October 26, 2005

Mr. David H. Oatley, Acting Chief
Nuclear Officer
Pacific Gas and Electric Company
Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424

SUBJECT: DIABLO CANYON POWER PLANT, UNIT NO. 1 - RELAXATION OF REQUIREMENTS ASSOCIATED WITH FIRST REVISED ORDER (EA-03-009) DATED FEBRUARY 20, 2004, REGARDING ALTERNATE EXAMINATION COVERAGE FOR REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES (TAC NO. MC7071)

Dear Mr. Oatley:

By letter dated May 27, 2005, Pacific Gas and Electric Company (PG&E) requested relaxation to implement an alternative to the requirements of Section IV.C.(5)(b) of the First Revised Nuclear Regulatory Commission (NRC) Order EA-03-009 (Order) dated February 20, 2004, for reactor pressure vessel (RPV) head penetration nozzles at Diablo Canyon Power Plant, Unit 1 (DCPP Unit 1).

PG&E requested relaxation from the Order where inspection coverage is limited by inaccessible areas of 79 vessel head penetration (VHP) nozzles for DCPP Unit 1, with respect to nondestructive examination, including ultrasonic testing, eddy current testing, and dye penetrant testing.

The NRC staff has reviewed and evaluated the information provided by PG&E in support of this request and concludes that PG&E's proposed alternative examination of the 79 VHP nozzles provides reasonable assurance of the structural integrity of the RPV head, VHP nozzles, and welds. Further inspections of these VHP nozzles in accordance with Section IV.C.(5)(b) of the Order would result in hardship without a compensating increase in the level of quality and safety. Therefore, pursuant to Section IV.F. of the Order, the NRC staff authorizes the proposed alternative inspection for the 79 VHP nozzles at DCPP Unit 1, subject to the following condition:

> If the NRC staff finds that the crack-growth formula in industry report MRP-55 is unacceptable, PG&E shall revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs PG&E of an NRC-approved crack-growth formula. If PG&E's revised analysis shows that the crack-growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation is rescinded and PG&E shall, within 72 hours, submit to the NRC written justification for continued operation. If the revised analysis shows that the crack-growth acceptance criteria are exceeded during the subsequent operating cycle, PG&E shall, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent

operating cycle, PG&E shall, within 30 days submit a letter to the NRC confirming that its analysis has been revised. Any future crack-growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack-growth rate formula.

The NRC staff's review is provided in the enclosed safety evaluation. If you have any questions, please contact Girija Shukla at (301) 415-8439.

Sincerely,

/RA/

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-275

Enclosure: Safety Evaluation

cc w/encl: See next page

operating cycle, PG&E shall, within 30 days submit a letter to the NRC confirming that its analysis has been revised. Any future crack-growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack-growth rate formula.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FIRST REVISED ORDER EA-03-009 RELAXATION REQUEST

ALTERNATE EXAMINATION COVERAGE

FOR REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON POWER PLANT, UNIT 1

DOCKET NO. 50-275

1.0 INTRODUCTION

By letter dated May 27, 2005, Pacific Gas and Electric Company (PG&E, the licensee) requested relaxation to implement an alternative to the requirements of Section IV.C.(5)(b) of the First Revised NRC Order EA-03-009 (Order) dated February 20, 2004, for reactor pressure vessel (RPV) head penetration nozzles at Diablo Canyon Power Plant, Unit 1 (DCPP Unit 1).

Specifically, PG&E requested relaxation from the First Revised NRC Order where inspection coverage is limited by inaccessible areas of 79 vessel head penetration (VHP) nozzles for DCPP Unit 1, with respect to nondestructive examination (NDE), including ultrasonic testing (UT), eddy current testing (ET), and dye penetrant testing (PT).

