the required HHSI flow while still meeting the 10 CFR 50.46 LOCA acceptance criteria. The proposed Technical Specification changes would permit the use of additional available margin, while maintaining a strong technical linkage between the measured system performance and the safety analysis. Although these proposed Technical Specification changes remove the numerical values from Technical Specification 4.5.2.h, neither the methodology nor the acceptance criteria for LOCA analysis are affected. Therefore, the current margins of safety for the plant will not be affected.

BACKGROUND

License Amendments Nos. 171 and 151 were issued for North Anna Units 1 and 2, respectively, on August 4, 1993. The changes to the Technical Specifications decreased the sum of the two lowest flow rates from $\geq$ 384 to $\geq$ 359 gpm, increased the total pump flow rate from $\leq$650 to $\leq$660 gpm, and added a value of $\geq$ 48.3 gpm to be used for simulated reactor coolant pump (RCP) seal injection.

The revised Technical Specification for the sum of the two lowest flow rates removed the allowance for instrument uncertainty. Instrument uncertainty is now added

to the revised limit prior to comparing to the raw surveillance results. The total pump flow rate was revised based on an engineering study that determined that the total flow rate should be limited to ≤ 660 gpm in order to prevent HHSI flow from exceeding the manufacturer's maximum flow rate for these pumps during the safety injection recirculation mode. The expanded acceptance range ensured that measured system performance remained bounded by the safety analysis requirements and the pump design while allowing more flexibility in the testing. Simulated RCP seal injection was added to the Technical Specifications for completeness of the surveillance requirements, and to reflect actual surveillance tests.

Emergency License Amendments Nos. 176 and 157 were issued for North Anna Units 1 and 2, respectively, on November 23, 1993. The emergency license amendments documented an NRC approved enforcement discretion which deleted the simulated RCP seal injection flow requirement. An emergency situation existed because the limitation on the RCP seal injection flow specified by the Technical Specifications had inhibited our ability to meet the minimum and maximum flow rates. To ensure that the total pump flow rate did not exceed the 660 gpm limit, the RCP seal injection was lowered. By meeting the sum of the flows and the total pump flow requirements with reduced seal injection, the limits of the safety analysis were met with margin.

These proposed Technical Specification changes are intended to provide more flexibility in establishing a wider range for the HHSI flow balance acceptance criteria. The Loss of Coolant Accidents (LOCA) are limiting for the minimum injection flow rate due to the assumption of ECCS spillage from the faulted loop. The pump runout concern, for maximum flow, arises because the reactor coolant system pressure is reduced to the containment pressure for the large break LOCAs. Therefore, the HHSI flow balance requirements are constrained by a number of considerations, including a) the injection flows needed to meet the LOCA acceptance limits, b) the HHSI pump runout limits, which are pump dependent, c) the reactor coolant pump seal injection requirements and d) the type of instrumentation used to perform the flow balance test and its inherent accuracy. The implications of these changes are discussed further in the Safety Significance Section.

SPECIFIC CHANGES

General

The Technical Specification changes described herein apply to North Anna Units 1 and 2.

TS 4.5.2.h.1.a

The sum of the two lowest flow rates (359 gpm) in TS 4.5.2.h.1.a will be replaced with the phrase "the minimum flow rate required to demonstrate compliance with 10 CFR 50.46." The TS will now read:

4.5.2.h.1 ...

a. The sum of the injection line flow rates, excluding the highest flow rate, is greater than or equal to the minimum flow rate required to demonstrate compliance with 10 CFR 50.46, and

b. ...

TS 4.5.2.h.1.b

The total pump flow rate (660 gpm) in TS 4.5.2.h.1.b will be replaced with the phrase "the evaluated pump runout limit." The TS will now read:

4.5.2.h.1 ...

a. ...

b. The total pump flow rate is less than or equal to the evaluated pump runout limit.

TS Bases 3/4.5.2 and 3/4.5.3

Additional discussion on the constraints that affect the HHSI flow balance is being added to the Bases. The current Bases for Units 1 and 2 are identical except for one sentence at the end of the Unit 2 Bases. The additional sentence addresses surveillance requirements for minimum injected flow and the HHSI pump runout. The additional sentence will be removed from the Unit 2 basis since it is superseded by the discussion being added. The addition to the Technical Specifications Bases is as follows:

In the event of modifications to an ECCS subsystem that could alter the subsystem flow characteristics, a flow balance test shall be performed. The flow balance test criteria are established based on the system performance assumed in the safety analysis (minimum flow limit) and on HHSI pump runout protection (maximum flow limit). In performing the flow balance, the effects of flow measurement instrument uncertainties accounting for system configuration and the variability between installed pumps must be properly considered.

