VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

December 16, 1993

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

Serial No. 93-624
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Docket Nos. 50-338
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License Nos. NPF-4
NPF-7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
INSERVICE TESTING PROGRAM PLANS
RESPONSE TO NRC SAFETY EVALUATION REPORT

Revision 6 of the ASME Section XI Inservice Testing (IST) Program Plans for Pumps and Valves for North Anna Units 1 and 2 was submitted to the NRC for review and approval by letter dated June 14, 1990 (Serial No. 90-368). In addition, changes to Revision 6 of the program plans with supplemental information were submitted by letter dated October 17, 1990 (Serial No. 90-368A). These submittals describe our IST Program Plans for the second ten-year inspection interval (December 14, 1990 - December 14, 2000) for both units.

By letter dated September 17, 1993, the NRC provided the Safety Evaluation (SE) report for Revision 6 of the IST Program Plans and for the close-out of outstanding actions regarding our response to Generic Letter 89-04. In Appendix A to the Technical Evaluation Report (TER) supporting the SE, the NRC identified three relief requests that were denied and need to be addressed by Virginia Electric and Power Company within three months of the date of the SER. Appendix A also identified several items that require a response within one year of the date of the SER. Attachment 1 to this submittal responds to all the open items from Appendix A. No further response is planned.

Regarding the three relief requests, Virginia Electric and Power Company withdraws relief request V-27 and is currently in compliance with Section XI. The IST Program Plans have been revised accordingly. We are resubmitting relief requests P-9 and P-10 with supporting justification in the attachments.

Other changes in Revision 7 to the IST Program Plans resulted from a review of the IST Program and Appendix A to the TER. As indicated in the program plan summaries, relief requests P-5, 9, 10, 13, 16, and V-20, 39, 53, 57, 72, 74 need NRC approval for Unit 1 and relief requests P-5, 9, 10, 13, 15, 16, and V-20, 40, 54, 58, 73, 75 need NRC approval for Unit 2.

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In its Safety Evaluation, the NRC inquired into the status of the flow instrumentation for the EDG fuel oil transfer pumps. Permanently mounted flow instruments have been installed and flow is being measured to the accuracy requirements of ASME Section XI.

Enclosed find ten copies of the revised North Anna Units 1 and 2 Inservice Testing Program Plans for Pumps and Valves (Revision 7) for your review. To facilitate your review of this program submittal, a summary of the program changes between Revision 6 and Revision 7 is included in each plan. Revision 7 to the Inservice Testing Program Plans and the relief requests therein have been reviewed by the Station Nuclear Safety and Operating Committee.

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

Very truly yours,

W. L. Stewart
Senior Vice President - Nuclear

Attachments

1. Response to Inservice Testing Program Plan anomalies
2. North Anna Unit 1 Inservice Testing Program Plan, Revision 7 (10 copies)
3. North Anna Unit 2 Inservice Testing Program Plan, Revision 7 (10 copies)

cc: U.S. Nuclear Regulatory Commission
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Mr. R. D. McWhorter
NRC Senior Resident Inspector
North Anna Power Station

ATTACHMENT 1

NRC SAFETY EVALUATION OF
NORTH ANNA UNITS 1 AND 2
INSERVICE TESTING PROGRAM PLANS
REVISION 6

RESPONSE TO IST PROGRAM ANOMALIES

1. SER Anomaly: In TER section 2.6.1.1, Pump Relief Request 9, the licensee requests relief from measuring pump inlet and differential pressure for service water pumps, 1(2)-SW-P-1A and -1B as required by Section XI, Paragraph IWP-3100. The licensee did not consider calculating inlet pressure and using this to calculate differential pressure. Furthermore, the licensee did not provide sufficient information on how the Code acceptance criteria will be applied using only discharge pressure and flow. Therefore, relief should be denied.

North Anna Response: Relief Requests P-9 for Unit 1 (P-9 for Unit 2) have been revised to address the Code acceptance criteria and the burden of measuring the reservoir level, and are being resubmitted for NRC approval. The revised bases for P-9(9) contain the following points.

The service water reservoir level indicator is a measuring stick located outside and several feet away from the observation point. The measuring stick tends to collect residue from the surface of the reservoir, thus obscuring the markers. Therefore, measuring the reservoir level can be difficult during periods of inclement weather or during low light conditions. However, the reservoir level changes very little from test to test and can be considered to be constant. A review of the quarterly test data indicates that the maximum variation in reservoir level is less than 2 feet, which is less than 1 psi. The discharge pressure gauge has a full scale reading of 100 psig and typical discharge pressures range from 50 to 65 psig. Even the maximum variation, which in all probability will not occur between successive tests, is a small percentage of the total head developed by the pump. Therefore, the repeatability of the tests and the ability to detect degradation will not be significantly affected if only discharge pressure is measured.

