VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 19, 1995

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

Serial No. 95-462
NL&OS/JDH R0
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
TURBINE REHEAT STOP AND INTERCEPT VALVES

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 increase the surveillance test interval and extend the visual and surface inspections for the turbine reheat stop and intercept valves. The relaxation of the testing frequency and inspections will provide operational flexibility while continuing to require an adequate level of testing and inspections to verify turbine control system operability. This request is being submitted as part of our Cost Beneficial Licensing Action (CBLA) program and complies with NRC guidelines for consideration as a CBLA submittal.

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

Attachments

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A001

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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 19TH day of September, 1995.

My Commission Expires: May 31, 1998.

Vicki L. Hull
Notary Public

(SEAL)

ATTACHMENT 1

DISCUSSION OF CHANGES

VIRGINIA ELECTRIC AND POWER COMPANY

Discussion of Changes

Introduction

Pursuant to 10 CFR 50.90, Virginia Electric and Power Company requests changes to Technical Specifications Surveillance Requirements 4.7.1.7.2 for North Anna Power Station Units 1 and 2. The Technical Specifications surveillance requirements currently require testing and inspection of the Turbine Overspeed Protection System control valves to ensure their ability to prevent overspeeding of the turbine. The proposed change would increase the surveillance test interval for the turbine reheat stop and intercept valves from "at least once per 31 days" to "at least once per 18 months" and extend the visual and surface disassembly inspection interval of the turbine reheat stop and intercept valves to 60 months. The surveillance test and disassembly inspection intervals for the turbine throttle and governor valves will continue to be consistent with the current Technical Specifications surveillance requirements.

The proposed changes would also revise the inspection criteria for the throttle, governor, reheat stop, and reheat intercept valve disassembly inspections. The change would remove the requirement to perform the disassembly inspection on all of the remaining turbine control valves of that type, when unacceptable flaws or excessive corrosion are identified which can be directly attributed to a service condition specific to the inspected valve.

The proposed changes to the North Anna Units 1 and 2 Technical Specifications will not adversely affect the safe operation of the plant. In addition, these proposed changes will not result in an unreviewed safety question as defined in the criteria of 10 CFR 50.59.

Background

Current Licensing Basis

The existing turbine overspeed protection system testing requirements were issued as part of the original operating licenses for North Anna Units 1 and 2 dated April 1, 1978 and August 21, 1980 respectively. This testing frequency was based on the

manufacturers instruction book for the operation and control of the North Anna Power Station Westinghouse steam turbines. By letter dated April 16, 1984, the NRC amended the North Anna Units 1 and 2 Technical Specifications (Amendment Nos. 56 and 38) to state that the turbine valves shall be demonstrated operable once per 31 days instead of once per 7 days as originally required. The revised surveillance requirement was based on past demonstrated reliability and performance of the turbine overspeed protection system and a viable ongoing maintenance inspection and turbine valve test program coupled with an in-place inspection program for the low pressure turbine discs.

Current Design Basis

The turbine overspeed protection system functions to prevent overspeeding the turbine-generator unit. As part of the turbine overspeed protection system, the control valves function to isolate the high-pressure and low-pressure turbines from the steam supply. There are four types of turbine control valves: the turbine governor valves, the turbine throttle valves, the turbine reheat stop valves, and the turbine reheat intercept valves. There are four of each type of these valves per unit. The governor valves and throttle valves control steam flow to the high-pressure turbine and the reheat stop and intercept valves control steam flow to the low-pressure turbines.

A turbine overspeed condition significantly increases the probability of turbine missile generation relative to operation at normal speed due to the increased stress in the turbine rotor at higher operating speeds. Regular testing and inspection of the turbine control valves reduce the probability of their failure and the probability of turbine overspeed. The primary function of the intercept valves is to operate during total or partial loss of load to prevent turbine overspeed while the reheat stop valves serve as an additional safety device to prevent overspeeding of the turbine. The reheat stop valves, upon closure, ensure that the residual steam in the moisture separator reheaters does not cause additional overspeeding.

The turbine overspeed protection system is described in Section 10.2 of the North Anna Power Station Updated Final Safety Analysis Report.

