



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

June 19, 2015

Mr. Edward D. Halpin
Senior Vice President and
Chief Nuclear Officer
Pacific Gas and Electric Company
Diablo Canyon Power Plant
P.O. Box 56, Mail Code 104/6
Avila Beach, CA 93424

SUBJECT: DIABLO CANYON POWER PLANT, UNIT NO. 1 – REQUEST FOR
ALTERNATIVE RPV-U1-EXTENSION TO ALLOW USE OF ALTERNATE
REACTOR INSPECTION INTERVAL REQUIREMENTS (TAC NO. MF4678)

Dear Mr. Halpin:

By letter dated August 18, 2014, as supplemented by letter dated March 20, 2015, Pacific Gas and Electric Company (the licensee) proposed an alternative to the inservice inspection (ISI) interval requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Paragraph IWB-2412, "Inspection Program B," for Diablo Canyon Power Plant (DCPP), Unit 1. Inspection Program B requires volumetric examination of essentially 100 percent of reactor pressure-retaining welds identified in Table IWB-2500-1 once each 10-year interval. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(z) (50.55a(a)(3)(i) at the date of application), the licensee requested to use a proposed alternative to extend the DCPP Unit 1 reactor pressure vessel (RPV) inspection interval from 10 to 20 years. The paragraph headings in 10 CFR 50.55a were changed by *Federal Register* notice dated November 5, 2014 (79 FR 65776), which became effective on December 5, 2014 (e.g., 10 CFR 50.55a(a)(3)(i) is now 50.55a(z)(1), and 50.55a(a)(3)(ii) is now 50.55a(z)(2)). The cross-reference tables, which are cited in the notice, can be found in the Agencywide Documents Access and Management System (ADAMS) at Accession Nos. ML14015A191 and ML14211A050.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the licensee's submittal and, as set forth in the enclosed safety evaluation, concludes that extending the ISI interval from 10 to 20 years will provide an acceptable level of quality and safety because the DCPP, Unit 1 RPV is bounded by Westinghouse Electric Company, LLC topical report WCAP-16168-NP-A, Revision 3, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval," October 2011, which supports the request, and the request met all of the provisions set forth in the WCAP and the NRC staff's safety evaluation for the WCAP dated July 26, 2011. Further, the NRC concludes that the licensee's alternative to the implementation plan is acceptable on the basis that the change creates a more uniform distribution of plant inspections over the extended ISI interval. However, the proposed 2025 inspection must be performed before May 6, 2025, to stay within the allowed 10 additional years for the third ISI interval. By e-mail dated May 11, 2015 (ADAMS Accession No. ML15132A306), the licensee agreed to perform the examination by the specified date. Therefore, pursuant to

E. Halpin

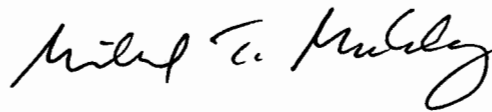
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10 CFR 50.55a(z)(1), the NRC staff authorizes the licensee's alternative ISI schedule for the specified welds for extension to May 2025.

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

If you have any questions, please contact Siva Lingam at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael T. Markley". The signature is fluid and cursive, with the first name "Michael" and last name "Markley" clearly distinguishable.

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-275

Enclosure:
Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
REGARDING REQUEST FOR ALTERNATIVE RPV-U1-EXTENSION TO ALLOW USE OF
ALTERNATE REACTOR INSPECTION INTERVAL REQUIREMENTS

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON POWER PLANT, UNIT 1

DOCKET NO. 50-275

1.0 INTRODUCTION

By letter dated August 18, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14230A618), as supplemented by letter dated March 30, 2015, (ADAMS Accession No. ML15089A595), Pacific Gas and Electric Company (PG&E, the licensee) submitted a relief request, which proposed an alternative to 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 Diablo Canyon Power Plant (DCPP), Unit 1. Inspection Program B requires volumetric examination of essentially 100 percent of reactor pressure-retaining welds identified in Table IWB-2500-1 once each 10-year interval. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(z)(1), the licensee requested the use of a proposed alternative to extend the DCPP, Unit 1 reactor vessel inspection interval from 10 years to 20 years on the basis that the alternative provides an acceptable level of quality and safety.

The paragraph headings in 10 CFR 50.55a were changed by *Federal Register* notice dated November 5, 2014 (79 FR 65776), which became effective on December 5, 2014 (e.g., 10 CFR 50.55a(a)(3)(i) is now 50.55a(z)(1), and 50.55a(a)(3)(ii) is now 50.55a(z)(2)). The cross-reference tables, which are cited in the notice, can be found in the ADAMS Accession No. ML14015A191 and ADAMS package Accession No. ML14211A050.

