From: James Medoff
To: James Davis
Date: 07/05/2006 2:57:34 PM
Subject: FYI: Draft Audit Report Shell TLAA on Metal Fatigue - Audit Report Section 4.3

Jim and Erach:

Here is the draft Shell for Audit Report Section 4.3 on the TLAA on Metal Fatigue: Section 4.3.1 is for Class 1 fatigue. Section 4.3.2 is for Non-class 1 fatigue. Section 4.3.3 is in Environmental Impacts on Fatigue.

Erach you will have fill in some inputs to Section 4.3.1 and will have to write most of Section 4.3.3.

Thanks,

Jim

CC: Dan Hoang; INTERNET:erachp@comcast.net

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Subject: FYI: Draft Audit Report Shell TLAA on Metal Fatigue - Audit Report Section 4.3
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Color Coding for this Plate Shell for Audit Report Section 4.3, "Metal Fatigue":

Blue – Boilerplate Contents, that should remain unchanged, but might change in format setup minimally if there is a minor difference in the manner the applicant formatted the fatigue discussions for its Class 1 components for the manner that Entergy did their format for VY or Pilgrim.

Black – Information that will change in the original draft based on the plant-specific information provided by the applicant in Section 4.3.1 of its LRA.

Green – Information that will change later on based on information provided by the applicant later on in the LRA process as part of its efforts to resolve Audit Questions, Audit Open Issues, RAIs, SER Open Items, or SER Confirmatory Items.

4.3 Metal Fatigue

A metal component subjected to cyclic loading at loads less than the static design load may fail due to fatigue. Metal fatigue of components may have been evaluated based on an assumed number of transients or cycles for the current operating term. The validity of such metal fatigue analysis is reviewed for the period of extended operation. The GALL Report identifies fatigue aging-related effects that require evaluation as possible time-limited aging analyses (TLAAs), pursuant to 10 CFR 54.21(c). The staff provides its bases for evaluating TLAAs on Metal Fatigue in Section 4.3 of NUREG-1800, Revision 1, "Standard Review Plant for License Renewal Application for Nuclear Power Plants" (SRP-LR). The applicant provides its TLAA on Metal Fatigue in Section 4.3 of the LRA.

4.3.1 Fatigue Analyses for Class 1 Components

4.3.1.1 Summary of Technical Information in the Application

LRA Section 4.3.1 provides the applicant's TLAA assessment for metal fatigue of Class 1 components in the reactor coolant pressure boundary (RCPB). The applicant identifies that metal fatigue analyses for PNPS RCPB components (i.e., Class 1 components) conform to the definition for a TLAA in 10 CFR 54.3. The applicant identifies that the Class 1 components include the reactor pressure vessel (RPV) and its appurtenances, the components internal to the RPV (RPV internals), and Class 1 piping.

The applicant identifies that the original 40-year metal fatigue evaluations for the reactor coolant pressure boundary (RCPB) components that were designed to are based on the methods for calculating cumulative usage factor methods (CUFs) in Section III of the ASME Boiler and Pressure Vessel Code (Section III) if the components were designed in accordance with Section III. The applicant stated that these CUFs are calculated in accordance with the "Procedure for Analysis for Cyclical Loading" in Article NB-3000 of Section III.

RVP and RPV Appurtenances

The applicant provided the 40-year CUFs for the RPV and its appurtenances, the RPV internals, and the Class 1 piping commodity groups in Table 4.3-1 of the LRA. Table 4.3-1 includes 40-year CUFs for the following components: (1) RPV closure flange, (2) RPV closure

studs, (3) RPV bottom head and support skirt, (4) feedwater (FW) nozzles, (5) steam outlet nozzles, (6) recirculation inlet nozzles, (7) recirculation outlet nozzles, (8) core spray nozzles, (9) vessel shell, (10) vent nozzle, and (11) instrument nozzles.

