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BGE

November 19, 1998

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Responses to Requests for Additional Information for the Review of the Calvert Cliffs Nuclear Power Plant, Units 1 & 2, Integrated Plant Assessment on Metal Fatigue

REFERENCES:

(a) Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated April 8, 1998, "Application for License Renewal"

(b) Letter from Mr. D. L. Solorio (NRC) to Mr. C. H. Cruse (BGE), September 2, 1998, "Request for Additional Information for the Review of the Calvert Cliffs Nuclear Power Plant, Units 1 & 2, Integrated Plant Assessment on Metal Fatigue"

(c) Letter from Mr. D. L. Solorio (NRC) to Mr. C. H. Cruse (BGE), September 24, 1998, "Renumbering of NRC Requests for Additional Information on Calvert Cliffs Nuclear Power Plant License Renewal Application Submitted by the Baltimore Gas and Electric Company"

Reference (a) forwarded the Baltimore Gas and Electric Company (BGE) License Renewal Application (LRA). Reference (b) forwarded questions from NRC staff on certain sections of the BGE LRA, on the subject of metal fatigue. Reference (c) forwarded a numbering system for tracking BGE's response to all of the BGE LRA requests for additional information and the resolution of the responses. Attachment (1) provides our responses to the questions contained in Reference (b). The questions are renumbered in accordance with Reference (c).

Should you have further questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

Charles H. Cruse

STATE OF MARYLAND :
: TO WIT:
COUNTY OF CALVERT :

I, Charles H. Cruse, being duly sworn, state that I am Vice President, Nuclear Energy Division, Baltimore Gas and Electric Company (BGE), and that I am duly authorized to execute and file this response on behalf of BGE. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other BGE employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Charles H. Cruse

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 19 day of November, 1998.

WITNESS my Hand and Notarial Seal: Michelle D. Hall
Notary Public

My Commission Expires: February 1, 2002
Date

CHC/KRE/dlm

Attachment: (1) Response to Request for Additional Information; Integrated Plant Assessment on Metal Fatigue

cc: R. S. Fleishman, Esquire
J. E. Silberg, Esquire
S. S. Bajwa, NRC
A. W. Dromerick, NRC
H. J. Miller, NRC
C. I. Grimes, NRC
D. L. Solorio, NRC
Resident Inspector, NRC
R. I. McLean, DNR
J. H. Walter, PSC

ATTACHMENT (1)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION;

INTEGRATED PLANT ASSESSMENT ON METAL FATIGUE

Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
November 19, 1998

NRC Question No. 7.1

Section 5.2, page 5.2-14, of the application *[Baltimore Gas and Electric Company (BGE) License Renewal Application (LRA)]* contains a list of Chemical and Volume Control System (CVCS) subcomponent parts for which fatigue is considered plausible. The LRA further indicates that the CVCS charging inlet nozzle was identified as the most bounding location. Identify which subcomponents have fatigue analyses. Describe the review process used to evaluate the subcomponent parts for fatigue, including the selection of the bounding location.

BGE Response

The CVCS pressure boundary components identified in Section 5.2, "Chemical and Volume Control System," Group 1 show thermal fatigue is plausible. All of these components are Design Class 1 components. The piping was designed to American National Standards Institute (ANSI) B31.7 Class 1, which required a specific fatigue analysis at the component and subcomponent level. All items met the Code requirements. The valves included in Section 5.2 Group 1 were designed to the Class 1 requirements of Draft American Society of Mechanical Engineers (ASME) Code for Pumps and Valves for Nuclear Power. A specific fatigue analysis was also required for these components. These components also met their Code requirements.

As part of the development of the Fatigue Monitoring Program (FMP), engineering reviews of design analysis documents were performed. These reviews determined that all components in the CVCS from the regenerative heat exchanger to the Reactor Coolant System (RCS) loop piping, and from the RCS loop piping to the letdown heat exchanger had fatigue loadings. The criteria for determining the bounding location(s) is the location(s) that has the highest design analysis cumulative usage factor (CUF). The engineering reviews determined that the transients experienced by the charging inlet nozzles to the RCS loop piping resulted in the highest fatigue usage and bounded the remaining components. Following the submittal of Section 5.2 of the LRA, analyses performed by BGE identified an additional location near the charging isolation valve that has a high usage factor and is no longer enveloped by the charging nozzles. The FMP has been modified to include these new locations. See response to Question No. 7.5 below.

NRC Question No. 7.2

Section 5.2 of the LRA indicates that the FMP tracks the fatigue usage at the charging inlet nozzle. Describe the parameters that are monitored by the FMP that are applicable to the charging inlet nozzle. Also describe how the monitored parameters are compared to the fatigue analysis/analyses of record (AOR).

BGE Response

Baltimore Gas and Electric Company LRA page 5.2-16 describes the FMP and the specific charging inlet nozzle transients that are monitored. The controlling transients monitored for the charging inlet nozzles are the loss and recovery of charging flow and the loss and recovery of letdown flow.

The specific parameters monitored are:

Loss and recovery of charging flow - Charging flow, RCS loop flow, RCS cold leg temperature, pressurizer (PZR) pressure, charging header inlet temperature, and containment temperatures;

Loss and recovery of letdown flow - RCS loop flow, letdown isolation valve position, RCS cold leg temperature, charging header inlet temperature, and containment temperatures.

The number of both transients are compared to the number of transients in the AOR every six months. All other transients analyzed in the AOR are assumed to have occurred and the corresponding fatigue contribution is accounted for as "initial" fatigue usage in the FMP.

The FMP also uses an alternative to the "cycle-based fatigue" approach described above for the charging inlet nozzles. This approach is "stressed-based fatigue." All thermal and mechanical loadings are computed and accounted for directly using a stressed-based fatigue algorithm and measured plant conditions to estimate the CUF.

NRC Question No. 7.3

Electric Power Research Institute (EPRI) Report TR-107515, "Evaluation of Thermal Fatigue Effects on Systems Requiring Aging Management Review for License Renewal for the Calvert Cliffs Nuclear Power Plant," dated December 1997, provides the results of the fatigue analyses of the CVCS piping. Section 3.2.1.1 of the EPRI report indicates that the existing fatigue analysis of the piping did not account for the auxiliary spray transients. The EPRI report further indicates that revised analyses are under development. Describe the manner by which the time-limited aging analyses (TLAA) for the revised CVCS fatigue analyses will satisfy 10 CFR 54.21(c) considering the existing analysis did not account for the auxiliary spray transients. Also provide the schedule for completion of the revised CVCS fatigue analyses. Also, describe the expected impact of these revised analyses on the evaluation contained in EPRI Report TR-107515.

