DiabloCanyonNPEm Resource

From: Ferrer, Nathaniel
Sent: Wednesday, August 04, 2010 1:39 PM
To: Soenen, Philippe R; Grebel, Terence
Cc: DiabloHearingFile Resource
Subject: FW: Draft RAI Set 19 - Metal Fatigue
Attachments: Draft RAI Set 19 Metal Fatigue RAIs.doc

With attachment.

From: Ferrer, Nathaniel
Sent: Wednesday, August 04, 2010 11:02 AM
To: Grebel, Terence; 'Soenen, Philippe R'
Cc: DiabloHearingFile Resource
Subject: Draft RAI Set 19 - Metal Fatigue

Terry and Philippe,

Attached is Draft RAI Set 19 containing draft RAIs, specifically on portions of the metal fatigue review. Please review the attached draft RAIs and let me know if and when you would like to have a teleconference call. The purpose of the call will be to obtain clarification on the staff's request.

Please let me know if you have any questions.

Nathaniel Ferrer
Project Manager
Division of License Renewal
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
(301)415-1045

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"DiabloHearingFile Resource" <DiabloHearingFile.Resource@nrc.gov>
Tracking Status: None
"Soenen, Philippe R" <PNS3@PGE.COM>
Tracking Status: None
"Grebel, Terence" <TLG1@PGE.COM>
Tracking Status: None

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Diablo Canyon Nuclear Power Plant, Units 1 and 2 (DCPP)
License Renewal Application (LRA)
Draft Request for Additional Information Set 19
Metal Fatigue

<u>D-RAI 4.3-1</u>

<u>Background</u>: In LRA Section 4.3.1, “Cycle Count Action Limits and Corrective Actions” subsection, the applicant identifies that the corrective actions for the Metal Fatigue of Reactor Coolant Pressure Boundary Program if an action limit on the cycle counting of a design basis transient is reached. The applicant states, in part, that if one of the cycle count action limits is reached, corrective actions will include a review of the fatigue usage calculations will be performed to ensure that the analytical bases of the leak-before-break (LBB) fatigue crack propagation analysis is maintained.

The applicant also makes the following statement in LRA Section 4.3.1 to indicate that the action limit on cycle counting would be capable of initiating corrective actions in a timely fashion:

> “Cycle count action limits have been established based on the design number of cycles. In order to assure sufficient margin to accommodate occurrence of a low probability transient, corrective actions must be taken before the remaining number of allowable cycles for any specified transient, including the low-probability, higher-usage-factor events, becomes less than one. Events which occur more frequently contribute less per event to the usage factor. To account for both cases, corrective actions are required when the cycle count for any of the significant contributors to the usage factor is projected to reach a specified percentage of the design number of cycles before the end of the next fuel cycle.”

SRP-LR Section 4.3.2.1.1.3 indicates the program description in GALL AMP X.M1, “Metal Fatigue of Reactor Coolant Pressure Boundary,” states an applicant may reference the program in GALL AMP X.M1 to accept a CUF-based metal fatigue TLAA in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii). The program description in the GALL AMP states that the AMP is an acceptable option for managing metal fatigue for the reactor coolant pressure boundary (RCPB) components, considering environmental effects. The “scope of program” element in GALL AMP X.M1 states that the scope of the program includes preventive measures to mitigate fatigue cracking of metal components of the reactor coolant pressure boundary caused by anticipated cyclic strains in the material.

<u>Issue 1</u>: Fatigue usage calculations are ASME Section III mandated design calculations. LBB fatigue flaw growth analyses are performed pursuant to the requirement in 10 CFR Part 50, Appendix A, General Design Criterion 4, “*Dynamic Effects,*” and are submitted to the NRC for staff approval. It is not evident how a component fatigue usage factor calculation can be applied to an LBB analysis and how the integrity of the LBB analysis is maintained by this count.