2.0 REGULATORY REQUIREMENTS

Inservice inspection 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 a way to detect anomaly and degradation indications so that structural integrity of these components can be maintained. This is required by 10 CFR 50.55a(g), except where specific relief has been granted by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). The regulations in 10 CFR 50.55a(z) state that alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a or portions thereof may be used, when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be

Enclosure

submitted and authorized prior to implementation. The applicant or licensee must demonstrate that: (1) the proposed alternative would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), components (including supports) that are classified as ASME Code Class 1, 2, and 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions and addenda of the ASME Code, that become effective subsequent to editions specified in paragraphs (g)(2) and (3) of this section, 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 successive 120-month inspection intervals (following the initial 120-month inspection interval) must comply with the requirements in the latest edition and addenda of the ASME Code, which was incorporated by reference in 10 CFR 50.55a(a) 12 months before the start of the 120-month interval (or the optional ASME Code Cases listed in NRC Regulatory Guide (RG) 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," October 2014; ADAMS Accession No. ML13339A689), subject to the conditions listed in 10 CFR 50.55a(b).

RG 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," May 1988 (ADAMS Accession No. ML003740284), 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 pressure vessels (RPVs).

RG 1.174, Revision 1, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," November 2002 (ADAMS Accession No. ML023240437), 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.

RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," March 2001 (ADAMS Accession No. ML010890301), describes methods and assumptions acceptable to the NRC staff for determining the RPV neutron fluence.

The licensee has requested relief from ASME Code requirements pursuant to 10 CFR 50.55a(g)(6)(i). The DCP, Unit 1 third 10-year ISI interval is based on the ASME Code, Section XI, 2001 edition through 2003 addenda. ASME Code, Section XI, 2001 edition without addenda applies to ultrasonic examinations performed per ASME Code, Section XI, Appendix VIII requirements. The applicable ASME Code, Section XI for the fourth 10-year ISI interval for DCP will be the 2007 edition with 2008 addenda. Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request, and the Commission to grant, the relief requested by the licensee. The end date for the DCP, Unit 1 third 10-year ISI interval is May 6, 2015.

3.0 TECHNICAL EVALUATION

3.1 Background

The ISI of Categories B-A and B-D components consists of visual and ultrasonic examinations intended to discover whether new 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.

3.1.1 WCAP-16168-NP, Revision 2¹

By letter dated July 26, 2011 (ADAMS Accession No. ML111610242), the NRC staff issued revised final safety evaluation (SE), which found that the Westinghouse Electric Company, LLC (Westinghouse) topical report WCAP-16168-NP, Revision 2 (the WCAP), "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval," is acceptable for referencing in licensing applications for pressurized-water reactors (PWRs) designed by Westinghouse, Combustion Engineering, Inc., and Babcock and Wilcox, Inc. (B&W). The WCAP was developed to support a risk-informed assessment of extensions to the ISI intervals for ASME Code, Section XI, Examination Category B-A and B-D components, from 10 to 20 years using data from three different PWR plants (referred to as the pilot plants) representing each of the vendors.

The analyses in the WCAP used probabilistic fracture mechanics tools and inputs from the work described in NUREG-1806, "Technical Basis for Revision of the Pressurized Thermal Shock (PTS) Screening Limit in the PTS Rule (10 CFR 50.61): Summary Report," dated May 24, 2006 (ADAMS Accession No. ML061580318), and NUREG-1874, "Recommended Screening Limits for Pressurized Thermal Shock (PTS)," March 1, 2007 (ADAMS Accession No. ML070860156). The PWR Owners Group (PWROG) analyses incorporated the effects of fatigue crack growth and ISI data. Design basis transient data was used as an input for the fatigue crack growth evaluation. The effects of ISI data were modeled consistently with the previously-approved probabilistic fracture mechanics codes WCAP-14572-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection," February 1999 (ADAMS Accession Nos. ML012630327, ML012630349, and ML012630313). These effects were inputs into the evaluations performed with the "Fracture Analysis of Vessels - Oak Ridge" (FAVOR) computer code. All other inputs were identical to those used in the PTS risk re-evaluation underlying 10 CFR 50.61a, "Alternative Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events."

The PWROG concluded, as a result of these studies, that the ASME Code, Section XI, 10-year ISI interval for Examination Category B-A and B-D components in PWR RPVs can be safely extended from 10 to 20 years. This conclusion, based on the results from the pilot plant analyses, was considered to apply to any plant designed by the three PWR vendors

¹ Buschbaum, D.E., PWR Owners Group, letter to U.S. Nuclear Regulatory Commission, "Transmittal of NRC Approved Topical Report WCAP-16168-NP-A, Revision 2, "Risk-Informed Extension of Reactor Vessel - In-Service Inspection Interval" (TAC No. MC9768) (MUHP 5097/5098/5099 Task 2008/2059, PA MSC-0120)," dated June 13, 2008 (ADAMS Accession No. ML082820046).

represented in the pilot plant study, as long as certain critical plant-specific criteria (defined in Appendix A of the WCAP) are bounded by the analysis for the applicable pilot plant.

