

October 19, 2000

Mr. Gregory M. Rueger
Senior Vice President, Generation and
Chief Nuclear Officer
Pacific Gas and Electric Company
Diablo Canyon Nuclear Power Plant
P. O. Box 3
Avila Beach, CA 93424

SUBJECT: DIABLO CANYON NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2 - SAFETY
EVALUATION RELIEF REQUEST PRS-6 - USE OF THE AMERICAN SOCIETY
OF MECHANICAL ENGINEERS CODE CASE N-616 (TAC NOS. MA9202 AND
MA9203)

Dear Mr. Rueger:

By letter dated June 16, 2000, as supplemented by letter dated October 12, 2000, you submitted a relief request for Diablo Canyon Nuclear Power Plant (DCNPP), Unit Nos. 1 and 2 to use the American Society of Mechanical Engineers (ASME) Code Case N-616, "Alternative Requirements for VT-2 Visual Examination of Class 1, 2, and 3 Insulated Pressure-Retaining Bolted Connections." Specifically, you requested NRC approval to use Code Case N-616 and perform VT-2 visual examinations of bolted connections with the insulation in place when the bolting materials contain sufficient chromium to make it resistant to boric acid corrosion. You stated that the use of Code Case N-616 for VT-2 visual examination without the removal of insulation provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(a)(3)(i).

Based on its review, the NRC staff has concluded that the use of Code Case N-616 for Class 1, 2, and 3 systems is an acceptable alternative because it provides an acceptable level of quality and safety for examination of insulated joints containing corrosion resistant bolting. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the second inservice inspection interval at DCNPP, Unit Nos. 1 and 2. In addition, this alternative will extend to the locations listed in Table 1 of your June 16, 2000, submittal after low alloy or carbon steel bolting are replaced with corrosion resistant bolting material.

Mr. Gregory M. Rueger

- 2 -

October 19, 2000

The NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation.

Sincerely,

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-275
and 50-323

Enclosure: Safety Evaluation

cc w/encl: See next page

The NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation.

Sincerely,

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
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***No changes to SE**

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Diablo Canyon Power Plant, Units 1 and 2

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE INSERVICE INSPECTION PROGRAM

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2

DOCKET NOS. 50-275 AND 50-323

1.0 INTRODUCTION

By letter dated June 16, 2000, and supplemental letter dated October 12, 2000, Pacific Gas and Electric Company (PG&E or the licensee), submitted a request for approval for an alternative to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI requirements for inservice inspection (ISI). The information provided by the licensee in support of the request for relief from Code requirements has been evaluated and the basis for disposition is documented below.

2.0 BACKGROUND

Inservice inspection (ISI) of the ASME Code Class 1, 2 and 3 components shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code (Code) and applicable addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(6)(g)(i). Section 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if (i) the proposed alternatives would provide 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.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2 and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first ten-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. For Diablo Canyon Units 1 and 2, the applicable edition of Section XI of the ASME Code for the second ten-year ISI interval is the 1989 Edition.

3.0 LICENSEE'S EVALUATION

Components for which Relief is Requested:

Class 1, 2, and 3 pressure retaining bolted connections when the bolting material is resistant to boric acid degradation.

Code Requirement from which Relief is Requested:

1989 Edition, no Addenda, of the ASME Code:

Subparagraph IWA-5242(a): "For systems borated for the purpose of controlling reactivity, insulation shall be removed from pressure retaining bolted connections for visual examination VT-2."

Content of the Relief Request:

Relief is requested from removal of insulation at bolted connections for VT-2 visual examination when the bolting material is resistant to boric acid degradation. The applicable time period for which relief is requested is the second ten-year ISI interval.

Basis for Requesting Relief and Justification for Granting Relief:

The licensee states that the use of Code Case N-616 for VT-2 visual examination without the removal of insulation provides an acceptable level of quality and safety. Relief from IWA-5242(a) is requested pursuant to 10 CFR 50.55a(a)(3)(i).

