



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

January 19, 2018

Mr. Dean Curtland  
Site Director, Duane Arnold Energy Center  
Next Era Energy Duane Arnold, LLC  
3277 DAEC Road  
Palo, IA 52324-9785

SUBJECT: DUANE ARNOLD ENERGY CENTER – REQUEST FOR RELIEF NO. RR-01,  
REGARDING EXTENSION OF PERMANENT RELIEF FROM ULTRASONIC  
EXAMINATION OF REACTOR PRESSURE VESSEL CIRCUMFERENTIAL  
SHELL WELDS FOR THE RENEWED OPERATING LICENSE TERM  
(CAC NO. MF9380, EPID L-2017-LLR-0108)

Dear Mr. Curtland:

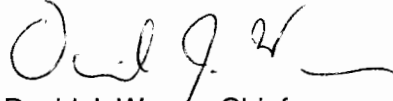
By letter dated March 7, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17069A172), as supplemented by letter dated September 5, 2017 (ADAMS Accession No. ML17250A920), NextEra Energy Duane Arnold, LLC (the licensee) submitted relief request (RR) No. RR-01 to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements at the Duane Arnold Energy Center (DAEC). Specifically, DAEC requested relief from reactor pressure vessel (RPV) circumferential weld examinations as currently required by the ASME Code, Table IWB-2500-1, through the end of the period of extended operation.

Based on the information provided in the licensee's RR and responses to the NRC staff's request for additional information in a letter dated September 5, 2017, the NRC staff concludes that the licensee's proposed alternative is in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(z)(1). The NRC staff finds the request to eliminate the requirement to inspect the RPV circumferential welds, except for the areas of intersection with the axial welds, provides reasonable assurance of structural integrity and an acceptable level of quality and safety. Therefore, the requested relief is authorized in accordance with 10 CFR 50.55a(z)(1) and is permanently deferred through the term of the DAEC renewed facility operating license which expires at midnight on February 21, 2034.

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

If you have any questions regarding this matter, please contact Mr. Mahesh Chawla at (301) 415-8371 or by email at [Mahesh.Chawla@nrc.gov](mailto:Mahesh.Chawla@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "D. J. Wrona", with a long horizontal flourish extending to the right.

David J. Wrona, Chief  
Plant Licensing Branch III  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-331

Enclosure:  
Safety Evaluation

cc: ListServ



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. RR-01

REGARDING EXTENSION OF PERMANENT RELIEF FROM ULTRASONIC EXAMINATION

OF REACTOR PRESSURE VESSEL CIRCUMFERENTIAL SHELL WELDS

FOR THE RENEWED OPERATING LICENSE TERM

DUANE ARNOLD ENERGY CENTER

NEXTERA ENERGY DUANE ARNOLD, LLC

DOCKET NO. 50-331

1.0 INTRODUCTION

By letter dated March 7, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17069A172), as supplemented by letter dated September 5, 2017 (ADAMS Accession No. ML17250A920), NextEra Energy Duane Arnold, LLC (the licensee) submitted relief request (RR) No. RR-01 to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements at the Duane Arnold Energy Center (DAEC).

Specifically, the licensee requested relief from reactor pressure vessel (RPV) circumferential weld examinations as currently required by the ASME Code, Table IWB-2500-1, through the end of the DAEC period of extended operation (PEO). The proposed alternative in the RR, which was made pursuant to the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(z)(1), would eliminate the requirement to inspect the RPV circumferential welds, except for the areas of intersection with the axial welds. This is consistent with the guidance provided in Generic Letter (GL) 98-05, "Boiling Water Reactor [BWR] Licensees Use of the BWRVIP-05 [Boiling Water Reactor Vessel Internals Project] Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds" (ADAMS Accession No. ML031430368), for operation under the initial license and the NRC staff's safety evaluation (SE) dated October 18, 2001, in BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal" (ADAMS Accession No. ML031710349, Non-publicly available) for the PEO. The proposed alternative is for the 20-year term of DAEC's PEO, which will end on February 21, 2034. The ASME Code, code of record (COR) for DAEC's fifth 10-year inservice inspection (ISI) interval is the 2007 Edition through the 2008 Addenda.

