



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

January 21, 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 (NAPS), UNIT NOS. 1 AND 2, FOURTH
10-YEAR INSERVICE INSPECTION (ISI) PROGRAM, RELIEF REQUESTS (RRs)
FOR ALTERNATIVE N1-I4-RI-001 AND N2-I4-RI-001 (TAC NOS. ME3449 AND
ME3450)

Dear Mr. Heacock:

By letter to the U.S. Nuclear Regulatory Commission (NRC), dated February 23, 2010, as supplemented by letter dated September 13, 2010, Virginia Electric and Power Company (the licensee) submitted relief requests for Alternatives N1-I4-RI-001 and N2-I4-RI-001 based, in part, on the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section XI, Code Case N-716, "Alternate Piping Classification and Examination Requirements, Section XI, Division 1," at NAPS Unit Nos. 1 and 2. Specifically, in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), the licensee proposed an alternative to implement a risk-informed/safety-based ISI (RIS_B) program for piping based on Code Case N-716. The fourth 10-year ISI program which began May 1, 2009, and will end April 30, 2019, for NAPS Unit No. 1, and which began December 14, 2010, and will end on December 13, 2020, for NAPS Unit No. 2.

Based on the review of the information the licensee provided, the NRC staff concludes pursuant to Section 50.55a(a)(3)(i), that the proposed alternative to implement an RIS_B program provides an acceptable level of quality and safety. The NRC staff's approval of the licensee's RIS_B program does not constitute approval of Code Case N-716. All other ASME Code 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.

D. Heacock

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

Sincerely,

A handwritten signature in black ink that reads "Nicholas J. D'Amico for". The signature is written in a cursive style with a horizontal line at the end.

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

Docket Nos. 50-338 and 50-339

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

RELIEF REQUESTS FOR ALTERNATIVE N1-I4-RI-001 AND N2-I4-RI-001

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NOS. 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated February 23, 2010, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML100560430) as supplemented by letter dated September 13, 2010, (ADAMS Accession No. ML102570807), Virginia Electric and Power Company (the licensee), requested U.S. Nuclear Regulatory Commission (NRC) authorization to implement a risk-informed inservice inspection (RI-ISI) program plan for North Anna Power Station (NAPS), Unit Nos. 1 and 2 for the fourth 10-year interval ISI program. The licensee proposed the use of the risk-informed/ safety-based ISI (RIS_B) program for the fourth interval American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code) of records, 2004 Edition, for Examination Category B-F, B-J, C-F-1, and C-F-2 Class 1 and 2 piping welds. The fourth 10-year ISI program which began May 1, 2009, and will end April 30, 2019, for NAPS Unit No.1, and which began December 14, 2010, and will end on December 13, 2020, for NAPS Unit No. 2.

The licensee requested to implement the RIS_B program, based in part, on ASME Code Case N-716, "Alternative Piping Classification and Examination Requirements, Section XI, Division 1". The provisions of N-716 may be used in lieu of the requirements of IWB-2420, IWB-2430, Table IWB-2500-1 (Examination Categories B-F and B-J), IWC-2420, IWC-2430, and Table IWC-2500-1 (Examination Categories C-F-1 and C-F-2) for ISI of Class 1 or 2 piping and IWB-2200 and IWC-2200 for preservice inspection of Class 1 or 2 piping, or as additional requirements for Class 3 piping or non-Class piping, for plants issued an initial operating license prior to December 31, 2000. The N-716 requirements are expected to reduce the number of inspections required but also define additional requirements for Class 3 piping or non-Class piping. Code Case N-716 is referred where there is a need to incorporate detailed methodology.

The NRC staff has evaluated the licensees Relief Requests (RRs) and determined pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), that the proposed alternative to implement RIS-B program provides an acceptable level of quality and safety. The NRC staff's approval of the licensee's RIS_B program does not constitute approval of Code Case N-716.

Enclosure

2.0 REGULATORY EVALUATION

Pursuant to Section 50.55a(g), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, "except design and access provisions and preservice examination requirements" set forth in the Code to the extent practical within the limitations of design, geometry, and materials of construction of the components. Paragraph 50.55a(g) also states that ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable addenda, except where specific relief has been granted by the NRC. The objective of the ISI program, as described in Section XI of the ASME Code and applicable addenda, is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary of these components that may impact plant safety.

The regulations also require, during the first 10-year ISI interval and during subsequent intervals, that the licensee's ISI program complies with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference into Section 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. NAPS Unit Nos. 1 and 2 are currently in their fourth 10-year ISI interval which began May 1, 2009, and December 14, 2010, respectively.