Applying the Code acceptance criteria to discharge pressure instead of differential pressure is a conservative application of the acceptance criteria for deep draft pumps. For deep draft pumps, the total developed head is calculated by adding the measured discharge pressure to the height from the discharge pressure gauge to the pump impeller, and subtracting the height from the reservoir surface to the pump impeller. Therefore, the measured discharge pressure will always be a smaller number than the actual total head developed by the pump. Applying the Section XI acceptance criteria to just the discharge pressure instead of the total developed head for a deep draft pump is a conservative application of the acceptance criteria because the

operability band is smaller.

It should be noted that the first paragraph in the NRC's evaluation contains a basic error in describing how the hydraulic parameters change with changing system loads. This paragraph states that,

> "As the service water temperature varies, the loads and the amount of cooling needed by running equipment changes. This requires making adjustments in the service water system flow. These adjustments change the system's operating characteristics. Measuring discharge pressure and flow would show changing discharge pressures with changing flow rates. These measurements would have no repeatability and no comparison could be made in which to monitor for pump degradation. However, pump differential pressure will remain relatively constant, as long as the pump does not degrade, and provide a means for, trending, comparison and evaluation of a pump's hydraulic condition."

In fact, both differential pressure and discharge pressure will vary with flow rate because both the differential and discharge pressure are dependent on flow rate as described by each pump's pump curve. In the case of the service water pumps, the inlet pressure is essentially constant as described above, thus, differential pressure and discharge pressure will vary by the same magnitude as flow varies.

In order to trend pump performance when the system conditions change from test to test, the measured test quantities must be normalized using the reference quantities that were determine for that point on the pump curve from either an earlier test or from a reference pump curve as explained in Relief Request P-12. The normalized test values can then be compared to earlier normalized test values to provide an evaluation of the pump's hydraulic condition over time. This comparison can be performed with either differential pressure or discharge pressure assuming that the inlet pressure is constant.

The second paragraph of the NRC evaluation states that,

> "However, it is possible to perform a test by varying the system flows and pump discharge pressure and recording these values as additional sets of reference values. This approach in establishing additional set(s) of reference values is explained in IWP-3112 of the Code. The licensee

has not indicated that this approach was taken."

The subject of changing system conditions was not addressed in P-9(9) because this issue was addressed in Relief Request P-12. Instead of using additional sets of references values, North Anna proposed using a reference pump curve in Relief Request P-12.

2. SER Anomaly: In TER section 2.6.1.2, Pump Relief Request 10, the licensee requests relief from measuring pump inlet and differential pressure for service water pumps, 1(2)-SW-P-4 as required by Section XI, Paragraph IWP-3100. The licensee did not consider calculating inlet pressure and using this to calculate differential pressure. Furthermore, the licensee did not give enough information on how the Code acceptance criteria will be applied using only discharge pressure and flow. Therefore, relief should be denied.

North Anna Response: Relief Requests P-10(10) have been revised to address the Code acceptance criteria and the burden of measuring the lake level, and are being resubmitted for NRC approval. The revised bases for P-10(10) contain the following points.

The North Anna lake level indicator is a measuring stick located outside and several feet away from the observation point. The measuring stick tends to collect residue from the surface of the lake, thus obscuring the markers. Therefore, measuring the lake level can be difficult during periods of inclement weather or during low light conditions. However, the lake level changess very little from test to test and can be considered to be constant. A review of the quarterly test data indicates that the maximum variation in lake level is about 2 feet, which is less than 1 psi. The discharge pressure gauge has a full scale reading of 100 psig and the discharge pressures range from 50 to 65 psig. Even the maximum variation, which in all probability will not occur between successive tests, is a small percentage of the total head developed by the pump. Therefore, the repeatability of the tests and the ability to detect degradation will not be significantly affected if only discharge pressure is measured.

Applying the Code acceptance criteria to discharge pressure instead of differential pressure is a conservative application of the acceptance criteria for deep draft pumps. For deep draft pumps, the total developed head is calculated by adding the measured discharge pressure to the height from

the discharge pressure gauge to the pump impeller, and subtracting the height from the lake surface to the pump impeller. Therefore, the measured discharge pressure will always be a smaller number than the actual total head developed by the pump. Applying the Section XI acceptance criteria to just the discharge pressure instead of the total developed head for a deep draft pump is a conservative application of the acceptance criteria because the operability band is smaller.