3.1.2 Summary of NRC Staff Evaluation for WCAP-16168-NP, Revision 2

The NRC staff issued a final SE dated July 26, 2011, superseding the initial SE dated May 8, 2008 (ADAMS Accession No. ML081060053), in the WCAP that addressed the PWROG's request for clarification of the information needed in applications utilizing the WCAP. In this letter, the staff concluded that the methodology presented in the WCAP is consistent with the guidance provided in RG 1.174, Revision 1 and is acceptable for referencing in requests to implement alternatives to ASME Code inspection requirements for PWR plants in accordance with the limitations and conditions specified in the SE. In addition to showing that the subject plant is bounded by the pilot plants/parameters identified in Appendix A in the WCAP, the SE requires the following:

1. Licensees must demonstrate that the embrittlement of their RPV is within the envelope used in the supporting analyses. Licensees must provide the 95th percentile total through-wall cracking frequency ($TWCF_{TOTAL}$) and its supporting material properties at the end of the period in which the relief is requested to extend the ISI from 10 to 20 years. The 95th percentile total TWCF ($TWCF_{95-TOTAL}$) must be calculated using the methodology in NUREG-1874. The RT_{MAX-X} and 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 methodology documented in the latest revision of RG 1.99 or other NRC-approved methodology.
2. Licensees must report whether the frequency of the limiting design basis transients during prior plant operation are less than the frequency of the design basis transients identified in the PWROG fatigue analysis that are considered to significantly contribute to fatigue crack growth.
3. Licensees must report the results of prior ISI of RPV welds and the proposed schedule for the next 20-year ISI interval. The 20-year inspection interval is a maximum interval. In its request for an alternative, each licensee shall identify the years in which future inspections will be performed. The dates provided must be within plus or minus one refueling cycle of the dates identified in the implementation plan provided to the NRC in PWROG letter OG-10-238 dated July 12, 2010 (OG-10-238; ADAMS Accession No. ML11153A033).
4. Licensees with B&W plants must (a) verify that the fatigue crack growth of 12 heat-up/cool-down transients per year that was used in the PWROG fatigue analysis bounds the fatigue crack growth for all of its design basis transients and (b) identify the design bases transients that contribute to significant fatigue crack growth.
5. Licensees with RPVs having forgings that are susceptible to underclad cracking and with RT_{MAX-FO} values exceeding 240 °Fahrenheit (F) must submit a plant-specific evaluation to extend the inspection interval for ASME Code, Section XI,

Category B-A and B-D RPV welds from 10 to a maximum of 20 years because the analyses performed in the WCAP are not applicable.

6. Licensees seeking second or additional interval extensions shall provide the information and analyses requested in Section (e) of 10 CFR 50.61a.

WCAP-16168-NP-A, Revision 3, which contains this SE for the WCAP, was issued in October 2011 (ADAMS Accession No. ML11306A084; referred to as the WCAP-A in the rest of this SE).

3.2 Proposed Alternatives

3.2.1 Description of Proposed Alternatives

The licensee proposes to defer the ASME Code required Categories B-A and B-D weld ISI for DCP, Unit 1 until 2025. This schedule differs slightly from the schedule proposed in the revision to PWROG OG-10-238 in that the licensee also proposed to change the number of inspections performed in 2015 and 2025. These changes will be further discussed in Section 3.3 of this SE.

3.2.2 Components for Which Relief is Requested

The affected component is the DCP, Unit 1 RPV. 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:

Examination Category	Item Number	Description
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 Head Welds
B-A	B1.30	Shell-to-Flange Weld
B-D	B3.90	Nozzle-to-Vessel Welds

3.2.3 Basis for Proposed Alternative

The basis for the proposed alternative is WCAP-A. Plant-specific parameters for DCP, Unit 1 are summarized in the enclosure to the licensee's letter dated August 18, 2014. The format of the information is patterned after that found in Appendix A of the WCAP-A.

All of the critical parameters listed in Tables 1, 2, and 3 of the enclosure to the submittal are bounded by the WCAP-A Westinghouse pilot plant.

3.3 NRC Staff Technical Evaluation

The NRC reviewed the licensee's proposal to extend the DCP, Unit 1 ISI interval in order to determine whether the licensee met the risk-informed criteria set forth in the WCAP-A for a Westinghouse plant. By showing that DCP, Unit 1 is bounded by the Westinghouse pilot plant analysis with respect to the five criteria discussed in Section 3.1.2 of this SE, the licensee would

have a sufficient technical basis for extending the ISI in accordance with the provisions of the WCAP-A. The DCP, Unit 1 RPV has a single layer cladding and is bounded by the Westinghouse pilot plant basis.

