



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

April 30, 2013

Mr. David A. Heacock
President and Chief Nuclear Officer
Virginia Electric and Power Company
Innsbrook Technical Center
5000 Dominion Blvd.
Glenn Allen, VA 23060

SUBJECT: SURRY POWER STATION UNITS 1 AND 2 - RELIEF IMPLEMENTING
EXTENDED REACTOR VESSEL INSPECTION INTERVAL (TAC NOS. ME8573
AND ME8574)

Dear Mr. Heacock:

By letter dated April 25, 2012, as supplemented by letter dated February 15, 2013 (Agencywide Document Access and Management System (ADAMS) Accession Number ML12130A217 and ML13056A413, respectively), Virginia Electric and Power Company (Dominion), the licensee, proposed an extension of the inservice inspection (ISI) interval requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Paragraph IWB-2412, Inspection Program B for Surry Power Station (SPS) Units 1 and 2.

Specifically, Relief Requests CMP-007 and CMP-009 propose alternatives pursuant to Section 50.55a(a)(3)(i) of Title 10 to the *Code of Federal Regulations* (10 CFR) to extend the ISI for examinations of the reactor pressure vessel (RPV) welds (Category B-A) as well as the nozzle-to-vessel welds and inner radius sections (Category B-D) from 10 to 20 years.

The NRC staff has completed its review of the submittals for Relief Requests CMP-007 and CMP-009. The NRC staff concludes that increasing the ISI interval for Categories B-A and B-D components from 10 years to 20 years will result in no appreciable increase in risk. This conclusion is based on the fact that the plant-specific information provided by the licensee is bounded by the data in the WCAP-A and the requests meet all the conditions and limitations described in the WCAP-A. Therefore, Relief Requests CMP-007 and CMP-009 provide an acceptable level of quality and safety and the alternatives can be authorized for Categories B-A and B-D components pursuant to 10 CFR 50.55a(a)(3)(i) until the end of the Fourth ten-year inspection interval, which is now December 13, 2023 for Unit 1, and May 9, 2024 for Unit 2.

D. Heacock

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If you have any questions regarding this matter, please contact the Project Manager, Karen Cotton at (301) 415-1438 or via e-mail at Karen.Cotton@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "R. Pascarelli".

Robert J. Pascarelli, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-280 and 50-281

Enclosure:
Safety Evaluation

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UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUESTS FOR RELIEF CMP-007 AND CMP-009 REGARDING
FOURTH TEN-YEAR INSERVICE INSPECTION PROGRAM INTERVAL
VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION, UNITS 1 AND 2
DOCKET NUMBERS 50-280 AND 281

1.0 INTRODUCTION

By letter dated April 25, 2012 (Reference 1), as supplemented by letter dated February 15, 2013 (Reference 2) (Agencywide Document Access and Management System (ADAMS) Accession Number ML12130A217 and ML13056A413, respectively), Virginia Electric and Power Company (Dominion), the licensee, proposed an extension of the inservice inspection (ISI) interval requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Paragraph IWB-2412, Inspection Program B for Surry Power Station (SPS) Units 1 and 2. The licensee requests to use alternatives to Relief Requests CMP-007 and CMP-009, to the requirements of the ASME Code, Section XI, Paragraph IWB-2412, Inspection Program B.

Specifically, Relief Requests CMP-007 and CMP-009 propose alternatives pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR) to extend the ISI interval for examinations of the reactor pressure vessel (RPV) welds (Category B-A) as well as the nozzle-to-vessel welds and inner radius sections (Category B-D) from 10 to 20 years.

The current Fourth ten-year interval ends on December 13, 2013 for Unit 1 and May 9, 2014 for Unit 2.

2.0 REGULATORY REQUIREMENTS

In accordance with 10 CFR 50.55a(g)(4), the licensee is required to perform ISI of ASME Code Class 1, 2, and 3 components and system pressure tests during the first 10-year interval and subsequent 10-year intervals that 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), subject to the limitations and modifications listed therein.

For the Fourth ten-year ISI intervals at SPS, the Code of record for the inspection of ASME Code Class 1, 2, and 3 components is the 1995 Edition through the 1996 addenda of the ASME

Enclosure

Code, Section XI. The regulation in 10 CFR 50.55a(a)(3) states, in part, that the Director of the Office of Nuclear Reactor Regulation may authorize an alternative to the requirements of 10 CFR 50.55a(g). There are two justifications for an alternative to be authorized. First, per 10 CFR 50.55a(a)(3)(i), the licensee must demonstrate that the proposed alternative would provide an acceptable level of quality and safety. For the second possible justification for an alternative to be authorized, described in 10 CFR 50.55a(a)(3)(ii), the licensee must show that following the ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Regulatory Guide (RG) 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2, describes general procedures acceptable to the staff for calculating the effects of neutron radiation embrittlement of the low-alloy steels currently used for light-water-cooled reactor vessels.