<u>Request 1</u>: Provide your basis for expanding the cycle counting activities of the DCPP Metal Fatigue of Reactor Coolant Pressure Boundary AMP to include the 10 CFR 54.21(c)(1)(iii) aging management of the LBB TLAA. Identify the design basis transients accounted for in the fatigue flaw growth analysis in the LBB. Clarify whether the counting activities will be based on a comparison of the total number of all transients monitored for the LBB or on the number of transient types in the LBB. Clarify whether the relationship between the cycle counting activities

in the Metal Fatigue of Reactor Coolant Pressure Boundary Program and the LBB is currently accounted for in a plant procedure or in the UFSAR.

Issue 2: The staff notes that, according to the last sentence of the previously quoted material, the applicant will take corrective actions "when the cycle count for any of the significant contributors to the usage factor is projected to reach a specified percentage of the design number of cycles before the end of the next fuel cycle."

Request 2: Identify all transients in LRA Table 4.3-2 that are considered to be the significant contributors to fatigue usage and explain the criteria used to make this determination. Explain why PG&E's cycle count action limit is based on only significant contributors to fatigue usage and does not account for less significant transients. Please describe the confirmatory analysis supporting the conclusion that a lower contributing transient would not significantly impact the CUFs for the components.

D-RAI 4.3-2

Background: In LRA section 4.3.1, "Cumulative Usage Corrective Actions" subsection, the applicant states, in part, that if the action limit on the CUF monitoring is reached, corrective actions will include:

1. Determine whether the scope of the Fatigue Management Program must be enlarged to include additional affected reactor coolant pressure boundary locations. This determination will ensure that other locations do not approach design limits without an appropriate action.

2. Enhance fatigue managing to confirm continued conformance to the code limit.

Issue 1: Corrective Action (1) is included in the enhancement of LRA Metal Fatigue of Reactor Coolant Pressure Boundary Program in LRA Appendix A Commitment No. 21. The staff noted that the corrective action is only applicable to reactor coolant pressure boundary components. However, in its review of LRA Section 4.3.2, the staff confirmed that the TLAA does include the CUF results for some ASME Code Class 2 components that were analyzed to ASME Section III CUF requirements for Code Class 1 components. As a result, the staff noted that the action in CUF monitoring corrective action 1 may be applicable to the ASME Code Class 2 components analyzed within the scope of the AMP.

Request 1: Verify correction action (1) on LRA page 4.3-5, applies to reactor coolant pressure boundary components, component supports, and ASME Code Class 2 components analyzed to ASME Section III CUF requirements for Code Class 1 components.

Issue 2: Corrective Action 2. of LRA page 4.3-5 states "Enhance fatigue managing to confirm continued conformance to the code limit"

Request 2: Clarify what actions would be taken to enhance the fatigue monitoring for this corrective action.

D-RAI 4.3-3

Background: LRA Section 4.3.1.1 indicates the applicant will use FatiguePro® to perform the cycle counting for the applicant's design basis transients and updates of the CUF values for ASME Section III Code Class 1 components and for those Class 2 components that were conservatively analyzed to ASME Section III CUF requirements for Class 1 components.

Issue: The staff has confirmed that the use of FatiguePro® software is currently accounted for in the applicant's design basis cycle count procedure. The use of FatiguePro® applies a one-dimensional Green's function method to compute the stress value inputs for the component CUF values that the software program tracks. The staff addressed potential non-conservatisms in the ability of FatiguePro® to perform CUF calculations in NRC RIS 2008-30, "Fatigue Analysis of Nuclear Power Plant Components," dated December 16, 2008. In RIS 2008-30, the staff recommended that license renewal applicants perform an analysis to confirm the use of FatiguePro® would yield conservative CUF values relative to those that would be generated using the ASME Section III Subarticle NB-3200 methods. The staff notes that the use of FatiguePro® is not currently reflected in LRA Commitment No. 21, and the LRA does not provide a basis to determine if the afore mentioned FatiguePro® methodology will yield conservative CUF values relative to the use of the methodology described in ASME Section III, Subarticle NB-3200.