Pursuant to Section 50.55a(g), a certain percentage of ASME Code Category B-F, B-J, C-F-1 and C-F-2 pressure retaining piping welds must receive ISI during each 10-year ISI interval. The ASME Code requires 100 percent of all B-F welds and 25 percent of all B-J welds greater than 1-inch nominal pipe size be selected for volumetric or surface examination, or both, on the basis of existing stress analyses. For Categories C-F-1 and C-F-2 piping welds, 7.5 percent of non-exempt welds are selected for volumetric or surface examination, or both. According to Section 50.55a(a)(3), the NRC may authorize alternatives to the requirements of Section 50.55a(g), if an applicant demonstrates that the proposed alternatives would provide an acceptable level of quality and safety, or that compliance with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee has proposed to use an RIS_B program for ASME Code Class 1 and 2 piping (Examination Categories B-F, B-J, C-F-1 and C-F-2 piping welds), as an alternative to the ASME Code, Section XI requirements. As stated in Section 1.0 of this safety evaluation, the provisions of N-716 are expected to reduce the number of required examinations but may also define additional requirements for Class 3 piping or non-Class piping. The application states that this proposed program will be substituted for the current program in accordance with Section 50.55a(a)(3)(i) by alternatively providing an acceptable level of quality and safety.

The licensee states that N-716 is founded in large part on the RI-ISI process as described in Electric Power Research Institute TR-112657 Revision B-A, "Revised Risk-Informed Inservice Inspection (RI-ISI) Evaluation Procedure," (EPRI TR) (ADAMS Accession No. ML013470102) which was previously reviewed and approved by the NRC. The NRC staff has reviewed the development of the proposed RIS_B program using the following documents:

Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis" (ADAMS Accession No. ML023240437),

RG 1.178, "An Approach For Plant-Specific Risk-Informed Decisionmaking - Inservice Inspection of Piping" (ADAMS Accession No. ML032510128), and

RG 1.200, Revision 1, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" (ADAMS Accession No. ML070240001).

RG 1.174 provides guidance on the use of probabilistic risk analysis (PRA) findings and risk insights in support of licensee requests for changes to a plant's licensing basis. RG 1.178 describes RI-ISI program as one that incorporates risk insights that can focus inspections on more important locations while at the same time maintaining or improving public health and safety. RG 1.200 describes one acceptable approach for determining whether the quality of the PRA, in total or the parts that are used to support an application, is sufficient to provide confidence in the results, such that the PRA can be used in regulatory decision making.

3.0 TECHNICAL EVALUATION

N-716 is founded, in large part, on the RI-ISI process as described in the EPRI TR, which was previously reviewed and approved by the NRC. In general, the licensee simplified the EPRI TR method because it does not evaluate system parts that have been generically identified as high-safety-significant (HSS), and uses plant-specific PRAs to evaluate in detail only system parts that cannot be screened out as low-safety-significant (LSS).

An acceptable RI-ISI program replaces the number and locations of nondestructive examination (NDE) inspections based on ASME Code, Section XI requirements with the number and locations of these inspections based on the RI-ISI guidelines. The proposed RIS_B program permits alternatives to the requirements of IWB-2420, IWB3-2430, and IWB-2500 (Examination Categories B-F and B-J), and IWC-2420, IWC-2430, and IWC-2500 (Examination Categories C-F-1 and C-F-2), or as additional requirements for Subsection IWD, and may be used for ISI and preservice inspection of Class 1, 2, and 3, or non-Class piping. All piping components, regardless of risk classification, will continue to receive ASME Code-required pressure and leak testing, as part of the current ASME Code, Section XI program.

The RI-ISI process includes the following steps which, when successfully applied, satisfy the guidance provided in RGs 1.174 and 1.178.

- Scope definition
- Consequence evaluation
- Degradation mechanism evaluation
- Piping segment definition
- Risk categorization
- Inspection/NDE selection
- Risk impact assessment
- Implementation monitoring and feedback

These processes result in a program consistent with the concept that, by focusing inspections on the most safety-significant welds, the number of inspections can be reduced while at the same time maintaining protection of public health and safety. In general, the methodology in N-716

replaces a detailed evaluation of the safety significance of each pipe segment with a generic population of high safety-significant segments, followed by a screening flooding analysis to identify any plant-specific high safety-significant segments. The screening flooding analysis is performed in accordance with the flooding PRA approach that is consistent with Section 4.5.7 of ASME RA-Sb-2005, Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications, Addendum B to ASME Code RA-S-2002 (Reference 4), as endorsed in RG 1.200. As described below, the acceptability of the licensee's proposed RIS_B program is evaluated by comparing the processes it has applied to develop its program with the steps from the EPRI-TR process.

