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

November 15, 2010

Mr. David A. Heacock
President and Chief Nuclear Officer
Virginia Electric and Power Company
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: NORTH ANNA POWER STATION (NAPS), UNIT NOS. 1 AND 2, FOURTH 10-YEAR INSERVICE TESTING INTERVAL PROGRAM, PUMPS AND VALVES RELIEF REQUEST (RR) (TAC NOS. ME2776 AND ME2777)

Dear Mr. Heacock:

By letter dated November 24, 2009, as supplemented by letters dated April 27, May 20, and August 19, 2010, Virginia Electric and Power Company (the licensee) submitted relief requests (RRs) P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, V-1, V-2 and V-3 from certain requirements of the American Society of Mechanical Engineers *Operation and Maintenance of Nuclear Power Plants Code* (ASME Code) at NAPS, Unit Nos. 1 and 2. Specifically, in accordance with Title 10 of the *Code* of *Federal Regulations* (10 CFR) 50.55a(a)(3)(i), 50.55a(a)(3)(ii), and 50.55a(f)(6)(i), the licensee proposed an alternative to requirements of ASME Code Class 1, 2, and 3 pumps and valves inservice testing (IST). The licensee requested implementation of this alternative during fourth 10-year IST program scheduled to start on December 15, 2010, and end on December 14, 2020.

Based on the review of the information the licensee provided, the NRC staff concludes pursuant to 10 CFR, Section 50.55a(a)(3)(ii), RR No. P-6 is authorized on the basis that compliance with the specified requirements of the ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. RR Nos. P-1, P-2 (Part-B), P-3, P-4, P-5, P-7, P-8, V-1, V-2, and V-3 were issued in a separate safety evaluation dated September 30, 2010. All other ASME Code requirements for which relief was not specifically requested and approved in the subject requests for relief remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions concerning this matter, please contact Dr. Sreenivas, at (301) 415-2597.

Sincerely,

Robert Martin for

Gloria Kulesa, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure:
Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOURTH 10-YEAR INTERVAL INSERVICE TESTING

RELIEF REQUEST NO. P-6

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2

VIRGINA ELECTRIC AND POWER COMPANY

DOCKET NOS. 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated November 24, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093350600), as supplemented by letters dated April 27, 2010 (ADAMS Accession No. ML101170589), May 20, 2010 (ADAMS Accession No. ML101440128) and August 19, 2010 (Accession No. ML102360041), Virginia Electric and Power Company (the licensee), requested relief from certain requirements of the American Society of Mechanical Engineers, *Operation and Maintenance of Nuclear Power Plants* Code (ASME Code), 2004 Edition, under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(f)(4)(ii), for the fourth 10-year Interval Inservice Testing (IST) Program for North Anna Power Station (NAPS), Unit Nos. 1 and 2. The NAPS Unit Nos. 1 and 2 fourth 10-year IST interval is scheduled to start on December 15, 2010, and end on December 14, 2020.

The U.S. Nuclear Regulatory Commission (NRC) staff has evaluated the licensee's submittal. Pursuant to 10 CFR 50.55a(a)(3)(ii), Relief Request (RR) No. P-6 is authorized on the basis that compliance with the specified requirements of the ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Section 50.55a(f), "Inservice Testing Requirements," requires, in part, that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed in accordance with the specified ASME Code and applicable addenda incorporated by reference in the regulations. Exceptions are allowed where alternatives have been authorized or relief has been requested by the licensee and granted by the NRC pursuant to paragraphs (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a.

In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety (10 CFR 50.55a(a)(3)(i)); (2) compliance would result in hardship or unusual difficulty without a

compensating increase in the level of quality and safety (10 CFR 50.55a(a)(3)(*ii*)); or (3) conformance is impractical for the facility (10 CFR 50.55a(f)(6)(i)). Section 50.55a allows the NRC to authorize alternatives and to grant relief from ASME Code requirements upon making necessary findings. NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provides alternatives to ASME Code requirements which are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, Revision 1, "Guidelines for Inservice Testing at Nuclear Power Plants."

