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

August 4, 2014

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 1 - REQUEST FOR RELIEF FROM APPENDIX IX OF ASME CODE, SECTION XI, ALTERNATE REPAIR OF A VENT VALVE LINE OF MAIN STEAM PIPING (TAC NO. MF3711)

Dear Mr. Halpin:

By letter dated March 28, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14088A001), Pacific Gas and Electric Company (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Appendix IX, "Mechanical Clamping Devices for Class 2 and 3 Piping Pressure Boundary," at Diablo Canyon Power Plant (DCPP), Unit 1. In its request, the licensee proposed an alternate repair for a leaking 3/4-inch vent valve line connected to main steam system line 1066.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee proposed an alternative to the requirements of Paragraphs IX-1000(c)(2) and IX-6000(a) of Appendix IX to the ASME Code, Section XI, to repair the leaking vent valve line using a mechanical clamp on the basis that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the proposed alternative provides reasonable assurance of structural integrity of the subject vent valve line. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii). Therefore, the NRC staff authorizes the use of proposed alternative at DCPP, Unit 1 until the next scheduled refueling outage in fall 2015. On March 29, 2014 (ADAMS Accession No. ML14090A344), the U.S. Nuclear Regulatory Commission (NRC) staff verbally authorized the use of this proposed alternative. The attached safety evaluation documents the NRC staff's detailed technical basis for the authorization.

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

If you have any questions, please contact Peter Bamford at 301-415-2833 or via e-mail at Peter.Bamford@nrc.gov.

Sincerely,

Eric R. Oesterle, Acting Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-275

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF FROM THE REQUIRMEMENTS OF

APPENDIX IX OF ASME CODE, SECTION XI, 2001 EDITION WITH 2003 ADDENDUM

ALTERNATE REPAIR OF MAIN STEAM PIPING VENT VALVE LINE

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON POWER PLANT, UNIT 1

DOCKET NO. 50-275

1.0 INTRODUCTION

By letter dated March 28, 2014 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML14088A001), Pacific Gas and Electric Company (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, Appendix IX, "Mechanical Clamping Devices for Class 2 and 3 Piping Pressure Boundary," at Diablo Canyon Power Plant (DCPP), Unit 1. In its request, the licensee proposed an alternate repair for a leaking 3/4-inch vent valve line connected to main steam system line 1066.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested relief from the requirements of Paragraphs IX-1000(c)(2) and IX-6000(a) of Appendix IX to the ASME Code, Section XI, to repair the leaking vent valve line using a mechanical clamp on the basis that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. These two exceptions are related to the containment boundary and inservice volumetric examination of the defect area, respectively.

On March 29, 2014 (ADAMS Accession No. ML14090A344), the U.S. Nuclear Regulatory Commission (NRC) staff authorized the use of the proposed alternative at DCPP, Unit 1 until the next scheduled refueling outage in fall 2015. This safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

2.0 REGULATORY EVALUATION

In the subject relief request, the licensee requested authorization of an alternative to the requirements of Appendix IX of Section XI of the ASME Code pursuant to 10 CFR 50.55a(a)(3)(ii).

Enclosure

Adherence to Appendix IX, Paragraphs IX-1000(c)(2) and IX-6000(a) of Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI.

The regulations in 10 CFR 50.55a(a)(3) state, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternative provides an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff concludes that regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Proposed Request for Relief

On March 26, 2014, the licensee identified a pin-hole steam leak during main steam system inservice inspection (ISI) pressure test walkdowns. The affected component is the ASME Code, Section XI, Class 2, 3/4-inch carbon steel line for vent valve MS-1-908 connected to Main Steam System Line 1066. The leak is located in a socket weld upstream of the vent valve. This vent valve line is downsteam of the relief valves in Main Steam Line 1066, and is located outside the reactor containment and upstream of the main steam isolation valve on Main Steam Lead 1-4. The piping for the vent valve line is 3/4-inch, Schedule 80 (0.154-inch nominal wall thickness), seamless carbon steel, A106 Grade B piping.

The ASME code of record is Section XI, 2001 Edition including Addenda through 2003, for the current 10-year ISI interval and the Repair/Replacement Program. The applicable ASME Code requirements for the temporary repair are Section XI, Article IX-1000 of Appendix IX.

DCPP, Unit 1 was in Mode 1 upon discovery of the leak and the licensee determined that a permanent ASME Code, Section XI repair was not possible during Mode 1 or 2 operation as the leak is un-isolable and subject to full steam generator (SG) pressure. To perform a permanent ASME Code repair, it would be necessary for DCPP, Unit 1 to shut down from Mode 1 to Mode 5. The licensee stated that when the plant is shut down from Mode 1 to Mode 5 and then returned to Mode 1, plant inspections and Technical Specification (TS) surveillances need to be performed, which would result in total radiological dose to personnel exceeding 150 millirem (mrem). In addition, a shutdown and subsequent restart would cycle plant systems and components. The licensee stated that the additional dose received by plant personnel and unnecessary cycling of plant systems and components represents a hardship without compensating increase in plant quality and safety.

