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

December 19, 2016

Mr. Bryan C. Hanson
President and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 2 – RELIEF REQUEST FOR DISSIMILAR METAL BUTT WELD EXAMINATIONS (CAC NO. MF7291)

Dear Mr. Hanson:

By letter dated January 28, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16028A156), as supplemented by letter dated September 1, 2016 (Reference 2) (ADAMS Accession No. ML16246A202), Exelon Generation Company, LLC, the licensee, submitted a request to the U.S. Nuclear Regulatory Commision (NRC) for authorization of a proposed alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Case N-770-1, as conditioned by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(6)(ii)(F) for Calvert Cliffs Nuclear Power Plant, Unit No. 2 (CCNPP2).

Specifically, the licensee proposed alternative ultrasonic (UT) examination coverage requirements to those of 10 CFR 50.55a(g)(6)(ii)(F) for 16 dissimilar metal butt welds (DMBWs) at CCNPP2. The licensee proposed examination techniques and procedures to be used during the 2017 outage for the identified welds to be similar to those previously used in 2011. Pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use an alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

As set forth in the enclosed Safety Evaluation, the NRC staff has concluded that the proposed alternative in Relief Request RR-ISI-04-11 provides reasonable assurance of structural integrity and leak tightness of the subject dissimilar metal butt welds and that complying with the specified requirement would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the regulatory requirements of 10 CFR 50.55a(z)(2) have been fulfilled and authorizes use of RR-ISI-04-11 at CCNPP2 for the remainder of the fourth 10-year inservice inspection interval.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized in the subject proposed alternative remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the project manager, Richard Guzman, at 301-415-1030 or Richard.Guzman@nrc.gov.

Sincerely,

Stephen S. Koenick, Acting Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-318

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RR-ISI-04-11 REGARDING

DISSIMILAR METAL BUTT WELD EXAMINATIONS

CALVERT CLIFFS NUCLEAR POWER PLANT, LLC

EXELON GENERATION COMPANY, LLC

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 2

DOCKET NO. 50-318

1.0 INTRODUCTION

By letter dated January 28, 2016 (Reference 1), as supplemented by letter dated September 1, 2016 (Reference 2), Exelon Generation Company, LLC, the licensee, submitted a request for authorization of a proposed alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Case N-770-1(Reference 3), as conditioned by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(6)(ii)(F) for Calvert Cliffs Nuclear Power Plant, Unit No. 2 (CCNPP2). Specifically, the licensee proposed alternative ultrasonic (UT) examination coverage requirements to those of 10 CFR 50.55a(g)(6)(ii)(F) for 16 dissimilar metal butt welds (DMBWs) at CCNPP2. Pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use an alternative for the identified welds listed in Table 1A of its submittal on the basis that the required examination coverage of "essentially 100 percent" or "100 percent of the susceptible material volume" for cast austenitic stainless steel (CASS) items is unattainable due to physical obstructions and the limitiation imposed by design, geometry, and/or materials of construction.

2.0 REGULATORY EVALUATION

Paragraph 55a(g)(6)(ii)(F) of 10 CFR 50 requires that licensees of existing operating pressurized water reactors (PWRs) implement the requirements of ASME Code Case N 770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities" (N-770-1), subject to the conditions specified in paragraphs (g)(6)(ii)(F)(2) through (g)(6)(ii)(F)(10), by the first refueling outage after August 22, 2011. Paragraph 55a(g)(6)(ii)(F)(4) of 10 CFR 50 states, "The axial examination coverage requirements of Paragraph -2500(c) may not be considered to be satisfied unless essentially 100 percent coverage is achieved."

Enclosure

Paragraph 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the NRC if the applicant demonstrates that: (1) the proposed alternatives would provide an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on analysis of the regulatory requirements, the NRC staff concludes that regulatory authority exists to authorize the proposed alternative RR-ISI-04-11 pursuant to 10 CFR 50.55a(z)(2).