Request: Provide your technical basis to show FatiguePro® cycle tracking and CUF update methodology generates results more conservative than those generated using the CUF methodology of ASME Section III, Subarticle NB-3200. Explain how the Metal Fatigue of Reactor Coolant Pressure Boundary Program addresses the confirmatory analysis, recommended in RIS 2008-30.

D-RAI 4.3-4

Background: LRA Section 4.3.1.2 provides the applicant's present and projected status of monitored locations. On LRA page 4.3-6, the applicant states that a "review of the operating history of DCPP Units 1 and 2 was performed from initial startup to year-end 2008 in order to baseline the transient event count in the enhanced Fatigue Management Program." In LRA Section 4.3.1.2, *Baselining Method* subsection, (LRA page 4.3-7), the applicant states that a DCPP specific procedure defines tracking requirements and recording of plant cyclic transients. The applicant states that in 1996, FatiguePro software was installed at DCPP to monitor and record plant instrumentation in order to identify transients and that this provided actual plant transient data from the time of the software installation date through 2008, except for a gap in the data from mid-2002 through year-end 2004, which affected the baseline count for the charging and feedwater (FW) cycling transients. LRA Section 4.3.1.2, *Baselining Method* subsection also provides specific details on the cycle count baselining methods and assumptions for the "Auxiliary Spray during Cooldown" transient, RHR Operation (during Cooldown)" transient, charging cycling transient, and FW cycling transient.

Issue 1: LRA Section 4.3.1.2 gives no indication about the rigor used to develop the cycle count at DCPP. On page 4.3-7, the applicant only states that "data from several sources were considered" for the recount activities.

Request 1: Identify the sources of information used to develop the DCPP transient operating history.

Issue 2: On LRA page 4.3-7, the applicant states that, after considering the documented sources of cycle counting information, “an explicit cycle count could not be determined for some transients.” However, the LRA does not identify which transients are not determined explicitly.

Request 2: Identify the transients that were not derived explicitly. Discuss the technical rationale used to derive the 60-year cycle projections for the identified transients.

Issue 3: The applicant’s number-of-events basis for the “Auxiliary Spray during Cooldown” transient is given on LRA page 4.3-7. The staff has determined that LRA Table 4.3-2 does not list this transient as within the scope of the design basis transients for this TLAA.

Request 3: Provide the basis for excluding the “Auxiliary Spray during Cooldown” transient from LRA Table 4.3-2.

Issue 4: The applicant’s number of events basis for the charging system is given at the bottom of LRA page 4.3-7. In LRA Table 4.3-2, the applicant identifies three transients for the charging system (Transients 15, 16, and 17 in the table). The applicant does not provide any correlation in the LRA between the number of events basis for charging system on LRA page 4.3-7 and the design basis transients in LRA Table 4.3-2 that are impacted by this charging system basis. The applicant also does not specify which quantitative SF was applied to these events or justify its use in the projection basis.

Request 4: Identify which of the transients in LRA Table 4.3-2 were assessed in accordance with charging system events basis that was provided at bottom of page 4.3-7. For each of the transients that were assessed in accordance with this projection basis, identify the SF that was applied to the assessment and justify its use.

D-RAI 4.3-5

Background: On page LRA 4.3-8, the applicant states t the projection rate (PR) for the unaccounted periods were performed using both a long-term rate based on the entire transient history for the plant (i.e., number of occurrences since initial plant startup) and a short term rate for the incremental cycles that have occurred over the last 10 years. On this page, the applicant states that the two rates were combined using a weighted average in accordance with the following equation:

$$PR = [(LTW)*(\text{long-term rate}) + (STW)*(\text{short-term rate})] / [(LTW) + (STW)],$$

with LTW being the long-term weighting factor and STW being the short-term weighting factor. The applicant states that the values of LTW and STW were determined on an event- or component-specific basis to reflect the most likely future behavior of that event or component.

Issue 1: It is not evident how the LTW and STW values could be derived on a component-specific basis when presumably the design basis CUF calculations for Class 1 components (and possibly some Class 2 components analyzed to AMSE Section III Class 1 CUF criteria) would involve more than one analyzed transient, and under this basis individual LTW and STW values would have to be assigned to each transient contributing to the CUF calculation for a given component.