BGE Response

The purpose of EPRI Report TR-107515 specific to Calvert Cliffs was to provide evidence that the effects of reactor water environments for ASME Class 1 components are already compensated for by the portion of the design fatigue curve margin factor of 20 that is ascribed to moderate environmental effects (approximately 4). This study was specifically discussed in the LRA and at several public meetings in early 1998.

The study results do not represent Calvert Cliffs' fatigue AOR nor fatigue design basis for any component. The study was intended to be representative of conditions for typical older vintage Combustion Engineering (CE) pressurized water reactors (PWRs), and intended to be compared to the results reported in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components," for such plants, but was not intended to be a Calvert Cliffs licensing basis calculation. There is no direct applicability of this study to the CVCS fatigue AOR or our FMP.

The AOR for the charging piping between the charging inlet nozzles and the charging header did not account for auxiliary spray initiations before the installation of orifices in the charging bypass piping. The reason for not including the auxiliary spray transients was the original plant construction included a spring loaded check valve in the charging bypass line. The purpose of the spring loaded check valve was to prevent charging flow from entering the charging piping connected to the RCS loop piping during auxiliary spray operations while providing the necessary relief capacity required downstream of positive displacement pumps. The spring loaded check valves were incorrectly installed with the shipping spring and did not perform their function of blocking charging flow to the

RCS loop piping during auxiliary spray operations. The check valve internals were removed and an orifice was installed in both units' charging bypass lines.

Calvert Cliffs has completed revising the AOR to account for this modification. The revision was performed under the current licensing basis and requirements.

The management of Nuclear Steam Supply System (NSSS) fatigue effects meets the requirements of 10 CFR 54.21(c)(1)(iii). Managing fatigue effects in the CVCS will continue as stated in Section 2.1.3.3 and described on pages 5.2-15 through 17 of the LRA.

Since EPRI TR-107515 was intended only to be representative of typical older-vintage CE PWRs, there is no need nor any intent for BGE and EPRI to modify the results of the EPRI Report to reflect these plant modifications.

NRC Question No. 7.4

Section 3.2.2.1 of EPRI Report TR-107515 indicates that the charging and auxiliary spray piping were reanalyzed to account for the installation of an orifice for the stop check valve in the bypass line around isolation valve CV-519. Section 3.2.2.3 of the EPRI report describes the back-projection of fatigue usage from FMP data, which was only available for the May through December 1995 time frame. Provide the date of the installation of the orifice in the bypass line. Describe the impact of the modification to the bypass line, if any, on the parameters monitored by the FMP. Also describe the impact of the modification, if any, on the computation of previous fatigue usage and the projection of fatigue usage to 40 and 60 years.

BGE Response

The purpose of EPRI Report TR-107515, specific to Calvert Cliffs, was to provide evidence that the effects of reactor water environments for ASME Class 1 components are already compensated for by the portion of the design fatigue curve margin factor of 20 that is ascribed to moderate environmental effects (approximately 4). This study was specifically discussed in the LRA and at several public meetings in early 1998.

The study results do not represent Calvert Cliff's fatigue AOR nor fatigue design basis for any component. The study was intended to be representative of conditions for typical older vintage CE PWRs, and intended to be compared to the results reported in NUREG/CR-6260 for such plants, but was not intended to be a Calvert Cliffs licensing basis calculation. There is no direct applicability of this study to the CVCS fatigue AOR or our FMP.

The Unit 1 orifice was installed during the 1994 refueling outage, the Unit 2 orifice was installed during the 1995 refueling outage.

There was no impact on the parameters monitored by the FMP; the same parameters are monitored. Only the fatigue usage equation was modified to account for the way the system now operates.

The baseline fatigue usage was adjusted to include past usage resulting from the bypass check valve not working properly since initial plant operations. With the deficient spring configuration (see response to NRC Question 7.3), flow through the bypass check valve was nearly the same as the flow through the orifice is now. The FMP now includes the effects of the orifice flow. The projection for actual fatigue usage through 60 years of operations is less than the updated AOR usage.

No further changes are anticipated for the FMP because of the installation of these orifices.

NRC Question No. 7.5

Section 3.2.2.5 of EPRI Report TR-107515 summarizes the fatigue CUF projections for the charging piping and auxiliary spray piping locations. The projected CUFs in these lines are higher than the projected CUF at the CVCS charging inlet nozzle. However, as discussed in Item 1 above, the CVCS charging inlet nozzle was identified as the most bounding fatigue location. Explain why the projected CUFs are higher in the charging and auxiliary spray piping locations than at the bounding location.

BGE Response

The purpose of EPRI Report TR-107515 specific to Calvert Cliffs was to provide evidence that the effects of reactor water environments for ASME Class 1 components are already compensated for by the portion of the design fatigue curve margin factor of 20 that is ascribed to moderate environmental effects (approximately 4). This study was specifically discussed in the LRA and at several public meetings in early 1998.

The study results do not represent Calvert Cliffs' fatigue AOR nor fatigue design basis for any component. The study was intended to be representative of conditions for typical older vintage CE PWRs, and intended to be compared to the results reported in NUREG/CR-6260 for such plants, but was not intended to be a Calvert Cliffs licensing basis calculation. There is no direct applicability of this study to the CVCS fatigue AOR or our FMP.

Section 5.2 of the BGE LRA was submitted to NRC before the completion of the CVCS and auxiliary spray piping re-analyses. Orifices were installed in the charging bypass lines during the 1994 refueling outage for Unit 1 and the 1995 refueling outage for Unit 2. Prior to the orifice installations, the charging inlet nozzles were the bounding locations. The installation of the orifices in the charging bypass lines changed some of the transient definitions in the AOR. This required a re-analysis and update to the AOR. The results of the re-analysis showed other locations in the CVCS to have higher CUFs than the charging inlet nozzles. Four additional locations were added to the FMP. The locations are the charging pipe adjacent to each nozzle, an elbow in the common charging piping, and a section of the auxiliary spray piping. The CVCS and auxiliary spray system now have five cycle-based locations in the FMP for each unit.