The licensee proposed to implement a repair in accordance with Appendix IX of ASME Code, Section XI. However, the subject piping forms the containment boundary, and the mechanical clamping device prevents volumetric inspection of the adjacent piping. Therefore, pursuant to

10 CFR 50.55a(a)(3)(ii), the licensee requested relief from the containment boundary restriction of Paragraph (c) of Article IX-1000 of Appendix IX of ASME Section XI and relief from the volumetric monitoring requirements of Paragraph (a) of Article IX-6000 so that repair may be performed on the vent valve line using a mechanical clamping device that meets the remaining provisions of Article IX-1000 of Appendix IX of ASME Code, Section XI. As required by Paragraph (a) of Article IX-1000 of Appendix IX of ASME Code, Section XI, the proposed clamping device will not remain in service beyond the next scheduled DCPP, Unit 1 refueling in fall of 2015, at which time the defect will be repaired or piping replaced.

After discovery, the licensee monitored the leak and it had remained stable. The licensee performed visual examination of the defect area using a ten times magnification instrument and determined the leak source is a triangular shape, approximately 0.050-inch in diameter in the largest dimension, and volumetric in nature. The licensee determined that the through-wall pinhole defect appeared to be the result of a welding abnormality that has corroded through the wall. According to the licensee, the location of the leak (45 degrees off the extrados point of the elbow above) and the orientation and shape of the defect in relation to the cantilever load suggests the defect was not caused by fatigue. Additionally, on March 28, 2014, the licensee performed a vibration inspection survey over a frequency span of 2 to 10 hertz and observed very low vibration amplitudes and broadly distributed energy across the frequency span with no dominant peaks. Furthermore, the licensee performed a radiographic examination of the weld on March 28, 2014, using a 58 curie iridium source and computed radiography phosphor film. The licensee took multiple exposures with varying angles to assure that the flaw was properly characterized to the extent possible. The licensee stated that the temperature of the piping (approximately 500 degrees Fahrenheit (°F)) and the active steam leak limited the accessibility of the area of investigation. Based on the radiographic results, the licensee stated that the flaw appears to initiate on the root of the fillet weld, and propagate radially along the lower fusion line of the weld, adjacent to the coupling. At this location, the fitting was scaled to be 0.191-inch thick and the pipe is 0.133-inch thick. By interpreting the different radiographic views, the licensee determined that the flaw has volumetric aspects which are not commonly found with fatigue cracks. The radiographic density of the flaw is greater than is expected to be found in a fatigue crack, and the direction of flaw propagation appears to follow the fusion zone without any other orientation. The licensee explained that these attributes, when considered with no measurable vibration on the pipe and the off-axis location of the flaw, do not indicate a fatigue-type crack.

The licensee calculated the allowable flaw size at the fillet weld of the main steam vent valve line using the linear elastic fracture mechanics method in IWB-3612 of Section XI of the ASME Code. The licensee assumed the weld was a flux weld and that the flaw is in the circumferential direction. The licensee considered loadings from design pressure, deadweight, and seismic events. The calculated allowable flaw length for the normal/upset condition is 1.16 inches. The calculation included all seismic loads regardless of whether they are for normal/upset or emergency/faulted conditions. The allowable flaw size of 1.16 inches exceeds the existing flaw size of 0.050 inches in the largest dimension.

The licensee noted that subsequent crack growth is not expected to be significant. Because this is a carbon steel component, and due to the location of Vent Valve MS-1-908, the mechanism considered for crack growth is fatigue. For fatigue crack growth to occur, cyclic loading is required. The leak location is subjected to cyclic pressure from plant startup-

shutdown events, which are limited in number. The licensee stated that thermal stress cycling is expected to be insignificant because of the vent valve line configuration. The only other cyclic load would be from vibration, which the licensee measured on March 28, 2014, and determined to be low in amplitude in the vicinity of the Vent Valve MS-1-908. In addition, based on the location of the leak and the orientation and shape of the defect in relation to the load on the pipe, the licensee determined that the cause of the defect is not due to vibrational fatigue. The licensee further stated that due to the lack of cyclic events and cyclic stress, crack growth is not expected to be significant through the end of the operating cycle.

The licensee stated that an ultrasonic (UT) examination demonstrated that the base material in the pipe stub next to the pinhole defect is approximately 0.18-inch thick and, therefore, complies with minimum wall requirements and is of sufficient thickness to install a mechanical clamping device. The mechanical clamping device is designed to encapsulate the 3/4-inch vent valve line and conform to the geometry of the pipe configuration. The licensee further stated that even in the unlikely event that flaw growth caused failure of the vent valve line, the clamp will provide the needed restraint to maintain the piping configuration and prevent it from separating.