Request 1: Explain the technical rationale for selection of LTW and STW and how this accommodates events on a component basis.

Issue 2: The PR basis provided on LRA page 4.3-8 only involves a general description about the PR value derivation; the LTW and STW values were derived on a transient-specific (event-specific) or component-specific basis. Thus, the PR basis discussion on LRA page 4.3-8 does not provide the staff with any quantitative basis correlation with the LTW and STW factors used to derive the PRs for the design basis transients in LRA Section 4.3.

Request 2: Identify which transients, in LRA Table 4.3-2, this applies to. Explain how the LTW and STW values were used for the transient projection basis.

D-RAI 4.3-6

Background: LRA Table 4.3-2 provides the applicant's list of design basis transients that pertain to the metal fatigue assessments for ASME Code Class 1, 2, or 3 components or components designed to the ANSI B31.1 design specification. UFSAR Table 5.2-4 provides a list of design basis transients for the DCPP units.

Issue 1: The applicant has determined that UFSAR Table 4.3-2 provides an accurate correlation for all normal operation condition, upset condition, and test condition transients and their design limits in UFSAR Table 5.2-4, with the exception of normal operating condition transient #8, "T_{avg} Coastdown from Nominal to Reduced Temperature," which currently is not within the scope of LRA Table 4.3-2.

Request 1: Provide your basis for why UFSAR Table 5.2-4, normal operating condition transient #8, "T_{avg} Coastdown from Nominal to Reduced Temperature," is not currently within the scope of LRA Table 4.3-2 and why the applicable 60-year cycle projection data have not been included for this transient in LRA Table 4.3-2.

Issue 2: LRA Table 4.3-2 identifies that the normal operating condition transient Nos. 5, 13, 14, 15, 16, 17, 18, and 19, and upset condition transient Nos. 24, 26, 27, 28, 29, 30, and 31 are applicable to the scope of the metal fatigue analyses but are not currently within the scope of UFSAR Table 5.2-4.

Request 2 Clarify how these transients relate to the scope of the design basis that is currently described in the DCPP UFSAR (if at all) or applicable design basis procedures or calculations.

Issue 3: LRA Table 4.3-2 includes transient data entries for the "Design Basis Cycles, FSAR Table 5.2-4" and "Limiting Analyzed Value" columns in the table. The "Limiting Analyzed Value" column is subject to the following Footnote (c) clarification:

> "The limiting analyzed value is the lowest number of transients that are considered in DCPP fatigue analyses. The enhanced Fatigue Management Program compares actual to this limiting analyzed value so that all plant analyses remain valid."

The staff has observed that for those transients in LRA Table 4.3-2 that derive from the list of transients in UFSAR Table 5.2-4, the value listed in the "Limiting Analyzed Value" column is sometimes the same as that listed in the "Design Basis Cycles, FSAR Table 5.2-4" column and sometimes it is lower than the value listed in the "Design Basis Cycles, FSAR Table 5.2-4" column.

Request 3: Clarify which columns (the value in the “Design Basis Cycles, FSAR Table 5.2-4” column or the value in the “Limiting Analyzed Value” column) should be relied upon for the design basis transient occurrence limits.

Issue 4: LRA Table 4.3-2 includes test condition transient #37, “Tube Leak Tests.” The applicant identifies 800 as the value for the “Design Basis Cycles, FSAR Table 5.2-4” column and “Limiting Analyzed Value” column entries for this transient. The staff has determined however, that UFSAR Table 5.2-4 lists this as test condition transient #3.b, and that for this transient, the design basis is broken down into four cases for the transient as follows:

- Case 1 with a design limit of 400 cycles
- Case 2 with a design limit of 200 cycles
- Case 3 with a design limit of 120 cycles
- Case 4 with a design limit of 80 cycles

Request 4: Justify why the “Design Basis Cycles, FSAR Table 5.2-4” column and “Limiting Analyzed Value” column entries in LRA Table 4.3-2 for “Tube Leak Test” transient are not same as those given in UFSAR Table 5.2-4 for this transient. Specifically define and discuss each of the Case bases for this transient as defined in UFSAR Table 5.2-4, and explain how DCPP arrived at design basis limit values for each of the Case bases (i.e., for Cases 1 – 4).