3.1 Scope Definition

The scope of evaluation to support the RIS_B program development and of the proposed changes includes ASME Code Class 1, 2, and 3 and non-Class piping welds. Standard Review Plan (SRP) 3.9.8 and Reference 3 address scope issues. The primary acceptance guideline in the SRP is that the selected scope needs to support the demonstration that any proposed increase in core damage frequency (CDF) and risk are small. The scope of NAPS Unit Nos. 1 and 2 evaluations included all piping where ASME Code inspections could be discontinued providing assurance that the change in risk estimate would, as a minimum, capture the risk increase associated with implementing the RIS_B program in lieu of the ASME program. RG 1.178 identifies different groupings of plant piping that should be included in an RI-ISI program, and clarifies that a "full-scope" risk-informed evaluation is acceptable. The scope of the RIS_B program is consistent with the definition of full-scope in RG 1.178. Therefore, the NRC staff concludes that the "full-scope" extent of the piping included in the RIS_B program changes satisfies the SRP and RG guidelines and is acceptable.

3.2 Consequence Evaluation

The methodology described in RG 1.178 and the EPRI TR divide all piping within the scope of the proposed EPRI RI-ISI program into piping segments. The consequence of each segment failure must be estimated as a conditional core damage probability (CCDP) and conditional large early release probability (CLERP) or by using a set of tables in the EPRI TR that yield equivalent results. The consequences are used to determine the safety significance of the segments.

In contrast to the EPRI TR methodology, N-716 does not require that the consequence of each segment failure be estimated to determine the safety-significance of piping segments. Instead, N-716 identifies portions of systems that should be generically classified as HSS at all plants. A consequence analysis is not required for system parts generically classified as HSS because there is no higher safety significance category to which the system part can be assigned and degradation mechanisms, not consequence, are used to select inspection locations in the HSS weld population. The licensee's PRA is subsequently used to search for any additional, plant-specific HSS segments that are not included in the generic HSS population.

Sections 2(a)(1) through 2(a)(4) in N-716 provide guidance that identifies the portions of systems that should be generically classified as HSS based on a review of about fifty (50) RI-ISI programs. These previous RI-ISI programs were all developed by considering both direct and indirect effects of piping pressure boundary failures and the different failure modes of piping. This is consistent with the guidelines for evaluating pipe failures with PRA described in RG 1.178, the EPRI TR, and SRP 3.9.8, and, therefore, the generic results are derived from acceptable analyses. Section

2(a)(5) in N-716 provides guidance that defines additional, plant-specific HSS segments that should be identified using a plant-specific PRA of pressure boundary failures.

Each of the licensee's consequence evaluations (the generic and the plant-specific flooding analysis) considers both direct and indirect effects of piping pressure boundary failures and the different piping failure modes to systematically use risk insights and PRA results to characterize the consequences of piping failure. This is consistent with the guidelines for evaluating pipe failures with PRA described in RG 1.178 and the EPRI TR and is, therefore, acceptable.

3.3 Degradation Mechanism Evaluation

Section 3.4 of the EPRI TR, including its subsections, addresses the identification and evaluation of degradation mechanisms of interest to a RI-ISI program. This section of the EPRI TR notes that there is no correlation between design stresses and piping failures. It further notes that most piping failures are the result of active degradation mechanisms in concert with loading conditions. This section, therefore, places significant emphasis on identifying all applicable degradation mechanisms for all piping segments and appropriately addressing their significance. This section of the EPRI TR fundamentally provides a three-step process to identify and evaluate degradation mechanisms:

- a) based on industry experience, identify all possible degradation mechanisms
- b) based on plant operating experience, assign degradation mechanisms to piping segments
- c) based on the degradation mechanisms present assign pipe rupture potential and expected leak conditions to each pipe segment.

This section of the EPRI TR identifies, and contains a description of the conditions required for, all applicable degradation mechanisms. The section also characterizes pipe rupture potential as high, medium or low and the expected leak conditions as large, small, or none. Although not specifically addressed in this section, these classifications are used to assign pipe failure probabilities that are used in determining the pipe failure frequency. This section of the EPRI TR admonishes the user to pay particular attention to the subject of water hammer during the plant operating experience review. Two reasons are cited: first, the occurrence of water hammer is highly plant specific; and second, the presence of water hammer may necessitate changing the rupture potential category of a given pipe segment from medium to high.

The approaches employed by the EPRI TR, the Code Case, and the relief request with respect to the evaluation of degradation mechanisms are generally similar. Based on the general similarity, the NRC accepts the licensee's conceptual approach to this topic. Despite the general similarity between these approaches, there are some significant differences. These are described below.

