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

November 4, 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. 2 – INSERVICE INSPECTION PROGRAM RELIEF REQUEST NDE-RCS-SE-2R19, ASSOCIATED WITH THE USE OF ALTERNATE SIZING QUALIFICATION CRITERIA THROUGH A PROTECTIVE CLAD LAYER (CAC NO. MF5348)

Dear Mr. Halpin:

By letter dated December 2, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14336A607), Pacific Gas and Electric Company (the licensee) submitted relief request (RR) NDE-RCS-SE-2R19 to the U.S. Nuclear Regulatory Commission (NRC) requesting the use of an inspection procedure at the Diablo Canyon Power Plant (DCPP), Unit No. 2 with a depth-sizing error that is greater than the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Cases N-695, "Qualification Requirements for Dissimilar Metal Piping Welds Section XI, Division 1," and N-696, "Qualification Requirements for Appendix VIII Piping Examinations Conducted From the Inside Surface, Section XI, Division 1," for the third 10-year inservice inspection (ISI) interval.

Specifically, pursuant to paragraph 50.55a(g)(5)(iii) of Title 10 of the *Code of Federal Regulations* (10 CFR), the licensee requested relief from the depth-sizing uncertainty qualification requirement for ultrasonic examinations conducted from the inside diameter of pipes (i.e., root mean square error not greater than 0.125 inches), contained in ASME Code Cases N-695 and N-696. The licensee requested relief from the requirements for ISI items on the basis that the ASME Code requirement is impractical.

The NRC staff has completed its review of the relief request as discussed in the enclosed safety evaluation. The NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). The NRC staff has determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness in the subject welds. Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), the NRC staff grants the use of the proposed alternative for the remainder of the third 10-year ISI interval at DCPP, Unit No. 2.

All other 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 the Project Manager, Siva P. Lingam, at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

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

Docket No. 50-323

Enclosure:
Safety Evaluation

cc w/encl: Distribution via ListServ

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE NDE-RCS-SE-2R19 FOR THE

THIRD 10-YEAR INSERVICE INSPECTION INTERVAL

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON POWER PLANT, UNIT NO. 2

DOCKET NO. 50-323

1.0 INTRODUCTION

By letter dated December 2, 2014 (Agencywide Documents Access and Management System Accession No. ML14336A607), Pacific Gas and Electric Company (PG&E, the licensee) submitted a relief request (RR) NDE-RCS-SE-2R19 to the U.S. Nuclear Regulatory Commission (NRC) for Diablo Canyon Power Plant (DCPP), Unit No. 2. This RR requests the use of an inspection procedure with a depth-sizing error that is greater than the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Division 1, Code Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds," and Code Case N-696, "Qualification Requirements for Appendix VIII Piping Examinations Conducted From the Inside Surface, Section XI, Division 1," for the third 10-year inservice inspection (ISI) interval.

Specifically, pursuant to paragraph 50.55a(g)(5)(iii) of Title 10 of the *Code of Federal Regulations* (10 CFR), the licensee requested relief from the depth-sizing uncertainty qualification requirement for ultrasonic examinations conducted from the inside diameter (ID) of pipes (i.e., root mean square error (RMSE) not greater than 0.125 inches), contained in ASME Code Cases N-695 and N-696. The licensee requested relief from the requirements for ISI items on the basis that the ASME Code requirement is impractical.

2.0 REGULATORY EVALUATION

In its letter dated December 2, 2014, the licensee requested relief from the 0.125-inch RMSE depth-sizing acceptance criteria contained in ASME Code Cases N-695 and N-696 pursuant to 10 CFR 50.55a(g)(5)(iii).

ASME Code Cases N-695 and N-696 are accepted for use in NRC Regulatory Guide (RG) 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," August 2014 (ADAMS Accession No. ML13339A689), and incorporated by reference in 10 CFR 50.55a(a).

Enclosure

Paragraph 10 CFR 50.55a(g)(4)(ii) states, in part, that:

> Inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in paragraph (a) of this section 12 months before the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, Revision 17,...

Paragraph 10 CFR 50.55a(g)(5)(iii) states, in part, that:

> If the licensee has determined that conformance with certain Code requirements is impractical for its facility, the licensee must notify the Commission and submit, as specified in §50.4, information in support of the determination.