As in P-9(9), the first paragraph in the NRC's evaluation for P-10(10) contains the same basic error in describing how the hydraulic parameters change with changing system loads. Also, the comments in P-9(9) pertaining to trending with discharge pressure apply to P-10(10).

3. SER Anomaly: In TER section 2.7.1.1, Pump Relief Request 12, the licensee requests relief from establishing fixed set(s) of reference values for component cooling water pumps 1(2)-CC-P-1A and -1B, and service water pumps 1(2)-SW-P-1A, -1B, and -4 as required by Section XI, Paragraphs IWP-3100 and -3110. Relief should be granted provided the licensee's calculated curve bounds the operating curve of the designated pump and that the acceptance criteria are applied as described in the above TER section.

   North Anna Response: The tests are performed within the bounds of the data used to generate the reference curve and the acceptance criteria are applied as described in TER section 2.7.1.1. This response addresses the concern in Anomaly 3 and no further response is necessary.

   Reference to the third degree polynomial was deleted from the alternate testing section in Revision 7. Also, reference to establishing the pump curve using a minimum of six points was replaced by reference to using a minimum of five points. The use of five points to define the pump curve is taken from guidance provided by the NRC in their Safety Evaluation Report for Surry Power Station which was received in March of 1993. These changes should not affect the conclusions reached by the NRC in the SER.

4. SER Anomaly: In TER section 3.2.3.5, Valve Relief Requests 42, for Unit One, and 43 for Unit Two, the licensee requests relief from the test frequency requirements of Section XI, Paragraph IWV-3521 and proposes to use disassembly and inspection per Generic Letter 89-04, Attachment 1, Position 2 with an extended interval for various safety injection

check valves. According to the licensee's P&IDs, it appears that a part-stroke exercise open of these valves could be performed when shutting the plant down to the cold shutdown condition. The licensee should investigate into the possibility of performing a part-stroke exercise open for these valves when shutting down the plant to the cold shutdown condition. The licensee should document their findings in their IST program.

North Anna Response: Flowing the SI accumulator check valves every cold shutdown is not practical for the following reasons.

1) The flow from the accumulator is dependent on the pressure differential between the accumulator and the RCS. The pressure differential cannot be controlled to the fine degree necessary to preclude dumping too much water into the pressurizer, thus making it difficult to control pressurizer level while pressure is being reduced during cooldown.

2) Dumping relatively cold accumulator water into the RCS when the RCS temperature is high (just under 200°F) could thermally shock the system. Typically, The RCS temperature is high during cold shutdowns of short duration.

Relief Requests V-42(43) have been revised to include the items given above. The revision to V-42(43) addresses the concern in Anomaly 4 and no further response is necessary.

5. SER Anomaly: In TER section 3.2.3.6, Valve Relief Requests 42, for Unit One, and 43 for Unit Two, the licensee requests relief from the test methodology of Section XI, Paragraph IWV-3522 and proposes to use disassembly and inspection per Generic Letter 89-04, Attachment 1, Position 2, with an extended interval for various safety injection check valves. The licensee's basis for hardship to extend the interval appears adequate. However, Generic Letter 89-04, Attachment 1, Position 2, includes certain guidelines for extending the inspection interval. The licensee should review these guidelines which are not addressed in the relief request. Further, if the licensee finds that non-intrusive techniques prove adequate for determination of valve full-stroke open capability, relief is not required; however, the implementation of a sampling non-intrusive testing method may need to be modified according to the discussion in TER section 3.2.3.6.

North Anna Response: Documentation that justifies going to the extended disassembly and inspection interval per the guidelines in Generic Letter 89-04, Attachment 1, Position 2 will be maintained on file at North Anna Power Station. North Anna is developing non-intrusive techniques. After the techniques are developed, the sampling plan described in TER section 3.2.3.6 will be used. V-42(43) have been revised to describe the sampling plan.

The above response and the revised relief requests address the concerns in Anomaly 5. No further response is necessary.

6. SER Anomaly: In TER section 3.3.1.3, Valve Relief Requests 70 for Unit One and 71 for Unit Two, the licensee requests relief from the test frequency requirements of Section XI, Paragraph IWV-3521 for component cooling water check valves 1-CC-193 and -198 (Unit One) and 2-CC-194 and -199 (Unit Two). The licensee's proposal to verify a full-stroke of these valves when the reactor vessel is defueled is inadequate. Relief cannot be granted for an unspecified time interval. Interim relief should be granted for the licensee to reevaluate the testing frequency and resubmit this relief request.

