

**VIRGINIA ELECTRIC AND POWER COMPANY**  
**RICHMOND, VIRGINIA 23261**

November 9, 2001

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

Serial No. 01-638A  
NL&OS/ETS R0  
Docket No. 50-339  
License No. NPF-7

Gentlemen:

**VIRGINIA ELECTRIC AND POWER COMPANY**  
**NORTH ANNA POWER STATION UNIT 2**  
**ALTERNATIVE REPAIR TECHNIQUES – RELIEF REQUEST NDE-049**  
**REQUEST FOR ADDITIONAL INFORMATION**

Virginia Electric and Power Company (Dominion) responded to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," in a letter dated August 31, 2001 (Serial No. 01-490). In our response, we provided information regarding the inspections that we were planning to perform of the reactor vessel head penetrations for North Anna and Surry Power Stations Units 1 and 2. In a subsequent letter dated October 18, 2001 (Serial No. 01-638), Dominion requested relief to use alternative repair techniques in the event that any instances of cracking requiring repair were discovered during the inspection of the North Anna Unit 2 reactor vessel head penetrations (RVHPs). The bases to permit the use of the alternative repair techniques were provided in relief requests NDE-048 and 049, which were included as attachments to that letter.

During the NRC's review of the relief requests, the staff identified a need for additional information to facilitate their review of relief request NDE-049. The staff's questions were provided on November 5, 2001, by Mr. Stephen Monarque, the NRC North Anna Project Manager. The attachment to this letter provides the response to the staff's questions.

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

Very truly yours,



Leslie N. Hartz  
Vice President - Nuclear Engineering

Attachment

Commitments made in this letter: None

*Aug 8*

cc: U.S. Nuclear Regulatory Commission  
Region II  
Sam Nunn Atlanta Federal Center  
61 Forsyth St., SW, Suite 23T85  
Atlanta, Georgia 30303-8931

Mr. M. J. Morgan  
NRC Senior Resident Inspector  
North Anna Power Station

Mr. J. E. Reasor, Jr.  
Old Dominion Electric Cooperative  
Innsbrook Corporate Center, Suite 300  
4201 Dominion Blvd.  
Glen Allen, Virginia 23060

Mr. M. Grace  
Authorized Nuclear Inspector  
North Anna Power Station

**ATTACHMENT**

**Response to NRC Request for Additional Information  
Relief Request NDE-049  
North Anna Power Station Unit 2**

**Virginia Electric and Power Company  
(Dominion)  
North Anna Power Station Unit 2**

## ATTACHMENT

### RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION NORTH ANNA POWER STATION UNIT 2 RELIEF REQUEST NDE-049

#### NRC Question 1:

NB-4622.11 states that "Whenever PWHT is impractical or impossible, limited weld repairs to dissimilar metal welds of P-No. 1 and P-No. 3 material or weld filler metal F-No. 43 may be made without PWHT..." Provide a comparison of the radiation exposure attributed to performing PWHT vs. no PWHT.

#### **Response:**

During the preparation of Radiation Work Permits, we have estimated that all the inspection and repair activities for three penetrations using remote inspection processes and the machine GTAW ambient temperbead welding process could be completed with approximately 9.7 man-rem of personnel exposure. Performing the repairs with PWHT or preheat and a post weld hydrogen bake would require removing vessel head insulation to provide access and installing and removing heating pads as well as performing the actual heating operations. Based on the experience and estimates of other plants, (Oconee and Three Mile Island) that have performed similar repairs with heat treatment, the additional work could double the dose estimate for the job. Furthermore, that experience indicates the GTAW ambient temperbead process could save as much as 20 man-rem per penetration repaired compared to a manual welding process.

#### NRC Question 2:

NB-4622.11(d)(2) requires the repaired region shall be examined by the radiographic method and, if practical, by the ultrasonic method. The proposed alternative states that radiographic testing (RT) examination cannot be performed because of configuration. Describe the difficulties with performing RT. Explain how the integrity of the repaired volume and heat affected zone (HAZ) will be established?

