

VIRGINIA ELECTRIC AND POWER COMPANY  
RICHMOND, VIRGINIA 23261

January 28, 2003

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

Serial No. 03-050  
NLOS/ETS  
Docket No. 50-339  
License No. NPF-7

Gentlemen:

**VIRGINIA ELECTRIC AND POWER COMPANY**  
**NORTH ANNA POWER STATION UNIT 2**  
**ASME SECTION XI INSERVICE INSPECTION PROGRAM RELIEF REQUEST CMP-020**  
**EXAMINATION OF REACTOR PRESSURE VESSEL HEAD-TO-FLANGE WELD**

During the Fall 2002 refueling outage, North Anna Power Station Unit 2 replaced the reactor pressure vessel head. The preservice examinations for the replacement head were conducted to the requirements of the 1995 Edition through 1996 Addenda of ASME Section XI. However, interferences due to lifting lugs and the weld configuration prohibited complete examination of the reactor pressure vessel head-to-flange weld.

Pursuant to 10 CFR 50.55a(g)(5)(iii), relief is requested from certain requirements of ASME Section XI Code associated with the examination of the reactor pressure vessel head-to-flange weld where only partial coverage can be obtained. Relief Request CMP-020 is attached and provides the basis of this request. A similar relief request was approved for FirstEnergy Nuclear Operating Company - Davis Besse Nuclear Power Station on December 17, 2002 (TAC MB5849).

This relief request has been approved by the Station Nuclear Safety and Operating Committee. If you have any additional questions concerning this request, please contact us.

Very truly yours,



Leslie N. Hartz  
Vice President – Nuclear Engineering

Attachment

Commitments made in this letter: None

A047

cc: U. S. Nuclear Regulatory Commission  
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**Attachment**

**Relief Request  
CMP-020 Examination Of Reactor Pressure Vessel  
Head-To-Flange Weld**

**Virginia Electric and Power Company  
North Anna Power Station Unit 2**

**Virginia Electric & Power Company  
North Anna Power Station Unit 2  
Third 10 Year Interval  
Request for Relief Number CMP-020**

**I. IDENTIFICATION OF COMPONENT**

Reactor pressure vessel head-to-flange weld (Weld 1, drawing 12050-WMKS-RC-R-1.2) for the replacement reactor vessel head.

**II. CODE REQUIREMENTS**

ASME Section XI – 1995 Edition through 1996 Addenda, Table IWB-2500-1, examination category B-A, item number B1.40 requires volumetric and surface examinations, as defined by Figure IWB-2500-5, of essentially 100 percent of the weld length of the reactor pressure vessel closure head-to-flange weld. “Essentially 100 percent” as clarified by ASME Code Case N-460, Alternative Examination Coverage for Class 1 and Class 2 Welds, is greater than 90 percent coverage of the examination volume, or surface area, as applicable.

**III. CODE REQUIREMENT FROM WHICH RELIEF IS REQUESTED**

In accordance with 10CFR50.55a(g)(5)(iii), relief is requested from the “essentially 100 percent” volumetric examination coverage requirement for the identified reactor pressure vessel head-to-flange weld. This requirement is considered impractical due to the configuration of the reactor pressure vessel head.

**IV. BASIS FOR RELIEF**

The ultrasonic examination of the reactor pressure vessel head-to-flange weld is conducted in accordance with Section XI, Appendix I of the ASME Code, 1995 Edition through the 1996 Addenda. Section XI, Appendix I states that the ultrasonic examination shall be conducted in accordance with Article 4 of Section V as supplemented by Table I-2000-1. Article 4, Section V requires the weld and the adjacent base metal be examined using nominal angles of 45 and 60 degrees, (deviation is permitted if geometry limits the coverage, however, separation of angles must be 10 degrees) and a straight beam. Four basic scan directions are required for the angle beams; two perpendicular to the weld axis (axial scan) from opposite directions and two parallel to the weld axis (circumferential scan) from opposite directions. These requirements apply for each of the 45 and 60 degree angle beams used. Each of the 45 and 60 degree angle beams is required to pass through all of the weld volume in the four basic scan directions.

The cross-sectional geometry of the component at the reactor pressure vessel head-to-flange weld produces a high transitional angle between the flange and the domed head. Scanning from the flange side may not provide the necessary angular orientation to provide full examination coverage. Examination is limited to 0.5 inch

from the weld toe due to the flange configuration. The reactor vessel closure head is a carbon steel vessel with stainless steel cladding on the inside surface. Due to this cladding, the ultrasonic beam cannot be "bounced" from the inside clad surface to increase the examination coverage. Therefore, a full-V examination from the flange side is not possible. Following operational service, radiographic examination of this weld will not be practical due to the projected high radiation levels at the inside surface of the head.