Paragraph 10 CFR 50.55a(g)(6)(i) states, in part, that:

> The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result of the requirements were imposed on the facility.

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.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Relief Request

Component Descriptions

The welds covered by NDE-RCS-SE-2R19 are eight dissimilar metal nozzle-to-safe-end welds and eight elbow-to-safe-end large-bore hot-leg and cold-leg welds (see Table 1 below). The hot-leg dissimilar metal welds are covered by ASME Code Case N-770-1,[1] Item number A-2, "Unmitigated butt weld at Hot Leg operating temperature (-2410) ≤ 625°F (329°C)," and the cold-leg welds are covered under ASME Code Case N-770-1, Item Number B "Unmitigated butt weld at Cold Leg operating temperature (-2410) ≥ 525°F (274°C) and < 580°F (304°C)." Both require 100 percent volumetric inspection coverage. The inspection of these welds is normally covered under ASME Code, Section XI, Appendix VIII, Supplement 10. The licensee is using

[1] 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 Section XI, Division 1," ASME International.

the alternative ASME Code Cases N-695 and N-696, which allows for the inspections to be conducted from the ID of the welds.

All austenitic welds are covered under the licensee's risk-informed program and are considered Inspection Category R-A Item Number 1.20, "Welds Not Subject to a Degradation Mechanism." Austenitic welds are normally covered under ASME Code, Section XI, Appendix VIII, Supplement 2. Four safe-end-to-elbow welds have cast stainless steel elbows, which are covered under ASME Code, Section XI, Appendix III, as modified by ASME Code, Section XI, Appendix I, Supplement 1. The austenitic welds are described in more detail in Table 2.

The nozzles are constructed from SA-508 ferritic steel, the safe ends are constructed from 316 stainless steel, and the pipes are constructed from wrought 316 stainless steel. The elbows are constructed from CF8M cast stainless steel.

Table 1: Dissimilar Metal Weld Descriptions

N-770-1 Item No.	Description	Weld Number	Nominal ID (Inches)	Thickness (inches)
A-2	Loop 1 outlet nozzle-to-safe end	WIB-RC-1-1	29 27.5/2.38"	2.5
B	Loop 1 inlet safe end-to-nozzle	WIB-RC-1-16	27.5	2.38
A-2	Loop 2 outlet nozzle-to-safe end	WIB-RC-2-1	29 27.5/2.38"	2.5
B	Loop 2 inlet safe end-to-nozzle	WIB-RC-2-16	27.5	2.38
A-2	Loop 3 outlet nozzle-to-safe end	WIB-RC-3-1	29 27.5/2.38"	2.5
B	Loop 3 inlet safe end-to-nozzle	WIB-RC-3-16	27.5	2.38
A-2	Loop 4 outlet nozzle-to-safe end	WIB-RC-4-1	29 27.5/2.38"	2.5
B	Loop 4 inlet safe end-to-nozzle	WIB-RC-4-16	27.5	2.38

Table 2: Austenitic Weld Descriptions

Description	Weld Number	Nominal ID (inches)	Thickness (inches)
Loop 1 outlet safe end-to-pipe	WIB-RC-1-2	29 27.5/2.38"	2.5
Loop 1 inlet cast elbow-to-safe end	WIB-RC-1-15	27.5	2.38
Loop 2 outlet safe end-to-pipe	WIB-RC-2-2	29 27.5/2.38"	2.5
Loop 2 inlet cast elbow-to-safe end	WIB-RC-2-15	27.5	2.38
Loop 3 outlet safe end-to-pipe	WIB-RC-3-2	29 27.5/2.38"	2.5
Loop 3 inlet cast elbow-to-safe end	WIB-RC-3-15	27.5	2.38

Description	Weld Number	Nominal ID (inches)	Thickness (inches)
Loop 4 outlet safe end-to-pipe	WIB-RC-4-2	29 27.5/2.38"	2.5
Loop 4 inlet cast elbow-to-safe end	WIB-RC-4-15	27.5	2.38

Applicable Code Requirement

The Code of record for the third 10-year ISI interval is ASME Code, Section XI, 2001 Edition with 2003 Addenda. For the Appendix VIII examination, ASME Code, Section XI, 2001 Edition without Addenda applies.