3.0 TECHNICAL EVALUATION

3.1 Components Affected

ASME Code Class 1 PWR Pressure Retaining dissimilar metal piping welds containing Alloy 82/182, ASME Code Case N-770-1 Inspection Items as shown below:

- Inspection Item B, Unmitigated butt weld at cold leg operating temperature:

Weld ID	NPS
109280 / 30-RC-21A-7	30"
109310 / 30-RC-21A-10	30"
110280 / 30-RC-21B-7	30"
110310 / 30-RC-21B-10	30"
111280 / 30-RC-22A-7	30"
111310/ 30-RC-22A-10	30"
112280 / 30-RC-22B-7	30"
112310 / 30-RC-22B-10	30"
115140 / 12-SI-2009-15	12"
116190 / 12-SI-2010-13	12"
117120 / 12-SI-2011-13	12"
118120 / 12-SI-2012-13	12"

- Inspection Item D, Uncracked butt weld mitigated with stress improvement:

Weld ID	NPS
113010 / 12-PSL-1	12"
113130 / 12-PSL-13	12"
114900 / 12-SC-2004-1	12"
136090 / 4-PS-2003-8	4"

3.2 Code Requirements

- The CCNPP2 code of record for the fourth 10-year inservice inspection interval that started on October 10, 2009 and is scheduled to end on June 30, 2019 is the 2004 Edition, no Addenda, of the ASME Code, Section XI.

- N-770-1, Paragraph -2420 says successive examinations are specified in Table 1. Table 1, Inspection Item B, requires examination every second inspection period not to exceed 7 years. Inspection Items D and E also require successive examinations based on defined criteria.

- N-770-1, Paragraph -2500(c) says in part if 100 percent coverage of the required volume for axial and circumferential flaws cannot be met, but essentially 100 percent coverage for circumferential flaws (100 percent of the susceptible material volume) can be achieved, the examination for axial flaws shall be completed to achieve the maximum coverage practical.

- 10 CFR 55a(g)(6)(ii)(F)(4) says the axial examination coverage requirements of Paragraph -2500(c) may not be considered to be satisfied unless essentially 100 percent coverage is achieved.

3.3 Licensee's Proposed Alternative

The licensee is proposing to use the previously obtained ultrasonic examination coverage (as shown in the January 28, 2016 submittal) of the DM butt welds identified above to satisfy the examination requirements of N-770-1 and 10 CFR 55a(g)(6)(ii)(F)(4).

3.4 Licensee's Basis for Requesting Relief

The licensee proposes to use coverage achieved during the N-770-1 baseline exams for the components listed above as an alternative to the N-770-1 and 10 CFR 55a(g)(6)(ii)(F)(4) required examination coverage of "essentially 100 percent" or "100 percent of the susceptible material volume" because this coverage is unattainable without enduring significant hardship. These welds have been examined in the past (i.e. 2011) using examination techniques qualified to meet the requirements of ASME Section XI, Appendix VIII as required in 10 CFR 50.55a(g)(6) and achieved the maximum practical amount of examination coverage obtainable within the limitations imposed by the design, geometry and materials of construction for the components. The examination coverage achieved for these components during the 2011 exams was shown in Table 1A of the January 28, 2016 submittal.

The 12 unmitigated welds are found in lower temperature regions of the reactor coolant system (at temperatures near Tcold). Therefore, there is a lower probability of crack initiation and a slower crack growth rate. These welds are also highly flaw tolerant, as demonstrated in MRP-109. As shown in MRP-109, it can be demonstrated that piping with substantial size flaws can continue to demonstrate structural integrity for a prolonged period of operation without repair. The additional 4 welds have been mitigated by stress improvement.

Where appropriate, contouring has already been completed on the examination surface. Further actions are limited by the design minimum wall calculations for the piping. Additional

axial flaw coverage would require a weld build-up of the DM weld followed by additional contouring and a Construction Code required radiography examination. The licensee proposes that these additional steps to improve axial coverage constitute a hardship that does not result in an increase to health and safety of the public.

Additionally, bare metal visual examinations in accordance with ASME Code Case N-722-1 (Reference 4) and N-770-1 will continue to be performed. During refueling outages qualified examiners perform walkdowns of the Class 1 components at both pressurized and cold shutdown conditions. These walkdowns satisfy the ASME Section XI pressure testing and the station Boric Acid Corrosion Control Program requirements.

Therefore, the licensee proposes that the UT examination coverages, which include a large percentage of the susceptible material for the circumferential and axial flaws, combined with the periodic system pressure tests and outage walk downs, provide an acceptable level of quality and safety for identifying degradation from primary water stress corrosion cracking (PWSCC) prior to the development of a safety significant flaw.

3.5 NRC Staff Evaluation

Operational experience has shown that PWSCC can occur as the result of the combination of susceptible material, corrosive environment, and tensile stresses, resulting in leakage and the potential for loss of structural integrity. The subject DMBWs meet these conditions, and therefore, may be susceptible to PWSCC. The examination requirements of N-770-1, as conditioned by 10 CFR 50.55a(g)(6)(ii)(F), are intended to ensure the structural integrity and leak tightness, thus an acceptable level of quality and safety, of DMBWs through nondestructive examination.