The EPRI TR and Code Case differ in the number of pipe segments which are evaluated. The EPRI TR requires the evaluation of each pipe segment to determine all applicable degradation mechanisms. This is then used to determine the safety significance of the segment. Alternatively, the Code Case identifies a generic population of piping segments to be assigned to the HSS category without evaluation, followed by a search for plant-specific HSS welds. The code case approach is at least as conservative as the EPRI TR approach because it identifies HSS as each

piping segment, which would have been so, identified by the EPRI TR and because it may identify additional piping segments as being of HSS. Based on this conservatism, the NRC finds the use of this aspect of the Code Case acceptable.

In lieu of conducting a degradation mechanism evaluation for all the LSS piping, all locations were conservatively assigned to the medium-failure potential for the purpose of assigning a failure frequency to be used to calculate the change in risk. This results in an equal or greater estimated increase in risk from discontinued inspections because the failure frequencies would always be equal to or less than those used in the licensee's analysis if the susceptibility of all LSS welds to all degradation mechanisms was determined. The NRC finds this approach acceptable because the assumed degradation mechanism will always result in the assignment of a failure probability at least as high as the complete analysis required by the EPRI TR methodology.

The EPRI TR and the code case both consider a long and identical list of degradation mechanisms. Both of these lists include primary water stress-corrosion cracking (PWSCC). In Reference 2, the licensee stated that PWSCC of dissimilar metal welds is addressed through a separate augmented inspection program designed to specifically address Alloy 600 welds which are susceptible to PWSCC. The basis for this program is contained in MRP 139 (Reference 5). The staff finds that the inclusion of these welds in a plant augmented inspection program designed to meet the requirements of MRP 139 is acceptable because these welds will be adequately inspected under the augmented program.

The RR differs from the EPRI TR in the manner in which thermal stratification, cycling, and striping (TACS) is addressed. The method contained in the EPRI TR does not allow for the consideration of the severity of fatigue. The method proposed by the licensee does. This method has been previously reviewed and accepted by the NRC staff (ADAMS Accession No. ML093220090) and will not be considered further here.

The RR and the EPRI TR differ on the number of pipe segments evaluated for flow-accelerated corrosion (FAC) and water hammer. The EPRI TR states that all pipe segments are to be evaluated for FAC and water hammer as the presence of these degradation mechanisms may affect the failure potential for the piping segment. In its relief request, the licensee stated that it evaluated all piping segments not specified as HSS by the code case to determine whether FAC or water hammer was present. The licensee stated that neither FAC nor water hammer was present in the pipe segments considered. The staff finds this approach acceptable as it is consistent with the EPRI TR for those segments considered and it is at least as conservative as the EPRI TR for those segments not fully evaluated as these segments were assumed to be of HSS.

3.4 Piping Segment Definition

Previous guidance on RI-ISI including RG 1.178 and the EPRI-TR centered on defining and using piping segments. RG 1.178 states, for example, that the analysis and definition of a piping segment must be consistent and technically sound.

The primary purpose of segments is to group welds so that consequence analyses can be done for the smaller number of segments instead of for each weld. Sections 2(a)(1) to 2(a)(4) in N-716 identify system parts (segments and groups of segments) that are generically assigned HSS without requiring a plant-specific consequence determination and any subdivision of these system

parts is unnecessary. Section 2(a)(5) in N-716 uses a PRA to identify plant-specific piping that might be assigned HSS. A flooding PRA consistent with ASME RA-Sb-2005 searches for plant-specific HSS piping by first identifying zones that may be sensitive to flooding, and then evaluating the failure potential of piping in these zones. Lengths of piping whose failure impacts the same plant equipment within each zone are equivalent to piping segments. Therefore, piping segments are either not needed to reduce the number of consequence analyses required (for the generic HSS piping) or, when needed during the plant-specific analysis, the length of pipe included in the analysis is consistent with the definition of a segment in RG 1.178.

An additional purpose of piping segments in the EPRI-TR is as an accounting/tracking tool. In the EPRI methodology, all parts of all systems within the selected scope of the RI-ISI program are placed in segments and the safety significance of each segment is developed. For each safety significant classification, a fixed percentage of welds within all the segments of that class are selected. Additional selection guidelines ensure that this fixed percentage of inspections is distributed throughout the segments to ensure that all damage mechanisms are targeted and all piping systems continue to be inspected. N-716 generically defines a large population of welds as HSS. An additional population of welds may be added based on the risk-informed search for plant specific HSS segments. When complete, the N-716 process yields a well-defined population of HSS welds accomplishing the same objective as accounting for each weld throughout the analysis by using segments. The Code Case provides additional guidelines to ensure that this fixed percentage is appropriately distributed throughout the population of welds subject to inspection, all damage mechanisms are targeted, and all piping systems continue to be inspected.