2.0 REGULATORY EVALUATION

The First Revised Nuclear Regulatory Commission (NRC) Order EA-03-009 (Order), issued on February 20, 2004, requires specific examinations of the RPV head and VHP nozzles of all pressurized-water reactor plants. Section IV.F. of the Order states that requests for relaxation of the Order associated with specific penetration nozzles will be evaluated by the NRC staff using the procedure for evaluating proposed alternatives to the American Society of Mechanical Engineers (ASME) Code in accordance with Paragraph 50.55a(a)(3) of Title 10 of the *Code of Federal Regulations*. Section IV.F. of the Order states that a request for relaxation regarding inspection of specific nozzles shall address the following criteria: (1) the proposed alternative(s) for inspection of specific nozzles will provide an acceptable level of quality and safety, or (2) compliance with this Order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

For DCPP Unit 1 and similar plants determined to have a moderate susceptibility to primary water stress corrosion cracking (PWSCC) in accordance with Sections IV.A and IV.B. of the Order, the following inspections are required to be performed every refueling outage in accordance with Sections IV.C.(5)(a) and (b) of the Order:

(a) Bare metal visual (BMV) examination of 100 percent of the RPV head surface (including 360E around each RPV head penetration nozzle). For RPV heads with the surface obscured by support structure interferences which are located at RPV head elevations downslope from the outermost RPV head penetration, a bare metal visual inspection of no less than 95 percent of the RPV head surface may be performed provided that the examination shall include those areas of the RPV head upslope and downslope from the support structure interference to identify any evidence of boron or corrosive product. Should any evidence of boron or corrosive product be identified, the licensee shall examine the RPV head surface under the support structure to ensure that the RPV head is not degraded.

<u>OR</u>

(b) For each penetration, perform a nonvisual NDE in accordance with either (i), (ii), or (iii):

(i) Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material) from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0 inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater). In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.

(ii) Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0 inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld

have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater).

(iii) A combination of (i) and (ii) to cover equivalent volumes, surfaces, and leak paths of the RPV head penetration nozzle base material and J-groove weld as described in (i) and (ii). Substitution of a portion of a volumetric exam on a nozzle with a surface examination may be performed with the following requirements:

1. On nozzle material below the J-groove weld, both the outside diameter and inside diameter surfaces of the nozzle must be examined.

2. On nozzle material above the J-groove weld, surface examination of the inside diameter surface of the nozzle is permitted provided a surface examination of the J-groove weld is also performed.

3.0 TECHNICAL EVALUATION

3.1 First Revised Order Requirements for Which Relaxation is Requested

Section IV.C. of the Order requires, in part, that inspections of Section IV.C.(5)(b) of the Order be performed every refueling outage for moderate susceptibility plants similar to DCPP Unit 1.

The licensee has requested relaxation from Section IV.C.(5)(b) of the Order. The specific relaxation requested is identified below.

3.2 Licensee's Proposed Alternative

The licensee seeks relaxation from the Order where inspection coverage is limited by inaccessible areas of 79 VHP penetration nozzles for DCPP Unit 1, with respect to NDE, including UT, ET, and PT.

The licensee proposes to achieve NDE coverage by means of UT from 2 inches above the weld down to the maximum extent possible.

The licensee finds that NDE coverage to at least one (1) inch below the J-groove weld is unnecessary for the cited nozzles because UT examination to the lower limit physically achievable provides an acceptable level of quality and safety, as described below.

Based on the ultrasonic probes used at DCPP, it is expected that the licensee will not be able to complete the full extent of ultrasonic testing from 2 inches above the J-groove weld to 2 inches below the lowest point of the toe of the J-groove weld, the bottom of the nozzle, or 1.0 inch below the lowest point at the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension and greater for some of the RPV head penetration nozzles.

The licensee notes that ultrasonic probes used to detect circumferential flaws are not effective near the end of the nozzle. These probes have separate transducers arranged vertically for sending and receiving the ultrasonic signal. The transducers in the probe are approximately one inch apart. With this configuration, the lower transducer will not contact the inside wall of the nozzle unless the upper transducer is inserted greater than approximately 1.0 inch into the nozzle. Since the scanning process requires that both transducers be in contact with the surface, the probe cannot scan the lower end of the nozzle. The Open Housing (OH) Probe has transducers oriented both vertically and horizontally, which will reduce the extent of the inaccessible examination areas.

The penetration nozzles installed in the DCPP Unit 1 RPV head have a 15-degree chamfer that extends up 0.233 inches into the inside diameter (ID) of the tube. There is also a threaded area with a thread relief on the outer diameter of the tube that extends up 0.75 inches from the bottom. These geometries limit the coverage for both the UT inspection tools that will be used on the Unit 1 RPV head penetrations. When the lower transducer on the probes goes below the top of the ID chamfer, the probes lose contact with the ID surface and it is not possible to obtain data. Based on the geometry involved in the transducer location and the chamfer at the lower end of the nozzle, the portion that cannot be scanned is the portion extending from the bottom of the nozzle upward for a distance of approximately 1.0 inch.