The reduction in pre-service volumetric coverage is detailed in Table CMP-20-1. Figures CMP-20-1 through CMP-20-5 are provided detailing the configuration limitations experienced. The pre-service examination on the component listed above was completed to the extent practical as required by the Code.

Furthermore, three lifting lugs are located 120° apart. Each lug obstructs the volumetric examination for approximately 8 inches, resulting in obstruction of 2 of the 45 feet of total weld length. This limits access to approximately 4 percent of the weld length. However, these lifting lugs result in only a 0.8 percent obstruction during the magnetic particle examination resulting in a 99.2 percent surface examination.

The limited volumetric examination and the surface examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the subject weld.

## **V. ALTERNATE PROVISIONS**

One-third of the reactor pressure vessel head-to-flange weld will be examined each period to the extent permitted by the configuration of the reactor pressure vessel closure head as radiologically practical.

In addition, it is proposed that the pre-service examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Table CMP-020-1

**North Anna Unit 2  
Pre-Service Examination Coverage Summary**  
Reactor Pressure Vessel Closure Head to Flange Weld  
**Category B-A, Item B1.40**

Exam	Sketch	Sketch Coverage	Weighting Factor	Coverage
45° Weld Metal ⊥	CMP-20-1	55%	2 sound beams/9	12.22%
60° Weld Metal ⊥	CMP-20-2	52%	2 sound beams/9	11.56%
45° Weld Metal	CMP-20-3	100%	2 sound beams/9	22.22%
60° Weld Metal	CMP-20-3	100%	2 sound beams/9	22.22%
0° Weld Metal	CMP-20-3	100%	1 sound beam/9	11.11%
				<b>Weld Total</b> 79.33%
45/60° Base Metal ⊥	CMP-20-4	88%	2 sound beams/7	25.14%
45° Base Metal	CMP-20-5	54%	2 sound beams/7	15.43%
60° Base Metal	CMP-20-5	54%	2 sound beams/7	15.43%
0° Base Metal	CMP-20-5	54%	1 sound beam/7	7.71%
				<b>Base Total</b> 63.71%

Weld Metal = 11.3% of total exam volume (11.3% x 79.33%) = 9%

Base Metal = 88.7% of total exam volume (88.7% x 63.71%) = 57%

Total Exam Coverage Achieved = 9% + 57% = 66%

Figure CMP-020-1

North Anna Unit 2  
Pre-Service Examination Coverage Summary  
Reactor Pressure Vessel Closure Head to Flange Weld  
Category B-A, Item B1.40

Component: RPV closure head to flange weld

Coverage Sketch No: 1 of 5    Scale: 50%

Exam: Weld metal, 45° ±

EXAM AREA

- $EFGH = 0.866 \times 6.6 = 5.716 \text{ in}^2$

DIRECTION 1

- Examined EFGH = 100 %

DIRECTION 2

- Examined EFJK =  $(.866 \times .7) + (.866 \times .7)/2 = 0.909 \text{ in}^2$
- $(.909 / 5.716) = 16 \%$

TOTAL

- $(100 \% + 16 \%) / 2 = 58 \%$
- $58 \% \times (43' / 45') = 55 \%$

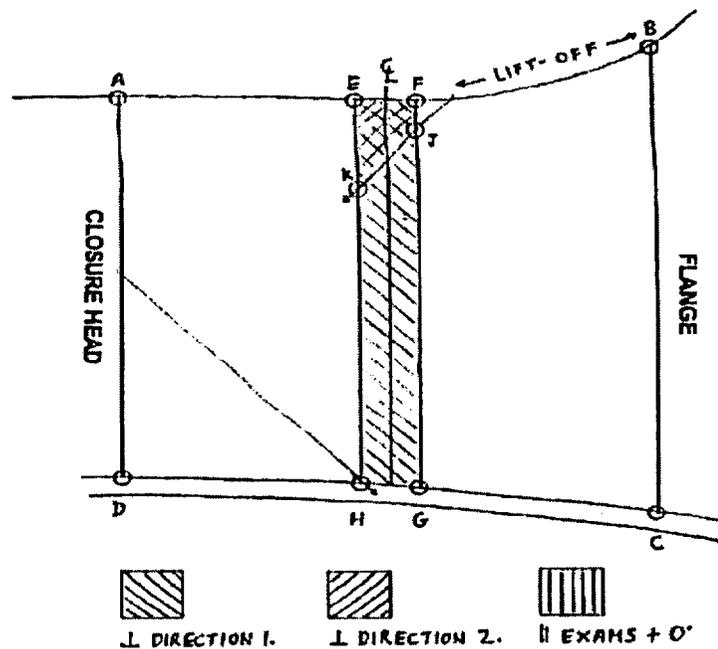


Figure CMP-020-2

North Anna Unit 2  
Pre-Service Examination Coverage Summary  
Reactor Pressure Vessel Closure Head to Flange Weld  
Category B-A, Item B1.40