North Anna Response: Relief Requests V-70(71) have been revised to indicate that the vessel is defueled every reactor refueling.

The revised relief requests address the concern in Anomaly 6. No further response is necessary.

7. SER Anomaly: In TER section 3.4.2.1, Valve Relief Request VR-57 (Unit One) and VR-58 (Unit Two), the licensee requests relief from the test frequency requirements of Section XI, Paragraph IWV-3411 for the reactor vessel head and pressurizer vent valves. The licensee proposes to exercise these valves during cold shutdown when the RCS is depressurized, but not more frequently than once every three months. However, while in cold shutdown with the RCS intact and at a reduced RCS pressure, exercising these valves, one at a time, is less likely to affect the other in series valve with pressure surges large enough to cause inadvertent opening. The licensee should investigate the possibility of exercising these valves each cold shutdown, but not more frequently than once every three months.

North Anna Response: The vessel vent valves have been stroked while the RCS was pressurized. This test revealed that when the upstream valve was stroked, the downstream SOV tended to lift due to the motive force of the steam. As long as these valves remain closed under RCS pressure, they are an effective isolation boundary. However, these valves should not be stroked while the RCS is pressurized.

The NRC indicated that, "at a reduced RCS pressure, exercising these valves, one at a time, is less likely to affect the other in-series valve with the pressure surges large enough to cause inadvertent opening." Efforts to quantify "a reduced RCS pressure" at which this test could be performed safely could lead to a breech of the RCS boundary inside containment. Also, maintaining the RCS pressurized would normally occur during shutdowns of short duration, which happen infrequently. The RCS would likely be depressurized during cold shutdowns of long duration which mostly occur due to planned maintenance. Therefore, efforts to quantify a reduced RCS pressure at which this test could be performed safely could place the plant at risk and create a burden without a compensating increase in safety.

Relief requests V-57(58) were revised to include the testing experience for the vessel head vent valves. The revised relief requests and the response given above address the concern in Anomaly 7. No further response is necessary. The pressurizer vent valves were determined to have no safety function and were deleted from the IST program.

8. SER Anomaly: In TER Section 3.4.3.1, Valve Relief Request 27, the licensee requests relief from the test frequency requirements of Section XI, Paragraph IWV-3411 for reactor coolant valves 1-RC-PCV-1455C and -1456 (Unit One) and 2-RC-PCV-2455C and -1456 (Unit Two). The licensee did not show impracticality and that exercising these valves is burdensome or a hardship without a compensating increase in the level of safety and quality. Therefore, relief should be denied.

North Anna Response: Relief Requests V-27(27) are being withdrawn and replaced by Cold Shutdown Justifications CSV-42(42). The reactor coolant power operated relief valves will be tested every cold shutdown.

The revision to the IST programs addresses the concern in Anomaly 8. No further response is necessary.

9. SER Anomaly: In TER section 3.7.1.1, Valve Relief Request 63 (Unit One) and 64 (Unit Two), the licensee requests relief from the test frequency requirements of Section XI, Paragraph IWV-3521 for service water discharge check valves 1(2)-SW-3, 1(2)-SW-10, 1-SW-22, and 2-SW-24. Verification of reverse flow closure for category C valves can be done by visual observation, by an electrical signal initiated by a position-indicating device, by observation of appropriate pressure indication in the system, by leak testing, or by other positive means. According to the licensee's P&ID's, there is a pressure transmitter upstream of the check valves being tested. When one or more of these service water pumps are idle, the idle pump's pressure transmitter can be compared to service water header pressure along with other indications to verify reverse flow closure of the idle pumps discharge check valve. Relief should be granted provided the licensee investigates into an alternate method to verify reverse flow closure other than full design flow at refueling outages and document their findings.

North Anna Response: Monitoring the discharge pressure gauge of the non-running pump would reveal gross failure of the check valve. However, this test may not detect leakage past the valve due to a partially stuck open disk. The service water pumps are deep draft pumps with enough tolerance between the impellers and the pump casing to pass significant flow without pressurizing the discharge piping to a detectable degree. Verification of design flow during refueling outages would still be necessary to confirm adequate closure. The observation of the non-running pump discharge gauge will be added to the quarterly test procedure to detect gross failure. However, because this test will not detect significant leakage, the refueling frequency verification should remain in place. Relief requests V-63(64) will remain in the IST program but were revised to include a discussion of the quarterly closure test. This change does not apply to auxiliary service water discharge check valves 1-SW-22 and 2-SW-24. Due to the plant configuration, these valves can be back seat tested every quarter.