The licensee stated that two probes will be used to perform UT inspection of the penetration nozzles at DCPP Unit 1. The Trinity Probe will be used to inspect nozzles that contain thermal sleeves (53 total) and part-length control rod drive mechanism (CRDM) drive shafts (8 total). The OH Probe will be used to inspect nozzles without thermal sleeves (18 total). Both probes use axially oriented time-of-flight tip diffraction (TOFD) as the primary crack detection method. The vent line examination (1 total) is not included in the discussion as the examination area has a different geometry that is not limited.

The TOFD techniques uses two transducers (a transmitter and a receiver) oriented along the vertical axis of the probe. The focus point of the TOFD beam is at the midpoint between the upper and lower transducers. Credit is only taken for inspecting areas that are covered by the focus point.

The OH Probe has a transducer pair with a 55-degree angle of refraction. The Trinity Probe has a transducer pair with a 44-degree angle of refraction. Since the Trinity Probe transducers are a smaller size and spacing is less than that of the OH Probe, the focus point of the Trinity Probe transducers are at a lower elevation (closer to the bottom of the tube) than the OH Probe focus point when the probes reach the top of the ID chamfer. However, due to the differences in the refracted angles, the thread relief on the outside diameter (OD) of the tube interferes with the TOFD beam for the Trinity Probe. Due to this interference, there is a small area above the thread relief where the Trinity Probe cannot inspect.

In addition to the axially-oriented TOFD transducers, the OH Probe has circumferentially-oriented TOFD transducers that the Trinity Probe does not have. This circumferentially-oriented TOFD signal allows the OH Probe to inspect the tube down to the top of the ID chamfer. Also, with the OH Probe’s circumferentially-oriented transducers, the TOFD beam is not interrupted by the OD thread relief. This is why the OH Probe coverage is consistently greater than the Trinity Probe coverage.

Table 1 shows the penetrations that will be inspected and their respective angle grouping. Industry field experience, including the examination of DCPP Unit 2, has shown that the J-groove weld reinforcement is larger than shown on design drawings. Therefore, actual scan coverage will be determined from the field data taken during the 1R13 inspection and that data will establish the limits to be used in the relaxation request. The accuracy of this measurement will be plus or minus 0.04 inches, based on the device data sampling capabilities. The specific limits to be used in the relaxation request will be provided to the NRC in a supplement to this request.

The penetrations are grouped in Table 1 according to penetration angle as measured from the center of the head. These dimensions are described by the penetration head angle noted in Table 1. The penetration head angle is measured from the center line of the reactor head to the intersection of the inner radius of the head with the center of each penetration tube.

Table 1: Penetration Data

Penetration Number	Angle (Degrees)	20 KSI line (Inches below the J-groove welds)				Inspection Method
		Uphill Side		Downhill Side		
		ID	OD	ID	OD	
1	0	.85	.35	.85	.35	Trinity
2-5	8					OH
6-9	11.4					Trinity
10-13	16.2					Trinity
14, 16, 18, 20	18.2					Trinity
15, 17, 19, 21	18.2					OH
22-25	23.3					Trinity
26-29	24.8					OH
30-37	26.2	1.35	.45	.49	.35	Trinity
38-45	30.2					Trinity
46-49	33.9					Trinity
50-57	35.1					Trinity
58-61	36.3					Trinity
62-69	38.6					Trinity
70-73	44.3	2.4	.30	.19	.32	Trinity
74-79	48.7	2.7	.25	.15	.35	OH

The bottom of each nozzle terminates in a chamfered surface approximately 2 inches below the J-groove weld on the downhill side of the weld. Eddy current probes integral to the Trinity and OH Probes are used to examine the accessible surface of the ID of the tube down to the point where the eddy current probes lose contact due to the chamfered surface. The eddy current probes do not maintain adequate contact with the nozzle at its lower end due to this nozzle geometry. Using the Trinity Probe for thermal sleeved locations and OH Probe for non-thermal sleeved locations, ID coverage is down to the top of the chamfered area. For both probes, the examination is capable of detecting flaws initiating on the ID surface within the scanning area.