The NRC's findings with respect to authorizing the alternatives and granting the relief to the ASME Code are given below:

3.0 TECHNICAL EVALUATION

3.1 Relief Request P-6

(a) System/Component(s) for Which Relief is Requested

Pumps: 1-RS-P-2A
1-RS-P-2B

2-RS-P-2A
2-RS-P-2B

System: Recirculation Spray
Group: B
Class: 2

Function: The outside recirculation spray pumps supply borated spray to cool and depressurize the containment atmosphere following a containment depressurization actuation signal and maintain containment sub-atmospheric following an accident.

(b) ASME Code Requirements

ISTB-3300(e)(1) (Reference Values) requires that reference values shall be established within +20% of pump design flow rate for comprehensive tests.

ISTB-3100, "Preservice Testing," ISTB-3100(b) requires preservice testing of vertical line shaft pumps to be performed in accordance with ISTB-5210, "Preservice Testing."

ISTB-5210(a) states that in systems where resistance can be varied, flow rate and differential pressure shall be measured at a minimum of 5 points. If practicable, these points shall be from pump minimum flow to at least pump design flow. A pump curve shall be established based on the measured points. At least one point(s) -shall be designated as the reference point(s).

(c) Licensee's Request for Relief

The licensee has requested to use an alternative from the Code requirements of paragraphs ISTB-3100(b) and ISTB-3300(e)(1), for performing comprehensive and preservice pump testing of the outside recirculation spray pumps, 1-RS-P-2A and 2B and 2-RS-P-2A and 2B.

The outside recirculation spray pumps supply borated water spray to cool and depressurize the containment atmosphere following a containment depressurization actuation signal. The borated water spray also maintains containment pressure sub-atmospheric following an accident. There are two outside recirculation spray pumps per unit. The test loop for the outside recirculation spray pumps consists of a 10-inch pump discharge line feeding into a 4-inch recirculation line which feeds back to the pump sump (See Figure P-6.1, ADAMS Accession No. ML093350600).

Note: All Referenced Figures' numbers used herein are the same as in the NAPS, Unit Nos. 1 and 2 submitted RR P-6. The licensee states that NAPS, Unit Nos. 1 and 2 have similar Figures numbers. The referenced figures are not reproduced herein. Only a portion of Figure P-6.2 (ADAMS Accession No. ML093350600) is reproduced for clarification.

(d) Licensee's Basis for Requesting Relief

> The outside recirculation spray pumps for Unit 2 were subject to long term full flow testing in 1979, during the construction phase of the plant. A test loop was established by replacing the spray nozzles from each of the two spray headers (150 nozzles for each header) with plugs, discharging pump flow to the spray headers and directing the flow back to the containment sump. A dike was constructed around the containment sump to simulate water levels in containment that are expected during an accident. The outside recirculation spray pumps took suction from the sump, thus, completing the loop. Reestablishing this full flow test loop for the purpose of periodic testing would require significant plant modifications and is not practicable.
>
> [Currently], the spray headers [and nozzles] are inaccessible without installing a significant amount of scaffolding. Even if the nozzles were accessible, the plugging of 300 spray nozzles, running the full flow test and returning the system to its operable configuration present substantial challenges in terms of the complexity of the temporary modifications, labor intensive nature of the modifications, and controls and post modification testing needed to ensure that the system is returned to the original configuration.

Consequently, full flow testing cannot be performed in the existing 10-inch discharge piping because the water would be directed to the spray headers, which would spray water throughout the containment. Also, the discharge piping was not designed to be temporarily reconfigured so that pump design flow could be achieved. However, the 4-inch recirculation line is available for comprehensive and preservice pump testing.

(e) Licensee's Proposed Alternative

The loss-of-coolant accident (LOCA) containment analysis assumes that the outside recirculation spray pumps deliver 3350 gallons per minute (gpm). The LOCA containment accident analysis flow rate of 3350 gpm is used as the pump design flow. To be within 20% of the pump design flow rate, as required by ISTB-3300(e)(1), requires a reference flow of 2680 gpm. With the 4-inch recirculation line as the test loop, only a flow rate of approximately 1450 gpm can be established. This is approximately 43% of the design flow rate. Therefore, the licensee proposes to establish the reference values for comprehensive pump testing at approximately 1450 gpm or within 57% of the design flow.