The licensee has replaced originally installed American Society for Testing and Materials (ASTM) A193 Grade B7 steel bolting material with SA453 Grade 660 (A-286) and SA564 Grade 630 (17-4 PH stainless steel) corrosion resistant bolting at nearly all locations in Class 1 borated systems and most locations in Class 2 systems. The licensee contends that removing and reinstalling insulation, including erection and removal of scaffolding, would require significant time and radiation exposure. The licensee also stated that removing and reinstalling insulation on bolted connections in systems at high temperature during pressurization also poses an unnecessary physical hazard to maintenance personnel.

Pressure tests at Diablo Canyon are conducted at nominal operating pressure (NOP) with a hold time of four hours in accordance with CC N-498-1 and N-416-1. The two code cases were approved for use at Diablo Canyon by safety evaluations dated May 1, 1998, and June 14, 1995, respectively. The code cases allow pressure tests to be conducted at NOP as opposed to higher hydrostatic test pressures. The four-hour hold time at NOP prior to examination is also included in the current relief request.

The submittal also includes an attachment which lists the remaining insulated connections having low alloy or carbon steel bolting as of April 7, 2000. PG&E expects to install corrosive resistant bolting at many of these remaining locations, and stated that this relief request would extend to those new locations after the installation is complete. The bolting that is not replaced will continue to be visually examined at pressure followed by insulation removal and

reexamination when the joint is not pressurized as required by CC N-533-1. CC N-533-1 was approved for use at Diablo Canyon by a safety evaluation dated March 16, 2000.

Proposed Alternative Examination

PG&E will implement ASME CC N-616 for performance of VT-2 visual examination at all of the locations where corrosive resistant bolting is installed without removal of the insulation. The following restrictions will apply to those locations where this relief is used:

1. A four-hour hold time at system NOP will be utilized prior to examination.
2. This relief will not apply to :
 - (a) A453 Grade 660 bolting that is pre-loaded to 85 percent of yield or greater.
 - (b) Bolts made from A193 Grade B6 material (Grade 410 stainless steel) tempered below 1100°F.
 - (c) Bolts made from SA 564 Grade 630 material that were not hardened to H1100 condition.
 - (d) UNS-S66286 (previously known as A286, also known as AISI 660) bolting that is preloaded to greater than 100 ksi.

If evidence of leakage is detected at locations where corrosive resistant bolting material is used, either by discovery of active leakage or evidence of boric acid crystals, the insulation will be removed and the bolted connection will be reexamined. If necessary, the bolted connection will be evaluated in accordance with the corrective measures of subarticle IWA-5250.

4.0 STAFF EVALUATION

The Code requires the removal of all insulation from pressure-retaining bolted connections in systems bolated for the purpose of controlling reactivity when performing VT-2 visual examinations during system pressure tests. The Code requires this examination to be performed each refueling outage for Class 1 systems and each inspection period for Class 2 and 3 systems. The licensee has requested relief from the Code requirements to use Code Case N-616, *Alternative Requirements for VT-2 Visual Examination of Class 1, 2, and 3 Insulated Pressure-Retaining Bolted Connections, Section XI, Division 1*. This code case was approved by ASME on May 7, 1999, but has not yet been reviewed by the NRC staff for general applicability.

The staff has developed a position over the years on the use of AISI Type 17-4 PH stainless steel (SA-564 Grade 630), AISI Type 410 stainless steel (SA-193 Grade 6), and A-286 stainless steel (SA-453 Grade 660) fasteners. The 17-4 PH stainless steel and the 410 stainless steel are suitable for use in contact with primary water if they are aged at a temperature of 1100°F or higher. If they are aged at a lower temperature, they become susceptible to primary water stress corrosion cracking. The hardness of these alloys should be below R_c 30 if they are

