Attachment 15
PG&E Letter DCL-14-028

Conclusions of a Third Party Review

of

AREVA Calculations

Intertek

April 1, 2014

Mr. Jeffrey Summy
Diablo Canyon Power Plant
Pacific Gas and Electric
P.O. Box 56
Avila Beach, CA 93424-0056

RE: Third Party Review of Diablo Canyon Pressurizer Spray Nozzle Laminar Flaw Analysis

(Intertek AIM Letter AES 13128558-2Q-1)

REF: (1) "Diablo Canyon Unit 2 Pressurizer Spray Nozzle Laminar Flaw Analysis," AREVA Document 32-9213780-001, (March 27, 2014)

(2) ASME Boiler and Pressure Vessel Code, Section XI, "Rules for the Inservice Inspection of Nuclear Power Plant Components,: (2004 Edition through 2005 Addenda)

Dear Mr. Summy:

Intertek AIM has completed a third party review of the aforementioned referenced AREVA report on the evaluation performed on the laminar flaw indications in the pressurizer spray nozzle in Diablo Canyon Unit 2. The purpose of this letter is to provide the scope and conclusions from the review.

SCOPE AND OBJECTIVES

An independent third party review was performed on the pressurizer spray nozzle flaw evaluation. The flaw evaluation was conducted by AREVA Inc. for Pacific Gas & Electric (PGE). The detected indications in the spray nozzle were located in the weld overlay associated with the overlay repair. All indications were laminar in nature and located along the overlay weld between the weld metal and underlying component materials.

The objective of the review was technical in nature and focused on two areas,

1) Technical approach and model assumptions for the fracture mechanics and fatigue analyses employed by AREVA in the evaluations. This included the analytical methods used, the analytical model with proper boundary conditions, and general validation of selected results.

2) Applicability and consistency of the flaw evaluation to ASME Code Section XI flaw evaluation procedures and acceptance criteria.

During the review process, Intertek AIM provided formal review comments through PGE Document Comment/Resolution Form procedure and participated in the resolution of the comments. Intertek also participated in telephone conferencing with PGE and AREVA on a regular basis to discuss the technical comments, analysis developments, and final resolution.

All Intertek AIM comments were addressed and resolved.

DISCUSSION

Overall, the flaw evaluation uses proper methods and conservative inputs to the analysis for allowable flaw size and flaw propagation by fatigue crack growth (FCG) for the 38 year evaluation period. The following list provides the details of the review:

1) The fractures mechanics model and flaw growth analysis were based on linear elastic fracture mechanics method. This is an acceptable approach. This approach is consistent with the LEFM–based procedures in ASME Section XI Appendices A and C.

2) A center-cracked panel (CCP) model of finite-width is used to represent the laminar flaws. This is a reasonable model to use for the analysis of the flaws in the overlay. The model was applied in a conservative manner in terms of physical dimensions of the flawed region and nozzle stresses acting on the flaw plane. Because the CCP model is two-dimensional, it represents the length of the laminar and planar flaws as being 360 degrees around the nozzle circumference.

3) Stress determination from the FEM analyses and stress bounding techniques used to generate the input to the FCG analyses are conservative. Both loading modes acting on the flaw (i.e., radial and in-plane shear) were accounted for in the evaluation.

4) Weld residual stresses are included in the determination of mean stress and R ratio as needed for the FCG calculations.

5) Crack-tip stress intensity factor computations for mixed-mode loading (Modes I and II) used the square root of the sum of the squares (SRSS) method for combining the effects of normal and shear stresses acting on the flaw. The SRSS of K_I and K_{II} is an acceptable way to combine loading modes and follows from LEFM theory for strain energy release rate for combined mixed-mode loading.

6) The crack growth rates used for the different materials in the nozzle overlay are obtained from either ASME Section XI or from published industry sources. The crack growth rate models are applied conservatively in the analysis. Specifically, R ratio is conservatively defined for the transients and no credit is taken for negative R ratio effects.

In summary, the evaluation of the laminar flaws in the spray nozzle overlay is conservative and consistent with ASME Section XI analysis procedures.