Relevant Licensing Experience

It should be noted that, by letter dated July 13, 1993, the NRC issued an amendment to Duquesne Light Company for Beaver Valley Power Station Unit 2 which provided similar increased flexibility for testing the turbine reheat stop and intercept valves.

Discussion

Westinghouse Electric Corporation has performed an evaluation for North Anna Power Station Units 1 and 2 of the probability of generating turbine missiles as a direct function of the reduced testing frequency of the reheat stop and intercept valves. The evaluation focused on the two overspeed events (e.g., design and intermediate overspeed) that are affected by the test intervals of the reheat stop and intercept valves. A third overspeed event (destructive overspeed) does not result from failures of these valves, therefore, it was not included in the evaluation. The North Anna turbines are also of the heavy hub design which reduces the probability of turbine generated missiles from disk failure resulting from a destructive overspeed. The results of their evaluation are discussed in Westinghouse evaluation report, "Evaluation of Turbine Missile Ejection Probability Resulting from Extending the Test Interval of Interceptor and Reheat Stop Valves at North Anna Units 1 and 2," dated December 21, 1994 (submitted herewith). The Westinghouse evaluation calculates the effects of extending the test interval for the reheat stop and intercept valves to 18 months using the fault tree models and methodology from the Westinghouse report WCAP-11525, "Probabilistic Evaluation of Reduction in Turbine Valve Test Frequency," dated June 1987. The NRC has accepted this methodology for use in the determination of the probability of turbine missile generation in a supplemental safety evaluation issued in their letter to Westinghouse Electric Corporation dated November 2, 1989. The throttle and governor valves were not within the scope of this evaluation and their surveillance frequency remains unchanged.

The turbine control valves have been tested monthly with no failures attributable to valve or control system malfunctions. In addition, operational experience has shown that the valves have not failed to close in response to turbine trip demands nor experienced valve stem sticking while the units were carrying load. This high level of reliability is maintained, in part, by the volatile chemical treatment of the feedwater

system which essentially eliminates valve failure due to scale buildup on the valve surfaces.

Reduction of the visual and surface inspection of the turbine overspeed protection system control valves is intended to eliminate clearly unnecessary inspections and is not intended to eliminate inspections necessary to achieve the objectives of the Technical Specifications surveillance requirements. The change would only remove the requirement to perform the disassembly inspection on all of the remaining turbine control valves of that same type, when unacceptable flaws or excessive corrosion are identified during the valve disassembly inspection which can be directly attributed to a service condition specific to the inspected valve. If an operational malfunction occurs, all valves of that same type will be inspected.

The extended visual and surface inspection interval for the turbine reheat stop and intercept valves to 60 months, provided that there is no indication of operational distress, is based upon the recommendation from Westinghouse Electric Corporation as part of their installation manual.

The proposed Technical Specifications changes are based upon past operational experience, Westinghouse recommendations for inspection intervals, and the results of the Westinghouse evaluation report included with this submittal.

Evaluation of Postulated Turbine Missiles

The turbine overspeed protection specification is provided to ensure that the turbine is protected from destructive overspeed. Protection from excessive overspeed is required since excessive overspeed of the turbine could generate potentially damaging missiles that could impact and damage safety-related components, equipment, or structures.

The North Anna Updated Final Safety Analysis Report (UFSAR) Section 10.2.1 describes the evaluation of postulated turbine missiles. Both the probability of missile ejection and the probability of impact to safety-related items were considered in the UFSAR as described below.

The probability (P4) of damage to plant structures, systems, and components important to safety is:

$$P4 = P1 \times P2 \times P3$$

where:

P1 = the probability of generation and ejection of a high energy missile,

P2 = the probability that a missile strikes a critical plant region, given its generation and ejection, and

P3 = the probability that the missile strike damages its target in a manner leading to unacceptable consequences. Unacceptable consequences are defined here as the loss of the capacity to maintain the integrity of the reactor coolant pressure boundary, to shut down the plant, maintain it in a safe-shutdown condition, and/or limit offsite radiation exposures.

The proposed changes to the North Anna Technical Specifications do not increase the probability of the generation of missiles or the probability of damage to any plant structures, systems, or components currently evaluated in the North Anna UFSAR.

