



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

December 13, 2011

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, UNIT NO. 1 (NORTH ANNA UNIT 1),
FOURTH 10-YEAR INTERVAL INSERVICE INSPECTION (ISI) PROGRAM, NON
DESTRUCTIVE EXAMINATION (NDE), NDE-003 (TAC NO. ME6263)

Dear Mr. Heacock:

By letter dated May 17, 2011, Virginia Electric and Power Company (the licensee) requested relief pertaining to the examination requirements for the pressurizer nozzle-to-vessel weld and nozzle inner radius section and from certain requirements of the American Society of Mechanical Engineers (ASME), 2004 Edition for *Boiler and Pressure Vessel Code* under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(4), for the fourth 10-year ISI program for North Anna Unit 1. The 2004 Edition of ASME Code, Section XI, Table IWB-2500-1, Category B-D, Item B3.110, requires a volumetric examination of pressurizer surge line nozzle-to-vessel weld 9, but does not require an examination of the nozzle inside radius.

The U.S. Nuclear Regulatory Commission staff has concluded based on the information provided by the licensee, pursuant to 10 CFR 50.55a(a)(3)(ii), that Relief Request No. NDE-003 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.

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

Sincerely,

for R Martin

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

Docket No. 50-338

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOURTH 10-YEAR INTERVAL INSERVICE INSPECTION (ISI)

RELIEF NO. NDE-003

NORTH ANNA POWER STATION, UNIT NO. 1

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO. 50-338

1.0 INTRODUCTION

By letter dated May, 17, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML100220125), Virginia Electric and Power Company (the licensee), requested relief from certain requirements of the American Society of Mechanical Engineers (ASME), 2004 Edition for *Boiler and Pressure Vessel Code* (Code), under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(4), for the fourth 10-year ISI program for North Anna Power Station, Unit No. 1 (North Anna Unit 1). The North Anna Unit 1 fourth 10-year ISI interval started on May 1, 2009, and will end on April 30, 2019.

The U.S. Nuclear Regulatory Commission (NRC) staff has concluded based on the information provided by the licensee, pursuant to 10 CFR 50.55a(a)(3)(ii), that Relief Request No. NDE-003 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

The ISI of ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code, and applicable addenda, as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements set forth in the ASME Code, Section XI, "Rules for ISI of Nuclear Power Plant

Enclosure

Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components.

The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code of record for the North Anna Unit 1 fourth 10-year ISI interval program is the 2004 Edition with no Addenda of Section XI of the ASME Code. The North Anna Unit 1 fourth 10-year ISI interval started on May 1, 2009, and will end on April 30, 2019.

3.0 EVALUATION

Relief Request N1-14-NDE-003-R1

ASME Code Components

ASME Code Class:	1
System	Pressurizer (PZR)
Examination Category;	B-D
Item No.:	ASME Code, Section XI, Item B3.110 (2004 Edition) ASME Code, Section XI, Item B3.120 (1998 Edition)
ISI Component ID:	PZR Surge Line Nozzle Weld 9 and PZR Nozzle Inside Radius (NIR) Section 9NIR

ASME Code Requirements

The 2004 Edition of ASME Code, Section XI, Table IWB-2500-1, Category B-D, Item B3.110, requires a volumetric examination of PZR surge line nozzle-to-vessel weld 9. The 2004 Edition of Section XI does not require an examination of the NIR of weld 9 (9NIR). However, 10 CFR 50.55a(b)(2)(xxi)(A) mandates use of the 1998 Edition of Section XI for the examination requirements of full penetration welded nozzles in vessels. Category B-D, Item B3.120 of the 1998 Edition requires a volumetric examination of the NIR section of the PZR surge nozzle, weld 9NIR. Section 50.55a(b)(2)(xxi)(A) allows an enhanced visual VT-1 on the inside surface in lieu of the volumetric requirement, which is performed from the outside surface.

Licensee's Basis for Relief Request (as stated)

The [PZR] surge line nozzle is integrally cast into the bottom head of the [PZR], is located under the [PZR] skirt, and is surrounded by 78 heater penetrations. In addition, access to the North Anna Unit 1 [PZR] surge line nozzle is obstructed by multi-layered, stainless steel mirror insulation and the cables for the [PZR] heaters. Removal of the insulation and cables would be difficult as well as labor and time intensive. It is also likely that cable or heater pin damage could occur during removal.