LRA Table 4.3-2 identifies which design basis operational and transient categories form the basis for the calculations for the applicant's 40-year CUF values. These operational and transients include: (1) RPV bolt-up, RPV hydrostatic pressure test, (3) cold startup of the reactor, (4) power reduction of 50% from 100% rated power, (5) loss of feedwater heaters, (6) loss of reactor feedwater pumps, (8) main turbine load reject, (9) other transients leading to a reactor SCRAM, (10) recirculation pump start, (11) reduction of power and operational mode change to the "Hot Standby" operating mode, (12) normal operational shutdowns of the reactor, including power reductions and operational mode changes, (13) reactor blowdown, (14) reactor vessel floodup, and (15) detensioning of the RPV closure flange bolts. For each of these operational or transient categories, the table identifies: (1) the number of cycles that were projected in the original 40-year design basis, (2) the number of cycles that are currently projected in the 40-year design basis, (3) the number of cycles logged as of December 31, 2001, (4) the projection factor used to project the number of cycles logged in the future, (5) the number of cycles projected at 40 years of licensed operations, and (6) the number of cycles projected at 60 years of licensed operations, if the LRA is approved.

The applicant identified that the limiting RPV components in the RPV shell, heads, and closure flange, and support skirt are the RPV closure bolts. The applicant identified that the 40-year CUF for the RPV closure flange is 0.07. The applicant identified that the limiting RPV appurtenance components (RPV nozzle components) for metal fatigue are the RPV feedwater nozzles. The applicant provided two 40-year CUF values for these nozzles. The applicant identified the normal 40-year CUF value as 0.637, as based on the number of allowable design basis operations and transients that could impart thermally induced cyclical loading on the nozzles. The applicant also provided a more conservative 40-year CUF of 0.800, which was based on adding the impact of rapid thermal cycling/thermal sleeve leakage in addition to that from the design basis thermal operations and transients.

The applicant indicated that it performed a recalculation of the CUF for the FW nozzles and projected the CUF value to the expiration of the PEO (i.e., to 60 years of licensed operations). The applicant stated that the 60-year CUF value for the FW nozzles is 0.899. The applicant therefore concluded the CUF analysis for the FW nozzles is acceptable under the criteria of 10 CFR 54.21(c)(1)(ii) because the value will be less than 1.0 at the expiration of the PEO. For the remaining RPV shell, head, closure flange, nozzle, and support skirt component, the applicant concluded that the 40-year CUF values for the RPV shell, head, and closure flange components either remain valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i) or the applicable aging effect of "cracking – fatigue" would be managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

RPV Internals

The applicant identifies that the RPV internals were designed to the intent of Section III. The applicant clarified that it had reviewed the design documents for the RPV internals, but determined the core shroud stabilizers (i.e., core shroud tie rods) were the only RPV internals that received a CUF calculation. The applicant identified that the 40-year CUF for the core shroud stabilizers was 0.330 and provided this value in LRA Table 4.3-1. The applicant concluded that the 40-year CUF values for the RPV core shroud stabilizers will either remain

valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i) or the applicable aging effect of "cracking – fatigue" would be managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

RCPB Piping Components

The applicant states that the RCPB piping in the recirculation system (RRS) was originally designed in accordance with the 1967 Edition of the ANSI B31.1 design specification, but clarified that the system, including the connecting Class 1 portions of the core spray system (CSS), residual heat removal (RHR), reactor water cleanup (RWCU) systems was replaced in response to the recommendations of Generic Letter (GL) 88-01 and NRC NUREG-0313. The applicant reanalyzed the replacement piping for metal fatigue in accordance with calculational requirements for CUFs in the ASME Section III. The applicant provided the 40-year CUF values for the RRS piping Loops A and B (including the connecting Class 1 portions of CSS, RHR, and RWCU) in LRA Table 4.3-1. The applicant stated that the remainder of the RCPB piping is designed the ANSI B31.1 design specification. The applicant identified that the 40-year CUF for RRS Loop A was 0.094 and that the 40-year CUF value for RRS Loop B was 0.110. The applicant concluded that the 40-year CUF values for the RRS piping and branch piping – Loop A and RRS piping and branch piping – Loop B will either remain valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i) or the applicable aging effect of "cracking – fatigue" would be managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

Impact of Environmental Conditions on CUF Calculations

The applicant indicated that its evaluation of environmental factors on the CUF values for the Class 1 components is provided in LRA Section 4.3.3. The applicant provides the environmentally-impacted CUF values are provided in LRA Table 4.3-3. The project team evaluates the licensee's TLAA evaluations on environmentally-impacted fatigue analyses in Section 4.3.3 of this Audit Report.

LRA Commitment #31

The applicant has included Commitment #31 on the TLAA on Metal Fatigue. In this commitment, the applicant committed to implement one of the following proposed corrective actions if the applicant determines that any CUF value is greater than 1.0:

1. Further refine of the fatigue analysis to lower the predicted CUF to less than one.

2. Management of fatigue at the affected locations by an inspection program that has been reviewed and approved by the NRC (e.g., periodic non-destructive examination of the affected locations at inspection intervals to be determined by a method acceptable to the NRC).