Evaluation of Acceptance Criteria

The NRC staff considers 1×10^{-7} per year an acceptable risk rate for the loss of an essential system from a single event (reference NRC Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles"). Thus, the probability (P4) of damage to plant structures, systems, and components important to safety is an acceptable risk for values less than or equal to 1×10^{-7} per year.

The NRC staff also accepts a value of 1×10^{-2} for the combined probabilities of strike and damage (P2 x P3) for an unfavorably oriented turbine generator. (Reference NRC letter from C. E. Rossi to J. A. Martin of Westinghouse Electric Corporation, "Approval for Referencing of Licensing Topical Reports WSTG-1-P, WSTG-2-P, and WSTG-3-P," dated February 2, 1987.)

Based on an evaluation of the probability of damage to plant structures, systems, and components important to safety (P4 = P1 x P2 x P3) considering the acceptance of the

values described above for (P4) and (P2 x P3), a general acceptance criterion for probability of turbine missile ejection (P1) can reasonably be established as 1×10^{-5} per year.

Probability of Missile Ejection Resulting from Extending Test Interval

Three overspeed events were considered in evaluating the probability for missile ejection: design overspeed (120 percent of rated speed), intermediate overspeed (132 percent of rated speed), and destructive overspeed. The evaluation of turbine missile ejection probability focused on the design and intermediate overspeed events since they would be affected by the test intervals of the reheat stop valves and intercept valves. The destructive overspeed event does not result from failures of reheat stop and intercept valves and, therefore, was excluded from further consideration in this evaluation.

The Westinghouse evaluation presents the total probability of turbine missile ejection for the design and intermediate overspeed events. The total probability of turbine missile ejection is based on conditional probabilities of missile ejection given that design or intermediate overspeed occurs. The turbine overspeed event occurs if there is a system separation (generator trip). Therefore, the total probability for a missile ejection must be multiplied by the average annual frequency of system separation for the unit so that they can be measured against the acceptance criteria. Westinghouse conservatively assumed the bounding annual frequency of system separation to be one-half (0.5).

The Westinghouse evaluation determined the contribution of the total turbine missile ejection probability, due to design and intermediate overspeed, to be less than 5 percent of the "general" acceptance criteria for total missile ejection probability. This leaves an adequate reserve margin of 95 percent of the "general" acceptance criteria for other significant overspeed events such as destructive overspeed.

System Inspection Intervals

Westinghouse Electric Corporation's installation manual recommends that for nuclear units the inspection cycle for the turbine reheat and intercept valves can be increased to a maximum of 60 months provided there is no indication of operational distress.

Based upon this recommendation by Westinghouse, the maximum test interval for visual and surface inspection of the turbine reheat stop and intercept valves is proposed to be increased from 40 months to 60 months.

Reduction of the visual and surface inspection of the turbine overspeed protection system control valves is intended to eliminate clearly unnecessary inspections and is not intended to eliminate inspections necessary to achieve the objectives of the Technical Specifications surveillance requirements. The change would only remove the requirement to perform the disassembly inspection on all of the remaining turbine control valves of that same type, when unacceptable flaws or excessive corrosion are identified during the valve disassembly inspection which can be directly attributed to a service condition specific to the inspected valve. If an operational malfunction occurs, all valves of that same type will be inspected.

An increase in the visual / surface inspection interval of the turbine reheat stop and intercept valves will not reduce the safety of the plant. The Technical Specifications surveillance requirements will continue to require inspections necessary to ensure operability of the valves. Should a malfunction or degradation of any of these valves occur during operations, all valves of that type will be inspected for the same indications and corrective actions implemented.

Operating and Testing Experience

Operating experience and testing at North Anna Units 1 and 2 were also considered in support of these proposed Technical Specifications changes. There have been no incidents of turbine stop or intercept valve stem sticking while the units were carrying load. Industry experience also indicates that the extended test frequency will reduce damage to the moisture separator reheaters caused by cycling the reheat stop and intercept valves.