NRC Question No. 7.6

Section 3.2.3 of EPRI Report TR-107515 contains an evaluation of environmental effects on the CVCS charging inlet nozzle using methodology developed in EPRI Report TR-105759, "An Environmental Factor Approach to Account for Reactor Water Effects in Light Water Reactor Pressure Vessel and Piping Fatigue Evaluations," dated December 1995. The attached evaluation summarizes the staff's technical concerns regarding the methodology in EPRI Report TR-105759. Attached are comments on the LRA of the EPRI methodology for environmental fatigue factors to the Calvert Cliffs plant. Based on these comments, provide the following:

(a) Discuss the impact of the current Argonne National Laboratory (ANL) statistical correlations of environmental test data on the Calvert Cliffs fatigue evaluation.

(b) The technical basis for the assertion that the ASME Code stainless steel fatigue design curve contains sufficient margin to accommodate moderate environmental effects. Include a discussion of the factor required to adjust the laboratory test data for size and surface finish effects and the margin necessary to account for scatter of the test data.

(c) The technical justification for the strain threshold values.

BGE Response

Per Reference (1), the NRC staff is redirecting this question and issuing it to the Nuclear Energy Institute for an industry response.

NRC Question No. 7.7

Section 5.2 of the LRA indicates that Calvert Cliffs Units 1 and 2 have experienced cases of fatigue failures in CVCS piping that were attributed to vibration loads imposed by operation of the charging pumps. The LRA indicates that BGE performed piping design modifications to reduce vibration and improve the CVCS reliability. Describe the modifications that were performed to reduce the vibration. Indicate whether vibration monitoring of the piping was performed subsequent to the modifications. Identify the Codes and Standards used, and summarize the significance of the results for the period of extended operation, if any, of the vibration monitoring.

BGE Response

The piping in question is that in the immediate area of the CVCS charging pumps, particularly the suction piping. The modifications performed on the CVCS to reduce vibration in the area of the charging pumps included increasing the size of the discharge desurgers, replacing schedule 10 pump suction piping with schedule 40 piping, and adding suction stabilizers. The modifications were evaluated in a Safety Evaluation Report dated October 18, 1979 (Reference 43 to Section 5.2 of the LRA, incorrectly dated October 18, 1980 in the LRA). Vibration monitoring has been performed on the charging pumps to verify the success of these modifications. Although damage to the CVCS from charging pump vibration is no longer expected, fatigue was conservatively considered to be plausible. Detection of any actual fatigue damage to the CVCS in the area affected by pump vibration will rely on the Age-Related Degradation Inspection (ARDI) Program detailed in section 5.2 of the LRA.

NRC Question No. 7.8

To verify that no significant vibrational fatigue is occurring for the components, Section 5.2 of the LRA indicates that a new program will be developed to provide requirements for inspections of representative components. The LRA further indicates that the program details are discussed in the Aging Management Program section for CVCS Group 2. However, the Group 2 program is for managing the effects of corrosion. Discuss the specific elements of the Group 2 corrosion program that are relevant in monitoring vibration fatigue.

BGE Response

For Group 2 components:

The Calvert Cliffs ARDI Program will conduct inspections of representative components to detect the effects of crevice corrosion and pitting, and will contain acceptance criteria that ensure corrective actions will be taken such that there is reasonable assurance that the pressure boundary function will be maintained.

For Group 6 components:

The Calvert Cliffs ARDI Program will conduct inspections of representative components to detect the effects of vibrational fatigue, and will contain acceptance criteria that ensure corrective actions will be taken such that there is reasonable assurance that the pressure boundary function will be maintained.

NRC Question No. 7.9

Section 4.1, "Reactor Coolant System," of the LRA indicates that Calvert Cliffs has shut down on several occasions due to RCS leakage associated with the reactor coolant pumps (RCPs). The LRA also indicates that a vibration monitoring and reduction program has been implemented for the piping associated with the RCP seal leakoff lines. Describe the parameters that are currently monitored by this program. Also, provide the acceptance criteria for the monitored parameters including the technical basis for the acceptance criteria.

BGE Response

Baltimore Gas and Electric Company implemented a monitoring program for the RCPs, not the RCP seal leakoff lines. This program included new monitoring equipment improved motor-to-pump alignment procedures, and balancing the pump at the coupling if needed. Calvert Cliffs has experienced some failures on the RCPs at the seal sensing lines due to fatigue. These failures occurred in the early 1980s. Calvert Cliffs installed braided jumper hoses on the sensing lines in 1986/87 to prevent the fatigue failures. No failures have occurred since the installation of the new hoses.

NRC Question No. 7.10

Section 4.1 of the LRA indicates that the FMP monitors and tracks low-cycle fatigue usage for the limiting components of the NSSS and steam generator (SG) safe-ends-to-reducer welds. Describe the parameters that are monitored by the FMP that are applicable to the NSSS and SG safe-end-to-reducer welds. Also describe how the monitored parameters are compared to the fatigue AOR.

BGE Response

Two different methods are utilized to compute fatigue usage for the various monitored components. The first method is the cycle-based fatigue methodology. This method computes the CUF on the basis of counted plant events, for specifically identified events, utilizing incremental fatigue for each specific plant event developed from the AOR. The fatigue usage effect of all other plant events are combined into a separate initial fatigue usage, which is added to the incremental fatigue contributions to give the CUF at any given time.

The second method is the stressed-based fatigue methodology. This method computes actual transient stresses arising from all thermal and mechanical loadings in the plant and computes fatigue usage from that stress intensity history. The method used to determine the CUF for each monitored component is the method deemed most appropriate for its loading history.

