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PG&E Letter DCL-19-084

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

10 CFR 50.55a

Docket No. 50-323, OL-DPR-82
Diablo Canyon Power Plant Unit 2
ASME Section XI Inservice Inspection Program Request for Alternative NDE-RCS-SE-2R22 Use of Alternate Sizing Qualification Criteria Through a Protective Clad Layer

References: 1. 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," dated August 12, 2010 [ML102350309]

2. NRC Letter, "Diablo Canyon Power Plant, Unit No. 2 – Approval of Request for Relief NDE-RCS-SE-2R16 From Examination Requirements of ASME Code, Section XI, Appendix VIII, Supplement 10, Root Mean Square Error (TAC No. ME4577)," dated March 29, 2011 [ML110600356]

Dear Commissioners and Staff:

Pursuant to 10 CFR 50.55a(z)(1), Pacific Gas and Electric Company (PG&E) hereby requests NRC approval of Inservice Inspection (ISI) Request for Alternative NDE-RCS-SE-2R22 for the Diablo Canyon Power Plant Unit 2 Refueling Outage Twenty-Two (2R22). This request proposes an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Appendix VIII, Supplements 2 and 10 as modified by ASME Code Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds," and ASME Code Case N-696, "Qualification Requirements for Appendix VIII Examinations Conducted from the Inside Surface." The details of the request are included in the Enclosure.

The previous relief request (Reference 1) included a vendor report (both proprietary and nonproprietary versions), WDI-TJ-1044, Revision 1, "Demonstration Report/Technical Basis Document: Ultrasonic Examination of Diablo Canyon Unit 2

Reactor Pressure Vessel Nozzle-to-Safe End Welds from the ID Surface Through a Welded Protective Layer," which documented the technical justification for the ISI process. Reference 1 was reviewed and approved by the NRC (Reference 2). The vendor report is still valid, and applicable to the current alternative request since the same process will be employed in the 2R22 examinations of the reactor vessel nozzle-to-safe end and safe end-to-piping welds. The vendor report is not included with this letter, since it is accessible to the NRC staff via ADAMS Accession Number ML102350297.

PG&E requests approval of Request for Alternative NDE-RCS-SE-2R22 by October 31, 2020. This communication contains new regulatory commitments (as defined by NEI 99-04), to be implemented following NRC approval of this alternative. The commitments are identified in Attachment 1 of the Enclosure. If you have any questions or require additional information, please contact Mr. Hossein Hamzehee, Regulatory Services Manager, at (805) 545-4720.

Sincerely,

Paula Gerfen
Site Vice President

rntt/4231/51039089-01
Enclosure
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Diablo Canyon Power Plant, Unit 2
10 CFR 50.55a Request for Alternative NDE-RCS-SE-2R22

in Accordance with 10 CFR 50.55a(z)(1)

--Alternative provides an acceptable level of quality and safety--

Diablo Canyon Power Plant Unit 2
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--Alternative provides an acceptable level of quality and safety--

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--Alternative provides an acceptable level of quality and safety--

1. ASME CODE COMPONENT(S) AFFECTED

The reactor vessel outlet (hot leg) nozzle-to-safe end and safe end-to-piping welds are the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Class 1 and are listed in the table below. See Figure 1.2 in Reference 2 for safe end general configuration and materials.

Code Cat./ Item No. *	Description	Weld Number	Line ID/ Nominal Wall
N-770-2, A-2	Loop 1 outlet nozzle-to-safe end	WIB-RC-1-1(SE)	29"/2.5"
R-A, R1.20	Loop 1 outlet safe end-to-pipe	WIB-RC-1-2	29"/2.5"
N-770-2, A-2	Loop 2 outlet nozzle-to-safe end	WIB-RC-2-1(SE)	29"/2.5"
R-A, R1.20	Loop 2 outlet safe end-to-pipe	WIB-RC-2-2	29"/2.5"
N-770-2, A-2	Loop 3 outlet nozzle-to-safe end	WIB-RC-3-1(SE)	29"/2.5"
R-A, R1.20	Loop 3 outlet safe end-to-pipe	WIB-RC-3-2	29"/2.5"
N-770-2, A-2	Loop 4 outlet nozzle-to-safe end	WIB-RC-4-1(SE)	29"/2.5"
R-A, R1.20	Loop 4 outlet safe end-to-pipe	WIB-RC-4-2	29"/2.5"

*Safe end welds with SE suffix are dissimilar metal welds fabricated with Alloy 182 weld material and are examined in accordance with ASME Code Case N-770-2.

2. APPLICABLE CODE EDITION AND ADDENDA

The Diablo Canyon Power Plant (DCPP) fourth Inservice Inspection Interval Program Plan (ISIPP) is based on the ASME Code, Section XI, 2007 Edition with 2008 Addenda.