The licensee is using a risk-informed inspection program. The austenitic welds are covered under examination Category R-A, Item R1.20 (formerly Code Category B-F, B5.10 in ASME Code, Section XI, 2001 Edition through 2003 Addenda), specifies volumetric examination for the safe-end-to-piping and elbow welds.

All of the specified ultrasonic (volumetric) examinations scheduled to be conducted in the Unit 2 19th refueling outage (2R19) are required to be performed per ASME Code, Section XI, Appendix VIII, Supplements 2 (wrought austenitic welds) and 10 (dissimilar metal welds), with the exception of the cast side of the cold-leg elbow-to-safe-end welds. The rules of ASME Code, Section XI, Appendix III, as modified by ASME Code, Section XI, Appendix I, Supplement 1 (hereafter Supplement 1), are specified for the examination of the cast elbow sides of the cold-leg welds.

The licensee is using ASME Code Cases N-695 and N-696, which are included in Table 1 "Acceptable Section XI Code Cases," of NRC RG 1.147, Revision 17.

Proposed Inspection

PG&E proposes to use vendor procedures, personnel, and equipment qualified in accordance with the Performance Demonstration Initiative (PDI) implementation of Appendix VIII, Supplement 10, as modified by the requirements of ASME Code Case N-695 to examine the nozzle-to-safe-end dissimilar metal welds from the ID through the protective clad layer for the dissimilar meal welds, the safe-end-to-piping welds, and the safe-end-to-cast-stainless-steel-elbow welds.

The licensee proposes to use approved ASME Code Case N-695 with the demonstrated RMSE of 0.189 inches for ID examinations of the nozzle-to-safe-end welds in lieu of the specified 0.125-inch RMSE. The licensee also proposes to use approved ASME Code Case N-696 with the demonstrated RMSE of 0.245 inches for ID examinations of the safe-end-to-pipe and safe-end-to-elbow welds in lieu of the specified 0.125-inch RMSE.

In its letter dated December 2, 2014, the licensee stated, in part, that:

> If a reportable flaw is detected and determined to be ID surface connected during examination of the welds in accordance with this relief request, Pacific Gas and

Electric Company (PG&E) will provide a flaw evaluation including the measured flaw size as determined by ultrasonic examination for review. [Eddy current (EC)] testing (ET) will be used to determine if flaws are surface connected. Additional data including details of the surrounding ID surface contour in the region of the flaw and percentage of the exam area where UT (ultrasonic testing) probe lift-off is evident, if any, will be included.

In the event that any flaw(s) requiring depth sizing are detected during examination of welds in accordance with this relief request, the following criteria shall be implemented:

- Flaws detected and measured as less than 50 percent through-wall in depth shall be adjusted by adding a correction factor to the flaw depth such that the adjusted flaw depth is equal to the measured flaw depth+(applicable vendor RMSE - 0.125), prior to comparison to the applicable acceptance criteria;

- Flaws detected and measured as 50 percent through-wall depth or greater and to remain in service without mitigation or repair, PG&E shall submit flaw evaluation(s) for review and approval prior to reactor startup. The flaw evaluation shall include:

    - Information concerning the mechanism that caused the flaw

    - Information concerning the inside surface roughness/profile of the region surrounding the flaw

    - Information concerning areas, where UT probe lift-off is observed.

It is worth noting that the above actions are included in the body of the RR and as regulatory commitments.

Basis for the Request

RMSE (as stated by the licensee)

All welds included in this request have been previously examined from the ID with an Appendix VIII detection process qualified on similar configurations and materials (i.e., without CRC [corrosion resistant clad]) in the thirteenth refueling outage; the nozzle-to-safe end dissimilar metal welds were similarly examined again in the sixteenth refueling outage. The ultrasonic examinations were supplemented by surface profilometry and EC testing. Greater than 90 percent coverage of the required exam areas was achieved in all cases. This inspection history confirms that the inside surface profiles of the welds included in this request are suitable for ultrasonic examination from the ID in accordance with the referenced requirements as modified by the proposed alternative sizing requirements.

Corrosion Resistant Clad

The safe-end welds and safe-end forgings have a 0.073-inch to 0.125-inch thick protective clad layer applied to the ID and outside diameter (OD) of the dissimilar metal weld and the safe end forgings.