The cycle-based monitored locations, the critical transient(s), and parameter(s) monitored are as follows:

- Reactor Pressure Vessel (RPV) Outlet Nozzles (BGE LRA pages 4.2-20 and 21); RCS cooldown from Mode 1 operation (≥ 5% power); parameters monitored are RCS cold leg temperatures, PZR pressure and reactor power.
- PZR Spray System (BGE LRA page 4.1-29); initiation of main and auxiliary spray; parameters monitored for initiation of main spray are PZR pressure, RCS loop flow, PZR temperature and RCS cold leg temperature; parameters monitored for initiation of auxiliary spray are charging flow, RCS loop flow, PZR temperature, charging temperature, RCS cold leg temperature, PZR pressure, and containment temperatures.
- Safety Injection (SI) Nozzles (BGE LRA page 4.1-29); initiation of shutdown cooling (SDC) and safety injection check valve (SICV) test; parameters monitored for initiation of SDC are SDC flow, SI trip signals, RCS cold leg temperatures, PZR pressure, low pressure safety injection (LPSI) header temperature and containment temperatures; SICV test is manually logged by plant operators; parameters logged are charging temperature. RCS cold leg temperatures, and PZR pressure.
- Charging Inlet Nozzles (BGE LRA page 4.1-29); loss and recovery of charging flow and loss and recovery of letdown flow; parameters monitored for loss and recovery of charging flow are charging flow, RCS loop flow, RCS cold leg temperature, PZR pressure, and containment temperatures; parameters monitored for loss and recovery of letdown flow are RCS loop flow, RCS cold leg temperature, letdown isolation valve position, charging temperature, and containment temperatures.
- Charging Nozzle Piping 11(21)A; loss and recovery of charging flow and loss and recovery of letdown flow; parameters monitored for loss and recovery of charging flow are charging flow, RCS loop flow, RCS cold leg temperature, PZR pressure, and containment temperatures; parameters monitored for loss and recovery of letdown flow are RCS loop flow, RCS cold leg temperature, letdown isolation valve position, charging temperature, and containment temperatures.
- Charging Nozzle Piping 12(22)B; loss and recovery of charging flow, loss and recovery of letdown flow, and initiation of auxiliary spray; monitored for loss and recovery of charging flow are charging flow, RCS loop flow, RCS cold leg temperature, PZR pressure, and containment temperatures; parameters monitored for loss and recovery of letdown flow are RCS loop flow, RCS cold leg temperature, letdown isolation valve position, charging temperature, and containment temperatures; parameters monitored for initiation of auxiliary flow are charging flow, RCS loop flow, PZR temperature, charging temperature, RCS cold leg temperatures, and containment temperatures.
- PZR Surge Nozzles (BGE LRA page 4.1-29); PZR heatups and RCS cooldown from Mode 1 operation (≥ 5% power); parameters monitored for PZR heatups are PZR temperature, PZR pressure, and reactor power; parameters monitored for RCS cooldown are RCS leg temperatures, PZR pressure and reactor power.
- SG Secondary Shells (BGE LRA page 4.1-29); initiation of main feedwater flow and initiation of auxiliary feedwater (AFW) flow; parameters monitored for initiation of main feedwater flow are feedwater flow, feedwater temperature, SG pressure and RCS cold leg temperature; parameters monitored for initiation of AFW flow are AFW flow, SG pressure, reactor power, RCS cold leg temperature and feedwater temperature.

- SG Feedwater Nozzles; (BGE LRA page 4.1-29); initiation of main feedwater flow; parameters monitored are feedwater flow, feedwater temperature, SG pressure and RCS cold leg temperature.
- RPV Closure Studs (BGE LRA pages 4.2-20 and 21); RCS heatups; parameters monitored are RCS cold leg temperatures, PZR pressure and reactor power.
- PZR Bottom Head/Support Skirt (BGE LRA page 4.1-29); plant cooldown from Mode 1 operation (≥ 5% power) and reactor trips; parameters monitored are RCS cold leg temperatures, PZR pressure, and reactor power, parameters monitored for reactor trips are reactor power and reactor trip breaker positions.
- SDC Outlet Nozzles (BGE LRA page 4.1-29); plant cooldown from Mode 1 operation (≥ 5% power); parameters monitored are RCS cold leg temperatures, PZR pressure, and reactor power.
- SG Tube-to-Tubesheet Welds (BGE LRA page 41.-29); RCS leak test; manually logged by plant operators.
- Charging System Piping; loss and recovery of charging flow; parameters monitored are charging flow, RCS loop flow, RCS cold leg temperature, and PZR pressure.
- Auxiliary Spray Piping; auxiliary spray initiation, parameters monitored are charging flow, RCS loop flow, PZR temperature, charging temperature, RCS cold leg temperatures, PZR pressure, and containment temperatures.

The number for each of the above transients are compared to the number of transients in the AOR every six months. For all locations, all other transients analyzed in the AOR are assumed to have occurred and the corresponding fatigue contribution is accounted for as initial fatigue usage in the FMP.

The stress-based monitored locations, and parameter(s) monitored are as follows:

- SG safe-end-to-reducer weld (four locations for each weld); parameters monitored are RCS power, RCS temperature, feedwater flow, feedwater temperature, SG pressure, and SG level.
- Charging inlet nozzles; parameters monitored are RCS loop flow, PZR pressure, charging flow, charging temperature, and RCS cold leg temperature.
- PZR spray nozzle; parameters monitored are charging flow, PZR level, PZR pressure, RCS cold leg temperature, and RCS loop flow.
- PZR surge line nozzle; parameters monitored are RCS cold and hot leg temperatures, reactor power, PZR pressure, PZR level, RCS loop flow, PZR temperature, charging flow and charging temperature.
- Surge line elbow; parameters monitored are RCS cold and hot leg temperatures, reactor power, PZR pressure, PZR level, RCS loop flow, PZR temperature, charging flow and charging temperature.
- Hot leg surge line nozzle; parameters monitored are RCS cold and hot leg temperatures, reactor power, PZR pressure, PZR level, RCS loop flow, PZR temperature, charging flow, and charging temperature.

For each stress-based location, an ASME NB-3200 fatigue calculation is performed as the monitored parameters change and incremental usage is determined. The incremental usage is summed with past usage to give the current usage. The current usage is compared to the ASME Code allowable of one.

NRC Question No. 7.11

Section 4.1 of the LRA indicates that a one-time fatigue analysis will be performed for the RCPs, motor-operated valves (MOVs), and pressurizer relief valves to determine if these components are bounded by components and transients currently included in the FMP. Describe the fatigue criteria that were used in the original design of these components. Describe the purpose and criteria for the one-time fatigue analysis described in Section 4.1. Describe the manner by which the TLAA for these fatigue analyses will satisfy 10 CFR 54.21(c). Also provide the schedule for completion of these fatigue analyses.