The licensee stated that two complete 10-year ISIs have been performed on DCP, Unit 1. During the most recently completed ISI (2005), one indication was found in the beltline region. The indication was found to be acceptable per Table IWB-3510-1 of the ASME Code, Section XI. The indication was neither within the inner $1/10^{\text{th}}$ of the reactor vessel thickness, nor deeper than 1 inch from the clad-base metal interface, making the indication acceptable per the requirements of the alternate PTS Rule (10 CFR 50.61a).

The licensee proposed an examination date that deviates from the latest reviewed implementation plan, OG-10-238 for the PWROG plants. The current schedule would require that six ASME Code required volumetric examinations of the reactor vessel full penetration pressure-retaining Examination Category B-A and B-D welds be conducted in 2015 while two examinations be conducted in 2025. The licensee proposed to postpone performing its examination from the third ISI, which was scheduled for 2014, to the fourth ISI interval, scheduled for 2025 plus or minus one refueling outage. This change would decrease the number of plant inspections in 2015 from six to five and increase the number of plant inspections in 2025 from two to three. The NRC concludes that the licensee's alternative to the implementation plan is acceptable on the basis that the change creates a more uniform distribution of plant inspections over the extended interval. However, the proposed 2025 inspection must be performed before May 6, 2025, to stay within the allowed 10 additional years for the third ISI interval. By e-mail dated May 11, 2015 (ADAMS Accession No. ML15132A306), the licensee agreed to perform the examination by the specified date.

Table 3 of the licensee's submittal provided the TWCF of the limiting axial weld, plate, and circumferential weld, as well as the critical parameters needed to perform the calculations. In order to calculate the shift in the Charpy transition temperature produced by irradiation defined at the 30 ft-lb energy level, ΔT_{30} , the licensee used the methodology provided in RG 1.99, Revision 2. The licensee reported that the $TWCF_{95-TOTAL}$ for DCP Unit 1 was 5.56×10^{-9} per year, which is well within the Westinghouse pilot plant requirement of less than 1.76×10^{-8} per year. The NRC staff performed an independent set of calculations, which verified the results reported by the licensee; therefore, the staff finds the $TWCF_{95-TOTAL}$ acceptable.

With regard to the frequency and severity of design basis transients, the licensee was required to show that DCP, Unit 1 has a number of heatup/cooldown transients bounded by that of the Westinghouse pilot plant basis (seven heatup/cooldown cycles per year). The NRC staff requested that the licensee provide the plant design basis for DCP, Unit 1's heatup/cooldown cycles per year. The licensee responded stating that the projected number of reactor coolant system transient cycles for 60 years of operation is provided in Table 4.3-2 of the DCP, Unit 1 License Renewal application dated November 23, 2009 (ADAMS Accession No. ML093340125). After reviewing the table, the staff agrees that the frequency of the limiting design basis transients during prior plant operation are less than the frequency of the Westinghouse design basis transients identified in the PWROG fatigue analysis.

In summary, the licensee's submittal demonstrated that the RPV for DCP, Unit 1, is bounded by the limitations set forth in the WCAP-A and the associated SE from the NRC staff. The

licensee adequately confirmed that the DCP, Unit 1 RPV meets all of the applicable requirements set forth in the WCAP-A. DCP, Unit 1 is a Westinghouse plant so the fourth requirement stated in Section 2.3 related to B&W plants is not applicable. Furthermore, the licensee did not report any forgings that are susceptible to underclad cracking so the fifth requirement also is not applicable to this plant. Lastly, the licensee is not currently seeking additional interval extensions, so the sixth and final requirement is not applicable.

4.0 CONCLUSION

The NRC staff has completed its review of the licensee's submittal for an alternative ISI extension to allow use of alternate reactor inspection interval requirements for DCP, Unit 1. The staff concludes that extending the third ISI interval for Categories B-A and B-D components from 10 years to 20 years will not result in any considerable increase in risk. This conclusion is based on the fact that the DCP, Unit 1 RPV is bounded by the WCAP-A and the request met all of the provisions set forth in the WCAP-A and the NRC's SE. Therefore, the request will provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(z)(1), the NRC staff authorizes the licensee's alternative ISI schedule for the specified welds for extension to May 2025. The examination of the Category B-A and B-D components for DCP, Unit 1 shall be conducted prior to the end of the extended third interval.

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

Principal Contributors: A. Young, NRR
S. Sheng, NRR

Date: June 19, 2015

E. Halpin

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10 CFR 50.55a(z)(1), the NRC staff authorizes the licensee's alternative ISI schedule for the specified welds for extension to May 2025.

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

If you have any questions, please contact Siva Lingam at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

/RA/

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-275

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*via memo

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