Testing at design flow is important for pumps with characteristic head-flow curves that are flat or gently sloping in the low flow region (little change in developed head with increasing flow). In the low flow region, increasing internal flows, usually due to wear, are difficult if not possible to detect. Pumps with the "flat" curves at low flows should be tested at or near design conditions to determine if increasing internal recirculation flows have degraded pump performance to the point where design requirements cannot be met. This situation does not apply to the outside recirculation spray pumps if they are tested within 57% of the design flow. Testing at approximately 43% of the design flow will allow for detection of pump degradation because the pump curve for these pumps is highly sloped at the point of testing (Refer to Figure P-6.2, ADAMS Accession No. ML093350600).

The licensee stated that:

> In addition to the testing described above, the outside recirculation spray pumps are included in the North Anna Predictive Maintenance (PdM) Program. This program employs predictive monitoring techniques such as:
>
> - Vibration monitoring and analysis beyond that required by ISTB, and
> - Oil sampling and analysis (i.e. the upper and lower outside recirculation spray pump motor bearing oil reservoirs will be sampled as part of the PdM program).
>
> If the measured parameters are outside the normal operating range or are determined by the analysis to be trending towards an unacceptable degraded state, appropriate actions are taken that may include:
>
> - Increased monitoring to establish the rate of change,
> - Review of component-specific information to identify cause(s), and
> - Removal of the pump from service to perform maintenance
>
> With the restrictions described above, the highest flow rate that can be measured while maintaining stable test conditions is approximately 1450 gpm or approximately 43% of the pump design flow rate. Therefore, the five data points for the preservice test pump curve will be measured at points at or below 1450 gpm. Should a preservice or baseline curve be required, the manufacturer curve will be used in conjunction with the pump minimum operating point curves and the points

obtained will be reconciled to the manufacturers curve to provide assurance of acceptable pump operation.

(f) NRC Staff's Evaluation

As noted above, to perform pump testing within 20% of the design flow rate would require testing through the spray headers. However, the spray headers have open nozzles that are inaccessible without installing a significant amount of scaffolding. Even if the nozzles were accessible, plugging 300 spray nozzles (150 nozzles per spray header), running the full-flow test and returning the system to its original operable configuration would cause a hardship to the licensee without a compensating increase in quality and safety. Alternately, establishing a full design flow test loop in NAPS Unit Nos. 1 and 2, for the purpose of testing every 2 years, would require significant plant modifications and would not be practicable. Additionally, plugging and unplugging the spray nozzles or establishing temporary full flow test loops, along with installing and removing scaffolding, would increase personnel radiation exposure rates.

In lieu of testing through the spray headers or temporary full flow test loops, the licensee proposes to perform comprehensive and preservice pump testing using the 4-inch recirculation test loop line. Due to the size of this line, pump flow will be restricted and a flow rate within 20% of the design flow rate (3350 gpm) cannot be achieved. The design flow rate is the same as accident flow rate.

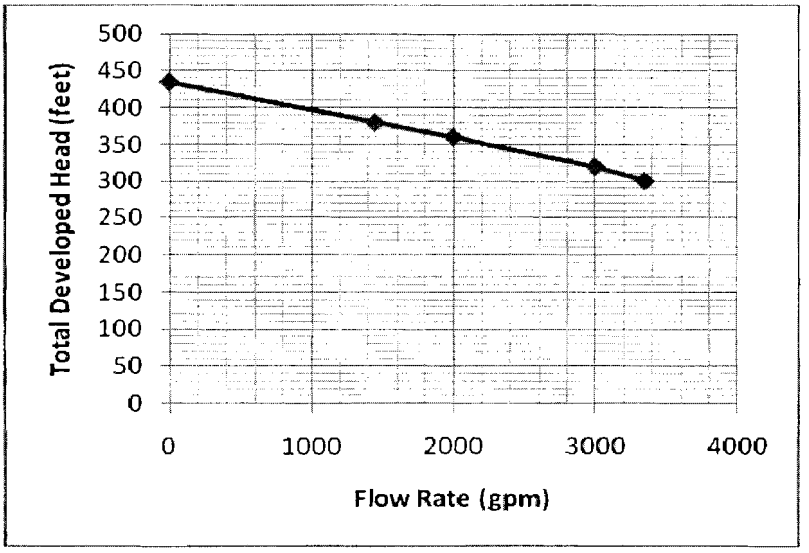
As an alternative to the testing within 20% of the design flow rate, as required ISTB-3300(e)(1), the licensee requested to set the reference value flow rate, of the outside recirculation spray pumps, at 1450 gpm during comprehensive pump testing. This is within approximately 57% of the design flow rate. Additionally, as an alternative to measuring at least five points for the preservice test, over a range of the pump minimum flow rate to at least the pump design flow rate, as required by ISTB-3100(b) and ISTB-5210(a), the licensee proposes to obtain the five points between the minimum flow rate and approximately 43% of the design flow rate.