CONCLUSIONS

It is concluded from this review that the evaluation of the laminar flaws detected during inservice inspection of the weld overlay for the pressurizer spray nozzle is an acceptable approach and follows the basic ASME Section XI methodology under IWB-3600. The inputs to the analysis are conservative. Therefore, the conclusions of the subject report that the laminar flaws will not have a significant impact on the integrity of the pressurizer spray nozzle weld overlay, in terms of final flaw area and minimum required overlay length evaluation for 38 year evaluation period, are justified.

If you have any questions or need any additional information, you can contact me at (408) 636-5322 (email: russell.cipolla@intertek.com).

Sincerely,

Russell C. Cipolla

Russell C. Cipolla
Project Manager

RCC/rcc

cc: S. Khatri
R. Thatipamala
Project File

Intertek

April 1, 2014

Mr. Jeffrey Summy
Diablo Canyon Power Plant
Pacific Gas and Electric
P.O. Box 56
Avila Beach, CA 93424-0056

RE: Third Party Review of Diablo Canyon Pressurizer Safety/Relief Nozzles Laminar/Planar Flaw Analysis

(Intertek AIM Letter AES 13128558-2Q-2)

REF: (1) "Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzles Laminar/Planar Flaw Analysis," AREVA Document 32-9213965-001, (March 27, 2014)

(2) ASME Boiler and Pressure Vessel Code, Section XI, "Rules for the Inservice Inspection of Nuclear Power Plant Components,: (2004 Edition through 2005 Addenda)

Dear Mr. Summy:

Intertek AIM has completed a third party review of the aforementioned referenced AREVA report on the evaluation performed on the laminar and planar flaw indications in the pressurizer safety/ relief nozzles at Diablo Canyon Unit 2. The purpose of this letter is to provide the scope and conclusions from the review.

SCOPE AND OBJECTIVES

An independent third party review was performed on the pressurizer safety/relief nozzles flaw evaluation. The flaw evaluation was conducted by AREVA Inc. for Pacific Gas & Electric (PGE). The detected indications in the safety/relief nozzles were located in the weld overlay associated with the overlay repair. The indications were predominately laminar in nature and located along the overlay weld between the weld metal and underlying component materials. Safety Nozzle A has one indication that is along the nozzle shoulder and therefore has a through-thickness length component oriented in the radial direction. This flaw is modeled as a planar flaw in the AREVA analysis.

The objective of the review was technical in nature and focused on two areas,

1) Technical approach and model assumptions for the fracture mechanics and fatigue analyses employed by AREVA in the evaluations. This included the analytical methods used, the analytical model with proper boundary conditions, and general verification of selected results.

2) *Applicability and consistency of the flaw evaluation to ASME Code Section XI flaw* evaluation procedures and acceptance criteria. This covers both laminar and planar flaw treatment.

During the review process, Intertek AIM provided formal review comments through PGE Document Comment/Resolution Form procedure and participated in the resolution of the comments. Intertek also participated in telephone conferencing with PGE and AREVA on a regular basis to discuss the technical comments, analysis developments, and final resolution.

All Intertek AIM comments were addressed and resolved.

DISCUSSION

Overall, the flaw evaluation uses proper methods and conservative inputs to the analysis for determining the allowable flaw size and flaw propagation by fatigue crack growth (FCG) for the 38 year evaluation period. The following list provides the details of the review:

1) The fractures mechanics model and flaw growth analysis are based on linear elastic fracture mechanics (LEFM) method. This is an acceptable approach. This approach is consistent with the LEFM–based procedures in ASME Section XI, Appendices A and C.

2) A center-cracked panel (CCP) model of finite-width is used to represent the laminar and planar flaws. This is a reasonable model to use for the analysis of the indications in the overlay. The model is applied in a conservative manner in terms of physical dimensions of the flawed region and the applied nozzle stresses acting on the flaw plane. Because the CCP model is two-dimensional, it represents the length of the laminar and planar flaws as being 360 degrees around the nozzle circumference.

3) Stress determination from the FEM analyses and stress bounding techniques used to generate the input to the FCG analyses are conservative. Both loading modes acting on the flaw (i.e., radial and in-plane shear) were accounted for in the evaluation.

4) Weld residual stresses are included in the determination of mean stress and R ratio as needed for the FCG calculations.