Enclosure

RPV circumferential weld examination relief was reviewed as a time limited aging analysis (TLAA) during the NRC staff's review of the DAEC license renewal application. This TLAA review concluded with Commitment No. 38 specified in NUREG-1955, "Safety Evaluation Report Related to the License Renewal of Duane Arnold Energy Center" (ADAMS Accession No. ML103070013). Commitment No. 38 states that DAEC will "submit a relief request to address the frequency requirements of the [ISI] of the RPV circumferential welds (BWRVIP-05)." Therefore, in addition to its objective common to a typical RR, this RR has also fulfilled Commitment 38 specified in NUREG-1955.

## 2.0 REGULATORY REQUIREMENTS

The ISI of the ASME Code, Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g). Section 50.55a(z)(1) of 10 CFR states that alternatives to the requirements of paragraph (g) may be used when authorized by the NRC if the "proposed alternative would provide an acceptable level of quality and safety."

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical, within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 120-month interval, and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(a) and subjected to the conditions listed in 10 CFR 50.55a(b), 12 months prior to the start of the 120-month interval.

For RPV circumferential welds, the July 28, 1998, SE for BWRVIP-05 concluded that elimination of the ISI of the RPV circumferential welds for BWRs is justified, since the failure frequency for circumferential welds in BWR plants is significantly below the criterion specified in Regulatory Guide (RG) 1.154, "Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors," dated January 1987 (ADAMS Accession No. ML003740028). The NRC staff notes that RG 1.154 was withdrawn on January 14, 2011 (76 FR 2726), for general application to future licensee RRs. However, the acceptability of the use of BWRVIP-05, specifically for DAEC, was previously affirmed in the NRC staff technical evaluation presented in Section 4.2.4, "Reactor Vessel Circumferential Weld Examination Relief," of NUREG-1955.

The GL 98-05 provided recommendations for licensees planning to request permanent relief from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of RPV circumferential welds (ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item 1.11, Circumferential Shell Welds). The recommendations were based on the July 28, 1998, SE for BWRVIP-05 and included the need for licensees to perform their required inspections of "essentially 100 percent" of all axial welds. These recommendations were only applicable to the remaining term of operation under the initial existing license. The SE for BWRVIP-74-A specified similar recommendations for the PEO.

Section 4.2.4 of NUREG-1955 noted that the anticipated changes in metallurgical conditions expected over the PEO require an additional analysis for 54 [Effective Full Power Years] EFPY to be reviewed and approved by the NRC staff. The NRC staff relies on RG 1.190,

dated March 2001 (ADAMS Accession No. ML010890301), to evaluate the neutron fluence at 54 EFPY for DAEC. RG 1.190 describes methods and assumptions acceptable to the NRC staff for determining the RPV neutron fluence.

### 3.0 TECHNICAL EVALUATION

#### 3.1 ASME Code Component Affected

The ASME Code components affected by the licensee's proposed alternative are listed below:

Code Class:	1
Component Numbers:	VCB-B001, VCB-A002, VCB-B003, and VCB-B004
Examination Category:	B-A
Item Number:	B1.11

#### 3.2 ASME Code Requirements

The ASME Code, Section XI, 2007 Edition through 2008 Addenda, Table IWB-2500-1, Examination Category B-A, Item B1.11, requires a volumetric examination for all RPV circumferential shell welds each interval.

#### 3.3 Licensee's Proposed Alternative to the ASME Code

The licensee's proposed alternative is relief from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of RPV circumferential welds (ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item B1.11) through February 21, 2034. The licensee's September 5, 2017, supplement confirms that the licensee will continue to perform their required inspections of "essentially 100 percent" of all axial welds.