The staff notes that the generic rules for the frequency of volumetric examination of dissimilar metal butt welds were established to provide reasonable assurance of the structural integrity of the reactor coolant pressure boundary. As such, the staff finds that plant specific analysis could be used to provide a basis for inspection relief if the inspection requirement presents a significant hardship. As such, the staff reviewed the licensee's proposed alternative under the requirements of 10 CFR 50.55a(z)(2), such that;

> Compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Full coverage of the welds is unattainable due to the presence of CASS material, physical obstructions and the limitations imposed by design, geometry, and/or materials of construction. The staff is not aware of other options for attaining the required examination coverage and, therefore, finds that attaining the required ASME Code Case N-770-1 examination coverage would present a hardship.

The licensee stated that CCNPP2 has examined these welds in the past (2011). The UT examination performed in spring 2011 was a manually-delivered, phased-array, single-sided UT examination performed in both the circumferential and axial directions from the outside diameter. The personnel and UT procedure, SI-UT-130, "Procedure for the Phased Array Ultrasonic Examination of Dissimilar Metal Welds" were qualified to the requirements of ASME Code Section XI Appendix VIII, Supplement 10, for detection and characterization of PWSCC.

The SI-UT-130 procedure is also qualified to scan DMBWs with single-sided access. This qualification allows for interrogation of DMBWs that have CASS safe ends or restricted scanning conditions from the opposite side. These previous UT examinations could not obtain essentially 100 percent coverage of the required examination volume due to weld taper, insulation support obstruction, and the presence of the CASS safe-ends.

In the January 28, 2016 submittal the licensee stated that Exelon Nondestructive Examination procedures have adopted the industry NDE Improvement Focus Group (NIFG) guidance for examination of DMBWs based on operating experience with these examinations. These procedures will be in effect during the CCNPP2 DMBW examinations. In the September 1, 2016 response to NRC request for additional information the licensee confirmed that they would use current qualified techniques and the NIFG requirements determined to be "needed" according to the Nuclear Energy Institute Guideline for the Management of Materials Issues.

As identified in MRP-109 (Reference 5) and WCAP-17128-NP (Reference 6), the axial flaw(s) that could result from a PWSCC mechanism in the susceptible alloy 82/182 butt weld are not structurally significant. The axial critical flaw length for an RCP inlet and outlet alloy 82/182 butt weld is 38.2" (MRP-109 Table 5-2) which exceeds the width of the CCNPP2 RCP inlet and outlet alloy 82/182 butt weld material width of 1.75"-2.5". Therefore a critical axial flaw in an RCP inlet or outlet alloy 82/182 butt resulting from a PWSCC mechanism is not credible and improving the exam axial flaw examination volume coverage would not result in an increase in safety.

All of the welds identified in this request received essentially 100 percent examination coverage for circumferential flaws in the susceptible material which alleviates any structural integrity concerns, because an axial PWSCC flaw will be arrested in the adjacent non-susceptible material. Flaw tolerance was further documented in Reference 7, which summarized a flaw tolerance evaluation which is bounding for all the Reactor Coolant Pump (RCP) inlet and outlet Dissimilar Metal Welds (DMWs). In addition, all DMWs operating at hot leg temperature or greater have been mitigated with stress improvement.

The initiation or growth of a safety significant flaw in a cold leg or mitigated alloy 82/182 DM butt weld is extremely unlikely. However, as an added measure of safety, the industry has developed guidelines, to improve their RCS leak detection capability in part due to the concern with PWSCC. In the January 28, 2016 submittal the licensee indicated the CCNPP2 procedures for reactor coolant inventory analysis use the recommendations and guidance of WCAP-16423-NP (Reference 8) and WCAP-16465-NP (Reference 9) as described in a previous response to NRC's request for additional information associated with CCNPP Unit 1 dated November 24, 2015 (ADAMS Accession No. ML15328A513). The enhanced leak rate monitoring and detection procedure monitors specific values of unidentified leakage, seven day rolling average, and baseline means. Action levels are initiated as low as when the unidentified leak rate exceeds 0.1 gpm. The enhanced leak detection capability provides an increased level of safety that if a flaw were to grow through wall, although unlikely, that it would be detected prior to growing to a safety significant size.