3. Repair of Replacement of the affected locations.

Commitment #31 requires the applicant to implement the corrective actions within . . . . .
finish of the writeup for Commitment #31.

4.3.1.2 Evaluation

Regulatory Bases for Evaluating TLAAs on Metal Fatigue of Class 1 Components

Cyclical loading is a time-dependent parameter that is a critical element of metal fatigue analyses. Therefore, metal fatigue analyses may be TLAAs according to 10 CFR 54.3 if the analyses also conform to the remaining criteria in this regulation for defining TLAAs.

10 CFR 54.21(c)(1) provides the three options (criteria) for accepting analyses that are identified as TLAAs:

(i) The analysis remains valid for the period of extended operation (PEO).

(ii) The analysis has been projected to the end of the PEO and remains acceptable.

(iii) The effects of aging on the intended function(s) will be managed during the PEO.

The NRC's criteria for evaluating and accepting TLAAs on metal fatigue are provided in Section 4.3 of NUREG-1800, Revision 1, "Standard Review Plan for License Renewal Applications for Nuclear Power Plants" (SRP-LR). The SRP-LR discusses how these criteria can be satisfied relative to the metal fatigue analyses that are required by the Section III or B31.1 design codes.

Section III requires cumulative usage factor calculations (CUFs) as the basis for performing the metal fatigue analyses for those Class 1 components that were designed to Section III.
The methodology requires the licensees to identify all normal operating and transient operating conditions (operational category) that can impart thermal cycling on the components and to identify the maximum alternating stress ranges for these operational categories. The figures in Mandatory Appendix I of Section III are used to derive the maximum allowable number of cycles from the maximum alternating stresses. The usage factors (UFs) are calculated by dividing the number of cycles allowed in the design basis for each operational category by maximum number of allowable cycles that were derived from the Appendix I of ASME III. The CUFs are calculated by adding the UFs for each component.

The ASME B31.1 design code (B31.1) requires a different type of fatigue analysis for those Class 1 components that were designed to B31.1 requirements. The methodology requires calculation of a maximum allowable stress range for each B31.1 component that is subject to thermal cycling and a determination of the number of full thermal cycles that are projected to the expiration of the operating license. B31.1 then requires a maximum allowable stress range reduction factor to be calculated and applied to the maximum allowable stress range.
Table 4.3-1 gives the B31.1 stress range reduction factors based on the number number of full thermal cycles that are projected to the expiration of the operating license:

Table 4.3-1. B31.1 Stress Range Reduction Factors

Number of Full Thermal Cycles (N)	Allowable Stress Range Reduction Factor (f)
7000 and less	1.0
7000 to 14,000	0.9
14,000 to 22,000	0.8
22,000 to 45,000	0.7
45,000 to 100,000	0.6
100,000 and over	0.5

Evaluation

The project team reviewed the following information to assess whether the TLAA on Metal Fatigue of Class 1 components is acceptable in accordance with 10 CFR 54.21(c)(1):

- Aging Management Review (AMR) line items in the LRA Tables 3.1.2-1, 3.1.2-2, and 3.1.2-3 for which "cracking -fatigue" was identified as an aging effect requiring management (AERM) and for which the "TLAA - Metal Fatigue" was credited as the means of aging management.
- LRA Section 4.3.1, including LRA Tables 4.3-1, and 4.3-2, "Project Cycles."
- PNPS Report No. LRPD-06, Revision 0, "Time Limited Aging Analyses – Mechanical Fatigue."
- Altran Report No. 93177-TR-03, Revision 0, Volumes I, II, III, and IV, "Pilgrim Reactor Vessel Cyclic Load Analysis."
- PNPS Calculation DC23A4084 & 23A4084, Revision 1, "Pilgrim Recirculation Piping Replacement," June 27, 1985.
- GE Report 25A5685, Revision 1, "Stress Report - Shroud Stabilizers Vessel," June 19, 1995.
- GE Report GENE-771-79-1194, Revision 2, "Shroud Repair Hardware Stress Analysis," June 19, 1995.
- Commitment #31 for the PNPS LRA.
- Criteria and methods for calculating CUF values in Section III, Article NB-3000 and in Section III, Appendix I.