BGE Response

The fatigue criteria used in the original design of these components are as follows:

- The RCPs were designed to the requirements of the 1965 edition of the ASME Boiler and Pressure Vessel Code, Section III, including the Winter 1967 Addenda. The fatigue analyses requirements of the ASME Code were included in the design analyses.
- The PZR block MOVs were designed as Nuclear Class 1 valves in accordance with the Draft ASME Code for Pumps and Valves for Nuclear Power.
- The SDC outlet isolation MOVs were designed as Nuclear Class 1 valves in accordance with the Draft ASME Code for Pumps and Valves for Nuclear Power with additional requirements of ANSI B31.7.
- The PZR relief valves were designed to the requirements of the 1965 edition of the ASME Boiler and Pressure Vessel Code, Section III, including the Winter 1967 Addenda, and ANSI B31.1.0 Nuclear Code Cases N-2 and N-10. Code Case N-10 applies to the pressure-containing stainless steel.

The purpose of the one-time fatigue evaluation is to determine if these components are bounded by other components included in the FMP. If they are not bounded, they will be added to the FMP.

The management of NSSS fatigue effects meets the requirements of 10 CFR 54.21(c)(1)(iii). Managing fatigue effects for these RCS components will continue as stated in Section 2.1.3.3 and described on pages 4.1-30 through 33 of the LRA.

The evaluation and potential modifications to the FMP will be complete by the end of 2003.

NRC Question No. 7.12

Section 4.1 of the LRA provides the CUFs through 1996 for the critical RCS components. Provide the projected CUFs for the critical RCS components at the end of the period of extended operation.

E Response

The CUF for the monitored cycle-based locations will be less than or equal to the CUF determined in the AOR. The design CUFs are:

- RPV Outlet Nozzles (BGE LRA pages 4.2-20 and 21)

  The maximum CUF for the RPV outlet nozzle is determined from the following equation assuming all AOR cycles have occurred:

  $CUF = \{[0.2475)(b)]/500\} + 0.0028 \leq 0.2503$

  where:

  0.2475 is the CUF computed in the AOR for 500 cycles of RCS cooldown;

  (b) represents the cumulative sum of RCS cooldowns, initiated from Mode 1 operation (≥ 5% power);

  500 is the assumed number of RCS cooldowns in the AOR; and

  0.0028 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

  As of June 30, 1998:

	Allowable	RCS Cooldowns (≥ 5% power)	Total RCS Cooldowns	CUF
Unit 1	500	88	96	0.04636
Unit 2	500	63	70	0.03399

  It is predicted that Calvert Cliffs will not sustain the 500 AOR-allowed RCS cooldowns during 60 years of operation. The CUF for the RPV outlet nozzles at 60 years of operation will be less than 0.2503.

- PZR Spray System (BGE LRA page 4.1-29)

  The maximum CUF for the PZR spray system is determined from the following equation assuming all AOR cycles have occurred:

  $CUF = \{[(i_{eff}) + (j_{eff(p)})]/120\} + 0.1873 \leq 1.0$

  where:

  (i_{eff}) and $(j_{eff(p)})$ are the cumulative sum of effective design cycles contributed by main and auxiliary spray initiation events respectively;

  120 is the assumed number of main and auxiliary spray initiations in the AOR; and

  0.1873 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	Main Spray	Auxiliary Spray	CUF
Unit 1	120	1.862	17.192	0.34609
Unit 2	120	0.238	16.879	0.32995

It is predicted that Calvert Cliffs will not sustain the 120 AOR-allowed effective spray transients for main and auxiliary spray during 60 years of operation. The CUF for the PZR spray system at 60 years of operation will be less than 1.0.

- SI Nozzles (BGE LRA page 4.1-29)

The maximum CUF for the SI nozzles is determined from the following equation assuming all AOR cycles have occurred:

$CUF = \{(0.1486)(f_{eff})/500\} + \{(0.0356)(v_{eff})/160\} + 0.0050 \leq 0.1892$

where:

0.1486 is the CUF computed in the AOR for 500 initiation of SDC transients;

(f_{eff}) is the cumulative sum of effective design cycles contributed by initiation of SDC;

500 is the assumed number of initiation of SDC transients in the AOR;

0.0356 is the CUF computed in the AOR for 160 SICV tests;

(v_{eff}) is the cumulative sum of effective design cycles contributed by SICV tests;

160 is the assumed number of SICV tests in the AOR; and

0.0050 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable SDC/SICV	SDC Initiation	SICV Tests	CUF
Unit 1	500/160	17.772	0.0	0.01027
Unit 2	500/160	14.523	0.0	0.00932

It is predicted that Calvert Cliffs will not sustain the 500 AOR-allowed effective SDC initiations or the 160 AOR-allowed SICV tests during 60 years of operation. The CUF for the SI nozzles at 60 years of operation will be less than 0.1892.

- Charging Inlet Nozzles (BGE LRA page 4.1-29)

The maximum CUF for the charging inlet nozzles is determined from the following equations assuming all AOR cycles have occurred:

$CUF = \{(0.7632)(g_{eff} + h_{eff})/1450\} + 0.0016 \leq 0.7648$

where:

0.7632 is the CUF computed in the AOR for 1450 loss and recovery of both charging and letdown flow;

(g_{eff}) is the cumulative sum of effective design cycles contributed by the loss and recovery of charging flow;

(h_{eff}) is the cumulative sum of the effective design cycles contributed by the loss and recovery of letdown flow, respectively; and

0.0016 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable Loss of Charging/Loss of Letdown	Loss of Charging	Loss of Letdown	CUF
Unit 1	1400/50	107.360	46.788	0.08274
Unit 2	1400/50	137.372	21.051	0.08499

It is predicted that Calvert Cliffs will not sustain the 1400 AOR-allowed effective loss of charging transients during 60 years of operation. As described on page 5.2-16 of the LRA, Calvert Cliffs will exceed the allowable limit of 50 loss-of-letdown transients before 40 years. However, an analyses is underway to increase the number of allowable loss-of-letdown transients to a sufficient number for 60 years of operation without the CUF for the charging nozzles exceeding one.