Industry Experience associated with Turbine Overspeed

The proposed Technical Specification changes were evaluated against industry experience associated with turbine overspeed events to determine if these changes could contribute to an increase in the probability of a turbine overspeed. The items reviewed included INPO Significant Event Report 7-92, "Turbine Failure Caused By

Overspeed" (Salem Unit 2 event of November 9, 1991), and NUREG-1275, "Operating Experience Feedback Report - Turbine-Generator Overspeed Protection Systems", dated April, 1995.

This review indicated that the primary factors contributing to turbine overspeed events were inadequate preventative and corrective maintenance on the Turbine Overspeed Protection System (TOPS) and system components and human factor deficiencies in performing TOPS surveillance testing. None of the referenced overspeed events were associated with the failure of turbine control valves (throttle, governor, reheat stop, and reheat intercept valves) to cycle closed when required to do so because of valve stem binding or valve failure.

The proposed change to the surveillance testing of the reheat stop and reheat intercept valves will extend the freedom of movement testing from at least once per 31 days to at least once per 18 months. This particular phase of turbine overspeed protection system testing is performed by energizing a solenoid operated valve (SOV) in the control oil supply to the actuator for the subject valve(s). This test SOV functions so that the control oil supply pressure will not be applied to the valve actuator and the subject valve will cycle closed. Deenergizing the test SOV will allow control oil pressure to be applied to the valve actuator and the valve will reopen. This test SOV is not part of TOPS and is not actuated on an actual or simulated turbine overspeed.

The proposed change to the surveillance testing for the reheat stop and reheat intercept valves does not modify the testing of any portion of the Turbine Overspeed Protection System other than the reheat stop and reheat intercept valves themselves. Therefore it has been determined that this proposed change will not increase the probability of a turbine overspeed event occurring of the type evaluated in the above documents.

Conclusion

The results of plant operating experience and testing as well as the manufacturers' recommendations have not disclosed significant problems relating to the proper operation of the turbine reheat stop and intercept valves. This taken together with the favorable turbine missile evaluation discussed above indicate that the turbine system reliability is acceptable with an 18-month test interval and a 60-month visual / surface

inspection interval for the reheat stop and intercept valves. Therefore, the proposed Technical Specification changes will not reduce the safety of the plant.

Specific Changes

The following specific Technical Specifications changes apply to both Units 1 and 2:

- Change the frequency for the turbine reheat stop valve testing by adding "at least once per 18 months" to the end of Surveillance Requirement 4.7.1.7.2.a.3.

- Change the frequency for the turbine reheat intercept valve testing by adding "at least once per 18 months" to the end of Surveillance Requirement 4.7.1.7.2.a.4.

- Clarify the test performance and verification requirements for the turbine overspeed protection system control valves by combining and rewriting Surveillance Requirements 4.7.1.7.2.a and 4.7.1.7.2.b into Surveillance Requirement 4.7.1.7.2.a as noted below:

    4.7.1.7.2 The above required turbine overspeed protection system shall be demonstrated OPERABLE

    a. By cycling each of the following valves through one complete cycle of full travel and verifying movement of each of the valves through one complete cycle by direct observation:

        1. Four Turbine Throttle valves at least once per 31 days,

        2. Four Turbine Governor valves at least once per 31 days, *

        3. Four Turbine Reheat Stop valves at least once per 18 months, and

        4. Four Turbine Reheat Intercept valves at least once per 18 months.

- Renumber Surveillance Requirement 4.7.1.7.2.c to 4.7.1.7.2.b.

- Renumber Surveillance Requirement 4.7.1.7.2.d to 4.7.1.7.2.c.

- Add "***" after "At Least once per 40 months, ..." in the first sentence of the new Surveillance Requirement 4.7.1.7.2.c.

- Add the following sentence to the end of the new Surveillance Requirement 4.7.1.7.2.c:

  "If unacceptable flaws or excessive corrosion are found, all other valves of that type shall be inspected unless the nature of the problem can be attributed to a service condition specific to that valve."

- Add the following sentence as footnote "***" at the end of the page 3/4 7-15 for Unit 1 and page 3/4 7-12 for Unit 2.

  "*** For reheat stop and reheat intercept valves, the inspection cycle may be increased to a maximum of once per 60 months provided there is no indication of operational distress."