- Criteria and methods in the B31.1 design code for performing maximum allowable stress reduction calculations.

- Section 4.3 of NUREG-1800, Revision 1, "Standard Review Plan for License Renewal Applications for Nuclear Power Plants."

The project team reviewed the design basis CUF calculations for the RPV and its appurtenances, as provided in Altran design basis stress reports for these components. The Altran reports provide the most recent design basis stress reports for the RPV and its appurtenances, including the RPV shell, heads, closure flange, studs, and nozzles, and support skirt. The design basis calculations in these reports include the most current 40-year CUF calculations for these components. The project team confirmed that the CUF calculations were based on the methods of Section III. The project team also confirmed that the 40-year CUF values provided in LRA Table 4.3-1 for these RPV components were based on the CUF values that were documented in these Altran design basis stress reports.

The projected team determined that there appeared to be many more components in LRA AMR Tables 3.1.2-1, 3.1.2-2, and 3.1.2-3 that received either Section III CUF calculations or B31.1 fatigue assessments than were actually analyzed for in Section 4.3.1 of the LRA. Therefore, upon its initial review, it became difficult for the project team to determine which commodity groups in LRA AMR Tables 3.1.2-1, 3.1.2-2, and 3.1.2-3 were analyzed in accordance with Section III CUF calculations, or alternatively with ASME B31.1 allowable stress reduction assessments. It also became apparent to the project team there could be some commodity groups in these LRA AMR tables that were not designed to Section III or B31.1 requirements. The project team questioned whether this TLAA should be credited for managing fatigue-induced cracking (i.e., "cracking – fatigue" in the LRA AMR Tables) in these components because they may not have received either Section III CUF or B31.1 allowable stress reduction analyses. Thus, the project team had difficulty in establishing how this TLAA was actually managing fatigue-induced cracking under the criteria of either 10 CFR 54.21(c)(1)(i), (ii), or (iii) for those commodity groups in for which the TLAA had been credited for aging management. Therefore, the project team identified that the following aspects of the applicant's TLAA on metal fatigue of Class 1 components needed resolution:

1. An inconsistency with number of commodity groups in LRA Tables 3.1.2-1, 3.1,2-2, and 3.1.2-3 for which the "TLAA – Metal Fatigue" was credited with aging management of "cracking – fatigue" and the number of commodity groups in LRA Table 4.3-1 for which the applicant had indicated that a 40-year CUF calculation had been performed for the current operating period. The project team issued audit **Question 503** to address this issue. On the final day of the audit, the project team consolidated Questions 503, 504, and 505 into one Question 503, Parts A, B, and C. Question 503 was renumbered Question 503, Part A.

2. A lack of clarity with respect to determining which commodity groups in LRA Tables 3.1.2-1, 3.1,2-2, and 3.1.2-3 for which the "TLAA – Metal Fatigue" was credited with aging management of "cracking – fatigue" had been analyzed in accordance with a B31.1 allowable stress reduction analysis, or managed with some other TLAA or AMP. The project addressed these issues in **Questions 504 and 505**, which were later renumbered as **Question 503, Parts B and C**.

3. A lack of clarity with respect to the meaning of the phrase "designed to the intent of

ASME Section III, as made in reference to the design code for the RPV internals. The project team issued audit **Question 507** to address this issue.

4. A lack of information in that the applicant had identified that some fracture mechanics or flaw growth analyses which could constitute TLAAs for the LRA but had failed to identify what these analyses were and to include an assessment of them against the acceptance criteria of 10 CFR 54.21(c)(1). The project team issued audit **Question 508** to address this issue.

5. An inconsistency between LRA Commitment No. 31, which requires corrective action for those Section III RCPB components whose CUFs are projected to exceed a value of 1.0 prior to the expiration of the PEO, and the corrective action referred to in LRPD-06, which states that corrective action will initiate when the Fatigue Monitoring Program indicates that the actual design basis transient cycles are approaching the design basis allowable limits for cycles (i.e., before the CUF gets to a value of 1.0). The project team issued audit **Question 515** to address this issue.

6. **Question 516** from Patel

7. An inconsistency between the limiting 40-year CUF (0.912) listed in PNPS Calculation DC23A4084 & 23A4084, Revision 1, for the PNPS piping safe end to the RRS inlet nozzles and limiting 40-year CUF value (0.110) listed in LRA Table 4.3-1 for the RRS and branch piping. The project team issued audit **Question 517** to address this issue.

