10 CFR 50.55a

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

November 18, 2019

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

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Docket No. 50-338
License No. NPF-4

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION ENERGY VIRGINIA)
NORTH ANNA POWER STATION UNIT 1
ASME SECTION XI INSERVICE TESTING PROGRAM
REQUEST FOR ALTERNATIVE TO REQUIREMENTS OF ASME OM CODE
RELIEF REQUEST P-9

Pursuant to 10 CFR 50.55a(z)(2), Virginia Electric and Power Company (Dominion Energy Virginia) requests an alternative from the requirements of American Society of Mechanical Engineers (ASME) OM Code, for North Anna Power Station (NAPS) Unit 1. Specifically, the ASME OM Code, 2004 Edition, paragraph ISTB-6200(a), mandates that when a measured performance test parameter of an Inservice Testing Program pump falls within the alert range in Table ISTB-5121-1, the frequency of testing specified in Table ISTB-3400 shall be doubled.

The proposed alternative is needed due to the undue hardship that would be incurred, without a compensating increase in the level of quality or safety, if the test frequency were doubled.

Relief Request P-9 is included in the attachment to this letter, and provides the basis for this request. The North Anna Facility Safety Review Committee has reviewed and approved the relief request.

If you have any questions or require additional information regarding the information provided in the attachment, please contact Ms. Diane E. Aitken at (804) 273-2694.

Very truly yours,

Mark D. Sartain
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Attachment

This letter contains no NRC commitments.

A047
NRR

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Attachment

RELIEF REQUEST P-9

VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION ENERGY VIRGINIA)
NORTH ANNA POWER STATION UNIT 1

RELIEF REQUEST P-9

Proposed Alternative in Accordance with 10 CFR 50.55a(z)(2)
Hardship or Unusual Difficulty Without Compensating Increase in Level of Quality or Safety

1.0 ASME Code Component Affected

Pump(s): 1-CH-P-1A

System: Chemical and Volume Control

Group: A

Class: 2

Function: This centrifugal pump supplies high pressure borated water to the reactor coolant system following a safety injection signal and provides normal charging to the reactor coolant system.

2.0 Applicable Code Edition and Addenda

ASME OM Code, 2004 Edition, no Addenda

3.0 Applicable Code Requirements

ISTB-6200(a), "Alert Range," requires that if the measured test parameter values fall within the alert range of the applicable table [Table ISTB-5121-1], the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

4.0 Reason for Request

One of seven vibration points recently exceeded 'alert' criteria during performance of the Comprehensive Pump Test (CPT) scheduled in conjunction with the Fall 2019 Unit 1 refueling outage. Vibration monitoring is a component of the CPT that is performed at a frequency of every refueling outage (18 months) as required by ISTB-3400. Per ISTB-6200, since the vibration measurement falls within the alert range, a CPT is required to be performed every 9 months until the condition is corrected. Performance of the CPT requires that the Chemical and Volume Control System (CVCS) 1A charging pump achieve the required reference flow rate. This can only be achieved with the reactor head removed from the reactor vessel, allowing flow to be directed into the reactor cavity. Therefore, this test cannot be performed during normal power operations.

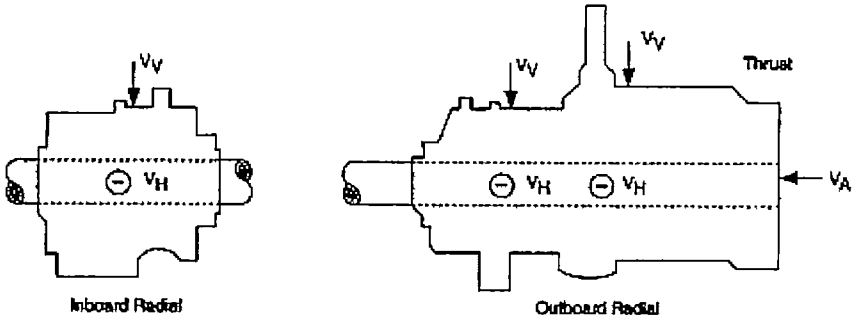
The proposed relief would permit continued performance monitoring of the Unit 1 1A charging pump (1-CH-P-1A) by performing quarterly Group A tests in lieu of performing the CPT at the increased test frequency of every 9 months. The Group A test can be performed safely while the associated unit is operational. This will eliminate the need to unnecessarily shutdown the plant and reach Mode 6 in order to perform the CPT. This relief will only apply to ISTB-6200 requirements as they relate to doubling of the CPT test frequency. With subsequent Group A testing, if

any measured IST parameter exceeds the alert criteria, the requirements of ISTB-6200(a) will be followed (i.e. the Group A test would be performed at the prescribed increased frequency).