Component: RPV closure head to flange weld

Coverage Sketch No: 2 of 5     Scale: 50%

Exam: Weld metal, 60° J

EXAM AREA

- $EFGH = 0.866 \times 6.6 = 5.716 \text{ in}^2$

DIRECTION 1

- Examined EFGH = 100 %

DIRECTION 2

- Examined EFJK =  $(.866 \times .3) + (.866 \times .5)/2 = 0.476 \text{ in}^2$
- $(.476 / 5.716) = 8 \%$

TOTAL

- $(100 \% + 8 \%) / 2 = 54 \%$
- $54 \% \times (43' / 45') = 52 \%$

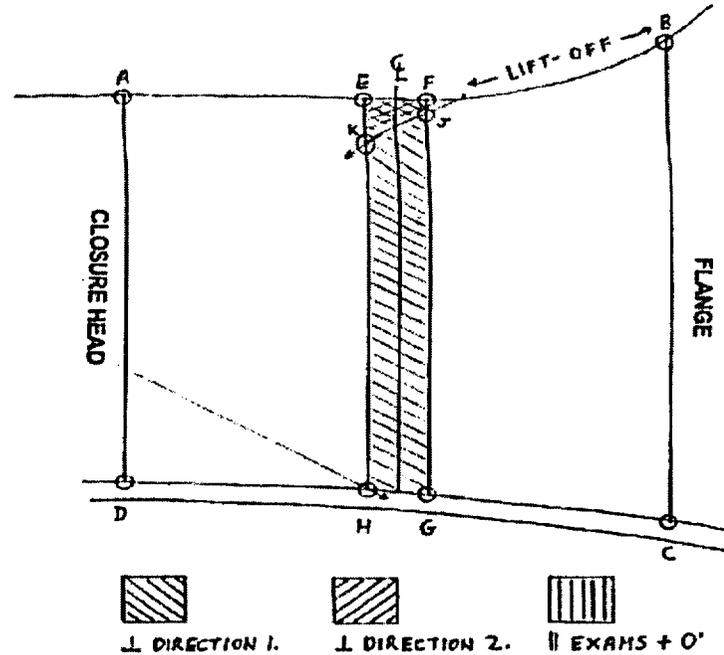


Figure CMP-020-3

North Anna Unit 2  
Pre-Service Examination Coverage Summary  
Reactor Pressure Vessel Closure Head to Flange Weld  
Category B-A, Item B1.40