The staff concludes that the segment identification in RG 1.178 as used as an accounting tool is not needed within the generic population of HSS welds. A flooding PRA consistent with ASME Code RA-Sb-2005 utilizes lengths of piping consistent with the segment definition in RG 1.178 whenever a consequence evaluation is needed. Therefore, the proposed method accomplishes the same objective as the approved methods without requiring that segments be identified and defined for all piping within the scope of the RIS_B program.

3.5 Risk Categorization

Sections 2(a)(1) through 2(a)(4) in N-716 identify the portions of systems that should be generically classified as HSS, and Section 2(a)(5) requires a search for plant-specific HSS segments. Application of the guideline in Section 2(a)(5) in N-716 identifies plant-specific piping segments that are not assigned to the generic HSS category but that are risk-significant at a particular plant. N-716 requires that any segment with a total estimated CDF greater than $1E-6$ /year be assigned the HSS category. The licensee augmented this N-716 metric on CDF with the requirement to also assign the HSS category to any segment with a total estimated large early release frequency (LERF) greater than $1E-7$ /year. The licensee stated that these guideline values are suitably small and consistent with the decision guidelines for acceptable changes in CDF and LERF found in the EPRI TR. The licensee reviewed the results of its flooding analysis and did not identify any segments that had a CDF greater than $1E-6$ /year or a LERF greater than $1E-7$ /year.

In Reference 1, the licensee clarified that these ancillary metrics were added as a defense-in-depth measure to provide a method of ensuring that any plant-specific locations that are important to safety are identified. All piping that has inspections added or removed per N-716 is required to be included in the change in risk assessment and an acceptable change in risk estimate is used to demonstrate compliance with RG 1.174 acceptance guidelines. The ancillary

metrics and guidelines on CDF and LERF are only used to add HSS segments and not, for example, to remove system parts generically assigned to the HSS in Sections 2(a)(1) through 2(a)(4).

The NRC staff concurs that a plant-specific analysis to identify plant-specific locations that are important to safety is a necessary element of RI-ISI program development. The results of the plant-specific risk categorization analysis provide confidence that the goal of inspecting the more risk-significant locations is met while permitting the use of generic HSS system parts to simplify and standardize the evaluation. Satisfying the guidelines in Section 2(a)(5) requires confidence that the flooding PRA is capable of successfully identifying all, or most, of the significant flooding contributors to risk that are not included in the generic results. RG 1.200 states that meeting the attributes of an NRC-endorsed industry PRA standard (ASME Code RA-Sb-2005 at the time of the application) may be used to demonstrate that a PRA is adequate to support a risk-informed application. RG 1.200 further states that an acceptable approach that can be used to ensure technical adequacy is to perform a peer review of the PRA.

In Reference 1, the licensee states that the NAPS Unit Nos. 1 and 2 Probabilistic Safety Assessment (PSA) model underwent a peer review in 2001. Subsequent updates were performed to NAPS Unit Nos. 1 and 2 PSA model to address areas of improvement identified during the peer review. A self assessment was performed on the model in August 2007 to assess against ASME Code PRA Standard RA-Sb-2005 and Revision 1 of RG 1.200. In December 2009, the North Anna PRA model was updated to meet Capability Category II requirements of the ASME Code PRA Standard.

In response to request for additional information (RAI), NAPS Unit Nos. 1 and 2 identified those supporting requirements that were assessed not to meet capability Category II of the ASME PRA Standard. None of the identified supporting requirements were grouped under the internal flooding gaps as categorized by the ASME PRA Standard. This suggests that all internal flooding supporting requirements meets capability Category II for the NAPS Unit Nos. 1 and 2 PRA. The remaining gaps were judged not significant to the application and were dispositioned by the licensee as documentation considerations or having minimal impact to the application.

The NRC staff concurs that the CDF and LERF metrics proposed by the licensee are acceptable because they address the risk elements that form the basis for risk-informed applications (i.e., core damage and large early release). The NRC staff accepts the proposed guideline values because these ancillary guidelines are applied in addition to the change in risk acceptance guidelines in RG 1.174, and only add plant-specific HSS segments to the RIS_B program (i.e., they may not be used to reassign any generic HSS segment into the LSS category).

The staff finds that the risk categorization performed by NAPS Unit Nos. 1 and 2 provides confidence that HSS segments have been identified. Sections 2(a)(1) through 2(a)(4) in N-716 which identify generic HSS portions of systems were applied to NAPS Unit Nos. 1 and 2 piping. The licensee's PRA used to fulfill the guideline in Section 2(a)(5) was performed using a PRA of adequate technical quality based on consistency between the PRA and the applicable characteristics of the NRC-endorsed industry standard ASME Code RA-Sb-2005.