- A. If an alternative volumetric examination method will be used in lieu of RT, provide a comparison (advantages, disadvantages, detection sensitivity for different types of flaws, etc) of the different characteristic between the methods.
- B. If the alternative to RT is a Section XI ultrasonic testing (UT) examination, describe the differences between a Section III and Section XI UT examination. The description should compare paragraphs/figures/tables with a proposed reconciliation. Items that should be included in the description are examination volume, examination coverage (scanning directions and transducers characteristics) and acceptance criteria. Include in the discussions any

demonstrations performed on mock-ups and the types of flaws in the mock-up which demonstrate that a Section XI UT is capable of detecting construction repair related flaws. Are the flaws representative examples of flaws common to fabrication? Perform a comparison between RT and UT (see question 1 above).

**Response:**

There are a number of reasons the configuration of the penetration-to-head partial penetration welds makes radiography (RT) of repairs to them impractical. In many cases the proximity of other penetrations would limit the ability to place a source for the RT such that some proposed repairs could not be radiographed at all. The curvature of the head is such that the source to weld to film alignment would be conducive to significant distortion of the RT image and there would be substantial difficulty in achieving acceptable geometric unsharpness. Furthermore the geometry of any attempted setup would involve continuous variation in material thickness from one edge of the radiograph to the other with consequent difficulty in achieving acceptable film densities. Finally, the radiation field on contact with the head is estimated to be 5 R/hr, which would result in significant fogging of the RT film and would prevent effective interpretation of the results.

**Response A and B**

As a consequence of the inability to perform any effective volumetric exam of the repair welds (see response to question 3 below) we will perform the exam required by NB-5245 for the original weld, which was a progressive surface exam (in this case PT) at 1/2 inch or one half the weld thickness (whichever is less) and on the final weld surface. The final surface exam will not be performed until at least 48 hours after completion of the weld. This progressive surface exam technique mandated by the Code has been shown capable of assuring the quality and integrity of welds where it is not possible to perform volumetric examinations. Per NB-4622.11(b), the repairs are limited to a maximum depth in the ferritic material of 3/8 inch, after defect removal and are expected to be much less than that because the potential PWSCC flaws are not expected to extend into the base metal. In any case, flaws will be completely removed prior to repair with the proposed temper bead alternative. Consequently the HAZ in ferritic material will be limited and the examinations described will provide assurance of its integrity. (Please note the typographical error in paragraph 1.0(c) of Enclosure 1 of the Relief Request NDE-049, which shows 1/8 inch as the maximum repair depth in the ferritic material as opposed to the intended 3/8 inch.)

As stated in the relief request in the discussion of the requirements of NB-4622.11(d)(1), final inspection will be conducted no sooner than 48 hours after completion of the welding.

### **NRC Question 3:**

The proposed alternative states that the final examination will be performed using PT and UT, if practical. Provide a discussion on when PT will be used and when UT will be used. Explain the criteria that will be used to determine if an examination is impractical. Explain how the integrity of the repaired volume and HAZ will be established.

### **Response:**

Subsequent evaluation has determined that ultrasonic inspection of the weld repair made with F-No. 43 filler metal (Inconel 52) is not practical because of the sound attenuation properties of the material related to the dendritic grain structure of the original weld metal and the repair weld material. In addition, the original weld configuration itself, which is a partial penetration weld between the reactor vessel head and the penetration nozzles varies from nearly perpendicular to the head ID surface to significantly oblique to that surface.

Because of our inability to perform either UT or RT on the proposed repairs, the examinations required by NB-5245 for partial penetration welds (progressive surface examination) will be conducted.

### **NRC Question 4:**

NB-5245 requires a progressive surface examination during the welding process of the partial penetration weld.

- A. The staff does not consider that this is a partial penetration weld repair. Because the repair is to arrest PWSCC, the staff believes that this is a special non-structural weld overlay fabricated with an ambient temperbead welding technique. Does your proposed alternative satisfy weld overlay requirements? Explain any differences.
- B. Provide a cross-section of the weld repair showing the layers of passes and nominal repair weld thickness.
- C. You proposed to perform a PT and UT of the finished weld. Are any other NDE methods being used to evaluate the detection, sizing, welding, and preservice examinations? Explain the difference between the proposed inspections for NB-5245 and NB-4622.11(d)(2).

### **Response A:**

The repairs contemplated to be performed per Relief Request NDE-049 are in fact repairs to the original partial penetration welds. As stated previously, the repair excavation will be inspected prior to welding to assure complete defect removal.

**Response B:**

Until the actual size of the repair excavation has been determined it is not possible to describe the number, placement, and thickness of weld beads and layers any more effectively than the description in Section 3.0 and Figures 2 and 3 of Enclosure 1 to Relief Request NDE-049.