5.0 Proposed Alternative and Bases for Use

The purpose of performing the CPT at double the normal test frequency while in the alert range is to monitor for additional pump performance degradation until the cause of the deviation is determined and the condition is corrected. The performance of pump 1-CH-P-1A performance monitoring can be tracked and trended from the results of testing at flow rates other than that of the CPT. In accordance with ISTB-3300, the reference point flow rate values shall be established within ±20% of pump design flow for the CPT, or at the highest practical flow rate for the Group A test if the CPT flow rate cannot be achieved. Currently, the CPT reference point flow rate is established at 634 gpm which exceeds the design basis accident flow rate for this pump. This flow rate cannot be achieved during normal plant operations when the Group A test is performed. The Group A test reference point flow rate is established as a range of flows from ≥ 120 gpm, but typically not more than 162 gpm, which is the highest practical flow rate for the Group A test as allowed by currently approved relief request P-8 (Reference 2).

The Unit 1 1A charging pump (1-CH-P-1A) is a horizontal, eleven-stage centrifugal pump, with a 900 HP, 1800 rpm motor that drives the pump at 4846 rpm though a speed increasing gearbox. A total of seven vibration monitoring points have been established in accordance with section ISTB of the ASME OM Code. The location of each monitoring point is depicted below:



Pump vibration reference values do not differ significantly when comparing the Group A and CPT values as shown in Table 1 below. The vibration point that is in alert, Thrust Bearing Vertical, reflects a small difference when comparing test reference values. As such, the Group A test provides a method to monitor pump vibration parameters comparable to that of the CPT.

Table 1: Comparison of Pump Vibration Reference Data: Quarterly v. CPTs			
Location & Axis	Quarterly Group A Test	Comprehensive Test	Delta (ips)
Total Flow	155.64 (gpm)	634.0 (gpm)	
Inboard Horizontal	0.1210 (ips)	0.1832 (ips)	0 0622
Inboard Vertical	0.0890 (ips)	0.1275 (ips)	0.0615
Outboard Horizontal	0.0620 (ips)	0.0870 (ips)	0.0250
Outboard Vertical	0.0960 (ips)	0.0908 (ips)	0.0052
Thrust Bearing Axial	0.1520 (ips)	0.1709 (ips)	0.0189
Thrust Bearing Horizontal	0.0660 (ips)	0.0927 (ips)	0.0267
Thrust Bearing Vertical	0 2890 (ips)	0.2760 (ips)	0.0130

Elevated vibration levels were first noticed on 1-CH-P-1A in August 2012 following a rebuild of the speed increaser gearbox, changing the speed increaser oil, and the installation of shaft guards and a permanent catch container. Step increases in measured vibration were noted at five of seven vibration monitoring locations, the most pronounced being the thrust bearing vertical and horizontal monitoring locations. During subsequent quarterly Group A tests, the thrust bearing vertical and horizontal measured vibrations periodically exceeded the associated ASME OM Code alert criteria which required a doubling of the Group A test frequency.

In January of 2013, an industry subject matter expert (SME) was contracted to perform in-depth vibration analysis of this pump. As a result of that analysis, a repair strategy was developed in February 2013 to address the increased vibration levels. In accordance with that strategy, the following actions were performed:

1. Verified pump hold down bolts are properly torqued.
2. Verified speed increaser hold-down bolts are properly torqued.
3. Verified pump bearing housing bolts are properly torqued.
4. Performed alignment checks (including soft foot and coupling gap) with laser alignment equipment for Speed increaser to pump & Motor to speed increaser.
5. Realigned pump during May 2013 pump seal replacement.
6. Performed dynamic inspection of the pump-to-gearbox coupling to check for wear or damage. None noted.
7. Verified gap setting between the speed increaser and pump to determine if an incorrect setting is pre-loading the pump and producing elevated vibration levels. No issues noted.
8. Removed IB and OB shaft guard/catch container and checked vibes afterwards. No deltas noted.
9. Loosened and raised shaft driven oil pump collar at top of oil reservoir and checked vibration levels afterwards. No deltas noted.
10. Performed bump test after shutdown using vibration vendor. No issues noted.
11. Checked shaft driven oil pump gear clearances. No issues noted.