The licensee states that contouring has already been completed on the examination surface and further actions are limited by the design minimum wall calculations for the piping; obtaining additional circumferential scan coverage would require a weld build-up of the DMBW, followed by contouring and an ASME Code, Section III, required radiographic examination. The NRC

staff has examined the drawings submitted by the licensee and finds that fulfilling the essentially 100 percent examination coverage requirement is not possible using currently available UT technology and procedures. The NRC staff finds that the lack of ASME Code Section XI, Appendix VIII-compliant examination of the CASS and carbon steel materials is not a structural integrity concern since they are not known to be susceptible to PWSCC or other service-related cracking in the reactor coolant system environment; thus, the NRC staff accepts the UT examination achieved for these materials. The NRC staff further finds that the efforts needed to obtain essentially 100 percent scan coverage of the susceptible material would present a hardship.

Additionally in the January 28, 2016 submittal, the licensee confirmed that they would continue to evaluate new technologies that offer improvements in nondestructive examination performance and examination coverage.

Therefore, examination coverage meeting that which was achieved previously and described in the January 28, 2016 submittal, which includes essentially 100 percent of the susceptible material for the safety significant circumferential flaw and a significant percentage of the susceptible material for the less safety significant axial flaw combined with the periodic system pressure tests, outage walkdowns and leakage monitoring, provides an acceptable level of quality and safety for identifying degradation from PWSCC prior to a safety significant flaw developing.

In summary, the NRC staff finds that performing the actions needed to achieve the UT examination coverage required by 10 CFR 50.55a(g)(6)(ii)(F)(4) would constitute a hardship. The NRC staff also finds that there is reasonable assurance of structural integrity and leak tightness of the subject welds.

4.0 CONCLUSION

As set forth above, the NRC staff has concluded that proposed alternative RR ISI-04-11, provides reasonable assurance of structural integrity and leak tightness of the subject dissimilar metal butt welds and that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the regulatory requirements of 10 CFR 50.55a(z)(2) have been fulfilled and authorizes use of RR ISI-04-11 at CCNPP2, for the remainder of the fourth 10-year inservice inspection interval.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized in the subject proposed alternative remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

5.0 REFERENCES

1. Letter from David T. Gudger, Exelon Generation Company, LLC to NRC, "Relief Request for Dissimilar Metal Butt Weld Examinations," January 28, 2016 (ADAMS Accession No. ML16028A156).

2. Letter from David T. Gudger, Exelon Generation Company, LLC to NRC, "Relief Request for Dissimilar Metal Butt Weld Examinations," September 1, 2016 (ADAMS Accession No. ML16246A202).

3. ASME Code Case N-770-1, Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without of Application of Listed Mitigation Activities, December 25, 2009.

4. ASME Code Case N-722-1, Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated With Alloy 600/82/182 Materials Section XI, Division 1, January 26, 2009.

5. EPRI, Materials Reliability Program Technical Report MRP-109, Rev. 1, Final Report, July 2004, "Materials Reliability Program: Alloy 82/182 Pipe Butt Weld Safety Assessment for US PWR Plant Designs: Westinghouse and CE Design Plants," (ADAMS Accession No. ML042430004).

6. Westinghouse Topical Report WCAP-17128-NP, Rev. 1, May 2010, "Flaw Evaluation of CE Design RCP Suction and Discharge Nozzle Dissimilar Metal Welds, Phase III Study," (ADAMS Accession No. ML12306A291).

7. Letter from J. Stanley (CENG) to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information – Relief Request RR-ISI-04-07A, Dissimilar Metal Butt Welds Baseline Examinations," dated February 18, 2013 (ADAMS Accession No. ML13051A740).

8. Westinghouse Topical Report WCAP-16423-NP, Rev. 0, September 2006, "Pressurized Water Reactor Owners Group Standard Process and Methods for Calculating RCS Leak Rate for Pressurized Water Reactors," (ADAMS Accession No. ML070310084).

9. Westinghouse Topical Report WCAP-16465-NP, Rev. 1, September 2006, "Pressurized Water Reactor Owners Group Standard RCS Leakage Action Levels and Response Guidelines for Pressurized Water Reactors," (ADAMS Accession No. ML070310082).

Principal Contributor: Keith Hoffman

Date: December 19, 2016

If you have any questions, please contact the project manager, Richard Guzman, at 301-415-1030 or Richard.Guzman@nrc.gov.

Sincerely,

/RA/

Stephen S. Koenick, Acting Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-318

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