Normally, pump testing at design flow is required because the reduction in the total developed head (TDH) increases as the pump flow increases. In the low flow region of the pump curve, increasing internal flow rates, as a result of internal wear, are difficult to detect. Pumps with flat curves in the at low flow region, should be tested at or near design conditions to determine if increasing internal recirculation flows have degraded pump performance to the point where design performance cannot be met. However, for the outside recirculation spray pumps at NAPS, Unit Nos. 1 and 2 the pump curves are not flat but highly sloped at approximately 43% of the design flow (Figure P-6). The NRC staff determined that testing at 43% of the design flow rate should allow for detection of degradation in the outside recirculation spray pumps, since the TDH changes noticeably with increased flow in this area of the pump curve. The following data (Table P-6) and curve (Figure P-6) for the pumps are derived from Figure P-6.2m, ADAMS Accession No. ML093350600:

Table P-6

Flow (gpm)	0	1450	2000	3000	3350
Total developed Head (feet)	435	380	360	320	300

Figure P-6
Outside Recirculation Spray Pump - Head-Flow Curve



Also, the licensee noted in their submittal that the outside recirculation spray pumps are included in the NAPS, Unit Nos. 1 and 2 PdM Program. The PdM Program employs predictive monitoring techniques such as vibration monitoring and its analysis. The outside recirculation spray pumps motor bearing reservoirs are also subject to periodic oil sample analysis. If measured parameters are outside the normal operating range or are determined by analysis to be trending toward a degraded state, the licensee will increase monitoring of additional parameters, review component-specific information to identify cause(s) for the abnormal parameters, and possibly remove the pump from service to perform corrective maintenance. The NAPS, Unit Nos. 1 and 2 PdM activities are beyond what is required by Subsection ISTB of the ASME OM Code. Therefore, the NRC staff finds that these additional actions provide further assurance of the ability to detect and correct pump degradation.

Based on a review of the pump curves information provided by the licensee and the description of the pump monitoring in the NAPS, Unit Nos. 1 and 2 PdM Program, the NRC staff finds that the alternative testing at lower flow rates for the outside recirculation spray pumps, 1-RS-P-2A/2B and 2-RS-P-2A/2B, provides reasonable assurance of the operational readiness of these pumps. Compliance with the specified ASME OM Code requirements would result in hardship without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

Based on the review of the information the licensee provided, the NRC staff concludes pursuant to 10 CFR 50.55a(a)(3)(ii), RR No. P-6 is authorized on the basis that compliance with the specified requirements of the ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. All other ASME Code requirements for which relief was not specifically requested and approved in the subject request remain applicable.

Therefore, the NRC staff authorizes the alternative noted above, at NAPS Unit Nos. 1 and 2, for the fourth 10-year IST program interval, which begins on December 15, 2010, and ends on December 14, 2020.

Principal Contributor: Gurjendra S. Bedi, NRR/DCI

Date: November 15, 2010

If you have any questions concerning this matter, please contact Dr. Sreenivas, at (301) 415-2597.

Sincerely,

/RA by RMartin Acting for/

Gloria Kulesa, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure:
Safety Evaluation

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