The licensee performed an operability determination to address the impact of the steam leak located on Main Steam Line 1066 on containment integrity and the requirements of TS 3.6.1, Containment. The licensee's calculations demonstrate that the leak on Main Steam Line 1066 at the current (prior to clamp installation) leak rate (0.015 pounds-mass per second (lbm/sec)) is well within the administrative limit of 0.5 lbm/sec for secondary side systems within the containment isolation boundary outside containment and do not adversely affect the consequence results of the dose analyses. Therefore, the primary containment remains operable and applicable 10 CFR 100 consequence limits continue to be met.

The proposed mechanical clamping device is designed to comply with the design requirements of Article IX-3000 of Appendix IX and the material requirements of Article IX-4000 of Appendix IX. These requirements meet or exceed the design rating of the piping. The clamping device enclosure material is carbon steel (SA 516 GR 70). Therefore, the clamping device is suitable for the intended application and capable of performing its specified design function. The licensee will use a sealant within the clamping device to eliminate the leak path. The sealant temperature rating is 600 °F, which is within the design rating of the piping. The degradation temperature of the sealant is 1200 °F. The licensee has performed an evaluation of the weight (76 pounds) of the clamping device on Main Steam Line 1066, including consideration of seismic loads during a design basis seismic event, on the piping stress analysis and concluded the piping will perform its design function and maintain its structural integrity. The licensee stated that main Steam Line 1066 is well supported with a bilateral restraint adjacent to the vent valve line.

The basis for the limitation in Paragraph (c) of Article IX-1000 for use of a clamping device in piping that forms the containment boundary is to prevent temporary repair of containment boundaries, which could depressurize and create the potential for interactions between the affected line and the containment atmosphere during accident conditions. However, in this case, the licensee has stated that for assumed accident analyses for DCPP, the SGs remain pressurized above the containment atmosphere, preventing interaction between the steam system and the containment environment. Furthermore, the mechanical clamping device will be located on a small, 3/4-inch pipe outside containment, which would not be directly exposed to

containment accident conditions. The licensee stated that the use of a mechanical clamping device on a portion of a system, which is considered containment boundary, is acceptable based on the system being continuously pressurized at pressures significantly greater than containment post-accident conditions and greater than ambient atmospheric pressure.

The licensee requests relief from the volumetric method monitoring requirements of Paragraph (a) of Article IX-6000 of the ASME Code, Section XI. In order to ensure structural integrity of the main steam vent valve line containing the defect, the clamping device being installed on the main steam vent valve line will entirely encapsulate the vent valve line piping section containing the flaw. This configuration will prevent access to perform a volumetric inspection of the piping immediately adjacent to the clamping device as required by Paragraph (a) of Article IX-6000.

Alternatively, the licensee proposes to visually monitor the clamping device for leakage once per day. The normal operating pressure at the location of the mechanical clamping device is in the range of 790-1005 pounds per square inch gauge (psig), and it is located in an area that is readily accessible for inspection. As such, positive verification of the leak-tight integrity of the mechanical clamping device will be accomplished by visual observations. Daily monitoring exceeds the requirements of Paragraph (c) of Article IX-6000 of Appendix IX, which states "The clamping device shall be monitored for leakage at least weekly. Any leakage at any time shall be dispositioned." The licensee stated that any observed leakage during operation will be evaluated according to the current administrative procedure requirements that limit un-isolable leakage from secondary side systems within the containment isolation boundary outside containment to less than 0.5 lbm/sec to ensure that there is no adverse effect on the consequence results of the dose analyses. In addition, Paragraph (a) of Article IX-6000 allows an exception to performing examinations of the area immediately adjacent to the clamping device using a volumetric method when it is precluded by the clamping device configuration.

The licensee proposed relief will apply until the next DCPP, Unit 1, refueling outage in fall of 2015 (Refueling Outage 19).

3.2 NRC Staff Evaluation

The NRC staff has reviewed the degradation of the vent valve line, the clamp design, and the licensee's stated hardship to determine if the proposed alternative provides reasonable assurance of the structural integrity of the subject vent valve line.

The NRC staff determined that the clamping device has been designed in full compliance with the requirements of ASME Code, Section XI, Article IX-3000, and materials have been specified in accordance with Article IX-4000. The design of the clamping device also meets or exceeds the design rating of the associated piping. Because the clamping device meets all design and materials requirements of ASME Code, Section XI, the NRC staff concludes that the use of the clamp is an acceptable temporary leak repair method, and that the clamp is suitable for the intended application and capable of performing its specified design functions.