The guidance in RG 1.174, "An Approach For Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes To The Licensing Basis, " Revision 1, describes a risk-informed approach, acceptable to the NRC, for assessing the nature and impact of proposed licensing basis changes by considering engineering issues and applying risk insights.

The guidance in RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," describes methods and assumptions acceptable to the staff for determining the pressure vessel neutron fluence.

2.1 Background

The ISI of Categories B-A and B-D components consists of visual and ultrasonic examinations intended to discover whether flaws have initiated, whether pre-existing flaws have extended, and whether pre-existing flaws may have been missed in prior examinations. These examinations are required to be performed at regular intervals, as defined in Section XI of the ASME Code.

2.2 Summary of WCAP-16168-NP, Revision 2

In 2006, the Pressurized Water Reactor (PWR) Owners Group submitted a topical report, WCAP-16168-NP, Revision 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval" (referred to as the WCAP in the rest of the document), to the NRC in support of making a risk-informed assessment of extensions to the ISI intervals for Categories B-A and B-D components. In the report, the PWR Owners Group took data associated with three different PWR plants (referred to as the pilot plants), one designed by each of the main contractors for PWR nuclear power plants in the USA, and performed the necessary studies on each of the pilot plants required to justify the proposed extension of the ISI interval for Categories B-A and B-D components from 10 to 20 years.

The analyses in the WCAP used probabilistic fracture mechanics tools and inputs from the work described in the NRC's pressurized thermal shock (PTS) risk re-evaluation (Reference 4 and 5). The PWR Owners Group analyses incorporated the effects of fatigue crack growth and inservice inspection. Design basis transient data was used as input to the fatigue crack growth evaluation. The effects of ISI were modeled consistent with the previously-approved

probabilistic fracture mechanics codes (Reference 6). These effects were put into evaluations performed with the Fracture Analysis of Vessels - Oak Ridge (FAVOR) computer code (Reference 7). All other inputs were identical to those used in the PTS risk re-evaluation.

From the results of the studies, the PWR Owners Group concluded that the ASME Code, Section XI 10-year inspection interval for Categories B-A and B-D components in PWR RPVs can be extended to 20 years. Their conclusion from the results for the pilot plants was considered to apply to any plant designed by the three vendors (Westinghouse, Combustion Engineering (CE), and Babcock and Wilcox (B&W)) as long as the critical, plant-specific parameters (defined in Appendix A of the WCAP) are bounded by the pilot plants.

2.3 Summary of NRC Safety Evaluation (SE)

The staff's conclusion in its SE of the WCAP (Reference 8) indicates that the methodology presented in the WCAP, in concert with the guidance provided by RG 1.174, Rev. 1 (Reference 9), is acceptable for referencing in requests to implement alternatives to ASME Code inspection requirements for PWR plants in accordance with the limitations and conditions in the SE. In addition to showing that the subject plant parameters and inspection history are bounded by the critical parameters identified in Appendix A in the WCAP, the following licensee action items from the SE are summarized below:

1. The dates identified in the request for alternative should be within plus or minus one refueling cycle of the dates identified in the implementation plan provided to the NRC. Any deviations from PWR Owners Group letter, OG-10-238 "PWR Owners Group Revision to the Revised Plan for Plant Specific Implementation of Extended Inservice Inspection Interval per WCAP-16168-NP". Revision 1, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval" PA-MS-01", July 12, 2012 (Reference 10) should be discussed in detail in the request for alternative. The maximum proposed ISI interval is 20 years.
2. The request for alternative ISI interval can use any NRC-approved method (NUREG-1874, "Recommended Screening Limits for Pressurized Thermal Shock (PTS)", 2007, (Reference 5)) to calculate ΔT_{30} and RT_{MAX-X} . However, if the request uses the NUREG-1874 methodology to calculate ΔT_{30} , then the request should include the analysis described in paragraph (6) of subsection (f) to the voluntary, alternative PTS rule (10 CFR 50.61a). The analysis should be done for all of the materials in the beltline area with at least three surveillance data points.
3. If the subject plant is a Babcock & Wilcox designed plant, the licensees must verify that the fatigue crack growth of 12 heat-up/cool-down transients per year bound the fatigue crack growth for all of its design basis transients and identify the design basis transients that contribute to significant fatigue crack growth.
4. If the subject plant has RPV forgings that are susceptible to underclad cracking or if the RPV includes forgings with RT_{MAX-FO} (Reference 5) values exceeding 240 °F, then the WCAP analyses are not applicable. The licensee must submit a plant-specific evaluation for any extension to the 10-year inspection interval for ASME Code, Section XI, Categories B-A and B-D RPV welds.

