UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 195 AND 176 TO

FACILITY OPERATING LICENSE NOS. NPF-4 AND NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY

OLD DOMINION ELECTRIC COOPERATIVE

NORTH ANNA POWER STATION, UNITS NO. 1 AND NO. 2

DOCKET NOS. 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated September 19, 1995, Virginia Electric and Power Company (VEPCO or the licensee) proposed changes to the Technical Specifications (TS) for the North Anna Power Station, Units No. 1 and 2 (NA-1&2). The proposed amendments 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, extend the visual and surface disassembly inspection interval of the turbine reheat stop and intercept valves to 60 months and revise the inspection criteria for the throttle, governor, reheat stop, and reheat intercept valve disassembly inspection. The proposed changes are the same as those approved for Beaver Valley Power Station, Unit 2, by amendment No. 53 to Facility Operating License No. NPF-73 issued July 13, 1993.

2.0 BACKGROUND

North Anna 1 and 2 are pressurized water reactors each utilizing a Westinghouse nuclear steam supply system and a three-loop reactor coolant system. The turbine generator for each unit is a conventional 1800 rpm Westinghouse tandem-compound unit consisting of one double-flow high pressure turbine and two double-flow low pressure turbines. Steam leaving the main high pressure turbine passes through four moisture separator-reheater units in parallel to the inlets of the low pressure turbines. Each of the four steam lines between the reheater outlet and low pressure turbine (crossover piping) are provided with a stop valve and an intercept valve in series.

The turbine control system is designed to trip the turbine under the following conditions: turbine overspeed, condenser low vacuum, excessive thrust bearing wear, reactor trip, generator trip, low bearing oil pressure, loss of electrohydraulic system power, loss of feedwater flow, or manual trip. Overspeed protection is accomplished by two independent systems - the electrohydraulic system and the mechanical overspeed system. The electrohydraulic system closes the governor and intercept valves if the turbine speed exceeds 103 percent of rated speed as sensed by an auxiliary reluctance pickup speed channel. If the turbine reaches 111 percent of rated speed, the mechanical overspeed sensor will trip the inlet stop valves and close all valves capable of admitting steam to the turbine. As another

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backup, the primary speed channel will also trip all valves at 111 percent of rated speed, using the auto-stop oil system. The primary speed channel receives a continuous turbine speed signal from a variable reluctance transducer mounted on the turbine shaft. The transducer output is a series of pulses whose frequency is proportional to turbine speed. At 111% of turbine speed, this system operates the emergency trip solenoid valve, which causes the auto-stop oil to drain, closing all steam valves to the turbine.

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.

3.0 EVALUATION

Existing surveillance requirement 4.7.1.7.2 requires that at least one turbine overspeed protection system be demonstrated OPERABLE: 1) every 31 days by direct observation of the movement of the 4 turbine throttle valves, the 4 turbine governor valves, the 4 turbine reheat stop valves and the 4 turbine reheat intercept valves through one complete cycle and 2) every 40 months, by disassembly of at least one of each of the preceding valves and performing a visual and surface inspection of all valve seats, disks and stems and verifying there are no unacceptable flaws or corrosion. Following implementation of the proposed change, the reheat stop valves and intercept valves would only be tested at 18 month intervals. The 4 throttle valves and the 4 governor valves will continue to be tested every 31 days. The proposed changes would extend the visual and surface disassembly inspection interval of the turbine reheat stop and intercept valves to 60 months provided there is no indication of operational distress. The proposed changes would also revise the inspection criteria for the throttle, governor, reheat stop, and reheat intercept valve disassembly inspections. The revision 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 conditi‐‐ specific to the inspected valve.

West... ..e Electric Corporation performed an evaluation for North Anna Power Station . its 1 and 2 (NA-1&2) of the probability of generating turbine missiles s 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 with the application). 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 staff accepted this methodology for use in the determination of the probability of turbine missile generation in a supplemental safety evaluation issued to Westinghouse Electric Corporation under a cover letter dated November 2, 1989. The throttle and governor valves were not within the scope of this evaluation and their surveillance frequency remains unchanged.