Safety Significance

Virginia Electric and Power Company has reviewed these proposed Technical Specifications changes and determined that the changes would not involve an unreviewed safety question.

1. The proposed changes would not significantly increase 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 changes have no adverse impact upon probability or consequences of any accident previously evaluated. Only the frequency of the surveillance requirements for cycling and inspection of the turbine reheat stop and intercept valves are changed. No new or unique accident precursors are introduced by this change in surveillance requirements.

The heavy hub design of the turbine rotors provides further assurance that the probability of the ejection of destructive missiles remains minimal. Based upon the results of the probabilistic risk assessment, the probability of a turbine generated missile is less than 10^{-5} per year which the Commission has endorsed as the acceptable level for turbine operation.

Turbine reheat stop and intercept valve testing performed to date has demonstrated the reliability of these valves. In addition, the operability of the other turbine valves (i.e., turbine throttle valves and governor valves) will continue to be verified every 31 days or as required by the Technical Specifications.

The demonstrated high reliability of the turbine reheat stop and intercept valves and the verification of the operability of the other turbine control valves provide adequate assurance that the turbine overspeed protection system will operate as designed, if needed. Therefore, the proposed change does not involve a significant increase in the probability or consequences of any accident previously evaluated.

2. The proposed changes would not create the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report. The Technical Specifications will continue to require testing and inspection of the turbine stop and intercept valves to ensure operability of the turbine overspeed protection system. The Westinghouse evaluations only support reducing the frequency of tests and inspections.

   Operating experience at North Anna Units 1 and 2 support of these proposed Technical Specifications changes. There have been no incidents of turbine stop or intercept valve stem sticking while the units were carrying load. Industry experience also indicates that the extended test frequency will reduce damage to the moisture separator reheaters caused by cycling the reheat stop and intercept valves.

   The proposed revision to the Technical Specifications will not change in the method by which any safety-related system performs its function. The design and operation of the turbine overspeed protection and turbine control systems are not

being changed. Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed changes would not reduce the margin of safety as defined in the basis for any Technical Specifications. The design and operation of the turbine overspeed protection and turbine control systems are not being changed and the operability of the turbine reheat stop and intercept valves will be demonstrated on a refueling outage basis. The results of the probabilistic evaluation performed by Westinghouse have identified no increase in the overall probabilities of turbine overspeed or turbine missile generation. The results of the accident analyses which are documented in the UFSAR continue to bound operation under the proposed changes, so that there is no safety margin reduction. Therefore, the proposed change does not involve a reduction in a margin of safety.

Based on the above evaluation, the proposed changes to the Technical Specifications will not adversely affect the safe operation of the plant. Therefore, the proposed change request for North Anna Units 1 and 2 does not result in an unreviewed safety question as defined in the criteria of 10 CFR 50.59.

Westinghouse Evaluation Report

Evaluation of Turbine Missile Ejection Probability Resulting from Extending the Test Interval of Interceptor and Reheat Stop Valves at North Anna Units 1 and 2

Evaluation of Turbine Missile Ejection Probability Resu g From Extending The Test Interval of Interceptor and Reheat Stop Valves at North Anna Units 1 & 2

prepared by:
Westinghouse Electric Corporation
December 21, 1994

At the request of Virginia Power, an evaluation of the effects of extending the test intervals of the turbine interceptor and reheat stop valves on turbine missile ejection probability at North Anna Units 1 and 2 was performed using fault tree models and methodology from the Westinghouse report WCAP-11525, "Probabilistic Evaluation of Reduction in Turbine Valve Test Frequency," Reference 1. This methodology addresses the probability of missile generation and ejection, also referred to as probability P1 in Section 10.2.1 of the North Anna Power Station Units 1 and 2 Updated Final Analysis Report.

The evaluation focused on the two out of the three overspeed events defined in WCAP-11525 that are affected by the test intervals of the reheat stop valves (RSVs) and interceptor valves (IVs); design and intermediate overspeed. The third overspeed event in WCAP-11525, destructive overspeed, does not result from failures of RSVs and IVs and was not included in the evaluation.