3. APPLICABLE CODE REQUIREMENT

The ISIPP is augmented with the requirements of ASME Code Case N-770-2 as modified by 10 CFR 50.55a for the examination of dissimilar metal vessel nozzle butt welds containing Alloy 82/182 material. These welds are identified as Category N-770-2, Item A-2 in the DCPP Unit 2 ISIPP. These requirements apply to the DCPP Unit 2 dissimilar metal welds connecting the reactor nozzles to the reactor coolant system (RCS) piping.

DCPP Risk Informed ISIPP examination Category R-A, Item R.120 (formerly Code Category B-F, B5.10 in the 2007 Edition through 2008 Addenda), specifies volumetric examination for the RCS safe end to piping welds.

All specified volumetric ultrasonic testing (UT) scheduled to be conducted during the Unit 2 Refueling Outage Twenty-Two (2R22) is required to be performed per ASME Section XI, Appendix VIII (hereafter Appendix VIII), Supplements 2 (wrought austenitic welds) and 10 (dissimilar metal welds).

The DCPP ISIPP references ASME Code Cases N-695 and N-696 are unconditionally approved for use in NRC Regulatory Guide (RG) 1.147, Revision 18. Updated revisions N-695-1 and N-696-1 are listed as Conditionally Acceptable in Draft RG DG-1342, the proposed Revision 19 of RG 1.147.

4. IMPRACTICALITY OF COMPLIANCE

ASME Code Cases N-695 and N-696 provide alternatives to Appendix VIII, Supplements 10 and 2 and include criteria for depth sizing accuracy. Key statements from Code Cases N-695 and N-696 are summarized below:

- Code Case N-695 paragraph 3.3(c) states: "... are qualified for depth sizing when the root mean square error (RMSE) of the flaw depth measurements, as compared to the true flaw depths, do not exceed 0.125 in. (3 mm)."

- Code Case N-696 paragraph 3.3(d) states: "... qualified for depth sizing when the flaw depths estimated by UT, as compared with the true depths, do not exceed 0.125 in. (3 mm) root mean square (RMS), when they are combined with a successful Supplement 10 qualification."

- Code Cases N-695-1 and N-696-1 revise the qualification requirement for depth sizing to 0.250 inch RMS. Additionally, Code Case N-695 contains an exclusion in the scope section that states: "This Case is not applicable to piping welds containing supplemental corrosion resistant clad (CRC) applied to mitigate intergranular stress corrosion cracking." This exclusion is carried through to N-695-1.

The requirements for the 0.125 inch RMSE depth sizing accuracy criteria of Code Cases N-695 and N-696 and the Code Case N-695 exclusion for examinations performed through CRC are impractical for DCPP to comply with. The specific issues are discussed below:

Root Mean Square Error

To date, although examination vendors have qualified for detection and length sizing in accordance with the requirements for examinations from the inside diameter (ID), the vendors have not met the established RMSE of 0.125 inch for indication depth sizing. Several process enhancements including new delivery systems, new search units and software modifications have been implemented but did not achieve the desired improvements in performance. This result indicates that the Code accuracy standard is impractical for use with the UT technology employed in the qualification efforts. Code Cases N-695-1 and N-696-1 were created to resolve this issue by establishing 0.250 inch RMS as the required standard for depth measurement. The DCPP examination contractor is able to meet the 0.250 inch RMS standard for depth measurement.

Code Cases N-695 and N-696, Examination through Corrosion Resistant Clad

The DCPP Unit 2 safe end welds and safe end forgings have a thin (nominal "t" of 0.090 inch; 0.073 inch to 0.125 inch in thickness) protective clad layer applied to the ID and outside diameter (OD) of the dissimilar metal weld and the safe end forgings.

During the DCPP Unit 2 reactor vessel fabrication process, the stainless steel safe end forgings were welded to the low alloy steel reactor nozzle forgings and heat treated with the entire vessel. This method resulted in the stainless steel safe end forging becoming "furnace sensitized." The protective clad layer is intended to act as a barrier to isolate the sensitized safe end dissimilar metal weld and stainless steel safe end forging from the surrounding environment. Sketches of the DCPP Unit 2 safe end general configuration and material types are included in Figure 1.2 in Reference 2.

The DCPP Unit 2 RCS safe end configuration with the protective ID and OD clad layers applied to the dissimilar metal weld and safe end forgings is unique to a small number of Westinghouse-designed units. In addition, suitable "blind" test samples are not available to support Appendix VIII, Supplement 2 and 10 qualifications for the DCPP Unit 2 configuration.