Component: RPV closure head to flange weld

Coverage Sketch No: 3 of 5    Scale: 50%

Exam: Weld metal, 45° / 60°  $\parallel$  and 0°

EXAM AREA

- EFGH = 0.806 X 6.6 = 5.716 in<sup>2</sup>

EXAMINED

- EFGH = 100 %

TOTAL

- 0° = 100 %
- 45°  $\parallel$  = 100%
- 60°  $\parallel$  = 100%

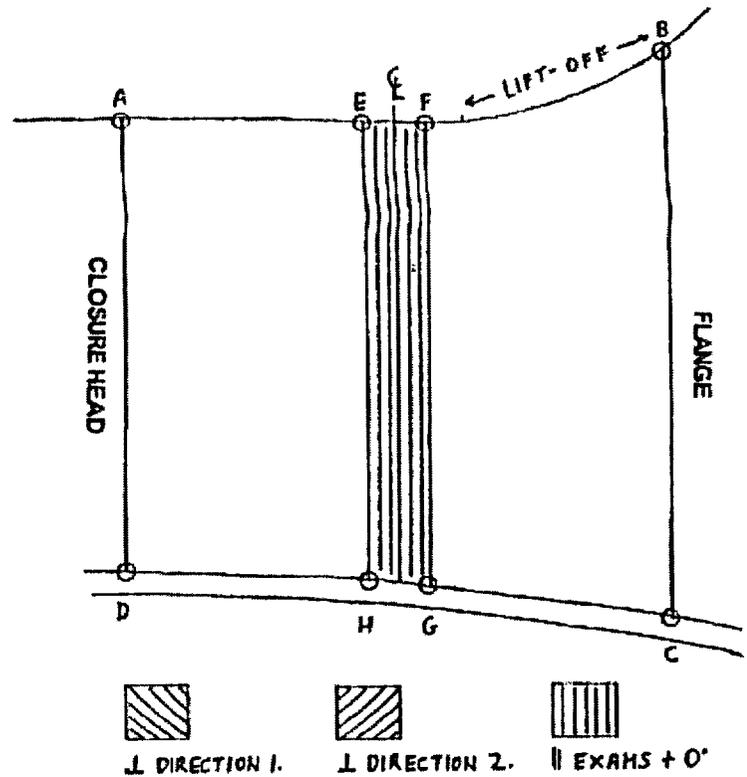


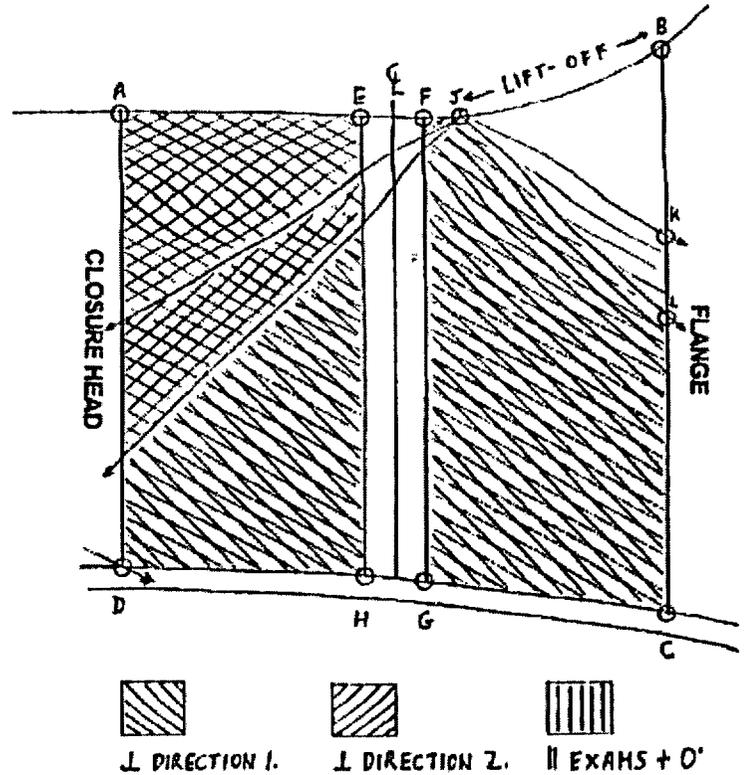
Figure CMP-020-4

**North Anna Unit 2  
Pre-Service Examination Coverage Summary  
Reactor Pressure Vessel Closure Head to Flange Weld  
Category B-A, Item B1.40**

Component: RPV closure head to flange weld

Coverage Sketch No: 4 of 5    Scale: 50%

Exam: Base metal, 45° / 60° ⊥



**EXAM AREA**

- $AEHD + FBCG = (3.3 \times 6.6) + (3.3 \times 7) = 44.88 \text{ in}^2$

**TWO SOUND BEAMS**

- $AEHD + FJLCG$
- $= (3.3 \times 6.6) + (.5 \times .7) + (2.8 \times 5.4) = 40.4 \text{ in}^2$
- $(40.4 / 44.88) = 90 \%$

**ONE SOUND BEAM**

- $JKL = (4 \times 8) / 2 = 1.6 \text{ in}^2$
- $(1.6 / 44.88) = 4 \%$
- $4 \%$  coverage x 50% credit (for only one sound beam) = 2%

**TOTAL**

- $90 \% + 2 \% = 92 \%$
- $92 \% \times (43 / 45) = 88 \%$

Figure CMP-020-5

**North Anna Unit 2**  
**Pre-Service Examination Coverage Summary**  
**Reactor Pressure Vessel Closure Head to Flange Weld**  
**Category B-A, Item B1.40**

**Component:** RPV closure head to flange weld  
**Coverage Sketch No:** 5 of 5    **Scale:** 50%  
**Exam:** Base metal, 45° / 60°  and 0°

**EXAM AREA**

- $AEHD + FBCG = (3.3 \times 6.6) + (3.3 \times 7) = 44.88 \text{ in}^2$

**EXAMINED**

- $AEHD + FJKG = (3.3 \times 6.6) + (.5 \times 7) = 25.28 \text{ in}^2$
- $(25.28 / 44.88) = 56 \%$
- $56 \% \times (43' / 45') = 54 \%$

**TOTAL**

- 0°  = 54%
- 45°  = 54%
- 60°  = 54%