properly heat treated. A-286 stainless steel is susceptible to stress corrosion cracking in primary water, particularly if preloaded above 100 ksi. NUREG/CR-3604, "Bolting Applications," states that A-286 stainless steel is not suitable for use as a reactor structural material because much safer materials are available. However, there are a large number of A-286 bolting currently in nuclear service, both in BWRs and PWRs. Bengtsson and Korhonen of ASEA-ATOM, Vasteras, Sweden, examined the behavior of A-286 in a BWR environment as reported in the Proceedings of the International Symposium on Environmental Degradation of Materials in Nuclear Power Systems-Water Reactors, August 22-25, 1983, Myrtle Beach, South Carolina sponsored by National Association of Corrosion Engineers, the Metallurgical Society of AIME, and the American Nuclear Society. They found the A-286 in comparison to other tested materials, was the most susceptible material they tested to intergranular stress corrosion cracking in BWR water. They also found that A-286 is less likely to crack as the applied stress is reduced. Piascik and Moore from Babcock & Wilcox reported a number of vessel internals bolt failures of A-286 bolts in Nuclear Technology, Vol. 75, December, 1986 in PWR water. They correlated the failures with bolt fillet peak stress and found that bolts preloaded below 100 ksi showed no failures.

The staff position is that any 17-4 PH stainless steel or 410 stainless steel stud or bolt aged at a temperature below 1100°F or with hardness above R_c 30 must have the thermal insulation removed for VT-2 examination during the system pressure test. For A-286 stainless steel studs or bolts, the preload must be verified to be below 100 ksi or the thermal insulation must be removed and the joint visually inspected. For nuts conforming to SA-194, experience indicates it would not be necessary to remove the thermal insulation for visual inspection.

This code case does not address the possibility that 17-4 PH stainless steel, 410 stainless steel, or A-286 fasteners could fail in service under insulation and the failure could go unnoticed. Also, all valve bodies, pump casings, and piping must contain at least 10 percent chromium and be in the proper heat treatment condition because the insulation could create an autoclave and materials with less than 10 percent chromium could experience high corrosion rates. This corrosion could go unnoticed. It also does not specifically require the four-hour hold time at operating temperature and pressure prior to conduction the VT-2 examination.

The licensee provided additional information to the staff via teleconference on September 13, 2000. In order to complete the review, the staff requested information regarding the chromium content of all piping, valve bodies, and pump casings in the subject areas. The licensee stated that all piping, valve bodies, and pump casings are either 304 stainless steel, 316 stainless steel, or CF-8M. These materials have chromium in the 18-20 percent range which exceeds the 10 percent chromium required by Code Case N-616. By letter dated October , 2000, the licensee confirmed and documented the above information. This information satisfies the staff's concerns.

The staff finds the relief request acceptable. The licensee stated that Code Case N-533, Revision 1 (Rev. 1), *Alternative Requirements for VT-2 Visual Examination of Class 1 Insulated Pressure-Retaining Bolted Connections, Section XI, Division 1*, was approved for use at Diablo Canyon by safety evaluation dated March 16, 2000. The approval included the condition of a four-hour hold time prior to the VT-2 visual examination. Code Case N-533 originally only applied to Class 1 pressure retaining bolted connections. Code Case N-533 and ASME Subparagraph IWA-5242(a) require that the insulation be removed from the bolted

connection during each refueling outage, and a VT-2 visual examination be performed for Class 1 connections. However, Code Case N-533 would not require pressurization during this examination. Any evidence of leakage is required to be evaluated in accordance with IWA-5250. Rev. 1 was issued to include Class 2 and 3 pressure retaining bolted connections, and requires that the insulation be removed and a VT-2 visual examination performed on Class 2 and 3 pressure retaining bolted connections once each period. The staff finds Code Case N-533 to be acceptable in that it removes most of the burden associated with the Code required examinations.

Code Case N-616 has eliminated the requirement to remove the insulation at any time if corrosion resistant bolting is used. In addition, the code case does not include the requirement to hold the system at operating pressure and temperature for a minimum of four hours. However, the licensee applies the criteria of IWA-5213 which requires a four-hour hold time after reaching system pressure and temperature.

5.0 CONCLUSION

The staff has concluded that the use of Code Case N-616 for Class 1, 2, and 3 systems is an acceptable alternative because it provides an acceptable level of quality and safety for examination of insulated joints containing corrosion resistant bolting. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the second inservice inspection interval at Diablo Canyon Units 1 and 2. In addition, this alternative will extend to the locations listed in Table 1 of the licensee's June 16, 2000, submittal after low alloy or carbon steel bolting has been replaced with corrosion resistant bolting material.

Principal Contributor: A. Lee
J. Davis

Date: October 19, 2000