In the TER, the NRC indicated that the licensee should investigate the use of diagnostics or some other means for verifying these valves full-stroke during a partial-stroke test. The check valves are 20" (1-(2)-SW-3 and 10) and 24" (1-SW-22 and 2-SW-24) in diameter. Acoustic monitoring has been performed on 1-SW-22 and the results were inconclusive due to the design of the valve. The valve has two half circle disks mounted vertically in the valve body. The disks are spring loaded to close. Acoustic monitoring

showed that under partial flow conditions, only one of the two disks struck the back seat with enough force to be detected. The other valves are of similar design. Therefore, due to the design of the valves, acoustic monitoring is not a suitable non-intrusive technique for these valves.

The above response and the revised relief requests address the concerns in Anomaly 9. No further response is necessary.

10. SER Anomaly: For Relief Requests (Unit 1/Unit 2) V37/V38, V42/V43, V53/V54, and V61/V62 the licensee proposes to use sample disassembly and inspection where a non-intrusive technique with a partial-flow test may be practical. Disassembly together with inspection to verify the full-stroke capability of check valves is an option only where full-stroke exercising cannot practically be performed by flow or by other positive means. The NRC staff considers valve disassembly and inspection to be a maintenance procedure that is not a test and not equivalent to the exercising produced by fluid flow. This procedure has some risk which may make its routine use as a substitute for testing undesirable when some method of testing is possible. Check valve disassembly is a valuable maintenance tool that can provide a great deal of information about a valve's internal condition and as such should be performed under the maintenance program at a frequency commensurate with the valve type and service.

The use of valve diagnostics to determine that a check valve opens or shuts fully or sufficiently to pass maximum required accident flow or prevent backflow during a partial-flow test is considered an acceptable means to satisfy the Code requirements. The licensee should investigate the use of alternate testing methods to full-stroke exercise these valves, such as using non-intrusive diagnostic techniques to demonstrate whether they swing fully open or closed during a partial flow test. If the licensee's investigation reveals that a full-stroke test with flow is not feasible, then valve disassembly may continue to be used as an alternative to Code testing provided that the licensee performs this procedure in accordance with Generic Letter 89-04 and provides an assurance of proper reassembly by performing a part-stroke test or reverse flow closure test of each valve prior to returning it to service following disassembly and inspection procedure, where practical.

North Anna Response: The potential for using valve

diagnostics for each group of valves is summarized below.

V-37(38) - The low head suction from containment sump isolation check valves 1-SI-1 and 16 (2-SI-1 and 21) cannot be flow tested without filling the containment sump with water. As stated in the relief request, the water would pick up contaminants from the sump. This untreated water should not be introduced into the system. Therefore, valve diagnostic techniques cannot be used and the only method to move the valve disk is to disassemble the valve.

V-42(43) - North Anna is evaluating non-intrusive techniques for the SI accumulator discharge check valves. This issue is addressed by Anomaly 5.

V-53(54) - A back seat/leak test has been developed for the low head pump seal water isolation check valves. The relief requests were revised to reflect the back seat testing. Therefore, valve diagnostic techniques are not necessary.

V-61(62) - During the preparation of Revision 7, it was determined that the closure function for the auxiliary feedwater header to main feedwater header isolation check valves was outside the scope of the IST program as discussed in the summary of changes to Revision 7. Relief requests V-61(62) dealt only with valve closure. Therefore, V-61(62) are being withdrawn.

The above responses address the concerns in Anomaly 10. No further response is necessary.

11. SER Anomaly: For Relief Requests V-69 (Unit 1) and V-70 (Unit 2), TER Section 3.1.2.2, the proposed alternative to perform an evaluation rather than a repair/replacement if leakage exceeds a target/specified rate is acceptable. However, several factors discussed in the evaluation must be considered to ensure the adequacy of the evaluation. The licensee should review their methods for performing the evaluation and incorporate the recommendations.

North Anna Response: As a result of guidance provided by the NRC in a meeting between Virginia Electric and Power Company and the NRC held on September 6, 1990, V-69(70) were withdrawn. However, the NRC SER granted relief with certain restrictions. Relief Requests V-69(70) have been revised to include these restrictions and are being resubmitted.

The revision to Relief Requests V-69(70) addresses the concerns in Anomaly 11. No further response is necessary.

VIRGINIA ELECTRIC AND
POWER COMPANY
NORTH ANNA UNIT 1
INSERVICE TESTING PROGRAM PLAN
SECOND INSPECTION INTERVAL
DEC. 14, 1990 - DEC. 14, 2000
REVISION 7