3.6 Inspection/NDE Selection

The licensee's submittals discuss the impact of the proposed RIS_B application on the various augmented inspection programs.

In Reference 1, the licensee states that the NAPS Unit Nos. 1 and 2 augmented inspection program for high energy line breaks (HELB) outside containment is not affected or changed by the RIS_B Program. The staff notes that N-716 contains no provisions for reducing the number of inspections in the inspection program for break exclusion region (BER). However, Code Case N-716 does include a provision to increase the number of HELB inspections if the HELB program is inspecting less than 10 percent of the welds in this region. Changes to the HELB program may be made as authorized by EPRI TR-1006937, "Extension of the EPRI Risk Informed ISI Methodology to the Break Exclusion Region Programs" (ADAMS Accession No. ML021790518), or by another process found acceptable by the NRC staff.

N-716 contains no provisions for changing the FAC augmented program developed in response to NRC Generic Letter (GL) 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning." The licensee's FAC program is relied upon to manage this damage mechanism but is not otherwise affected or changed by the RIS_B program.

MRP-139 (Reference 5) will be used as an augmented inspection program for the inspection and management of PWSCC susceptible dissimilar metal welds and will supplement the RI-ISI program.

The staff finds the licensee's approach to the integration of the proposed RI-ISI program with existing augmented inspection programs acceptable because it is consistent with the EPRI TR.

Section 3.6 of the EPRI TR addresses the selection of pipe segments for inspection. This section presents the current code requirements. It also establishes requirements for the RI-ISI program related to:

- Class 1 Category BJ welds
- Class 1, 2, 3 piping
- Piping subject to localized corrosion
- Impact of augmented inspection programs on the selection of pipe segments for RI-ISI
- Guidance for selecting individual welds for inspection within a group of welds
- Reinspection sample size

In its RR, the licensee has chosen to base its selection of pipe segments on the Code Case. This Code Case is not approved for use. The Code Case has adopted a pipe selection procedure which differs from that in the EPRI TR. While the approach adopted by the Code Case may or may not be more conservative than that adopted by the EPRI TR, the change in risk evaluation required by the Code Case, and described elsewhere in this Safety Evaluation, mandates that the increase in risk (CDF and LERF), as compared to the current Code requirements, for any given system cannot exceed 1×10^{-7} and 1×10^{-8} per year and that the total increase in CDF and LERF may not exceed 1×10^{-6} and 1×10^{-7} per year. The NRC staff finds the approach used in the code case and by the licensee to be acceptable because the CDF and LERF associated with the piping under consideration is generally lower and in no case is significantly greater than the risk currently accepted when the existing code requirements are used.

In addition to the information regarding the number of welds to be inspected, the EPRI TR contains information concerning additional criteria to be considered when selecting welds for inspection. The EPRI TR states that licensees should consider:

- Plant-specific service history
- Predicted severity of postulated damage mechanisms
- Configuration/accessibility of element to enable effective examination
- Radiation exposure
- Stress concentration
- Physical access to element

The Code Case also contains additional information for consideration in weld selection. This list includes:

- Plant-specific cracking experience
- Weld repairs
- Random selection
- Minimization of worker exposure

Additionally, the Code Case contains requirements that inspection locations be divided among the systems under consideration and that certain percentages of inspections will be conducted in specific locations. In its relief request the licensee has addressed these issues. The NRC staff finds this acceptable because the information provided in the relief request is consistent with that required by the EPRI TR and the Code Case.

The NRC staff reviewed the tables provided in the relief request which address degradation mechanisms, failure potential and the number of welds selected for evaluation. The NRC staff finds that the data contained in these tables is consistent with the requirements of the EPRI TR.

3.7 Risk Impact Assessment

The licensee uses a change in risk estimation process approved by the NRC staff in the EPRI TR. The change in risk assessment in the EPRI TR permits using each segment's CCDP and CLERP or, alternatively, placing each segment into high-, medium-, or low-consequence "bins" and using a single bounding CCDP and CLERP for all segments in each consequence bin. N-716 also includes both alternatives, and the bounding values to be used in the bounding analysis are the same as those approved for use in the EPRI TR. The licensee uses the alternative of placing each segment into consequence bins and using the associated bounding values for all segments in each bin during the change in risk assessment.

In the submittal, the licensee identified the different types of pipe failures that cause major plant transients such as those causing loss-of-coolant accidents (LOCAs) and corresponding types of feedwater and steam piping breaks. Conservative CCDP estimates were developed from the PRA for these initiating events. The NRC staff concludes that the scenarios described are reasonable because they are modeled in the PRA or include the appropriate equipment failure modes that cause each sequence to progress.