In the analysis performed by Westinghouse, the 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 were calculated for reheat stop valve and interceptor valve test intervals of 3 months, 12 months and 18 months. However, the test interval for control valves in the analysis was assumed to be monthly, since, as noted previously, the test frequency for the 4 throttle and governor valves in the TS will remain at least once per 31 days. 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. In order to provide a bounding estimate for failure of the overspeed protection control (OPC) solenoid valves, the analysis assumed a failure rate of 1.0 E-5/hr, which is conservative compared to the original data of 4.22 E-7/hr from WCAP-11525, Rev. 0. The conditional probabilities of missile ejection for design and intermediate overspeed were based on a low-pressure (LP) turbine rotor inspection interval of 5 years (60 months). This is conservative because the LP turbine rotor inspection interval at NA-1&2 is about 4.5 years (once every three refueling cycles).

The turbine overspeed event only occurs if there is a system separation (generator trip); therefore, the total probabilities of turbine missile ejection 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 NA-1&2.

Considering design and intermediate overspeed failure sequences only, the calculated conditional probability of turbine missile generation for an 18-month reheat stop and intercept valve surveillance test interval, given that generator load separation occurs, was determined to be 1.24 E-7 per year. The contribution of the turbine missile ejection probability, due to design and intermediate overspeed failures, to the NRC's total missile ejection probability acceptance criterion (1.0 E-5) is less than 5 percent. For NA-1&2, the product of the conditional probability of turbine missile generation for design and intermediate overspeed failure sequences, assuming proposed valve test and inspection intervals, and the assumed average generator load separation frequency, satisfies the appropriate acceptance criterion.

The extension of the reheat stop and intercept valve inspection interval is based on notification the licensee received from Westinghouse that the inspection interval may be increased to a maximum of 60 months provided there is no indication of operational distress.

In its September 19, 1995, submittal, the licensee stated that only clearly unnecessary inspections are intended to be eliminated by the removal of the requirement to inspect all valves of a given type if the identified problem can be directly attributed to a service condition specific to the inspected valve. Valve problems which are not directly attributable to a service condition specific to the inspected valve would continue to require inspections of all valves of that particular type.

Section 10.2 of the Standard Review Plan (SRP), NUREG-0800, provides guidance in evaluating the testing and inservice inspection of turbine steam admission valves. The purpose of the guidance is to ensure the turbine overspeed protection system will perform in a manner which satisfies the requirements of General Design Criterion (GDC) 4 of Appendix A to 10 CFR Part 50 with regard to the protection of structures, systems, and components important to safety from the effects of turbine missiles.

The proposed extension of the reheat stop and intercept valve test interval to once per 18 months and extension of the reheat stop and intercept valve inspection interval to once per 60 months were included as assumptions in the evaluation of turbine missile generation probability. The evaluation used a methodology previously accepted by the staff. The licensee has committed to perform surveillance testing and inspections to ensure that the turbine overspeed protection system is maintained and operated consistent with the assumptions of the evaluation. The staff reviewed the assumptions used in the evaluation and the methodology used to determine an appropriate acceptance criterion, and the staff found the approach to be acceptable. Since the evaluation demonstrates that the probability of turbine missile generation remains acceptably small following the proposed changes to the reheat stop and intercept valve test and inspection intervals, these proposed changes are acceptable.

Following identification of unacceptable flaws or excessive corrosion during inspection of one valve, other valves of that type are inspected to detect generic failure mechanisms indicated during the initial inspection. Clearly, if the identified problem can be directly attributed to a service condition specific to the inspected valve, a generic failure mechanism of the inspected valve type is not indicated. A problem directly attributable to a service condition specific to the inspected valve does not increase the expected failure probability of similar valves, and, consequently, the expected probability of turbine missile generation is not increased. Therefore, the proposed change removing the requirement to inspect other valves of a certain type following identification of a problem in a valve of that type, providing that the nature of the problem can be directly attributed to a service condition specific to the inspected valve, is acceptable.

The proposed amendment to NA-1&2 TS 4.7.1.7.2 complies with the requirements of GDC 4 of Appendix A to 10 CFR Part 50 with regard to the protection of structures, systems, and components important to safety from the effects of turbine missiles, and the change complies with the intent of the guidance of Section 10.2 of the SRP. The proposed amendment is, therefore, acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Virginia State official was notified of the proposed issuance of the amendment. The State official had no comment.

5.0 ENVIRONMENTAL CONSIDERATION

These amendments change a surveillance requirement. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that these amendments involve no significant hazards consideration and there has been no public comment on such finding (60 FR 54725). Accordingly, these amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: R. Clark

Date: February 8, 1996

SINGLE REQUEST

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