Some, and possibly all, heater cables would have to be disconnected so that the cables can be pulled back to allow access for removing insulation and performing the exam. Dose rates are predicted using a step approach to build the total projected exposure. The worst case option assumes that all 78 heater cables have to be disconnected and pulled back. These cables have brazed connections that will be time consuming to remove and replace following the exam. This option carries a dose estimate of 54.320 rem. If the outer ring of heaters can be left intact during the examination (disconnect/reconnect 46 heaters), then the dose estimate is 34.144 rem. If only the first ring of heaters has to be dealt with (20 heaters), then the dose estimate is 17.751 rem. Even if all the cables are removed, examination coverage would still be limited due to the weld joint design and heater penetration interferences.

Other personnel safety concerns potentially involved in this examination include the increased risk for an unexpected exposure event and increased likelihood of contamination with personnel wedged between the surge line and the exposed portion of the [PZR] heaters. Temporary shielding to reduce the dose is considered impractical because placement of the shielding material would obstruct and potentially preclude accessibility to the examination surface.

In conjunction with license renewal, Westinghouse has performed an evaluation to address the impact of operational transients for [North Anna Unit 1] to account for insurge/outsurge transients in addition to design transients in the [PZR] lower head. The results of the evaluation show that the Cumulative Usage Factor (CUF), after service equivalent to 60 years of operation for the lower head to nozzle weld, is 0.32 for the inside surface and 0.07 for the outside surface. The CUFs for the nozzle inner radius are 0.25 (inside surface) and 0.09 (outside surface). These CUFs are considerably less than the design limit of 1.0. The Westinghouse evaluation is documented in WCAP-15607 which analyzed the insurge/outsurge transients for North Anna and Surry. The title of WCAP-15607 is "Evaluation of Pressurizer Insurge/Outsurge Transients for Surry and North Anna." The WCAP was prepared in December 2000 for license renewal as a Westinghouse proprietary class 2 document and was not part of the Westinghouse Owners Group work.

We do not consider that the alternative visual VT-1 examination on the inside of the [PZR] nozzle to vessel weld can be reasonably or satisfactorily performed. The [PZR] manway at the top of the vessel would have to be removed and a boroscope threaded down the length of the [PZR] through the support plates and through a screen device located at the outlet of the surge line near the bottom of the vessel. The examination would be partially obscured by the thermal sleeves and the examination would only be of the non-structural cladding covering the welds. If performed, the examination would provide only marginal benefit as a result. The added exposure, the risk of foreign material intrusion into the reactor coolant system and the unusual difficulties attempting this examination are not commensurate with the limited benefit that may be obtained.

Due to the fact that compliance with the specified requirements would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety, an alternative is requested.

Licensee's Proposed Alternative Examination (as stated)

Dominion is applying per 10 CFR 50.55a(a)(3)(ii) for the following alternative:

The [PZR] surge line nozzle-to-vessel (weld and nozzle inner radius) will be examined as part of the normally scheduled ASME [Code] Class 1 system leakage test each refueling (ASME Code VT-2). In addition, the surveillance requirements of Technical Specifications [(TS)] that determine the reactor coolant system leak rate and the containment atmosphere radioactivity will be satisfied. The [PZR] surge line weld to the reactor coolant hot leg will also be examined as part of augmented inspections (associated with the [Electric Power Research Institute (EPRI)]-sponsored Materials Reliability Program) to detect environmentally affected fatigue (EAF) and will be used as the leading indicator of EAF. The inspection of the [PZR] surge line connection to the hot leg piping is already a part of the commitment for license renewal aging management at [North Anna].

The results of examination of the [PZR] surge line will be monitored through implementation of the North Anna Augmented Inspection Program and corrective action system, as necessary. NUREG-1801 provides various options for managing aging. Inspection is a valid, approved method for monitoring potential age-related degradation and may be preferred over analysis at times for validation. Dominion has elected to manage age related degradation, i.e., potential fatigue cracking, of the [PZR] surge line through inspection of the welds that connect the surge line in lieu of evaluation using Environmentally Assisted Fatigue Factors. This approach is acceptable because an evaluation using Environmentally Assisted Fatigue Factors would be used to determine if inspection is needed. In this case, Dominion has proactively included the welds that connect the surge line to the hot leg in the North Anna Augmented Inspection Program.