For the design overspeed case, the criterion was any one control valve failing to close at the onset of overspeed followed by successful throttle valve closure, or any two interceptor valves failing to close at the onset of overspeed followed by successful reheat stop valve closure. The turbine overspeed for this case was 120% of normal running speed.

For the intermediate overspeed case, the criterion was one interceptor valve and one reheat stop valve in the same steam path failing to close. The turbine speed for this case was 132% of normal running speed.

North Anna Units 1 and 2 turbine missile ejection probabilities due to design and intermediate overspeed were calculated using the latest BB-296 control valve failure data and generic data from WCAP-11525. These probabilities have been calculated for RSV and IV test intervals of 3 months, 12 months, and 18 months. However, the test interval of the control valve in the analysis is assumed to be monthly, based on North Anna Technical Specification Turbine Surveillance Requirement 3/4.7.17. The failure rates of key components for the analysis are given in Table 1.

The fault tree quantification results of the turbine overspeed probability as a function of RSV and IV test interval are also given in Table 1. The results indicate that design overspeed is minimally affected by the extension of the IV and RSV test intervals because the overspeed is dominated by the failure of the control valves, as shown in Table 5. On the other hand, the results indicate that intermediate overspeed probability increases significantly with the extension of the IV and RSV test interval.

The conditional probabilities of missile ejection for design and intermediate overspeed are presented in Table 2. These conditional probabilities are used as multipliers on the results in Table 1 to determine the probabilities of missile ejection given the overspeed event. These conditional probabilities are based on a low-pressure (LP) turbine rotor inspection interval of 5 years. These values are conservative for this analysis because the LP turbine rotor inspection interval for North Anna Units 1 & 2 is 4.5 years (once every three refueling cycles). Table 3 lists the North Anna missile ejection probabilities for each overspeed event and the total probability as a function of IV and RSV test intervals.

The turbine overspeed event occurs if there is a system separation (generator trip); therefore, the total probabilities of turbine missile ejection presented in Table 3 were multiplied by the average annual frequency of system separation. A system separation frequency calculation performed for another class of Westinghouse turbines resulted in a frequency of 0.28 per year. A bounding system separation frequency of 0.5 per year was assumed for the North Anna plants. Table 4 presents the total missile ejection probabilities due to design and intermediate overspeed given that system separation occurs.

In verifying the suitability of turbine valve test intervals, it is suggested that the general NRC acceptance criterion for turbine missile ejection (Reference 2) be used. Reference 2 examined the probability of damage to plant structures, systems, and components important to safety: P4 = P1 * P2 * P3. P4 should be shown to be less than or equal to 1.0E-07. For an unfavorably oriented turbine, Reference 2 allowed a value of 1.0E-02 for the product of P2 * P3 (strike and damage probabilities). This allowance sets a general acceptance criterion for P1 (missile ejection) of 1.0E-05.

The acceptance criterion is applied to a total probability of turbine missile ejection which summed the turbine missile probabilities of all known overspeed events. This analysis did not consider destructive overspeed probability; therefore, the "general" acceptance criterion of 1.0E-05 per year for turbine missile ejection from unfavorably oriented turbine would not be acceptable. However, it would be reasonable to allocate a fraction of the general acceptance criterion (5 to 10 percent, for example, but no more than 25 percent) for the design and intermediate overspeed missile ejection probabilities evaluated herein. This would leave an adequate reserve margin of 75 to 95 percent of the acceptance criterion for other significant overspeed events such as destructive overspeed.

Table 4 shows that the results meet the acceptance criterion. The contribution of the turbine missile ejection probability, due to design and intermediate overspeed for 3 months, 12 months, or 18 months, to the total missile ejection probability acceptance criterion (1.0E-05 per year) is less than 5 percent.

References:

1. WCAP-11525, "Probabilistic Evaluation of Reduction in Turbine Valve Test Frequency," prepared by Westinghouse Electric Corporation for the WOG TVTF Subgroup, dated June 1987.

2. Letter from C. E. Rossi of the U. S. Nuclear regulatory Commission to J. A. Martin of Westinghouse Electric Corporation, dated February 02, 1987.