Numerical acceptance criteria for the flow balance test are specified in the surveillance test procedure. These criteria are established based on the following considerations:

1) The total injected flow to the core (assuming spillage of the branch line with the highest flow) must meet or exceed that assumed in the safety analysis. The limiting safety analysis is the loss of coolant accident (LOCA) analysis. This criterion may vary, particularly since the inputs to the safety analysis controlled by LCO 6.9.1.7 may vary with reload cycle. The safety analysis flow requirements are thus established by the currently applicable LOCA analysis which has demonstrated compliance with the ECCS acceptance limits of 10 CFR 50.46.

2) The total pumped flow must be less than the HHSI pump runout limit. This flow varies with the specific HHSI pump assumed to operate during the accident. Since the HHSI pumps also function as normal charging pumps, their characteristics, including runout limits, will vary over service life.

3) The requirements for reactor coolant pump seal injection must be met during normal operation,

and the effects of seal injection during accidents must be considered in meeting constraints 1) and 2) above.

Minor changes have been made to the Index and the page following the above mentioned Bases to account for page numbering changes and the additional text. In addition, minor editorial changes were made to the Index to make it consistent with the body of the Technical Specification.

SAFETY SIGNIFICANCE

The proposed Technical Specification changes would provide North Anna with Technical Specifications for HHSI flow requirements that are similar to those in the NUREG-1431, STS. The STS requirements ensure that the pumps provide the required head at the test flow point and that the ECCS throttle valve position stops are in the correct position. These requirements, as used, define the system flow rates for both injection and pump runout concerns. The STS do not specify numerical values for these particular limits. Since the HHSI system flow at North Anna is controlled with different components than assumed for the STS plant, the functional requirements of the North Anna Technical Specifications will not be changed. Instead, the requirements will be changed so that explicit numerical values will be replaced by equivalent functional statements. For the minimum flow requirement from the two lowest flow rate lines, the numerical value is replaced by the phrase "the minimum flow rate required to demonstrate compliance with 10 CFR 50.46." For pump runout, the requirement becomes "The total pump flow rate is less than or equal to the evaluated pump runout limit." Testing of the HHSI system to these flow requirements will ensure that the system as currently designed and installed will continue to meet its intended safety function.

The HHSI flow balance process is constrained by the following considerations:

1) The total injected flow to the core (assuming spillage of the branch line with the highest flow) must meet or exceed that used in the safety analysis. The minimum HHSI flow required to meet the acceptance limits specified in 10 CFR 50.46 is dependent on the values assumed for the other key LOCA analysis inputs. Inputs representing core peaking factor limits, fuel design parameters or system configuration (e.g., steam generator tube plugging) can change on a reload basis, requiring LOCA reanalysis.

2) The total pumped flow must be less than the HHSI pump runout limit. This flow is dependent on the particular characteristics of each pump and may be time dependent. Since the North Anna HHSI pumps also function as normal charging pumps, their characteristics, monitored on a regular basis, vary slowly over service life.

3) The requirements for reactor coolant pump seal injection must be met during normal operation, and the effects of the seal injection flow during

accident conditions must be considered in meeting constraints 1) and 2) above.

4) The effects of flow measurement instrument accuracies and the variability between installed pumps must be properly considered.

Both of the requirements for this Technical Specification are determined for LOCA conditions. HHSI pump runout is a concern during a large break LOCA when the reactor cooling system (RCS) becomes depressurized to essentially containment pressure. The small break LOCA analysis provides the limiting condition for the minimum HHSI flows because of the required assumptions for faulted loop spillage. For other transients which rely on HHSI flow, the reactor coolant system loops are essentially intact so that none of the HHSI flow need be assumed lost or ineffective. These transients include the main steam line break, the control rod ejection accident, and the steam generator tube rupture.

For the minimum flow requirement, any modification of the minimum HHSI flow requirement would be developed based on the available margins that exist within the LOCA analysis. Such considerations include margin to the acceptance criteria for ECCS limits (10 CFR 50.46), margins between previously assumed LOCA core peaking factors and the cycle specific core peaking factor limits, LOCA analysis input conservatisms, and generic penalties which may be imposed to address ECCS modelling issues. Any modification of the HHSI flow requirements will be calculated using NRC approved methodology as identified in Technical Specification 6.9.1.7, the Core Operating Limits Report. The approved core design uncertainties as identified in the references to Technical Specification 6.9.1.7 will also be maintained.

For the maximum flow requirement, an engineering study of individual HHSI pump runout capacity will be performed consistent with the manufacturer's recommendations. The results of the study will be documented in accordance with the requirements of the Virginia Power Nuclear Design Control Program. Use of these results to establish surveillance requirements in the periodic test procedures will be controlled by the Station safety evaluation process for 10 CFR 50.59.