Dominion is an active member of the EPRI MRP and has access to research results, and is therefore aware of industry trends of failure or indications in this area. A search on the [Institute of Nuclear Power Operation (INPO)] website of operating experience involving degradation at the inside radius section of the surge line nozzle in a Westinghouse designed [PZR] as well as a query among industry experts identified no known indications for [PZR] [NIR] sections on any reactor or steam generator nozzle NIRs at Pressurized Water Reactor (PWR) plants.

Furthermore, Dominion has an active Boric Acid Corrosion Control Program that identifies and monitors borated water leakage to prevent boric acid related degradation of the Reactor Coolant System [(RCS)]. These programs ensure that a small amount of leakage will be identified and corrected prior to adversely affecting the overall level of plant quality and safety.

Staff's Evaluation

The 2004 Edition of ASME Code, Section XI, Table IWB-2500-1, Category B-D, Item B3.110 requires a volumetric examination of PZR surge line nozzle-to-vessel weld 9. Section 50.55a(b)(2)(xxi)(A) requires the inspection requirements of the 1998 Edition of ASME Code, Section XI be applied for Category B-D, Item B3.120, PZR NIR section. Section 50.55a(b)(2)(xxi)(A) also permits the use of enhanced VT-1 visual examination of the interior surface of the NIR section in lieu of the volumetric examination from the outside surface required by the 1998 Edition of the ASME Code. In lieu of the ASME Code and 10 CFR 50.55a(b)(2)(xxi)(A) requirements, the licensee has proposed to perform VT-2 visual examinations of PZR surge line nozzle-to-vessel weld 9 and PZR NIR Section 9NIR as part of the normally scheduled ASME Code, Class 1 system leakage test each refueling outage. In addition, the licensee will examine the PZR surge line weld to the reactor coolant hot leg as part of augmented inspections to detect EAF and will be used as the leading indicator of EAF.

The PZR surge line nozzle is integrally cast into the bottom head of the PZR, is located under the PZR skirt, and is surrounded by 78 heater penetrations. In addition, multi-layered, stainless steel mirror insulation and cables for the PZR heaters obstruct access to the subject nozzle. In order for the licensee to volumetrically examine PZR surge line nozzle-to-vessel weld 9 and PZR NIR Section 9NIR, it would have to remove the insulation and heater cables exposing the licensee's personnel to an estimated dose of 54.320 rem. The licensee considered temporary shielding; however, it was decided it would be impractical because the shielding material would obstruct and prevent accessibility of the examination surface. In addition, disconnecting the heater cables could also cause damage to both the cables and heaters.

The licensee noted that it considered an alternative visual VT-1 examination by employing a remote visual technology; however, it was determined it had a limited benefit as well as a limited probability of success. The subject nozzle has a perforated basket diffuser covering the nozzle opening on the inside of the PZR that would make it difficult if not impossible to place a probe into the subject nozzle opening. In addition, the examination would be partially obscured by the thermal sleeves and the examination would only be of the non-structural cladding covering the welds.

The staff determined that, based on the description of the PZR access provided in the licensee's submittal, it would be very difficult for the licensee to feed a boroscope through the PZR access manway, down through openings in the heater support baffles and perforated basket diffuser covering the surge nozzle opening. Therefore, the staff determined that based on the above, the ASME Code-required volumetric examination and/or the optional visual examination discussed in 10 CFR 50.55a(b)(2)(xxi)(A) would impose a hardship on the licensee without a compensating increase in quality and safety.

For the North Anna Unit 1 license renewal, Westinghouse performed an evaluation to address the impact of operational transients to account for insurge/outsurge transients in addition to design transients in the PZR lower head in the Westinghouse Commercial Atomic Power-15607 report. The results of the evaluation showed that the CUF, after service equivalent to 60 years of operation for the lower head to nozzle weld, is 0.32 for the inside surface and 0.07 for the outside surface and the CUFs for the NIR are 0.25 (inside surface) and 0.09 (outside surface). These CUFs are considerably less than the design limit of 1.0.