The licensee evaluated the flaw to determine the possible cause, anticipated flaw growth, and the critical flaw size. The NRC staff noted that industry operating experience shows that vibrational fatigue is one possible degradation mechanism for small branch lines attached to

larger piping. However, the licensee conducted visual and radiographic examination, as well as vibration measurements and claims that the flaw is due to a weld defect that has corroded through the wall and is not a result of vibrational fatigue. Thermal fatigue is another possible degradation mechanism. To address the potential flaw growth, the licensee calculated a critical flaw size of 1.16 inches using ASME Code, Section XI methodology, which exceeds the existing flaw size of 0.050 inches. The licensee did not perform a flaw growth calculation, but because of the low vibration measured in the vicinity of the flaw and the expectation of few thermal and pressure cycles before the next refueling outage, flaw growth is expected to be small. The licensee stated that regardless of the degradation mechanism, the proposed mechanical clamp will encapsulate the flaw and maintain the structural integrity of the pipe; even if the flaw growth caused failure of the vent valve line, the clamp will prevent the pipe from ejecting from the socket weld. The NRC staff concludes that the licensee has adequately addressed the degradation mechanism and potential for flaw growth. The NRC staff determines that the clamp will provide adequate structural integrity to the subject vent valve line.

The NRC staff concludes that the licensee's calculated leakage prior to installation of the clamp was 0.015 lbm/sec, which is below the administrative limit of 0.5 lbm/sec for secondary side systems within the containment isolation boundary outside containment. The NRC staff notes that the margin between the measured leak rate and the administrative limit is sufficient to minimize a potential failure. The clamp uses a sealant to prevent leakage through the leak path. The normal operating pressure at the location of the clamp is in the range of 790 -1005 psig. As such, positive verification of the leak-tight integrity of the mechanical clamping device will be performed by licensee's visual observations performed once per day.

The NRC staff notes that the clamping device will be installed on piping that is a part of the containment pressure boundary. Appendix IX of the ASME Code, Section XI, prohibits the use of clamping devices on containment pressure boundary piping because of concerns that temporary clamp devices may not be able to prevent interactions between the affected line and containment atmosphere during accident conditions. The licensee has addressed this concern by showing that the steam system containment function is maintained by both a closed system inside containment and system integrity outside of containment to provide protection for the assumed accident conditions. The NRC staff concludes that the use of a mechanical clamping device on a portion of a system considered part of the containment boundary is acceptable in this case because the system will be continuously pressurized during operation at pressures significantly greater than containment pressure and because the clamp is installed outside of containment so as not to interact with the containment atmosphere during accident conditions.

The clamp design covers the piping adjacent to the flaw. Therefore, the licensee is unable to perform volumetric inspections as required by Article IX-6000 of ASME Code, Section XI. In lieu of volumetric examinations, the licensee has proposed to increase the visual monitoring requirements of the ASME Code from weekly to daily. In addition, Paragraph (a) of Article IX-6000 allows an exception to performing examinations of the area immediately adjacent to the clamping device using a volumetric method when it is precluded by the clamping device. The NRC staff concludes that the increased visual monitoring of the clamping device is acceptable because of the accessibility of the repaired weld and the pressure in the steam system, which enables leakage during operation to be readily detected by visual observation.

The NRC staff concludes that requiring the licensee to perform a permanent ASME Code repair would impose a hardship because the affected piping cannot be isolated and, therefore, the plant would need to be shut down in order to perform the permanent Code repair. The shutdown and subsequent restart would unnecessarily cycle plant systems and components and expose personnel to radiation. Therefore, the NRC staff concludes that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

In summary, the NRC staff concludes that the proposed repair will restore the pressure boundary and provide reasonable assurance that the structural integrity of the degraded vent valve line will be maintained because: (1) the clamping design complies will all requirements of Appendix IX of the ASME Code, Section XI, aside from the two exceptions for which relief was requested, and (2) the two exceptions are acceptable because the proposed alternative provides acceptable justification and monitoring of the degraded vent valve (i.e., the pressure boundary will be maintained by the pressure in the steam system exceeding that of containment, and increased visual monitoring will be used in lieu of the required volumetric inspection).

4.0 CONCLUSION

Based on information submitted, the NRC staff determines that the proposed alternative provides reasonable assurance of structural integrity of the subject vent valve line. The NRC staff concludes that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii). Therefore, the NRC staff authorizes the use of the proposed alternative at DCPP, Unit 1 until the next scheduled refueling outage in fall 2015.

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

Principal Contributor: Joshua Kusnick

Date: August 4, 2014

If you have any questions, please contact Peter Bamford at 301-415-2833 or via e-mail at Peter.Bamford@nrc.gov.

Sincerely,

/RA/

Eric R. Oesterle, Acting Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-275

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Safety Evaluation

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