- Charging Nozzle Piping 11(21)A

The maximum CUF for the charging inlet nozzle piping 11(21)A is determined from the following equations assuming all AOR cycles have occurred:

$CUF_{(11a)} = \{(0.077)(g_{eff(11a)})/1000\} + 0.059 \leq 0.1360$

$CUF_{(21a)} = \{(0.156)(g_{eff(21a)})/1000\} + 0.295 \leq 0.4510$

where:

0.077 is the CUF computed in the AOR for 1000 loss and recovery of charging flow for the 11A nozzle piping;

0.156 is the CUF computed in the AOR for 1000 loss and recovery of charging flow for the 21A nozzle piping;

(g_{eff}) is the cumulative sum of effective design cycles contributed by the loss and recovery of charging flow for the affected unit and piping;

1000 is the assumed number of loss and recovery of charging flow transients in the AOR; and

0.059 and 0.295 are the initial fatigue usage for each pipe respectively, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable Loss of Charging	Loss of Charging	CUF
Unit $1_{(11a)}$	1000	112.490	0.06766
Unit $2_{(21a)}$	1000	145.132	0.31764

It is predicted that Calvert Cliffs will not sustain the 1000 AOR-allowed effective loss of charging transients during 60 years of operation. The CUF for the 11A and 21A charging inlet nozzle piping at 60 years of operation will be less than 0.4510.

- Charging Nozzle Piping 12(22)B

The maximum CUF for the charging inlet nozzle piping 12(22)B is determined from the following equations assuming all AOR cycles have occurred:

$$CUF_{(12b)} = \{(0.177)(g_{eff(12b)} + j_{eff(U1)})/1560\} + 0.032 \leq 0.2090$$

$$CUF_{(22b)} = \{(0.167)(g_{eff(22b)} + j_{eff(U2)})/1560\} + 0.143 \leq 0.3100$$

where:

0.177 is the CUF computed in the AOR for 1560 loss and recovery of charging flow for the 12B nozzle piping;

0.167 is the CUF computed in the AOR for 1560 loss and recovery of charging flow and auxiliary spray initiation for the 22B nozzle piping;

(g_{eff}) is the cumulative sum of effective design cycles contributed by the loss and recovery of charging flow for the affected unit and piping;

(j_{eff}) is the cumulative sum of effective design cycles contributed by the auxiliary spray initiation events for the affected unit; and

0.032 and 0.143 are the initial fatigue usage for each pipe respectively, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable Loss of Charging/Auxiliary Spray	Loss of Charging	Auxiliary Spray	CUF
Unit $1_{(12b)}$	1560	113.728	14.648	0.04163
Unit $2_{(22b)}$	1560	143.515	13.010	0.15976

It is predicted that Calvert Cliffs will not sustain the 1560 AOR-allowed effective loss and recovery of charging flow and auxiliary spray initiation events during 60 years of operation. The CUF for the 12B and 22B charging inlet nozzle piping at 60 years of operation will be less than 0.3100.

- PZR Surge Nozzles (BGE LRA page 4.1-29)

The maximum CUF for the PZR surge nozzles is determined from the following equation assuming all AOR cycles have occurred:

$$CUF = \{[(0.011)(c)]/500\} + \{[(0.716)(b)]/500\} + 0.006 \leq 0.7330$$

where:

0.011 is the CUF computed in the AOR for 500 PZR heatups;

(c) represents the cumulative sum of PZR heatup cycles;

500 is the assumed number of PZR heatups in the AOR;

0.716 is the CUF computed in the AOR for 500 RCS cooldowns;

(b) represents the cumulative sum of RCS cooldowns from Mode 1 operation (≥ 5% power);

500 is the assumed number of RCS cooldowns in the AOR; and

0.006 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	PZR Heatups	RCS Cooldowns	CUF
Unit 1	500/500	103	88	0.13428
Unit 2	500/500	72	63	0.09780

It is predicted that Calvert Cliffs will not sustain the 500 AOR-allowed PZR heatups or 500 AOR-allowed RCS cooldowns during 60 years of operation. The CUF for the PZR surge nozzles at 60 years of operation will be less than 0.7330.

- SG Secondary Shells (BGE LRA page 4.1-29)

The maximum CUF for the SG secondary shells is determined from the following equation assuming all AOR cycles have occurred:

$$CUF = \{[(0.8524)(k + l)]/1500\} + 0.0878 \leq 0.9402$$

where:

0.8524 is the CUF computed in the AOR for 1500 initiations of both main and AFW flow to each SG;

(k) and (l) represent the cumulative sum of initiations of main or AFW flow into each SG, respectively;

1500 is the assumed number of both main and AFW initiations in the AOR; and

0.0878 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable (both Feedwater & AFW)	Main Feedwater Initiations	AFW Initiations	CUF
Unit $1_{(SG11)}$	1500	116	165	0.10380
Unit $1_{(SG12)}$	1500	116	152	0.10306
Unit $2_{(SG21)}$	1500	266	174	0.11286
Unit $2_{(SG22)}$	1500	259	212	0.11462

It is predicted that Calvert Cliffs will not sustain the 1500 AOR-allowed initiations of both main and AFW into the SGs during 60 years of operation. The CUF for the SG secondary shells at 60 years of operation will be less than 0.9402.

- SG Feedwater Nozzles; (BGE LRA page 4.1-29)

The maximum CUF for the SG feedwater nozzles is determined from the following equation assuming all AOR cycles have occurred:

$$CUF = \{[(0.4042)(k)]/1500\} + 0.0131 \leq 0.4173$$

where:

0.4042 is the CUF computed in the AOR for 1500 main initiations of main feedwater flow;

(k) represents the cumulative sum of initiations of main feedwater flow into the SG;

1500 is the assumed number of initiations of main feedwater flow in the AOR; and

0.0131 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	Main Feedwater Initiations	CUF
Unit $1_{(SG11)}$	1500	116	0.01623
Unit $1_{(SG12)}$	1500	116	0.01623
Unit $2_{(SG21)}$	1500	266	0.02027
Unit $2_{(SG22)}$	1500	259	0.02008

It is predicted that Calvert Cliffs will not sustain the 1500 AOR-allowed initiations of main feedwater into the SGs during 60 years of operation. The CUF for the SG feedwater nozzles at 60 years of operation will be less than 0.4173.