5. BURDEN CAUSED BY COMPLIANCE

Root Mean Square Error

The numerous attempts by inservice inspection (ISI) vendors to meet the Supplements 2 and 10 and Code Cases N-695 and N-696 required RMSE value for depth sizing when examining from the ID have been unsuccessful. Use of revised Code Cases N-695-1 and N-696-1, as proposed in NRC Draft RG DG-1342, would establish 0.250 inch RMS as the qualification standard and is met by the examination vendor for existing Appendix VIII qualification specimens without corrosion resistant cladding.

Furthermore, the outside surface configuration of the DCPP Unit 2 safe end welds are not suitable for examination. Conditioning of the outside surface would require extensive effort and result in extensive personnel exposure as described in the following section.

Code Cases N-695 and N-696, Examination through Corrosion Resistant Clad

The DCPP Unit 2 reactor vessel was fabricated in the 1970 timeframe, prior to implementation of Appendix VIII qualification requirements. The distinctive DCCP Unit 2 RCS clad safe end weld configuration is not encompassed by the industry's performance demonstration initiative (PDI) program used to implement ASME XI, Appendix VIII requirements. Consequently, no ISI vendor is qualified to examine the DCPP configuration.

Removing the protective clad from either the ID or OD of the 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. General area dose rates in the vicinity of the subject welds (ex-core annulus area), averages 150-200 millirem per hour. Considering that OD machining to remove the overlay and achieve the required surface finish could exceed 20 man hours per nozzle, the total personnel exposure for four nozzles would reach 12-16 rem. In addition, 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.

Compliance with the PDI qualification program without alternative implementation would necessitate significant modification to the reactor coolant system safe end welds. Alterations such as this may result in reduced structural integrity of the reactor coolant pressure boundary.

6. PROPOSED ALTERNATIVE AND BASIS FOR USE

Root Mean Square Error

PG&E proposes to use a vendor qualified for ID detection and length sizing per Appendix VIII as applicable to the welds similar in configuration and materials (i.e., without CRC) to the welds included in this request. Indications requiring depth sizing will be treated as detailed in the following paragraphs.

The examination vendor contracted to perform the safe end examinations at DCPP has demonstrated the ability to depth size indications in dissimilar metal welds with a RMSE of 0.189 inch instead of the 0.125 inch RMSE required by Appendix VIII, Supplement 10 and Code Case N-695. Additionally, the vendor has demonstrated the ability to depth size with a 0.245 inch RMSE when applying combined aspects of Appendix VIII, Supplements 2 and 10 per Code Case N-696. Both of these qualifications are within the prescribed RMSE of 0.250 inch established in Code Cases N-695-1 and N-696-1.

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 for review, including the measured flaw size as determined by UT examination. Eddy current (EC) testing 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 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 measured per Code Cases N-695-1 and N-696-1.

- Flaws detected and measured as 50 percent through-wall depth or greater and to remain in service without mitigation or repair, will be classified as indeterminate depth as indicated in Draft RG DG-1342. 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

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) in the thirteenth, sixteenth and nineteenth refueling outages. The UT 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 UT examination from the ID in accordance with the referenced requirements as modified by the proposed alternative sizing requirements.

Code Cases N-695-1 and N-696-1, Examination through Corrosion Resistant Clad

PG&E proposes to use vendor procedures, personnel and equipment qualified in accordance with the PDI implementation of Appendix VIII, Supplements 10 and 2 as modified by the requirements of Code Cases N-695-1 and N-696-1 to examine the nozzle-to-safe end dissimilar metal and safe end-to-piping stainless steel welds from the ID through the protective clad layer.

PG&E's inspection vendor has performed additional demonstration activities in order to validate the ability to detect flaw(s), length-size the flaw(s), and depth-size the flaw(s) through a clad layer and ID weld inlays. Although not identical, the open test samples clad and weld layer thicknesses conservatively encompass the DCPP dissimilar metal weld configuration. The test samples include flaws of various depths and lengths oriented in both the axial and circumferential directions in the weld and heat affected zones for the dissimilar metal weld (representative of the nozzle to safe end welds).

When examining the test specimens, the vendor used a PDI qualified (detection and length sizing) ID examination procedure; the current revision of that same procedure will be employed in the 2R22 examinations. The vendor demonstrated the capability to accurately detect, length and depth size the test sample flaws through CRC in each of the samples and configurations examined. The results of these activities verify that the proposed examination technique is appropriate for application to the DCPP Unit 2 outlet nozzle-to-safe welds and safe end-to-piping welds, since the vendor procedure is the same for both weld types.

The DCPP ISI vendor has created a technical justification, WDI-TJ-1044, Revision 1, "Demonstration Report/Technical Basis Document: Ultrasonic Examination of Diablo Canyon Unit 2 Reactor Pressure Vessel Nozzle-to-Safe End Welds from the ID Surface Through a Welded Protective Layer" to document the process and results of the additional demonstration activities. Proprietary and nonproprietary versions of the vendor report were included in the 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 Diablo Canyon Unit 2 (Reference 1).