In its letter dated December 2, 2014, the licensee stated, in part, that:

> Removing the protective clad from either the ID or OD of the [reactor coolant system (RCS)] safe ends in order to create a configuration bounded by the PDI sample sets would result in extensive personnel exposure and potentially reduce the overall structural integrity of the component... ID machining of these locations would remove the protective layer and any benefit that the protective layer might afford to the underlying materials by isolating them from the surrounding environment... Alterations such as this may result in reduced structural integrity of the reactor coolant pressure boundary.

The inspection vendor performed an open demonstration on a mockup to show that the inspection procedure can detect size flaws with the corrosion resistant clad (CRC) in place. The results of these activities verify that the proposed examination technique is appropriate for application to the nozzle-to-safe welds and safe-end-to pipe welds, since the vendor procedure is the same for both weld types.

Proprietary and nonproprietary versions of the vendor report were included in PG&E letter DCL-10-103, "ASME Section XI Inservice Inspection Program Relief Request NDE-RCS-SE-2R16 Use of Alternate Sizing Qualification Criteria through a Protective Clad Layer," for DCPP, Unit No. 2, dated August 12, 2010 (ADAMS Accession No. ML102350309).

Cast Stainless Steel

The licensee proposes to use the PDI Appendix VIII procedure qualified for detection and length sizing in wrought materials to examine the cast stainless steel side of the cold-leg elbow-to-safe-end welds in lieu of Appendix III and Supplement 1 requirements. The examinations will be augmented with an ID EC examination.

Duration of the Proposed Relief

The duration of the proposed alternative is for safe-end weld examinations for the remainder of the third 10-year ISI interval, which commenced on July 1, 2006, and was originally scheduled to end March 12, 2016, but has been extended as per ASME Code, Section XI, Paragraph IWA 2430(d)(1) to correspond to refueling outage 2R19, which is scheduled to take place in spring 2016.

3.2 NRC Staff Evaluation

The licensee will use NRC-approved Code Case N-695 to satisfy the requirements of ASME Code, Section XI, Appendix VIII, Supplement 10, and ASME Code Case N-696 to satisfy the requirements of ASME Code, Section XI, Appendix VIII, Supplement 2. Code Cases N-695 and N-696 require that procedures used to inspect welds from the inside surface of the pipe be qualified by performance demonstration. The acceptance criterion in Code Cases N-695 and N-696 specify that the RMSE of the examination procedures shall not be greater than 0.125 inches. The licensee's inspection vendor was able to depth size with an RMSE of 0.189 inches. The licensee is requesting relief from the 0.125-inch depth-sizing requirement in ASME Code Case N-695 and N-696 pursuant to 10 CFR 50.55a(g)(5)(iii).

The NRC staff has confirmed that since 2002, the industry has not been able to satisfy the RMSE acceptance criterion of less than 0.125 inches when qualifying the volumetric examination inspection procedures performed from the inside surface of a pipe. Developing new technology capable of meeting the 0.125-inch RMSE and qualifying the new technology to meet the requirements of ASME Code Cases N-695 and N-696 would be a burden on the licensee. The NRC staff concludes that this repeated inability to qualify inside surface UT inspection techniques in accordance with ASME Code Cases N-695 and N-696 constitutes an impracticality as described in 10 CFR 50.55a(g)(5)(iii).

To address the issue of increased potential for undersizing of flaws by inside surface UT inspection procedures that do not meet ASME Code Cases N-695 and N-696 acceptance criterion, in 2012, the NRC staff, in conjunction with personnel from the PDI, examined the proprietary UT examination data set compiled from all attempts to date to qualify inside surface UT inspection procedures to the acceptance criterion contained in ASME Code Cases N-695 and N-696. Based on this examination, the NRC staff concluded that:

(a) For flaw depths less than or equal to 50 percent pipe wall thickness, a flaw could be appropriately depth sized if a correction factor is added to the measured flaw depth such that the adjusted flaw depth is equal to the measured flaw depth plus the difference between the vendor procedure qualification RMS error and 0.125 inches.

(b) For flaw depths greater than 50 percent wall thickness, the variability of sizing errors is sufficiently large so that no single mathematic flaw size adjustment formula is sufficient to provide reasonable assurance of appropriate flaw depth sizing. As a result, the NRC staff finds it necessary to evaluate the flaws that have depth greater than 50 percent through-wall on a case-by-case basis.