The Order allows for dye penetrant testings. However, dye penetrant testing would require extensive work under and around the RPV head. The radiation levels under the DCPP Unit 1 head are anticipated to be between 4000 mR/hour and 9000 mR/hour. The threaded tube OD makes a dye penetrant examination on the lower section of the tube impractical, resulting in the section of tube inaccessible to UT testing also being not available for dye penetrant testing. Therefore, performing dye penetrant testing on the bottom nozzle area would result in significant radiation exposure to personnel without a compensating increase in the level of quality and safety.

Accordingly, pursuant to Section IV.F.(2) of the Order, PG&E is requesting a reduction of the examination coverage area based on a flaw-tolerance analysis approach. As discussed below, this approach will provide an acceptable level of quality and safety with respect to the reactor vessel structural and leakage integrity.

3.3 Licensee’s Basis for Proposed Alternative

It is the licensee’s intent to perform the UT examination to the maximum extent possible. However, PG&E proposes to utilize inspection option (b)(i) and will achieve UT coverage 2 inches above the J-groove weld down to the lowest elevation that can be practically inspected on each nozzle with the UT probe being used.

The licensee states that testing of portions of the nozzle significantly below the J-groove weld is not significant to the phenomena of concern. The phenomena that are of concern are leakage through the J-groove weld and circumferential cracking in the nozzle above the J-groove weld. The nozzle is essentially an open-ended tube, and the nozzle wall below the J-groove weld is not part of the reactor coolant system (RCS) pressure boundary. The licensee believes the proposed inspection coverage does not preclude full UT examination coverage of the portions of these nozzles that are of primary interest.

The licensee notes that high stresses, on the order of the material yield strength, are necessary to initiate PWSCC. The yield strength of the head penetration nozzles for DCPP Unit 1 varies from 35 ksi to 45 ksi, which is a room temperature value. The stress level of 20 ksi is a conservative value below which PWSCC initiation is extremely unlikely.

Therefore, the assumption of any PWSCC crack initiation in the region of the penetration nozzle with a stress level of 20 ksi or less is conservative. The assumption of a through-wall flaw in these unlikely PWSCC crack initiation regions of the head penetration is an important additional conservatism, since the penetration tubes will be inspected with maximum achievable coverage on the tube ID.

A structural integrity evaluation has been performed for DCPP Units 1 and 2 reactor vessel head penetrations. The licensee performed a series of crack-growth calculations. They assumed a flaw where the lower extremity of the flaw is located on the penetration nozzle where either the inside or outside surface hoop stress drops below 0 ksi. They also assumed the flaw was through-wall at the point. These assumptions are conservative. The calculation demonstrated that more than one operating cycle would elapse before a postulated flaw in the unexamined area of the penetration nozzle would propagate into the pressure boundary formed by the J-groove weld. An operating cycle for DCPP Unit 1 is approximately 20 months (1.67 calender years or 1.26 Effective Full Power Years (EFPY)). DCPP Unit 1 Cycle 14 is planned to be a 17-month cycle; therefore, the calculations are conservative with respect to the time until a follow-up inspection will be performed. DCPP Unit 1 is currently in the moderate susceptibility category, and is required to perform nonvisual NDE in Unit 1 refueling outage thirteen (1R13). DCPP Unit 1 is expected to be in the high susceptibility category beginning in Unit 1 refueling outage fourteen (1R14) and thereafter. Therefore nonvisual NDE will be performed during each refueling outage, until the reactor head is replaced.

The methodology and the technical basis of the crack-growth calculation was based on the hoop stress distribution and the PWSCC crack-growth rate recommended in the industry topical report MRP-55 Revision 1. Application of the methodology and the technical basis was demonstrated in the site-specific analysis provided in WCAP-15429-P, Revision 0, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Diablo Canyon Units 1 and 2," dated February 2005, which was submitted by the licensee and reviewed by the staff for approval of a previous similar relaxation request for DCPP Unit 2.

The calculation demonstrates that the minium time for a flaw to propagate from 0.3 inches below the weld to the bottom of the J-groove weld would be at least 1.8 EFPY, which is greater than one operating cycle. The results of the flaw propagation calculation indicate that, even if a flaw were to occur in the uninspected region of the penetration nozzle, there would be adequate opportunity for detection prior to the crack reaching the RCS pressure boundary. The results demonstrate that the extent of the proposed inspection coverage would provide reasonable assurance of the structural integrity of the Unit 1 RPV head penetration nozzles and the J-groove welds. The flaw propagation calculations will be verified to be applicable to the as-built weld dimension, flaw locations, and flaw sizes as measured during the DCPP 1R13 RPV head examination.