5) Crack-tip stress intensity factor computations for mixed-mode loading (Modes I and II) uses the square root of the sum of the squares (SRSS) method for combining the effects of normal and shear stresses acting on the flaw. The SRSS of K_I and K_{II} is an acceptable way to combine loading modes and follows from LEFM theory for strain energy release rate for combined mixed-mode loading.

6) The crack growth rates used for the different materials in the nozzle overlay are obtained from either ASME Section XI or from published industry sources. The crack growth rate models are applied conservatively in the analysis. Specifically, R ratio is conservatively defined for the design transients and no credit is taken for negative R ratio effects.

7) The treatment of the planar flaw assumes the tip of the flaw resides in the ferritic nozzle material. This is a prudent condition since there is a possibility that the flaw may grow

into the nozzle material. The ASME Section XI IWB-3610 acceptance criteria are used to evaluate the flaw which is the correct criteria to apply under these conditions.

In summary, the evaluation of the laminar and planar flaws in the safety/relief nozzle overlays is conservative and consistent with ASME Section XI analysis procedures.

CONCLUSIONS

It is concluded from this review that the evaluation of the laminar and planar flaws detected during inservice inspection of the weld overlay for the pressurizer safety/relief nozzles is an acceptable approach and follows the basic ASME Section XI methodology under IWB-3600. The inputs to the analysis are conservative. Therefore, the conclusions of the subject report that the laminar and planar flaws will not have a significant impact on the integrity of the pressurizer safety/relief nozzle weld overlays, in terms of final flaw size and minimum required overlay length for the 38 year evaluation period, are justified.

If you have any questions or need any additional information, you can contact me at (408) 636-5322 (email: russell.cipolla@intertek.com).

Sincerely,

Russell C. Cipolla

Russell C. Cipolla
Project Manager

RCC/rcc

cc: S. Khatri
R. Thatipamala
Project File

Attachment 16
PG&E Letter DCL-14-028

List of Commitments

Commitment Number 1

PG&E makes a new regulatory commitment to submit a supplemental analysis that will evaluate the reported flaw sizes with additional margin to account for possible flaw sizing variations that are associated with the repeatability of manual ultrasonic examination results, in future ISI inspections. That supplemental analysis will be submitted no later than June 16, 2014.

Commitment Number 2

Revised Commitment:

ISI examination of Safety Nozzle A, B, and C, and the Spray Nozzle SWOLs will be performed during the next three ISI periods in accordance with Section XI, IWB-2420 using the manual phased array examination procedure EPRI-WOL-PA-1 Revision 2, "Procedure for Manual Phased Array Ultrasonic Examination of Weld Overlaid Similar and Dissimilar Metal Welds" or later revision, to confirm that the identified reflectors have not exceeded the acceptance criteria being established in the supplemental analysis (see Commitment #1). The reexaminations will include those indications that are located outside the defined inservice inspection volume.

Previous Commitment (Reference 8.10):

ISI examination of Safety Nozzle A, B, and C, and the Spray Nozzle SWOLs will be performed during the next three ISI periods in accordance with Section XI, IWB-2420.

Attachment 8
PG&E Letter DCL-14-028

AREVA Affidavit for

AREVA Calculations (Proprietary)

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is Phil A. Opsal. I am Manager, Product Licensing, for AREVA NP Inc. (AREVA NP) and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in the following documents: "32-9049112-003, 'Diablo Canyon Unit 2 - Pressurizer Spray Nozzle Weld Overlay Structural Analysis'," "32-9049061-005, 'Diablo Canyon Unit 2 Pressurizer Spray Nozzle Weld Overlay Residual Stress Analysis'," "32-9213780-001, 'Diablo Canyon Unit 2 Pressurizer Spray Nozzle Laminar Flaw Analysis'," "32-9049114-003, 'Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Structural Analysis'," "32-9049062-004, 'Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Residual Stress Analysis'," "32-9215965-001, 'Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzles Laminar/Planar Flaw Analysis'," and referred to herein as "Document." Information contained in this Document has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the

public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in this Document is considered proprietary for the reasons set forth in paragraphs 6(c) and 6(d) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document has been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

R.A. Gayheart P.E.

SUBSCRIBED before me this 28th
day of March, 2014.

Sherry L. McFaden
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 10/31/14
Reg. # 7079129

SHERRY L. MCFADEN
Notary Public
Commonwealth of Virginia
7079129
My Commission Expires Oct 31, 2014