8. An inconsistency between the limiting 40-year CUF (0.912) listed in PNPS Report No.25A5685, Revision 1 and GE Report GENE-771-79-1194, Revision 2 for the core shroud stabilizers and limiting 40-year CUF value (0.008) listed in LRA Table 4.3-1 for the RRS and branch piping. The project team also addressed this inconsistency in audit **Question 517.**

9. **Question 342** from Patel on: Request a basis for excluding CUF calculations for some Section III RCPB components.

10. **Question 344** from Patel on: Request an explanation why the MUR-based CUF values provided in GE Thermal Optimization Report No. GENE-0000-1892-02, Revision 0 (March 2002), were used for the CUFs in LRA Table 4.3-1 instead of those provided in the Altran Reports. Link to closure of Question 503, Parts A, B, and C, and to Questions 515 and 517.

11. **Question 345** from Patel on: PNPS's calculated 60-year CUF value for the RPV FW nozzle (0.899) may not be valid. Patel and Ken Chang both calculated the 60-year CUF for the RPV FW nozzles to be 1.217, which, if the accurate, is greater than 1.0 and would require the applicant to implement one of the corrective actions listed in Commitment #31.

12. **Question 425** from Patel on: CUFs in GE MUR Report do not match those in LRA Table 4.3-1. Similar to the issues raised in Question 517 by James Medoff.

The applicant has not currently provided its responses to these audit **Questions 503, Parts A, B, and C, 507, 508, 515, 516, 517, 342, 344, 345, and 425**. Therefore, the resolution of these

questions by the applicant remains open at this time. ***Once the response to Question* Questions 503, Parts A, B, and C, 507, 508, 515, 516, 517, 342, 344, 345, and 425 *are docketed, the project team member is to summarize and evaluate the applicant's responses the questions and provide the technical bases for closing the issues raised in the questions or for keeping the issues open. If the issues remain open, the project team member is to issue an appropriate RAI or RAIs on the TLAA subject matter. The project team should also provide the basis for accepting or not accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).***

4.3.1.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the TLAA on Metal Fatigue of PNPS Class 1 components in LRA Section A.2.2.2.1. The project team determined that the UFSAR Supplement summary description did provide the applicant's basis for accepting the TLAA on Metal Fatigue of Class 1 components, as initially proposed in Section 4.3.1 of the LRA. However, the project team concluded the USFAR Supplement summary description, as initially proposed, may not adequately summarize the TLAA or provide an acceptable basis for accepting the TLAA under 10 CFR 54.21(c)(1), because the TLAA discussion did not appear to cover all of AMR commodity groups in LRA Table 3.1.2-1, -2, and -3 for which the TLAA was credited with aging management of "cracking -fatigue." The project team determined that UFSAR Supplement summary description A.2.2.2.1 might need amending if the pending information from the applicant's resolution of audit **Questions 503, Parts A, B, and C; 507, 508, 515, 516, 517, 342, 344, 345, and 425** would mandate that changes or supplements be made to the information provided in LRA Section 4.3.2 or Commitment #31.

Therefore, the adequacy of the USFAR Supplement summary description A.2.2.2.1 remains open at this time. **Complete this section based on changes that will be made by Entergy to UFSAR Supplement A.2.2.2.1 and to Commitment #31.**

4.3.1.4 Conclusion

On the basis of its review, pending acceptable resolution of the project team's audit Questions on LRA Section 4.3 and pending acceptable amendments to LRA Section 4.3.1 and LRA Commitment #31, as discussed above, the project team concluded that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that, for metal fatigue analyses for the Class 1 components, the analyses remain valid for the period of extended operation. The project team also concluded that the UFSAR supplement contains an appropriate summary description of the RV internals fatigue analyses TLAA evaluation for the period of extended operation, as required by 10 CFR 54.21(d).

4.3.2 Fatigue of Non-Class 1 Components

4.3.2.1 Summary of Technical Information in the Application

The applicant evaluated those safety systems that provide a safety function equivalent to those for ASME Code Class 2 and 3 systems. The applicant stated that these systems were designed to B31.1. The applicant stated that B31.1 requires the applicant to assess whether the projected number of thermal cycles for these systems through 60 years of licensed operations would require the applicant to reduce the maximum allowable stresses for the

components in accordance with the B31.1 maximum allowable stress reduction criteria.