Potential Failure Consequences

In the event the proposed alternate examination process grossly mischaracterizes a significant planar flaw, the potential resulting failure of one of the RCS loop outlet welds could result in a loss of coolant accident (LOCA). Depending on the size of the postulated break, the specific consequences would vary. At the smallest end of the break size spectrum, the charging system would be capable of maintaining RCS pressure through normal makeup. Larger break sizes would result in depressurization of the RCS, reactor trip and a safety injection. The worst-case consequence would occur if one of the nozzle-to-pipe welds were to suffer 360-degree through-wall circumferential fracture. In this case, the break size is bounded by the line ID, which is less than the break size used in the large break LOCA design basis analysis.

ASME has determined that for flaw depths less than 50 percent wall thickness, reasonable assurance that a flaw will be appropriately depth-sized may be obtained using a procedure qualified to 0.250 inch RMSE. This standard, incorporated into Code Cases N-695-1 and N-696-1, is included in the NRC Draft RG DG-1342, the proposed Revision 19 of RG 1.147. Therefore, the proposed alternative for correcting measured flaw depths for flaws less than 50 percent wall thickness and performing and submitting a flaw specific analysis for flaws equal to or greater that 50 percent wall thickness is unlikely to result in gross flaw mischaracterization and any potential for resulting component failure.

Conclusion

All welds included in this request have been previously examined from the ID with an Appendix VIII qualified (PDI implementation for detection and length sizing without clad) examination process with approved alternative for depth sizing with clad similar to the UT examination process that is proposed in this request for alternative. The UT 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 history confirms that the inside surface profile of these welds is suitable for UT examination from the ID in accordance with the referenced requirements. PG&E will use the similar UT examination process supplemented by surface profilometry and EC testing for safe end dissimilar metal weld examinations in 2R22.

The supplemental vendor demonstration activities establish that the existing PDI qualified inspection procedure and process is effective for examining dissimilar metal and stainless steel piping welds through welded layers on the pipe inside surface such as the DCPP configuration. The potential depth sizing variation will be addressed by adoption of the RMSE value (0.250 inch) in Code Cases N-695-1 and N-696-1.

The proposed alternatives assure that ID ultrasonic examinations of the DCPP Unit 2 reactor coolant nozzle-to-safe end welds are performed using personnel, procedures, and equipment that are effective and provide an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z)(1).

7. DURATION OF PROPOSED ALTERNATIVE

The duration of the proposed alternative is for safe end weld examinations for the remainder of the DCPP Unit 2 fourth ISI interval which commenced on March 13, 2016, and is scheduled to end August 26, 2025, concurrently with the expiration of the operating license.

8. PRECEDENTS

The alternative depth sizing method of adding the difference between the demonstrated and required RMSE values to the measured indication depth was approved for Diablo Canyon Unit 1 by NRC letter dated January 3, 2014 (ADAMS Accession No. ML13350A151). The proposal here is to use 0.250 inch RMSE per Code Cases N-695-1 and N-696-1.

Use of the alternate depth sizing qualification criteria above through a protective clad layer was approved for Diablo Canyon Unit 2 in the third ISI interval by NRC letter dated November 4, 2015 (ML15299A034).

9. REFERENCES

1. 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," dated August 12, 2010 (ADAMS Accession No. ML102350309).
2. Enclosure 3 to PG&E Letter DCL-10-103, Westinghouse Report, WDI-TJ-1044-NP, Rev. 1, "Demonstration Report/Technical Basis Document: Ultrasonic Examination of Diablo Canyon Unit 2 Reactor Pressure Vessel Nozzle-to-Safe End Welds from the ID Surface Through a Welded Protective Layer" (ADAMS Accession No. ML102350297).

List of Regulatory Commitments

Commitment 1

If a reportable flaw is detected and determined to be inside diameter (ID) surface connected during examination of the welds in accordance with the Request for Alternative NDE-RCS-SE-2R22, PG&E will provide a flaw evaluation for review, including the measured flaw size as determined by ultrasonic testing (UT) examination. Eddy current testing 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 probe lift-off is evident, if any, will be included.

Commitment 2

In the event that any flaw(s) requiring depth sizing are detected during examination of welds in accordance with the Request for Alternative NDE-RCS-SE-2R22, the following criteria shall be implemented:

- Flaws detected and measured as less than 50 percent through-wall in depth shall be sized per ASME Code Cases N-695-1 and N-696-1;

- Flaws detected and measured as 50 percent through-wall depth or greater and to remain in service without mitigation or repair, will be classified as indeterminate depth as indicated in Draft Regulatory Guide DG-1342. 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 ultrasonic testing probe lift-off is observed.