D-RAI 4.3-7

Background: LRA Section 4.3 dispositions the CUF-based TLAAs for many ASME Code Class 1 components by multiplying the CUF values for the components by a factor of 1.2 if the design basis CUF was based on a 50-year design life or by 1.5 if the design basis CUF was based on a 40-year design life. For these TLAAs, DCPP states that the CUF values remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

Issue: The multiplication of the design basis CUF by a factor of 1.2 or 1.5 represents a projection of the CUF value for the period of extended operation in that it is changing the CUF value for the component. Thus, components dispositioned in accordance with this methodology should be dispositioned in accordance with the criteria in 10 CFR 54.21(c)(1)(ii) in that the CUF values have been projected for the period of extended operation and have been found to be acceptable when compared to a CUF value acceptance criterion of 1.0.

Request: Provide your basis why Class 1 components that are subject to this metal fatigue projection basis have not been dispositioned in accordance with the criterion in 10 CFR 54.21(c)(1)(ii).

D-RAI 4.3-8

Background: In the LRA Table 4.3-1, the applicant credits the “Global” monitoring (i.e. cycle count monitoring) of AMP B3.1 as the 10 CFR 54.21(c)(1)(iii) aging management monitoring basis for dispositioning the CUF analyses for the RPV Core Support Pads, Pressurizer Spray Nozzle, and Pressurizer Heater Penetration.

Issue: The LRA Table 4.3-1 or LRA Table 4.3-6 indicated that the RPV Core Support Pads, Pressurizer Spray Nozzle, and Pressurizer Heater Penetration in Unit 1 have a maximum limiting design basis CUFs of ~0.89, ~0.95, and ~0.94 respectively and limiting 60-year projected CUFs of ~1.07, ~1.14, and ~2.97.

Request: Justify your basis using the "Global" monitoring method of AMP B3.1 to monitor these components during the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii), and why it would not be more appropriate to monitor for these components using the CBF monitoring method.

D-RAI 4.3-9

Background: LRA Section 4.3.2.3 (top of pg. 4.3-20) states that the "Unit Loading and Unloading" transient does not need to be counted under the enhanced fatigue management program.

Issue: The staff have determined that the the "Unit Loading and Unloading" transient is within the scope of FSAR Section 5.2.1.5.1 and UFSAR Table 5.2-4, and that Technical Specification (TS) 5.5.5 makes reference to controls to track the FSAR, Section 5.2 and 5.3, cyclic and transient occurrences to ensure that components are maintained within the design limits. Thus, the staff is of the perception that the counting of this transient would be the activity that corresponds to the control to track the transient under the TS requirement.

Request: Provide your basis why the Metal Fatigue of Reactor Coolant Pressure Boundary Program would not need to count this transient during the period of extended operation when it does appear to be within the scope of the TS tracking requirement.

D-RAI 4.3-10

Background: LRA Section 4.3.3 provides the fatigue analyses of the reactor pressure vessel internals. The applicant stated that the qualification of reactor vessel internals was first performed by Westinghouse on a generic basis for 40 years of operation. The applicant stated that some DCPP internal components were subsequently analyzed on a DCPP-specific basis. The applicant indicated that the lower support plate, lower support columns, and core barrel nozzles had the highest cumulative usage factor values (CUF values) for the reactor vessel internal (RVI components and that the CUFs for the remaining RVI components were bounded by the CUF results for these limiting components. The applicant further stated that the enhanced DCPP Fatigue Management Program will monitor the 50-year design basis number of transients used in the T_{avg} operating range analysis to ensure that it remains valid during the period of extended operation.