To provide reasonable assurance of the structural integrity of examined welds, the NRC staff determined that the following compensatory measures shall be applied to any inspection not meeting the 0.125-inch RMSE for depth sizing to address the measurement uncertainty in flaw depth sizing when examining welds from the inside surface:

(1) Examine the welds under consideration using a UT technique that is qualified for flaw detection and length sizing.

(2) For flaw(s) with a measured depth of less than 50 percent of the wall thickness, the depth shall be adjusted by adding the measured flaw depth to the difference between the procedure qualification RMSE and 0.125 inches.

(3) For flaw(s) with measured depth of greater than 50 percent of the wall thickness, either the degraded weld needs to be repaired in accordance with the ASME Code or a flaw evaluation needs be submitted to the NRC staff for review and approval prior to reactor startup.

(4) In addition to information normally contained in flaw evaluations performed in accordance with ASME Code, Section XI, IWB-3600, the submitted flaw evaluation shall include: (a) information concerning the degradation mechanism that caused the crack; (b) information concerning the surface roughness and/or profile in the area of the examined pipe and/or weld; and (c) information concerning areas in which the UT probe may "lift off" from the surface of the pipe and/or weld.

(5) Perform EC examination(s) to confirm whether a flaw is connected to the inside surface of the pipe and/or weld.

The nozzle-to-safe-end and safe-end-to-pipe configurations differ from the PDI mockups in two respects. The weld surfaces were machined smooth and the stainless steel safe-ends and welds were cladded on both inner and outer surfaces. The PDI program has no representative mockups of cladded configurations. To show equivalency between examinations performed on surfaces with and without CRC, the vendor performed a non-blind demonstration on a cladded weld block. The vendor was capable of detecting and sizing flaws in the clad test block. While this demonstration was not blind, the NRC staff has no technical concerns with the ability of a combined UT/ET examination from a smooth ID to find and length size a flaw and confirm if a possible flaw is surface-connected. The depth-sizing concerns are already addressed in the mitigating actions in the proposed inspections.

The NRC staff also has no technical issues with the ID examinations of the wrought-pipe-to-cast-stainless-steel elbow welds. As with the CRC, UT and follow-up ET inspections from the ID should be effective at detecting and length-sizing flaws. Depth sizing is very challenging in cast stainless steels, but the proposed inspection procedure addresses this concern effectively.

The licensee included the following item in the body of the relief request and as a regulatory commitment in Attachment 1 to the letter dated December 2, 2014:

- Flaws detected and measured as 50 percent through-wall depth or greater and to remain in service without mitigation or repair, PG&E shall submit flaw evaluation(s) for review and approval prior to reactor startup. The flaw evaluation shall include:

    - Information concerning the mechanism that caused the flaw

- Information concerning the inside surface roughness/profile of the region surrounding the flaw

- Information concerning areas where UT probe lift-off is observed

This regulatory commitment is considered a condition of the relief as per 10 CFR 50.55a(g)(6)(i).

The NRC staff concludes that the licensee's alternative is consistent with the compensatory measures discussed above, because (1) the licensee will add the correction factor to the crack tip(s); (2) the licensee will use ET to verify whether an embedded flaw is connected to the inside surface; and (3) the licensee will submit any flaw analysis for flaws greater than 50 percent through-wall to the NRC staff for review and approval prior to startup.

Based on the above, the NRC staff determines relief from the depth-sizing RMSE acceptance criterion of ASME Code Case N-695 and using a vendor with a 0.189-inch RMSE for depth sizing and ASME Code Case N-696 with a 0.245-inch RMSE for depth sizing provides reasonable assurance of the structural integrity and leak tightness in the subject welds.

4.0 CONCLUSION

As set forth above, the NRC staff determines that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). Therefore, the NRC staff grants the licensee's relief request NDE-RCS-SE-2R19 at DCPP, Unit No. 2 for the third 10-year ISI interval, which began on July 1, 2006, and is currently scheduled to end in May 2016.

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

Principal Contributor: Stephen Cumblidge

Date

All other 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 the Project Manager, Siva P. Lingam, at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-323

Enclosure:
Safety Evaluation

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