In summation of the results which led to the conclusions above, the licensee provided figures of the crack-growth predictions for six nozzle angles. The licensee also provided figures detailing hoop stresses for five nozzle angles. As the crack-growth rate formula used in the structural integrity evaluation for Unit 1 is the same as the PWSCC crack-growth rate recommended in MRP-55, Revision 1, the licensee states the following:

> If the NRC staff finds that the crack-growth formula in industry report MRP-55 is unacceptable, then PG&E will revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs PG&E of an NRC-approved crack-growth formula. If PG&E's revised analysis shows that the crack-growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation request will be rescinded and PG&E will, within 72 hours, submit to the NRC written justification for continued operation. If the revised analysis shows that the crack-growth acceptance criteria are exceeded during the

subsequent operating cycle, PG&E will, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, PG&E will, within 30 days, submit a letter to the NRC confirming that its analysis has been revised.

The licensee requests approval of the proposed alternative through the period in which the First Revised NRC Order EA-03-009 is in effect, or until inspection technology is developed to a state that the examination volume can be extended to full compliance with the Order, or information is received from the NRC regarding nonacceptance of the crack-growth formula in MRP-55.

3.4 Staff Evaluation

The NRC staff's review of this request was based on criterion (2) of Section IV.F of the Order, which states:

Compliance with this Order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Full coverage is not achievable at DCPP Unit 1, for all vessel head penetration (VHP) nozzles (identified above in Section 2.2, Table 1), because of nozzle end geometry. Specifically, the bottom end of these nozzles are externally threaded, or internally tapered, or both. Thus, the geometry of the nozzle ends makes inspection in accordance with the Order difficult and would involve a hardship including increased personnel radiation dose due to possible surface examination options. This evaluation focuses on the issue of whether there is a compensating increase in the level of quality and safety such that these nozzles should be inspected in accordance with the Order despite this hardship.

The alternative inspection proposed by the licensee for the VHP nozzles is to volumetrically examine each nozzle from 2 inches above the weld down to the maximum extent possible. In support of this request, DCPP Unit 1's previous bare metal visual inspection results indicated no evidence of head material wastage or of leaking VHP nozzles. The NRC staff reviewed evaluations and analyses performed by the licensee in support of this request, as described below.

Stress profiles, based on the licensee's finite element analysis of CRDM penetrations at DCPP Unit 1, show that most residual stresses decrease significantly at distances identified in Table 1 of Section 2.2 above for minimum UT coverage achieved. The yield strength of the head penetration nozzles for DCPP Unit 1 varies from 35 ksi to 45 ksi, which is a room temperature value. Since the stress level at the unexamined area is low, initiation of a crack is very unlikely. Operating experience also indicates that locations with this low stress level have been much less susceptible to PWSCC. In addition, if examination of the high stress locations of these nozzles (i.e., nozzle locations adjacent to the J-groove weld and associated heat affected zone areas) finds no cracks, then cracking at the low stress locations is unlikely.

DCPP Unit 1 is currently in the moderate susceptibility category, and is required to perform nonvisual NDE during the current refueling outage, 1R13. DCPP Unit 1 is projected to be in the

high susceptibility category beginning in the following refueling outage, 1R14, and thereafter. As a high susceptibility plant under the Order required inspection frequency, the licensee will perform a bare metal visual inspection and non-visual NDE of the RPV head each refueling outage. Hence, while the requirements of the Order remain in effect, DCPP Unit 1 will perform nonvisual NDE of its RPV head and associated penetration nozzles each refueling outage.

The licensee's analysis, as documented in Section 2 above, used the methodology described in footnote 1 of the Order and conservative criteria to set the necessary height of the examination. The analysis postulated a through-wall crack in the unexamined area and showed that it would take the crack more than one operating cycle to reach the J-groove weld. The NRC staff concurs with this conclusion if the crack initiates from greater than or equal to 0.3 inches below the J-groove weld. The licensee stated the time to grow a crack from 0.3 inches below the J-groove weld to the weld was 1.8 EFPY, while the NRC staff conservatively estimates the value to be 1.3 EFPY. However, both values are larger than one approximate DCPP Unit 1 operational cycle of 20 months (1.26 EFPY). The NRC staff's assessment of the licensee's conclusion is based on data analysis of the supporting figures of the crack-growth predictions for six nozzle angles, as provided in the licensee's submittal. In addition, the licensee has agreed to verify the flaw propagation equations to be applicable to the as-built weld dimension, flaw locations, and flaw sizes as measured during the DCPP 1R13 RPV head examination. Therefore, the NRC staff concludes that the licensee's crack-growth assessment provides a reasonable basis for the proposed alternative inspection, to perform the UT examination below the J-groove weld to the maximum extent possible with a minimum inspection distance of 0.3 inches below the J-groove weld.