**Response C:**

As discussed previously, it will not be possible to inspect the final weld with radiography and ultrasonic examination. The relief states that UT would only be performed if practical. A progressive surface examination required by NB-5245 will be used instead to provide reasonable assurance of freedom from unacceptable volumetric flaws. As required by NB-4622.11(d)(2), the final surface examination by PT will not be conducted until at least 48 hours after the completion of welding. Eddy current (ET) may be used as a supplement to the PT but is not being proposed as a substitute for PT and will be used for information only at this time. No request for relief to use ET is required because it is not being substituted for the code-mandated exams.

**NRC Question 5:**

NB-4622.11(d)(3) requires that all NDE be performed according to NB-5000. Identify the NDE that will be performed according to NB-5000. On NDE that will not be performed according to NB-5000 and has not been addressed in prior answers, provide an explanation for the NDE's acceptability, which should include the advantages and disadvantages between Code-requirements and the proposed alternative.

**Response:**

The necessary PT examinations will be performed in accordance with NB-5000.

**NRC Question 6:**

The title of the proposed alternative (Enclosure 1 of the submittal) includes similar metal welds. However, you stated that NB-4622.9 is not applicable because the weld material is Inconel and base material is carbon steel. Explain the inclusion of the wording of similar metal welds in the title of the proposed alternative. If the proposed alternative also include similar material welds, than provide a discussion of the proposed alternative for similar metal welds and explain the differences between Code-requirements associated with this applications.

**Response:**

The proposed alternative, while appropriate for similar metal welding, is not intended to be used for similar metal welds and will be limited to repairs to dissimilar metal welds.

**NRC Question 7:**

Discuss the affects of any anomalies that occur at the triple point (carbon steel vessel, Inconel 600 CRDM, and Inconel 690 weld material meet) on NDE. Describe the types of defects (if any) found at these anomalies in the weld demonstrations.

**Response:**

The contemplated repairs do not involve any triple point phenomenon, which might be encountered with some other repair approaches. If the repair excavation goes all the way to the root of the existing partial penetration weld, that root condition will be essentially the same as for the original weld and will not be prone to form any "triple point anomalies."

**NRC Question 8:**

Identify the inservice inspection interval.

**Response:**

As stated in the Relief Request NDE-049, North Anna Unit 2 is currently in its second inservice inspection interval, which ends December 14, 2001. This relief is only being requested for the current interval.

**NRC Question 9:**

Enclosure 1, Section 1.0(e) references cases used in the repair/replacement plan. Discuss what "cases" are included. Does the repair include Code cases not endorsed or authorized by the NRC?

**Response:**

The only code cases which may be used in addition to the Relief Request is Code Case N-416-1 which has been approved for use by the NRC at North Anna Unit 2. The PT examinations which will be conducted in accordance with ASME 1989 Section III, NB-5245 will also satisfy the requirements of the 1992 Edition of Section III as stipulated in Code Case N-416-1.

**NRC Question 10:**

Enclosure 1, Section 4.0(b) states that ultrasonic examinations shall be in accordance with Appendix I. (Refer to the 1989 Edition with the 1989 Addenda and later Editions and Addenda.) Discuss preservice examination requirements, if any and the applicability of Section XI, Appendix VIII.

**Response:**

No ultrasonic examinations will be performed; therefore, Section XI, Appendix VIII does not apply. As discussed in Relief Request NDE-049, Paragraph IWB-2200(a) exempts control rod drive nozzle partial penetration welds (Category B-E) from preservice examination. In addition, the only inservice examination required for Category B-E welds is a visual examination of the external surface for evidence of leakage, further supporting the exemption from a preservice exam. IWA-4600(a), on the other hand, appears to require a preservice examination with the method that discovered the flaw. Because the proposed repairs would be to flaws detected by liquid penetrant examination, the final surface examination by PT, which will be performed on the repairs, can serve as the preservice examination record, thus resolving the apparent conflict between the two Code paragraphs.

**NRC Question 11:**

Enclosure 1, 4.0(e) states that UT will be according to Table IWB-3514-2 acceptance criteria. If the UT is a Section III requirement or is in lieu of a Section III requirement, explain the application of using a Section XI acceptance criterion.

**Response:**

No ultrasonic examinations will be performed.