The applicant stated that the number of thermal cycles projected for these systems through 60 years of licensed operation will not exceed 7000 cycles. Based on this projection, the applicant determined that, in accordance with the B31.1 acceptance criteria, no reductions of the maximum allowable stresses for these systems is necessary for the period of extended operation. The applicant therefore concluded that the piping stress calculations for these systems remain valid for the period of extended operation and are acceptable in accordance with 10 CFR 54.21(c)(1)(i).

4.3.2.2 Evaluation

Regulatory Bases for Evaluating TLAAs on Metal Fatigue of Non-Class 1 Components

The metal fatigue methods and criteria discussed in Section 4.3.1.2 for B31.1 methodologies apply.

Evaluation

The project team reviewed the following information to assess whether the TLAA on Metal Fatigue of Non-Class 1 components is acceptable in accordance with 10 CFR 54.21(c)(1):

- Aging Management Review (AMR) line items in the LRA Tables 3.2.2-X, 3.3.2-X and 3.4.2-X for which "cracking -fatigue" was identified as an aging effect requiring management (AERM) and for which the "TLAA - Metal Fatigue" was credited as the means of aging management.
- LRA Section 4.3.2, including LRA Table 4.3-2, "Project Cycles."
- PNPS Report No. LRPD-06, Revision 0, "Time Limited Aging Analyses – Mechanical Fatigue."
- Criteria and methods in the B31.1 design code for performing maximum allowable stress reduction calculations.
- Section 4.3 of NUREG-1800, Revision 1, "Standard Review Plan for License Renewal Applications for Nuclear Power Plants."

The project team determined that LRA Table 4.3-2 indicates that the total number of thermal cycles projected for PNPS through 60 years of licensed operations is 1684 cycles. Based on this number, the project team concluded that the applicant has made a valid conclusion that the total number of thermal cycles at 60 years will not exceed 7000 and that the stress calculations for the Non-Class 1 piping commodity groups designed to B31.1 will remain valid for the PEO.

B31.1 is an ASME piping design code. The project team reviewed those AMR lines items in LRA Tables 3.2.2-X, 3.3.2-X, and 3.4.2-X that indicated that "cracking – fatigue" was an applicable AERM for the Non-Class 1 commodity groups and was proposed to use the "TLAA – Metal Fatigue" as the basis for aging management. The project team determined that Section 4.3.2 did not clearly indicate which of these AMR commodity groups were designed to B31.1 and which commodity groups were not designed to B31.1 requirements. Thus, the project

team was unable to conclude that the TLAA on Metal Fatigue was an appropriate means of aging management for those Non-Class 1 commodity groups that were designed to a design code other than B31.1. The project team issued audit Question 506 to address this issue.

The applicant has not currently provided its responses to these audit **Questions 506.** Therefore, the resolution of Question 506 by the applicant remains open at this time. ***Once the response to Question 506 is docketed, the project team member is to summarize and evaluate the applicant's response to Question 506 and provide the technical for closing the issue or keeping the issue open. If the issue remains open, the project team member is to issue an appropriate RAI or RAIs on the TLAA subject matter. The project team should also provide the basis for accepting or not accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).***

4.3.2.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the TLAA on Metal Fatigue of PNPS Class 1 components in LRA Section A.2.2.2.2. The project team determined that the UFSAR Supplement summary description did provide an acceptable basis for accepting the TLAA on Metal Fatigue of Non-Class 1 commodity groups if the commodity groups were designed in accordance with B31.1. However, the project team concluded the USFAR Supplement summary description, as initially proposed, may not adequately summarize the TLAA or provide an acceptable basis for accepting the TLAA under 10 CFR 54.21(c)(1) for those Non-Class 1 commodity groups that were designed to a design code other than B31.1 The project team determined that UFSAR Supplement summary description A.2.2.2.2 might need amending if the pending information from the applicant in the resolution of audit **Question 506** would mandate that changes or supplements be made to the information provided in LRA Section 4.3.2 or Commitment #31.

Therefore, the adequacy of the USFAR Supplement summary description A.2.2.2.1 remains open at this time. ***This section is to be completed by the project team member based on changes that will be made by Entergy to UFSAR Supplement A.2.2.2.1 and to Commitment #31.***

4.3.2.4 Conclusion

On the basis of its review, pending acceptable resolution of audit Question 506 on LRA Section 4.3.2 and pending acceptable amendments to LRA Section 4.3.2 and LRA Commitment #31, as discussed above, the project team concluded that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that, for metal fatigue analyses for the Class 1 components, the analyses remain valid for the period of extended operation. The project team also concluded that the UFSAR supplement contains an appropriate summary description of the RV internals fatigue analyses TLAA evaluation for the period of extended operation, as required by 10 CFR 54.21(d).