However, this analysis incorporates a crack-growth formula as provided in the EPRI Report, "Material Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick Wall Alloy 600 Material (MRP-55), Revision 1." The NRC staff has completed a preliminary review of the crack-growth formula, but has not yet made a final assessment regarding the acceptability of the report. Therefore, a condition has been included regarding the approval of the proposed relaxations. The condition was agreed to by the licensee in their May 27, 2005, letter to the NRC, and is as follows:

> If the NRC staff finds that the crack-growth formula in industry report MRP-55 is unacceptable, then PG&E will revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs PG&E of an NRC-approved crack-growth formula. If PG&E's revised analysis shows that the crack-growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation request will be rescinded and PG&E will, within 72 hours, submit to the NRC written justification for continued operation. If the revised analysis shows that the crack-growth acceptance criteria are exceeded during the subsequent operating cycle, PG&E will, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, PG&E will, within 30 days, submit a letter to the NRC confirming that its analysis has been revised.

The safety issues that are addressed by the First Revised Order EA-03-009 are degradation (corrosion) of the low-alloy steel RPV head, reactor coolant pressure boundary integrity, and

ejection of a VHP nozzle due to circumferential cracking of the nozzle above the J-groove weld. The licensee's proposed alternative inspection, to perform the UT examination below the J-groove weld to the maximum extent possible with a minimum inspection distance of 0.3-inches below the J-groove weld, as conditioned, provides reasonable assurance that these safety issues are addressed.

The licensee stated that surface examination could be performed to increase the inspection coverage for each nozzle, however these additional inspections would require extensive work in approximately 4 to 9 R/hour radiation fields. The NRC staff finds that performing these additional surface examinations would result in significant hardship through radiation exposure without a compensating increase in the level or quality or safety.

Based on the above discussion, the proposed alternative inspection of DCPP Unit 1's VHP nozzles, to perform the UT examination below the J-groove weld to the maximum extent possible with a minimum inspection distance of 0.3 inches below the J-groove weld, as conditioned, is acceptable as it provides reasonable assurance of the structural integrity of the RPV head, VHP nozzles, and welds. Further inspections to comply with the First Revised Order requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

The NRC staff concludes that the licensee's proposed alternative inspection of DCPP Unit 1's VHP nozzles, to perform the UT examination below the J-groove weld to the maximum extent possible with a minimum inspection distance of 0.3 inches below the J-groove weld, as conditioned, provides reasonable assurance of the structural integrity of the RPV head, VHP nozzles, and welds. Further inspections of these VHP nozzles in accordance with Section IV.C.(5)(b), of the First Revised NRC Order EA-03-009 dated February 20, 2004, would result in hardship without a compensating increase in the level of quality and safety. Therefore, pursuant to Section IV. F., of the First Revised Order EA-03-009 dated February 20, 2004, the NRC staff authorizes the proposed alternative inspection as stated above for the VHP nozzles (identified above in Section 2.2, Table 1) at DCPP Unit 1, until the First Revised NRC Order EA-03-009 is replaced or rescinded, subject to the following condition:

> If the NRC staff finds that the crack-growth formula in industry report MRP-55 is unacceptable, then PG&E will revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs PG&E of an NRC-approved crack-growth formula. If PG&E's revised analysis shows that the crack-growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation request will be rescinded and PG&E will, within 72 hours, submit to the NRC written justification for continued operation. If the revised analysis shows that the crack-growth acceptance criteria are exceeded during the subsequent operating cycle, PG&E will, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, PG&E will, within 30 days, submit a letter to the NRC confirming that its analysis has been revised. Any future crack-growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack-growth rate formula.

Principal Contributor: J. Collins

Date: October 26, 2005

cc:

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