The licensee relied on its flooding analysis to identify the appropriate consequence bin for welds whose failure does not cause a major plant transient and for which a consequence estimate is required. As discussed above, the licensee performed its flooding analysis consistent with ASME Code RA-Sb-2005. The licensee stated that its flooding analysis did not identify any high consequence segments (lower bound CCDP and CLERP of $1E-4$ and $1E-5$, respectively) for LSS Class 2 piping that was being inspected under the ASME Code ISI program. Only segments with locations at which an inspection is being discontinued need to be included in the change in risk calculation so limiting the consequence evaluation to segments that are inspected is acceptable.

Section 5 in N-716 requires that any piping that has NDE inspections added or removed per N-716 be included in the change in risk assessment. Code Case N-716 requires no estimated risk increase for discontinuing surface examinations at locations that are not susceptible to outside diameter attack (e.g., external chloride stress-corrosion cracking). The NRC staff determined during the review and approval of the EPRI TR that the surface exams do not appreciably contribute to safety and need not be included in the change in risk quantification and, therefore, exclusion of surface examinations from the change in risk evaluations is acceptable. The licensee used nominally the upper-bound estimates for CCDP and CLERP. Acceptance criteria provided in Section 5(d) in N-716 include limits of $1E-7$ /year and $1E-8$ /year for increase in CDF and LERF for each system, and limits of $1E-6$ /year and $1E-7$ /year for the total increase in CDF and LERF associated with replacing the ASME Code, Section XI program with the RIS_B program. These guidelines and guideline values are consistent with those approved by the NRC staff in the EPRI TR and are, therefore, acceptable.

The change in risk evaluation approved in the EPRI TR method is a final screening to ensure that a licensee replacing the Section XI program with the risk-informed alternative evaluates the potential change in risk resulting from that change and implements it only upon determining with reasonable confidence that any increase in risk is small and acceptable. The licensee's method is consistent with the approved EPRI TR method with the exception that the change in risk calculation in N-716 includes the risk increase from discontinued inspection in LSS locations. CCDP and CLERP values greater than $1E-4$ and $1E-5$ were used for LSS welds to bound plant internal flooding study results. These values used for CCDP and CLERP were determined based on results from the plant internal flooding study and are conservatively applied as an upper bound for all LSS welds. In lieu of conducting a formal degradation mechanism evaluation for all LSS piping (e.g., thermal fatigue), these locations were conservatively assigned to the medium failure potential category for use in the change in risk assessment. The high failure potential category is not applicable since a review was conducted to ascertain LSS piping is not susceptible to FAC or water hammer. The NRC staff concludes that the licensee's method described in the submittal is acceptable because the deviation from the approved EPRI TR method expands the scope of the calculated change in risk.

The licensee provided the results of the change in risk calculations in the submittals and noted that most of the results indicate a decrease in risk and that all the estimates satisfy both the system level and the total guidelines. Therefore, the NRC staff finds that any increase in risk is small and acceptable.

3.8 Implementation Monitoring and Feedback

Section 6.2.3 of the EPRI TR addresses implementation, performance monitoring and corrective action strategies. This section does not contain sufficient information to be useful as an evaluation tool. However, this section states that there are no unique aspects of the EPRI method that would suggest a need to depart from any of the requirements of Element 3 of RG 1.178. Element 3 of RG 1.178 will, therefore, be used to evaluate this aspect of the request.

Element 3 of RG 1.178 is divided into three categories: program implementation, performance monitoring, and corrective actions. The program implementation category requires that a licensee's RI-ISI program have a schedule for inspecting all piping segments categorized as safety significant. It further states that the inspection interval will normally be that prescribed by Section XI of the Code but that certain degradation mechanisms may require the interval to be altered. The performance monitoring category requires that a licensee's RI-ISI program be updated based on: changes in plant design features, changes in plant procedures, equipment performance changes, examination results, and plant or industry operating experience. Additionally, a licensee must update its program periodically to correspond to the requirements contained in Section XI of the Code, Inspection Program B. The corrective action category requires a corrective action program that is consistent with the requirements of Section XI of the Code for both Code class and non-Code class piping.

Licensee information concerning this topic was obtained from the relief request itself and from Sections 6 and 7 of the Code Case. The Code Case information was used by the NRC in this review based on the licensee's statement that it would develop implementation procedures for its program in accordance with the Code Case. In its relief request the licensee states that it has a corrective action program and that it will review the RI-ISI program periodically as required by the Code or more frequently as directed by the NRC, or industry or plant-specific feedback. Sections 6 and 7 of the Code Case address inspection frequency and program updates. These sections indicate that inspection frequencies should normally be in accordance with Code requirements and that updates should be made on a Code-dictated schedule or more frequently in response to plant and industry events or information.