A detailed analytical model of the system has been constructed to provide the relationship between the assumed accident analysis safety injection flows and those measured in the surveillance program. Inputs to this model include the various pump head curves, the resistances of the cold leg injection lines and the RCP seal injection line, the HHSI pump runout limit, and measurement instrument accuracy allowances. The HHSI flow model is used to provide bounding HHSI flow values as a function of RCS pressure for use in the LOCA analysis models. These, in turn, can be translated to specific limits for the HHSI surveillance test. The HHSI ECCS subsystem is tested following completion of modifications to this ECCS subsystem that can alter the subsystem flow characteristics in a configuration that represents the system resistances with the HHSI system delivering flow to a depressurized RCS. This testing is performed in accordance with controlled test procedures and accounts for appropriate test

instrument measurement accuracies. Comparison of the flow test results to the predicted flow rates are used to confirm that the system configuration meets the analysis requirements. In addition, the test results feed back to confirm the adequacy of the models for the HHSI flow rates.

The linkage between the flow balance surveillance requirements and the safety analysis will continue to be maintained in accordance with Virginia Power's Nuclear Design Control Program. Specifically:

- ECCS performance inputs to the LOCA and other safety analyses are documented along with the analysis results and comparison to the appropriate acceptance limits in engineering calculations. These are prepared, independently reviewed by a cognizant engineer, and approved in accordance with the requirements of the Virginia Power Nuclear Design Control and Quality Assurance Programs, Technical Specification 6.9.1.7, and 10 CFR 50.46. LOCA reanalyses and results will continue to be reported in accordance with the requirements of 10 CFR 50.46 and 10 CFR 50.59. The HHSI pump design runout limits are developed and documented by the same process.

- The translation of safety analysis results to surveillance limits will be done with the use of analytical models of the ECCS which relate delivered flow and runout performance under test conditions to performance under accident conditions. These models will again be developed, documented, reviewed and approved in engineering calculations. The calculations will consider the impact of surveillance instrumentation in developing the surveillance limits.

- Surveillance instrumentation uncertainties will themselves be developed, documented, reviewed and approved in accordance with the Virginia Power Nuclear Design Control Program.

- Incorporation of the surveillance limits into the station periodic test procedures will be done in accordance with station administrative procedures, which require a 10 CFR 50.59 safety evaluation and review/approval by the Station Nuclear Safety and Operating Committee. The surveillance procedures will reference the appropriate engineering calculations as the technical bases.

- Updates to the accident analyses and/or test acceptance limits will be incorporated into the UFSAR and/or station and system design basis documents, as appropriate.

The various constraints discussed above are dynamic in nature. Because of this, optimized numerical values for the HHSI system flow balance minimum requirements may change from test to test. The proposed changes address these anticipated variations, while maintaining a strong technical linkage between the measured system performance and the safety analysis. This approach to presenting the HHSI flow limits in the Technical Specifications will provide the flexibility to assure that the HHSI system

is balanced to meet all of the requirements listed above. By removing the explicit numerical values from the Technical Specification, additional margins in other portions of the LOCA analysis can be utilized to change the range of acceptable flow rates for the HHSI testing.

CONCLUSION

A safety evaluation has been performed for the proposed Technical Specification changes. By meeting the proposed Technical Specifications 4.5.2.h.1.a and b, the limits of the safety analysis are met with margin. The proposed Technical Specification changes provide design flexibility by removing some of the fixed constraints on both the system operation and the safety analyses. Continued operation of North Anna Power Station in accordance with the proposed Technical Specification changes will not:

1. Involve an increase in the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report. The proposed Technical Specification changes continue to require that with one HHSI pump running, the sum of the flows through the two lowest flow branch lines will be equal to or greater than the minimum HHSI flow rate required by the safety analysis and that the total pump flow shall be less than or equal to the evaluated HHSI pump runout limit. These requirements ensure the correct flow balance alignment with flow rates required to meet the safety analysis and maintain pump operability within acceptable flow rates. In addition, there are no physical changes to the plant. Therefore, the probability of an accident or malfunction is unchanged.

   Likewise, the consequences of the accidents or malfunctions previously evaluated will not increase as a result of the proposed Technical Specification changes. The system performance will remain bounded by the safety analysis for all postulated accident conditions. The safety analysis will continue to be performed and evaluated in accordance with the requirements of 10 CFR 50.59 and 10 CFR 50.46.

2. Create a possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report. The proposed Technical Specification changes will not affect the capability of the HHSI System to perform its intended function. The proposed Technical Specification changes are bounded by the existing safety analysis and do not involve operation of plant equipment in a different manner from which it was designed to operate. Since a new failure mode is not created, a new or different type of accident or malfunction is not created.

3. Involve a reduction in the margin of safety as defined in the basis for any Technical Specification. The system performance will continue to bound the flow rates specified in the safety analysis, therefore safety margins are not reduced.