5. The shift in the Charpy transition temperature produced by irradiation defined at the 30 ft-lb energy level, ΔT_{30} , must be calculated using the latest approved methodology documented in Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," or other NRC-approved methodology.

3.0 PROPOSED ALTERNATES FOR SPS, UNITS 1 AND 2

3.1 Description of Proposed Alternatives

In CMP-007, the licensee proposes to defer the ASME Code required Categories B-A and B-D weld ISI for Unit 1 until December 13, 2023, and May 9, 2024 for Unit 2. This would be approximately 20 years from the last inspection at each unit. This schedule is consistent with the schedule proposed in the revision to PWR Owner Group Letter OG-10-238 (Reference 10).

3.2 Components for Which Relief is Requested

The affected components are the subject plant RPV and its interior attachments and core support structure. The following examination categories and item numbers from IWB-2500 and Table IWB-2500-1 of the ASME Code, Section XI, are addressed in this request:

For Relief Requests CMP-007 and CMP-009:

<u>Exam Category</u>	<u>Item Number</u>	<u>Description</u>
B-A	B1.11	Circumferential Shell Welds
B-A	B1.12	Longitudinal Shell Welds
B-A	B1.21	Circumferential Head Welds
B-A	B1.22	Meridional Shell Welds
B-A	B1.30	Shell-to-Flange Weld
B-A	B1.40	Head-to-Flange Weld
B-A	B1.50	Repair Weld
B-A	B1.51	Beltline Region
B-D	B3.90	Nozzle-to-Vessel Welds
B-D	B3.100	Nozzle Inner Radius Section

3.3 Basis for Proposed Alternatives, Relief Requests CMP-007 and CMP-009

The basis for Relief Requests CMP-007 and CMP-009 is found in the WCAP-16168-NP-A, Rev. 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval", June 13, 2008 (Reference 11, referred to as WCAP-A). Plant-specific parameters for each subject plant are summarized in Enclosures 1 and 2 to the submittal. The format of the information is patterned after that found in Appendix A of the WCAP-A.

The licensee concludes that all of the critical parameters listed in Tables 1, 2, and 3 of Attachments 1 and 2 to the submittal, are bounded by the WCAP-A Westinghouse pilot plant (Beaver Valley, Unit 1) and no additional evaluation is required.

3.4 Duration of Proposed Alternatives

The licensee states that the applicability of these alternates is for the Fourth ten-year ISI interval ten-year inservice inspection intervals with the next ASME Categories B-A and B-D RPV weld inspections scheduled for December 13, 2023 at Unit 1 and May 9, 2024 at Unit 2.

4.0 STAFF TECHNICAL EVALUATION

4.1 CMP-007, Unit 1 and CMP-009, Unit 2

The staff reviewed Enclosures 1 and 2 to the licensee's letter dated April 25, 2012, to make this evaluation. In Table 1 of each enclosure, the "Frequency and Severity of Design Transients" of Units 1 and 2 were found to be bounded by the WCAP-A. Also, the Units 1 and 2 RPVs have a single-layer cladding on the inside like the assumption used in the WCAP-A analysis.

Table 2 of the submittal includes additional information pertaining to previous RPV inspections and the schedule for future ones. The next inspection for Units 1 and 2 would be December 13, 2023 and May 9, 2024 (+/- one refueling outage), respectively. The staff has reviewed the revised PWR Owners Group plan and finds that the proposed alternatives matches the inspection plan for the PWR fleet.

With regards to the results from past interval inspections, there were a total of six indications in the most recent (Third) interval inspection of the beltline region at Unit 1. None were closer to the inside diameter than $1/10^{\text{th}}$ or 1 inch of the RV thickness. The indications were evaluated according to ASME Code, Section XI, Paragraph IWB-3500 and the flaw sizes were found to be acceptable without any further evaluation. With this information, the staff concludes that the additional information for Unit 1 in Table 2 of attachment 1 for the proposed alternative (CMP-007) is bounded by the WCAP-A.