The NRC staff finds the licensee's approach to implementing the program to be acceptable because, in accordance with RG 1.178, the licensee indicated that it inspects components on a frequency based on the ASME Code, that it has a corrective action program, and that it updates the program periodically and in response to plant and industry events and information.

3.9 Examination Methods

Section 4 of the EPRI TR addresses the NDE techniques which must be used in a RI-ISI program. This section emphasizes the concept that the inspection technique utilized must be specific to the degradation mechanism expected. Table 4.1 of the EPRI TR summarizes the degradation mechanisms inspected and the examination methods which are appropriate. Specific references are provided to the ASME Code concerning the manner in which the examination is conducted and the acceptance standard.

The Code Case addresses the issue of degradation mechanism/inspection technique in Table 1. Like Table 4.1 of the EPRI TR, Table 1 of the Code Case lists degradation mechanism and corresponding inspection techniques. This table also provides references to the ASME Code concerning the manner in which the examination is conducted and the acceptance standard.

In its relief request, the licensee states that the implementation of the RI-ISI program will conform to the Code Case, i.e., each HSS piping segment will be assigned to the appropriate item number within Table 1 of the Code Case. The NRC staff finds this acceptable because proper assignment of piping segments into Table 1 will ensure that appropriate inspections to detect the degradation mechanism under consideration are conducted. The NRC staff finds this approach acceptable because it is consistent with the EPRI TR.

Pursuant to Section 50.55a(a)(3)(i), alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if the licensee demonstrates that the proposed alternatives will provide an acceptable level of quality and safety. In this case, the licensee proposed to use an alternative to the risk-informed process described in Code Case N-716 which is based, in large part, on NRC-approved EPRI TR-112657. The implementation strategy is consistent with the EPRI-TR guidelines because the number and location of inspections is a product of a systematic application of the risk-informed process. Other aspects of the licensee's ISI program, such as system pressure tests and visual examination of piping structural elements, will continue to be performed on all Class 1, 2, and 3 systems in accordance with ASME Code, Section XI. This provides a measure of continued monitoring of areas that are being eliminated from the NDE portion of the ISI program. As required by the EPRI TR methodology, the existing ASME Code performance measurement strategies will remain in place. In addition, the Code Case N-716 methodology provides for increased inspection volumes for those locations that are included in the NDE portion of the program.

The EPRI TR methodology contains details for developing an acceptable RI-ISI program. Code Case N-716, modified as described by the licensee in its submittals, describes a methodology similar to the EPRI methodology but with several differences as described above in this SE. The NRC staff has evaluated each of the differences and determined that the licensee's proposed methodology, when applied as described, meets the intent of all the steps endorsed in the EPRI TR, is consistent with the guidance provided in RG 1.178, and satisfies the guidelines established in RG 1.174.

4.0 CONCLUSION

As set forth above, the NRC staff has determined pursuant to 10 CFR 50.55a(a)(3)(i) that the licensee proposed RIS_B program will provide an acceptable level of quality and safety for the proposed alternative to the piping ISI requirements with regard to (1) the number of locations, (2) the locations of inspections, and (3) the methods of inspection. Therefore, the licensee proposed alternative is authorized for the fourth 10-year ISI interval. All other ASME Code requirements for which relief was not specifically requested and approved in the subject request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Therefore, the NRC staff authorizes the alternative noted above, at NAPS Unit Nos. 1 and 2, for the fourth 10-year ISI program interval.

5.0 REFERENCES

1. Letter from J. Alan Price, Virginia Electric and Power Company to U.S. Nuclear Regulatory Commission, "Relief Request N1-I4-RI-001 and N2-I4-001, Request for Alternative - Implementation of a Risk-Informed Inservice Inspection Program Based on ASME Code Case N-716" for North Anna Power Station Units 1 and 2, February 23, 2010 (ADAMS Accession No. ML100560430)
2. Letter from J. Alan Price, Virginia Electric and Power Company to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information, Relief Request N1-I4-RI-001 and N2-I4-001, Request for Alternative - Implementation of a Risk-Informed Inservice Inspection Program Based on ASME Code Case N-716" for North Anna Power Station Units 1 and 2, September 13, 2010 (ADAMS Accession No. ML102570807)
3. ASME Code Case N-716, "Alternative Piping Classification and Examination Requirements, Section XI, Division 1," ASME, New York, New York, April 19, 2006.
4. ASME Code RA-Sb-2005, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," Addendum B to ASME RA-S-2002, ASME, New York, New York, December 30, 2005.
5. MRP-139, "Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline," Revision 1, December 2008, Electric Power Research Institute, Palo Alto, California.

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Date: January 21, 2011

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

Sincerely,

/RA by NDiFrancesco for/

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