The licensee noted that the PZR surge line to the reactor coolant hot leg will also be examined as part of augmented inspections to detect EAF and will be used as the leading indicator of EAF. Furthermore, the licensee has an active Boric Acid Corrosion Control Program that identifies and monitors borated water leakage to prevent boric acid-related degradation of the RCS. The augmented inspection results and the results of planned research by the EPRI-sponsored Materials Reliability Program will be used to address and assess EAF for the surge nozzle. In addition, the licensee is unaware of any operating experience involving degradation (i.e., indications) in PZR NIR sections or for any reactor or steam generator NIR sections at PWR plants.

The North Anna Unit 1 Technical Specification surveillance requirements regarding reactor coolant system leakage rate and the containment atmosphere radioactivity will further ensure the integrity of the PZR surge line nozzle. The NRC staff has determined that the licensee's proposed alternative to perform a VT-2 visual examination on the outside of the PZR surge line nozzle (which would effectively look for leakage from either the weld or the nozzle radius), the augmented inspections of other welds, and Boric Acid Corrosion Control Program, provide reasonable assurance of the integrity of the subject components.

4.0 CONCLUSION

As set forth above, the NRC staff has determined that the compliance with the ASME Code and 10 CFR 50.55a(b)(2)(xxi)(A) requirements would result in a hardship or unusual difficulty without a compensating increase in quality or safety. Furthermore, the staff concludes that the licensee's proposed alternative to perform a VT-2 visual examination on PZR surge line nozzle-to-vessel weld 9 and PZR NIR Section 9NIR, proposed augmented inspections of other welds, and the Boric Acid Corrosion Control Program provide reasonable assurance of the integrity of the subject PZR system components. Therefore, the licensee's proposed alternative to perform VT-2 visual examinations on PZR surge line nozzle-to-vessel weld 9 and PZR NIR Section 9NIR in lieu of the ASME Code-required volumetric examination is authorized for the fourth 10-year interval which started on May 1, 2009, and will end on April 30, 2019, pursuant to 10 CFR 50.55a(a)(3)(ii).

All other ASME Code, Section XI 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.

Therefore, the NRC staff authorizes the alternatives and relief noted above, at North Anna Unit 1, for the fourth 10-year ISI interval which began May 1, 2009, and will end on April 30, 2019.

Principal Contributor: Thomas Mc Lellan, NRR

Date: December 13, 2011

December 13, 2011

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, UNIT NO. 1 (NORTH ANNA UNIT 1),
FOURTH 10-YEAR INTERVAL INSERVICE INSPECTION (ISI) PROGRAM, NON
DESTRUCTIVE EXAMINATION (NDE), NDE-003 (TAC NO. ME6263)

Dear Mr. Heacock:

By letter dated May 17, 2011, Virginia Electric and Power Company (the licensee) requested relief pertaining to the examination requirements for the pressurizer nozzle-to-vessel weld and nozzle inner radius section and from certain requirements of the American Society of Mechanical Engineers (ASME), 2004 Edition for *Boiler and Pressure Vessel Code* under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(4), for the fourth 10-year ISI program for North Anna Unit 1. The 2004 Edition of ASME Code, Section XI, Table IWB-2500-1, Category B-D, Item B3.110, requires a volumetric examination of pressurizer surge line nozzle-to-vessel weld 9, but does not require an examination of the nozzle inside radius.

The U.S. Nuclear Regulatory Commission staff has concluded based on the information provided by the licensee, pursuant to 10 CFR 50.55a(a)(3)(ii), that Relief Request No. NDE-003 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.

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 No. 50-338

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

DISTRIBUTION:

Public LPL2-1 R/F
RidsNrrDorLpl2-1 Resource
RidsNrrDeEvib Resource
SSheng, NRR

RidsAcrsAcnw_MailCTR Resource
RidsOgcRp Resource
RidsNrrPMNorthAnna Resource
JMcHale, EDO RII

RidsRgn2MailCenter Resource
RidsNrrLAMO'Brien Resource
TMcLellan, NRR

ADAMS Accession No. ML11320A122

* SE transmitted by email dated September 22, 2011

OFFICE	NRR/LPL2-1/PM	NRR/LPL2-1/LA	NRR/EVIB/(A)BC	NRR/LPL2-1/BC
NAME	VSreenivas	MO'Brien	SSheng*	GKulesa (RMartin for)
DATE	11/28/11	11/28/11	9/22/11	12/13/11

OFFICIAL RECORD COPY