4.3.3 Effects of Reactor Water Environment on Fatigue Life

In Generic Safety Issue (GSI)-190, "Fatigue Evaluation of Metal Components for 60-year Plant Life." the NRC assessed the generic impacts of the effects of reactor coolant environment on fatigue life of Class 1 components. In accordance with interim staff guidance document ISG-16, "Time-Limited Aging Analyses (TLAAs) Supporting Information for License Renewal

Applications," the NRC has established its position that the environmental effects of the reactor coolant environments must be evaluated for their impacts on the 60-year metal fatigue CUF values for the high fatigue CUF locations listed in older vintage BWR plants.

4.3.3.1 Summary of Technical Information in the Application

In LRA Section 4.3.3, the applicant summarized the evaluation of the effects of reactor coolant environment on fatigue life of components and piping for the period of extended operation. ***Erach Patel to finish writing this section in a manner similar to the writeups for sections 4.3.1.1 and 4.3.2.1.***

4.3.3.2 Evaluation

Regulatory Bases

In GSI-166, "Adequacy of the Fatigue Life of Metal Components," the NRC raised concerns regarding the conservatism of the fatigue curves used in the design of the reactor coolant system components. Although the issues raised in GSI-166 were resolved for the current 40-year design life of operating components, the staff identified that the same issues would have to be assessed for their impacts on possible licension extension for operating reactors. The staff therefore issued GSI-190, "Fatigue Evaluation of Metal Components for 60-year Plant Life," to address these issues with respect to license renewal. The NRC closed GSI-190 in December 1999, concluding that the calculations supporting resolution of this issue, which included consideration of environmental effects and the nature of age-related degradation, indicate the potential for an increase in the frequency of pipe leaks as plants continue to operate. However, the NRC also concluded that, consistent with existing requirements in 10 CFR 54.21, licensees should address the effects of reactor coolant environment on component fatigue life as AMPs are formulated in support of license renewal. The NRC's bases for performing these evaluations are given in NUREG/CR-6260, NUREG/CR 6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," for carbon and alloy steels, NUREG/CR 5704, "Effects of LWR Coolant Environments on Fatigue on Fatigue Design Curves of Austenitic Stainless Steels."

Evaluation

The applicant evaluated the component locations listed in NUREG/CR-6260 that are applicable to an older-vintage BWR plant for the effects of the reactor coolant environment on the fatigue life of the components. For each location, detailed 60-year fatigue calculations were performed by applying the appropriate fatigue-environment (F_{en}) relationships from NUREG/CR 6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," for carbon and alloy steels, and those from NUREG/CR 5704, "Effects of LWR Coolant Environments on Fatigue on Fatigue Design Curves of Austenitic Stainless Steels," for stainless steel, as appropriate for the material. The applicant's calculations showed that the resulting ***. . . Erach Patel to finish of this regulatory evaluation section, including a discussion of the issues/question he raised on LRA Section 4.3.3, and his evaluation of the applicant's response to his audit questions and whether the responses resolve the technical or legal issues raised In the questions or whether the issues raised remain unresolved. If the issues remain unresolved, then Erach Patel is to write appropriate RAIs into this section and state that the TLAA in Section 4.3.3 remains open at this time. The evaluation should also provide a regulatory basis why the section is acceptable or remains***

unacceptable in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4.3.3.3 UFSAR Supplement

Erach Patel to write this section up similar to the manner the UFSAR Supplement summary sections on Class 1 and Non-Class 1 Fatigue have been written and assessed (Refer to Sections 4.3.1.3 and 4.3.2.3).

4.3.3.4 Conclusion

On the basis of its review, pending acceptable resolution of audit Questions on LRA Section 4.3.3 and pending acceptable amendments to LRA Section 4.3.3 and LRA Commitment #31, as discussed above, the project team concluded that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that, for the environmental metal fatigue analyses for the Class 1 components, the analyses remain valid for the period of extended operation. The project team also concluded that the UFSAR supplement contains an appropriate summary description of the RV internals fatigue analyses TLAA evaluation for the period of extended operation, as required by 10 CFR 54.21(d).