#### 3.4 Licensee's Basis for Alternative

Regarding the technical basis for relief from inspection of the RPV circumferential welds, the licensee cited information from Section 4.2.4 of NUREG-1955. In the license renewal application and NUREG-1955, relief from the circumferential weld examination was evaluated as a TLAA. The licensee quoted the NRC staff's conclusion from Section 4.2.4 as its first basis for the alternative. Please note that the licensee's quotes as presented in RR No. 1 contain some editorial deviations. The following are direct quotes from Section 4.2.4 of NUREG-1955.

Since the DAEC 54 EFPY mean [nil-ductility transition reference temperature]  $RT_{NDT}$  value is less than the 64 EFPY value used in the staff's SE dated July 28, 1998, the staff concludes that the RPV conditional failure probability of the limiting DAEC RPV circumferential weld is bounded by the staff analysis, and the [probability of failure] PoF value due to a [low temperature overpressure protection] LTOP event at 54 EFPY for the limiting RPV circumferential weld is less than the value used in the staff's SE dated July 28, 1998.

Regarding operator training and procedures that limit the frequency of cold overpressure events, the licensee quoted another NRC staff's conclusion from Section 4.2.4 of NUREG-1955 as the second basis for the alternative:

The applicant stated it will use the same procedures and training used to limit RPV cold overpressure events as those approved by the staff for DAEC to implement the BWRVIP-05 technical alternative for the term of the current operating license. By letter dated October 23, 2009, [the applicant] provided a response to RAI 4.2.4-2 [to state that] it will use training procedures (to limit RPV cold overpressure events) described in [the applicant's] relief request NDE-RO47.... Since the training procedures for DAEC were approved by the staff and they are consistent with the BWRVIP-05 report, the staff accepted the applicant's response and considers its concerns related to RAI 4.2.4-2 resolved.

### 3.5 Duration of the Alternative

The licensee requested use of the proposed alternative for the 20-year term of the renewed operating license which expires at midnight on February 21, 2034.

### 3.6 NRC Staff Evaluation of the Alternative

Section A.4.5, "Circumferential Weld Inspection Relief" of BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal," (proprietary and not in ADAMS) indicates that the July 28, 1998, SE for BWRVIP-05 conservatively evaluated the BWR RPVs to 64 EFPY, 10 EFPY greater than realistically expected for the end of the PEO. The NRC staff's evaluation of Section A.4.5 of BWRVIP-74-A results in two requirements specified in Action Item 11 for licensees to obtain relief from the ASME Code, Section XI, ISI requirements for RPV circumferential welds during the PEO. First, at the end of the PEO, the RPV circumferential welds will satisfy the limiting conditional PoF for the RPV circumferential welds in the July 28, 1998, SE. Second, during the PEO, the licensees have implemented operator training and established procedures that limit the frequency of cold overpressure events to the amount specified in the NRC staff's SE.

Section 4.2.4 of NUREG-1955 documents the NRC staff's evaluation of the RPV circumferential weld TLAA for the PEO. This evaluation is in accordance with the requirements from the July 28, 1998, SE for BWRVIP-05 for plants seeking relief from inspection of RPV circumferential welds. The NRC staff's evaluation in Section 4.2.4 of NUREG-1955 states:

The staff reviewed the applicant's calculations for the 54 EFPY mean  $RT_{NDT}$  value for the limiting RPV circumferential weld using the data presented in the submittal dated October 23, 2009, and found them to be acceptable. The 54 EFPY mean  $RT_{NDT}$  value is bounded by the 64 EFPY mean  $RT_{NDT}$  value used by the staff for determining the conditional failure probability of a circumferential weld. The 64 EFPY mean  $RT_{NDT}$  value from the staff's SE dated July 28, 1998, is representative of a Chicago Bridge and Iron Company (CB&I) weld because CB&I fabricated the DAEC RPV.