TABLE 1 Design & Intermediate Overspeed Probabilities as Function of Interceptor Valve (IV) and Reheat Stop Valve (RSV) Test Interval		
IV & RVS Test Interval	P(D) Design Overspeed Prob.	P(I) Intermediate Overspeed Prob.
3 months	5.17E-03	1.24E-06
12 months	5.34E-03	9.74E-06
18 months	5.46E-03	1.96E-05

Key Data for Table 1		
Component Failure Mode	Failure Rate (1 /hr)	Basis (See Notes Below)
Interceptor valve (IV) sticks open	2.91E-07	A
Reheat stop valve (RSV) sticks open	2.91E-07	A
Control valve sticks open	3.10E-06	B
Emergency trip fluid line (common to governor and interceptor valves) is clogged	6.97E-08	A
20/OPC solenoid valve failure	1.00E-05	C

Notes:

- A Original failure data from WCAP-11525, Rev. 0.
- B Current data base for BB-296 nuclear steam chest valves. The current failure data consists of 22 incidents of control valve sticking in 7,090,500 valve operating years.
- C This failure data applies for another class of Westinghouse turbines. It is conservative compared to the original data of 4.22E-07 /hr from WCAP-11525, Rev. 0.

TABLE 2

North Anna Units 1 & 2
Conditional Missile Ejection Probabilities for Design & Intermediate Overspeed

Overspeed (% Normal)		Conditional Probability
Design Overspeed (120%) -	P(M/D)	4.28E-05
Intermediate Overspeed (132%) -	P(M/I)	6.42E-04

TABLE 3

Probabilities of Turbine Missile Generation
Affected by Interceptor Valve (IV) and Reheat Stop Valve (RSV) Failure

(does not include system separation)

IV & RSV Test Interval	P(D) * P(M/D)	P(I) * P(M/I)	P(S) = [P(D) * P(M/D) + P(I) * P(M/I)]
3 months	2.22E-07	7.96E-10	2.22E-07
12 months	2.29E-07	6.25E-09	2.35E-07
18 months	2.34E-07	1.26E-08	2.47E-07

Notes:

- P(S) Probability of missile ejection due to design and intermediate overspeed (does not include system separation frequency).
- P(D) Probability of design overspeed (from Table 1).
- P(I) Probability of intermediate overspeed (from Table 1).
- P(M/D) Conditional probability of missile ejection at design overspeed (from Table 2).
- P(M/I) Conditional probability of missile ejection at intermediate overspeed (from Table 2).

TABLE 4

Probabilities of Turbine Missile Generation Affected by Interceptor Valve (IV) and Reheat stop Valve (RSV) Failure

(includes system separation)

IV & RSV Test Interval	P(S)	F(S)	P(T) = P(S) * F(S)
3 months	2.22E-07	0.5	1.11E-07
12 months	2.35E-07	0.5	1.18E-07
18 months	2.47E-07	0.5	1.24E-07

Notes:

- P(T) Probability of missile ejection due to design and intermediate overspeed (includes system separation frequency).
- P(S) Probability of missile ejection due to design and intermediate overspeed (does not include system separation frequency - from Table 3).
- F(S) Annual frequency of system separation.

TABLE 5

Importance Factors of Dominant Faults Contributing to Design and Intermediate Overspeed Probabilities

IV & RSV Test Interval	Importance Factors	
	Design Overspeed	Intermediate Overspeed
3 months	A (87.60) D (8.87) E (1.41)	B (85.32) D (54.99) C (38.40)
12 months	A (84.84) D (8.60) E (4.35)	B (94.65) C (70.64) D (25.31)
18 months	A (83.00) D (8.41) E (6.21)	B (95.72) C (77.84) D (18.65)

Notes:

- Importance factors are determined by summing the importances of all cutsets in which the fault appears.

- The letters A through E correspond to the following basic faults:

  A Control valve sticks open.

  B Reheat stop valve (RSV) sticks open.

  C Interceptor valve (IV) sticks open.

  D Emergency trip fluid line (common to governor and interceptor valves) is clogged.

  E Common cause failure of two interceptor valves stick open.

ATTACHMENT 2

PROPOSED TECHNICAL SPECIFICATIONS CHANGES
NORTH ANNA UNITS 1 AND 2

VIRGINIA ELECTRIC AND POWER COMPANY