- RPV Closure Studs (BGE LRA pages 4.2-20 and 21)

The maximum CUF for the RPV closure studs is determined from the following equations assuming all AOR cycles have occurred:

$$CUF_{(unit\ 1)} = 0.0012632(a) + 0.0027785 + 0.199585 \leq 0.834$$

$$CUF_{(unit\ 2)} = 0.0012632(a) + 0.0572892 + 0.16069 \leq 0.8496$$

where:

0.0012632 in the CUF computed in the AOR;

(a) represents the cumulative sum of RCS heatups;

and 0.0027785 and 0.0572892 is "fixed" fatigue usage for each unit respectively, the usage that is attributed to all other transients included in the design fatigue analysis after installation of the permanent cavity seals; and

0.199585 and 0.16069 is initial fatigue usage for each unit respectively, the usage that is attributed to all other transients included in the design fatigue analysis before installation of the permanent cavity seals.

As of June 30, 1998:

	Allowable	RCS Heatups	CUF
Unit 1	500	97	0.3249
Unit 2	500	71	0.3077

It is predicted that Calvert Cliffs will not sustain the 500 AOR-allowed RCS heatups during 60 years of operation. The highest CUF for the RPV closure studs at 60 years of operation will be less than 0.849.

- PZR Bottom Head/Support Skirt (BGE LRA page 4.1-29)

The maximum CUF for the PZR bottom head and support skirt is determined from the following equation assuming all AOR cycles have occurred:

$CUF = \{[(0.3453)(b)]/500\} + \{[(0.1597)(e)]/400 + 0.1534 \leq 0.6584$

where:

0.3453 is the CUF computed in the AOR for 500 RCS cooldowns;

(b) represents the cumulative sum of RCS cooldowns from Mode 1 operation ($\geq$ 5% power);

500 is the assumed number of RCS cooldowns in the AOR;

0.1597 is the CUF computed in the AOR for 400 reactor trips;

(e) represents the cumulative sum of reactor trips;

400 is the assumed number of reactor trips in the AOR; and

0.1534 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable RCS Cooldown/Reactor Trips	RCS Cooldowns (≥ 5% power)	Reactor Trips	CUF
Unit 1	500/400	88	123	0.26328
Unit 2	500/400	63	103	0.23803

It is predicted that Calvert Cliffs will not sustain the 500 AOR-allowed RCS cooldowns or 400 AOR-allowed reactor trips during 60 years of operation. The CUF for the PZR bottom and support skirt at 60 years of operation will be less than 0.6584.

- <u>SDC Outlet Nozzles (BGE LRA page 4.1-29)</u>

The maximum CUF for the SDC outlet nozzles is determined from the following equation assuming all AOR cycles have occurred:

$CUF = \{[(0.6295)(b)]/500\} + 0.0509 \leq 0.6804$

where:

0.6295 is the CUF computed in the AOR for 500 RCS cooldowns;

(b) represents the cumulative sum of RCS cooldowns from Mode 1 operation (≥ 5% power);

500 is the assumed number of RCS cooldowns in the AOR; and

0.0509 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	RCS Cooldowns (≥ 5% power)	CUF
Unit 1	500	88	0.16169
Unit 2	500	63	0.13022

It is predicted that Calvert Cliffs will not sustain the 500 AOR-allowed RCS cooldowns during 60 years of operation. The CUF for the SDC outlet nozzles at 60 years of operation will be less than 0.6804.

- <u>SG Tube-to-Tubesheet Welds (BGE LRA page 41.-29)</u>

The maximum CUF for the SG tube-to-tubesheet welds is determined from the following equation assuming all AOR cycles have occurred:

$CUF = \{[(0.29918)(q)]/320\} + 0.02466 \leq 0.3240$

where:

0.29918 is the CUF computed in the AOR for 320 RCS leak tests;

(q) represents the cumulative sum of RCS leak tests;

320 is the assumed number of RCS leak tests in the AOR; and

0.02466 is the initial fatigue usage, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	RCS Leak Tests	CUF
Unit 1	320	3	0.02746
Unit 2	320	2	0.02653

It is predicted that Calvert Cliffs will not sustain the 320 AOR-allowed RCS leak tests during 60 years of operation. The CUF for the SG tube-to-tubesheet welds at 60 years of operation will be less than 0.3240.

- Charging System Piping

The maximum CUF for the charging system piping is determined from the following equations assuming all AOR cycles have occurred:

$CUF_{U1} = \{(0.187)(g_{eff(U1)})/1000\} + 0.456 \leq 0.6430$

$CUF_{U2} = \{(0.161)(g_{eff(U2)})/1000\} + 0.656 \leq 0.8170$

where:

0.187 is the CUF computed in the AOR for 1000 loss and recovery of charging flow events;

(g_{eff}) is the cumulative sum of effective design cycles contributed by the loss and recovery of charging flow for the affected unit and piping;

1000 is the assumed number of loss and recovery of charging flow for the charging piping; and

0.456 and 0.656 are the initial fatigue usage for each pipe respectively, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	Loss of Charging	CUF
Unit $1_{(U1)}$	1000	128.884	0.48010
Unit $2_{(U2)}$	1000	14[illegible]874	0.67965

It is predicted that Calvert Cliffs will not sustain the 1000 AOR-allowed effective loss and recovery of charging events during 60 years of operation. The CUF for the charging system piping at 60 years of operation will be less than 0.8170.

- Auxiliary Spray Piping

The maximum CUF for the auxiliary spray piping is determined from the following equations assuming all AOR cycles have occurred:

$CUF_{U1} = \{(0.146)(j_{eff(U1)})/560\} + 0.294 \leq 0.4400$

$CUF_{U2} = \{(0.263)(j_{eff(U2)})/560\} + 0.128 \leq 0.3910$

where:

0.146 is the CUF computed in the AOR for 560 initiation of auxiliary spray events for Unit 1;

0.263 is the CUF computed in the AOR for 560 initiation of auxiliary spray events for Unit 2;

(j_{eff}) is the cumulative sum of effective design cycles contributed by the initiation of auxiliary spray;

560 is the assumed number of initiation of auxiliary spray events in the AOR; and

0.294 and 0.128 are the initial fatigue usage for each pipe respectively, the usage that is attributed to all other transients included in the design fatigue analysis.

As of June 30, 1998:

	Allowable	Initiation of Auxiliary Spray	CUF
Unit $1_{(U1)}$	560	14.648	0.29782
Unit $2_{(U2)}$	560	13.010	0.13411

It is predicted that Calvert Cliffs will not sustain the 560 AOR-allowed effective initiations of auxiliary spray during 60 years of operation. The CUF for the auxiliary spray piping at 60 years of operation will be less than 0.4400.