In August 2013, a pump vendor was contracted to evaluate vibration data for 1-CH-P-1A and provide recommendations to assist with resolving the elevated vibration conditions. The vendor concluded natural frequency was not involved and a parallel misalignment condition could potentially exist due to an observed vibration peak at two times (2X) the running speed. This observed value was 200% higher than at 1X the running speed. Additional vibration data was obtained from the pump vendor on October 6, 2013 in order to facilitate further diagnostic evaluation for any evidence of pump/motor misalignment. The vibration data was examined for indicators of coupling misalignment, cocked bearings, or a bowed rotor which could possibly be contributing to the elevated vibrations being measured. The results of this review concluded that the charging pump motor vibration data indicated no motor electrical issues, and the measured vibration spectra did not indicate any energy from imbalance, misalignment, looseness, bent shafts or eccentricity. The pump vendor concluded the existing amplitudes are considered normal for this type of pump at the pump free end bearing.

Later in October 2013, an engineering evaluation was performed, in accordance with the ASME OM Code, to establish the following new baseline vibration reference values for the CPT that reflected those measured following performance of the speed increaser maintenance in 2012:

Inboard Horizontal:	0.1832 ips
Inboard Vertical:	0.1275 ips
Outboard Horizontal:	0.0870 ips
Outboard Vertical:	0.0908 ips
Thrust Bearing Axial:	0.1709 ips
Thrust Bearing Horizontal:	0.0927 ips
Thrust Bearing Vertical:	0.2760 ips

Since March 2017, in an effort to correct the elevated vibrations, a vibration SME has provided further consultation support by reviewing planned recommendations and assessing the results. Recommendations included verifying the coupling setup followed by obtaining coast-down vibration data on the outboard pump bearing. Following an inspection and minor adjustment of the pump gearbox high speed shaft and pump shaft coupling, the vibration levels observed during the performance of the Group A test (July 13, 2017) remained relatively unchanged.
Subsequently, the following new baseline vibration reference values were established for the Group A test, reflecting those measured following performance of the shaft coupling adjustment:

Inboard Horizontal:	0.1210 ips
Inboard Vertical:	0.0890 ips
Outboard Horizontal:	0.0620 ips
Outboard Vertical:	0.0960 ips
Thrust Bearing Axial:	0.1520 ips
Thrust Bearing Horizontal:	0.0660 ips
Thrust Bearing Vertical:	0.2890 ips

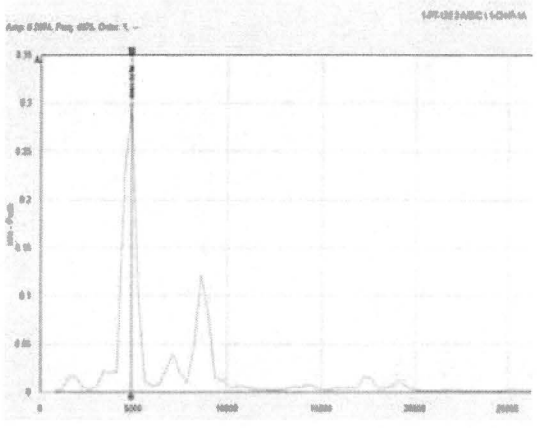
On September 22, 2019, during performance of the CPT, measured vibrations at the thrust bearing vertical axis reached 0.357 ips, exceeding the ASME OM Code prescribed alert range absolute criteria of 0.325 ips. The measured vibration data obtained on September 22, 2019 are provided below:

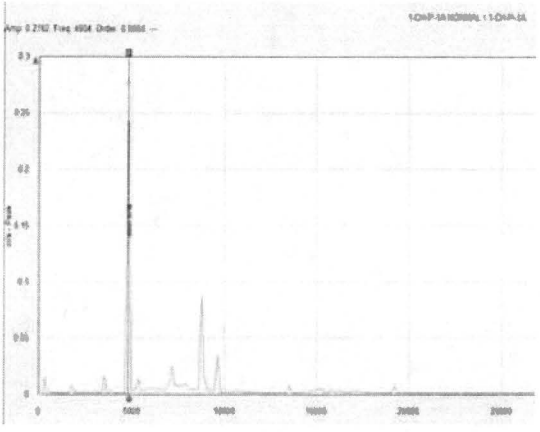
Table 2: 1-CH-P-1A Vibration Data & Criteria from 22 September 2019 CPT