Issue 1: . The staff is unable to determine from the LRA discussion which RVI components were required to be analyzed for fatigue as part of the ASME Section III design.

Request 1: Identify all DCPP RVI components that were required to receive CUF calculations under applicable ASME Section III design requirements. For these components, identify the transients that were involved in the calculation of the CUF values and identify what the CUF values are for the components, along with an indication on whether the value for a given RVI component represents an existing design basis value or 60-year projected values. Clarify how the value was calculated if the CUF value for the given RVI components represents a 60-year project value for the TLAA.

Issue 2: The LRA indicated that the fatigue of the RVI components will be managed by the DCPP Fatigue Management Program by monitoring the number of transients. The LRA does not provide any justification why it would be acceptable for the applicant to use cycle monitoring of the transients for the lower support plates, lower support columns, and core barrel nozzles as a bounding basis for monitoring the other RVI components that received CUF calculations.

Request 2: Provide your basis for why it is acceptable to use cycle-based monitoring of the transients associated with the lower support plates, lower support columns, and core barrel nozzles as a bounding basis for those non-monitored RVI components with CUF values.

D-RAI 4.3-11

Background: The GALL Report states that the AMP addresses the effects of coolant environment by applying an environmental life correction factors to existing ASME code fatigue analyses based on factors in NUREG/CR-6583 and NUREG/CR-5704, or appropriate alternative methods.

Issue: The applicant has stated that the environmental factors are determined by NUREG/CR-6583 and NURGE/CR-5704, or appropriate alternative methods.

Request: Clarify what appropriate alternative method would be used to calculate the environmental factors for fatigue calculations.

D-RAI 4.3-12

Background: 10 CFR Part 54.21 states that each application must identify and list those structures and components subject to an aging management review.

Issue 1: LRA Section 4.3 indicates that the following components were required to be analyzed in accordance with an applicable CUF analysis; however, the AMR Tables in LRA Section 3.1 do not appear to include applicable AMR items that address cumulative fatigue damage for the components:

- RV core support lugs or pads (as indicated in LRA Table 4.3-1)
- RV inlet and outlet nozzle support pads (as indicated in LRA Table 4.3-1
- Reactor coolant pump (RCP) casings (as indicated in LRA Section 4.3.2.3)
- Valve support bracket for the Unit 2 pressurizer (as indicated in LRA Table 4.3-6)
- SG primary manway, secondary, and feedring components (as indicated in LRA Table 4.3-7)
- RV internal lower support plate, lower support columns, core barrel nozzles, and baffle-former plates (as indicated in LRA Section 4.3.3)

Request 1: Provide your basis why the AMR tables in LRA Section 3.1 do not appear to include any AMR items addressing the management of cumulative fatigue damage for these components.

Issue 2: The staff have noted that the LRA includes AMRs on cumulative fatigue damage only ASME Section III Class 2 or 3 or ANSI B31.1 piping in the following balance of plant emergency safety feature (ESF), auxiliary system (AUX), and steam and power conversion subsystems:

- Safety Injection System (LRA Table 3.2.2-1)
- RHR System (LRA Table 3.2.2-3)
- Chemical and Volume Control System (LRA Table 3.3.2-8)
- Turbine Steam Supply System (LRA Table 3.4.2-1)
- Feedwater System (LRA Table 3.4.2-3)
- Auxiliary Feedwater System (LRA Table 3.4.2-5)

Request 2: Provide your basis why the AMR tables in LRA Sections 3.2, 3.3, and 3.4 do not appear to include any AMR items addressing cumulative fatigue damage for the ANSI B31.1 or B31.7 piping components in the systems:

- LRA Table 3.2.2-2, Containment Spray System AMRs
- LRA Table 3.2.2-4, Containment HVAC System AMRs
- All Table 2 AMR Tables for AUX subsystems in LRA Section 3.2 other than that for Table 3.3.2-8, Chemical and Volume Control System
- LRA Table 3.4.2-2, Auxiliary Steam System
- LRA Table 3.4.2-4, Condensate System