The NRC staff accepted the DAEC 54 EFPY mean  $RT_{NDT}$  value because: (1) Section 4.2.4 of NUREG-1955 indicates that the staff confirmed the validity of the data for the copper and nickel contents and the initial  $RT_{NDT}$  values for the limiting RPV bellline circumferential weld, and (2) Section 4.2, "Reactor Vessel Neutron Embrittlement" of NUREG-1955 indicates that the neutron

fluence at 54 EFPY is acceptable. It should be noted that Section 4.2 concludes that the fluence calculation was carried out using staff-approved methodologies (i.e., adheres to the guidance set forth in RG 1.190) and accounted for projected core operating conditions. In addition, the calculation is conservative because the applicant-predicted end of license irradiation is expected to be less than the 54 EFPY that was calculated. Therefore, the DAEC 54 EFPY mean  $RT_{NDT}$  value is valid and can be used in this evaluation.

Since the DAEC 54 EFPY mean  $RT_{NDT}$  value is bounded by the 64 EFPY mean  $RT_{NDT}$  value for the CB&I weld in the July 28, 1998, SE for BWRVIP-05, the NRC staff concludes that the PoF value due to a low-temperature overpressure protection event at 54 EFPY for the limiting DAEC RPV circumferential weld is less than the value from the July 28, 1998, SE. Therefore, the licensee has satisfied the first requirement for the RR during the PEO.

Regarding the second requirement for the relief during the PEO, the NRC staff verified the validity of the licensee's statement regarding operator training and plant procedures under Section 3.4 of this SE. Since the licensee will continue to apply the same operator training and procedures in RR NDE-RO47 (approved on January 6, 2005) to the PEO to limit RPV cold overpressure events, the NRC staff determined that the licensee has satisfied the second requirement for the relief request during the PEO.

Further, the July 28, 1998, SE for BWRVIP-05 requires that examination of the limiting RPV circumferential shell welds be performed if the corresponding volumetric examinations of the RPV axial shell welds revealed any presence of an age-related degradation mechanism. As indicated in Section 4.2.4 of NUREG-1955, the licensee confirmed that no recordable indications of cracking were identified during the previous volumetric examinations of the RPV axial welds at DAEC, further supporting this relief request.

Since both the BWRVIP-74-A, Action Item 11, requirements regarding RPV circumferential weld inspection relief during the PEO are satisfied, as discussed above, the NRC staff concludes that the licensee's proposed alternative provides an acceptable level of quality and safety. Therefore, the NRC staff finds the licensee's proposed alternative to be acceptable for the duration of the PEO.

#### 4.0 CONCLUSION

The NRC staff finds the information submitted by the licensee related to the RPV circumferential welds supports the determination that the conditional PoF at the end of the PEO is bounded by the limiting conditional PoF for a CB&I-fabricated RPV. This finding is based on the projected mean  $RT_{NDT}$  of the limiting circumferential weld material for DAEC, which is a function of the chemistry and projected neutron fluence for this material. The projected mean  $RT_{NDT}$  values for DAEC are less than the mean  $RT_{NDT}$  value associated with the limiting conditional PoF for a CB&I-fabricated RPV cited in the NRC staff's SE of BWRVIP-05. Additionally, the licensee will continue to implement operator training and procedures to limit the frequency of cold overpressure events to the amount specified in the NRC staff's SE for BWRVIP-05. Therefore, the licensee has satisfactorily addressed the two plant-specific requirements described in the SE in BWRVIP-74-A to obtain relief from inspection of circumferential RPV welds for the PEO.

On this basis, the NRC staff concludes that the proposed alternative in RR No. RR-01 for relief from inspection of RPV circumferential welds provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(z)(1), the request for proposed alternative in RR No. RR-01 from the requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item B1.11, pertaining to RPV circumferential shell welds is authorized for DAEC for the duration of the 20-year term of the renewed operating license, which expires at midnight on February 21, 2034.

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

Principal Contributor: Simon Sheng

Date of Issuance: January 19, 2018



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SSheng, NRR

**ADAMS ACCESSION No. ML17353A682****\*via e-mail**

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