Location & Axis	Measured (ips)	Reference Value (ips)	Delta (ips)	Alert Criteria (ips)
Inboard Horizontal	0.1960	0.1832	0.0128	0.3250 (absolute)
Inboard Vertical	0.1530	0.1275	0.0255	0.3187 (2.5*V_{ref})
Outboard Horizontal	0.1320	0.0870	0.0450	0.2175 (2.5*V_{ref})
Outboard Vertical	0.1310	0.0908	0.0392	0.2270 (2.5*V_{ref})
Thrust Bearing Axial	0.2150	0.1709	0.0441	0.3250 (absolute)
Thrust Bearing Horizontal	0.1580	0.0927	0.0653	0.2317 (2.5*V_{ref})
Thrust Bearing Vertical	0.3570	0.2760	0.0810	0.3250 (absolute)

This test was the first occurrence of the alert range criteria being exceeded during performance of the CPT following the speed increaser maintenance in 2012. When overlaid, data obtained during performance of each CPT reflects a consistently good correlation with the associated Group A Test data. Vibrations have remained elevated but consistent following speed increaser maintenance, and data scatter has remained consistent since 2001.

A vibration level of 0.357 ips indicates a rough running machine, but is not in the range of action expected to cause imminent equipment failure, which would be > 0.7 ips. Comparison of the vibration signatures associated with the Thrust Bearing Vertical monitoring point obtained during the CPT and a recent Group A test are provided below:





The spectrums shown are quite similar for both the Group A test and CPT and indicate the data collected is accurate and consistent over the data collection timeframe.

Evaluation of other pump performance criteria indicate the following:

Oil Analysis

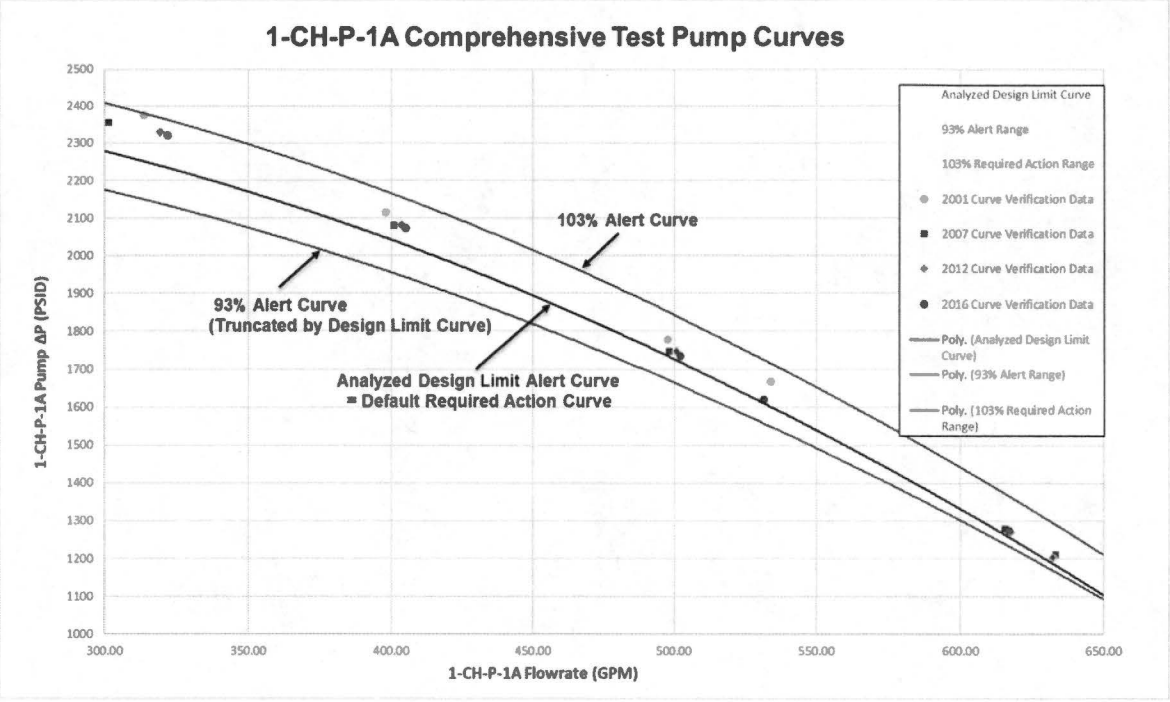
Based on a review of the oil samples collected from the pump bearing reservoir, no evidence of degradation has been identified since the initial increase of elevated vibrations noted in 2012. The presence of increased amounts of wear particles would indicate higher than normal bearing or rotating element wear and provide early indication of pump degradation. All critical parameters such as acceptable viscosity, stable presence of additives, and no increase in wear particles indicate no abnormal wear pattern or degradation mechanism has been initiated as part of the elevated vibrations observed.