With regards to the results from past interval inspections at Unit 2, a total of five indications were detected in the most recent (Third) interval inspection of the beltline weld region. All of the indications were evaluated and found to be acceptable flaw sizes per IWB-3500 of the ASME Code, Section XI. Four of the indications in the beltline weld metal were located inside of the inner 1 inch or $1/10^{\text{th}}$ thickness of the RPV beltline region. All of the indications were within the maximum number of flaws allowed and therefore acceptable according to the requirements of the alternate PTS Rule; therefore, there is no requirement for remedial action or further analysis.

The staff questioned four indications that were found near the inside diameter of the beltline weld region. In a letter dated February 15, 2013 (Reference 2), the licensee included specific dimensions for each of the four flaws. Three were within the circumferential weld metal, weld #1-03, between the intermediate to lower shells. The fourth indication was observed in the axial weld #1-07. The four indications were only observed in the 3rd ISI interval inspection. The licensee goes on to explain how the methodology used for the 3rd ISI interval inspection was approximately 8x more sensitive than either the 1st or 2nd ISI interval inspections. Therefore, it is likely that the indications were present but not recorded during the 1st and 2nd ISI interval inspections.

From the information provided, the staff concludes that the beltline region indications found in the Third interval inspection at Unit 2 were relatively small, and may have been fabrication-

induced defects that were not detected in the preservice or previous inservice examinations. There is no evidence that the beltline region indications are growing due to any active aging mechanism, and the size is acceptable per IWB-3500 of the ASME Code, Section XI and the flaw limits in the alternate PTS Rule. With this information, the staff concludes that the additional information for Unit 2 in Table 2 of the proposed alternative (CMP-009) is bounded by the WCAP-A.

The calculation of the through-wall cracking frequency (TWCF) performed using WCAP-A uses inputs from Table 3 of Enclosures 1 and 2 of the submittal as a basis. The request uses the RG 1.99, Rev. 2, Position 1.1 methodology to calculate ΔT_{30} for all RV beltline materials except the lower shell heat #C4415-1 in Unit 1 where credible surveillance data was available to use Position 2.1. The fluence values for all beltline materials for Units 1 and 2 were taken from the 2009 Westinghouse fluence calculations associated with the measurement uncertainty recapture (MUR) uprate submittal (References 12 and 13) rather than the more conservative Framatome fluence analysis used in the most recent Appendix H submittals (References 14 and 15). The use of the Westinghouse methods to calculate fluence in these relief requests is acceptable because they are using methods that adhere to RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence" guidance, and they've been benchmarked generically as well as using results from SPS capsule dosimetry analysis.

The staff questioned why the nozzle shell forgings and their associated circumferential welds for each unit were not included in Table 3 of Attachments 1 and 2. The February 15, 2013 supplement included revisions to Table 3 of Attachments 1 and 2 to include consideration of the nozzle shell forgings and their associated circumferential welds in the total TWCF for each unit.

The staff has reviewed the licensee's revised submittals and the basis documents for approving the relief request. The staff notes that the alternate PTS Rule does not include a RV with both forged shells and plate-welded shell elements. The staff considers the approach taken in the revisions to Table 3 in Attachments 1 and 2 will over predict the TWCF for each RV, adding extra conservatism to TWCF calculations, and are therefore acceptable to the staff. Given the revised inputs, the TWCF results were independently verified via staff calculation and the difference between the licensee's and staff's calculations were found to be insignificant. With this information, the staff concludes that the details of the TWCF calculations for SPS, Units 1 and 2 in Table 3 of the proposed alternatives (Relief Requests CMP-007 and CMP-009) are bounded by the WCAP-A. The licensee has demonstrated that the proposed alternatives will provide an acceptable level of quality and safety and meets the guidance provided by RG 1.174, Rev. 1 for risk-informed decisions.

5.0 CONCLUSION

The staff has completed its review of the submittals for Relief Requests CMP-007 and CMP-009 regarding Units 1 and 2. The staff concludes that increasing the ISI interval for Categories B-A and B-D components from 10 to 20 years will result in no appreciable increase in risk. This conclusion is based on the fact that the plant-specific information provided by the licensee is bounded by the data in the WCAP-A and the requests meet all the conditions and limitations described in the WCAP-A. Therefore, Relief Requests CMP-007 and CMP-009 provide an acceptable level of quality and safety and the alternatives can be authorized for Categories B-A and B-D components pursuant to 10 CFR 50.55a(a)(3)(i) until the end of the Fourth ten-year inspection interval, which is now December 13, 2023 for Unit 1, and May 9, 2024 for Unit 2.