Hydraulic Performance

1-CH-P-1A has been defined as the weaker pump on Unit 1 since installation of the replacement rotating element (7/2001). Following rotating element replacement, hydraulic performance has degraded slightly, as would be expected of a continuously running pump, but remains well within the IST acceptance criteria. Hydraulic performance data recorded during performance of the CPT on September 22, 2019 (632.1 gpm, 1207.1 psid as compared to reference values of 634.0 gpm flow and 1213.3 psid differential pressure, respectively) indicates hydraulic performance continues to align with the operating curve. There is no notable decrease in flow or discharge pressure which would indicate changing conditions within the pump.

Table: Hydraulic performance obtained during Comprehensive Pump Testing

	Total Flow (GPM)	Differential Pressure (psid)	Total Developed Head (ft-H2O)
4/5/2003	626.3	1236.5	2880
3/30/2006	630.6	1227.2	2871
9/29/2010	633.6	1207.0	2826
3/21/2015	630.6	1188.0	2775
10/3/2016	631.5	1206.7	2827
4/8/2018	630.9	1216.3	2832
9/22/2019	632.1	1207.1	2822



The prescribed safety function of 1-CH-P-1A is to supply high pressure borated water to the reactor coolant system following a safety injection signal, and to provide normal charging to the reactor coolant system. The maximum analyzed design basis accident required flow is 594.4 gpm at 2961.2 ft TDH. Since 2012 total run time for this pump has been 2800 hours - 3900 hours each year. Although vibrations remain elevated, pump hydraulic parameters continue to show no evidence of degrading pump performance. Therefore, it can be concluded that 1-CH-P-1A will continue to meet its prescribed safety function and flow requirements with the thrust bearing vertical vibration point measurement in alert.

Dominion is proposing to perform the quarterly Group A test in lieu of the CPT with the associated Unit operational as an alternative to shutting down the plant, establishing Mode 6 conditions, and removing the reactor vessel head in order to perform the CPT required by ISTB-6200(a). The Group A test data will be compared to the Group A vibration and hydraulic reference values and associated acceptance criteria. All performance data will continue to be analyzed for indications of degrading pump performance. Spectral analysis of vibration data will continue to be monitored for evidence of degrading trends. All aspects of ISTB-6200 shall remain applicable to Group A testing. Should vibrations exceed the alert threshold for the Group A test, testing frequency will be doubled.

Using the provisions of this relief request as an alternative to the specific requirements of ISTB-6200(a) identified above, which have been identified to be a hardship without a compensating increase in quality and safety, will provide adequate indication of pump performance. Therefore, pursuant to 10 CFR 50.55a(z)(2) Relief Request P-9 requests an alternative to the specific ISTB Code requirements identified in this relief request.

6.0 Duration of the Proposed Alternative

This is a relief request to accommodate continued pump performance monitoring utilizing the Group A test until after the alert surveillance comes due on June 24, 2020. The next CPT surveillance will be performed during the Unit 1 N1R28 refueling outage scheduled to occur in the spring of 2021. The duration of the proposed relief request will be through the remainder of the fourth IST Program Test interval which ends on December 14, 2020.

7.0 Precedents

The following similar Relief Requests have been submitted to the U.S. Nuclear Regulatory Commission for:

- Palo Verde Nuclear Generating Station, Unit 3, Relief Request PRR-08 (ADAMS Accession No. ML091900274), dated August 3, 2009
- Waterford Steam Electric Station, Unit 3, Relief Request PRR-WF3-2016-1 (ADAMS Accession No. ML16182A270)
- Waterford Steam Electric Station, Unit 3, Relief Request PRR-WF3-2017-3 (ADAMS Accession No. ML17341A120).

8.0 References

1. ASME OM Code, 2004 Edition
2. Relief Request P-8, Use of ASME Code Case OMN-16 for CVCS Charging Pumps, ADAMS Accession No. ML102460223