All other requirements of the ASME Code, Section XI, not specifically included in the request for the proposed alternatives, remain in effect.

6.0 REFERENCES

1. Lane, N. L., Site Vice President, Letter from Virginia Electric and Power Company to NRC, "Virginia Electric and Power Company (Dominion) Surry Power Station Units 1 and 2 ASME Section XI Inservice Inspection (ISI) Program Request for Alternative – Implementation of Extended Reactor Vessel Inservice Inspection Interval Relief Requests CMP-007 and CMP-009" April 25, 2012, ADAMS Accession No. ML12130A217.
2. Lane, N. L., Site Vice President, Letter from Virginia Electric and Power Company to NRC, "Virginia Electric and Power Company (Dominion) Surry Power Station Units 1 and 2 Response to Request for Additional Information Related to ASME Section XI Inservice Inspection (ISI) Program Request for Alternative – Implementation of Extended Reactor Vessel Inservice Inspection Interval Relief Requests CMP-007 and CMP-009" February 15, 2013, ADAMS Accession No. ML13056A413.
3. WCAP-16168-NP, Rev. 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval", October, 2007, ADAMS Accession No. ML072920413.
4. NUREG-1806, "Technical Basis for Revision Of the Pressurized Thermal Shock (PTS) Screening Limit in the PTS Rule (10 CFR 50.61): Summary Report", 2006, ADAMS Accession No. ML061580318.
5. NUREG-1874, "Recommended Screening Limits for Pressurized Thermal Shock (PTS)", 2007, ADAMS Accession No. ML070860156.
6. WCAP-14572-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection", 1999, ADAMS Accession Nos. ML012630327, ML012630349, and ML012630313.
7. Dickson, T. L and S. Yin, ONRL/NRC/LTR0418, "Electronic Archival of the Results of Pressurized Thermal Shock Analyses for Beaver Valley, Oconee, and Palisades Reactor Pressure Vessels Generated with the 04.1 Version of FAVOR", 2004, ADAMS Accession No. ML042960391.
8. US NRC revised SE for Reference 3, "Revised Final Safety Evaluation By The Office of Nuclear Reactor Regulation Topical Report WCAP-16168-NP-A, Revision 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval" Pressurized Water Reactor Owners Group Project No. 694", July 26, 2011, ADAMS Accession No. ML111600303.
9. Regulatory Guide 1.174, Rev. 1, "An Approach For Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes To The Licensing Basis", November, 29, 2002, ADAMS Accession No. ML023240437.

10. Arey, Jr., Melvin, Chairman, PWR Owners Group Letter OG-10-238, "PWR Owners Group Revision to the Revised Plan for Plant Specific Implementation of Extended Inservice Inspection Interval per WCAP-16168-NP. Revision 1, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval" PA-MSC-01", July 12, 2010, ADAMS Accession No. ML11153A033.
11. WCAP-16168-NP-A, Rev. 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval", June 13, 2008, ADAMS Accession No. ML082820046.
12. CN-REA-08-74, "Pressure Vessel Neutron Fluence Evaluation to Support the MUR for Surry Unit 1," July 29, 2009.
13. CN-REA-08-75, "Pressure Vessel Neutron Fluence Evaluation to Support the MUR for Surry Unit 2," July 30, 2009.
14. Letter 10-199 "Virginia Electric and Power Company (Dominion) Surry Power Station Units 1 and 2 License Amendment Request Revised Cumulative Core Burnup Applicability Limit for Heatup and Cooldown Curves Low Temperature Overpressure Protection System (LTOPS) Setpoint, and LTOPS Enable Temperature" to NRC, May 6, 2010, ADAMS Accession No. ML101310604.
15. Price, J. Alan, Letter 09-507 "Virginia Electric and Power Company (Dominion) Surry Power Station Units 1 and 2, Revised Reactor Vessel Materials Surveillance Capsule Withdrawal Schedules" to NRC, Oct. 26, 2009, ADAMS Accession No. ML092990570.

Principal Contributor: Patrick Purtscher, NRR

Date: April 30, 2013

D. Heacock

- 2 -

If you have any questions regarding this matter, please contact the Project Manager, Karen Cotton at (301) 415-1438 or via e-mail at Karen.Cotton@nrc.gov.

Sincerely,

/RA/

Robert J. Pascarelli, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-280 and 50-281

Enclosure:
Safety Evaluation

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