NRC Question No. 7.13

Section 4.1 of the LRA indicates that in order to remain within the design basis, corrective action is initiated well in advance of the CUF approaching one or the number of cycles approaching design allowable. Describe the specific criteria used to determine when corrective actions will be initiated.

BGE Response

Every six months the FMP requires a review of plant data, the resulting CUFs and cumulative critical transient usage for all components and transients monitored by the FMP. Engineering judgment is used to evaluate the rate of increase of both indicators, CUF and cumulative critical transient usage, and the approximate time until the limit(s) will be reached. An Issue Report is initiated years before reaching the limit(s). This allows sufficient time to strategically plan the corrective actions. There is no defined percentage limit(s) that triggers an Issue Report. The decision to write an Issue Report is based on how quickly the limit(s) is approaching and will vary for each monitored component and transient.

NRC Question No. 7.14

Electric Power Research Institute Report TR-107515 provides the results of a fatigue assessment of the pressurizer surge line. Section 3.3.1.1 of the EPRI report provides the results of an ASME Code Section III evaluation of the line that had been performed to address the issue of fatigue due to thermal stratification. The EPRI report lists a Class 1, Equation 12 stress that exceeds the ASME Code allowable limit. No further explanation is provided. Indicate whether the ASME Code stress limits were met for this analysis.

BGE Response

The purpose of EPRI Report TR-107515 specific to Calvert Cliffs was to provide evidence that the effects of reactor water environments for ASME Class 1 components are already compensated for by the portion of the design fatigue curve margin factor of 20 that is ascribed to moderate environmental effects (approximately 4). This study was specifically discussed in the LRA and at several public meetings in early 1998.

The study results do not represent Calvert Cliffs' fatigue AOR nor fatigue design basis. The study was intended to be representative of conditions for typical older vintage CE PWRs, and intended to be compared to the results reported in NUREG/CR-6260 for such plants, but was not intended to be a Calvert Cliffs licensing basis calculation. There is no direct applicability of this study to our fatigue AOR or our FMP.

Reference 3.7 of the EPRI Report refers to a Combustion Engineering Owners Group (CEOG) task that evaluated PZR surge line flow stratification. The CEOG task was performed to evaluate the impact of surge line thermal stratification as reported in NRC Bulletin 88-11 (Reference 2). The EPRI task only used the CEOG task results to assist in the ranking and determination of location(s) with thermal fatigue sensitivity.

The CEOG task used elastic-plastic analysis to demonstrate that even though the ASME Equation 12 limit of $3S_m$ was exceeded, the surge line does "shakedown" and all ASME requirements were met.

NRC Question No. 7.15

Section 4.1 of the LRA indicates that environmental effects do not apply to the RCS components because of the low oxygen concentrations and because the RCS carbon steel interior surfaces are clad with stainless steel. Discuss the applicability and impact of the latest stainless steel fatigue correlation from ANL on this conclusion.

BGE Response

Per Reference (1), the NRC staff is redirecting this question and issuing it to the Nuclear Energy Institute for an industry response.

NRC Question No. 7.16

Section 3.3.3 of EPRI Report TR-107515 contains an evaluation of the surge line using methodology developed in EPRI Report TR-105759. Discuss the applicability and impact of the latest stainless steel fatigue correlation from ANL on this evaluation.

BGE Response

Per Reference (1), the NRC staff is redirecting this question and issuing it to the Nuclear Energy Institute for an industry response.

NRC Question No. 7.17

Section 3.3.3.2 of EPRI Report TR-107515 indicates that the procedure in Section 3.1.3.2 of the EPRI report was used to develop the environmental factor used in the evaluation. Indicate whether the factor was calculated based on a "standard" treatment or "weighted average" approach as discussed in a June 1, 1998, letter from the Nuclear Energy Institute to the NRC regarding EPRI Report TR-105759. If the "weighted average" approach was used, provide the test data used to develop the approach. Include a statistical assessment of the test data scatter. Compare the results of the statistical assessment with the ANL assessment contained in NUREG/CR-6335, "Fatigue Strain-Life Behavior of Carbon and Low-Alloy Ferritic Steels, Austenitic Stainless Steels, and Alloy 600 in LWR Environments." On the basis of this comparison, indicate whether the use of the "weighted average" approach will produce an adequate margin to account for test data scatter.

BGE Response

Per Reference (1), the NRC staff is redirecting this question and issuing it to the Nuclear Energy Institute for an industry response.

NRC Question No. 7.18

Section 5.15, "Safety Injection," of the LRA contains a list of SI System components for which fatigue is considered plausible. The LRA indicates that the SI System vent/drain/test hand valves, instrument isolation hand valves, and relief valves connected to the piping are generally "thin-walled" components and, therefore, do not experience the large temperature gradients that would be necessary to cause significant degradation. Provide the technical basis for this conclusion.

BGE Response

The SI System vent/drain/test hand valves, instrument isolation hand valves, and relief valves connected to piping for which fatigue is considered plausible have been reevaluated. Fatigue will continue to be considered not plausible for these components because they are outside of the main process flowpath and will not experience any thermal transients under normal and anticipated conditions that would raise a fatigue concern. The "thin wall" description of these components will no longer be used. The LRA will be revised to reflect these changes.

NRC Question No. 7.19

Section 5.15 of the LRA indicates that the FMP tracks the fatigue usage at the SI nozzle. Describe the parameters that are monitored by the FMP that are applicable to the SI nozzle. Also describe how the monitored parameters are compared to the fatigue AOR.

BGE Response

The SI nozzles are part of the RCS piping and are discussed in Section 4.1 of the BGE LRA. Baltimore Gas and Electric Company LRA page 4.1-29 through 31 describe the FMP and the specific transients that are monitored for the SI nozzles.

The critical transients for the SI nozzles are plant cooldown with initiation of SDC and the SICV test. The specific parameters monitored for SDC initiation are SDC flow, SI actuation signal, LPSI header temperatures, RCS cold leg temperatures, containment temperatures, and PZR pressure. The SICV tests are manually logged by plant operators. The specific parameters recorded for the SICV tests are charging temperature, RCS cold leg temperatures, and PZR pressure. The number of SDC initiations and SICV tests are compared to the number of transients in the AOR every six months.

For both locations, all other transients analyzed in the AOR are assumed to have occurred and the corresponding fatigue contribution is accounted for as initial fatigue usage in the FMP.

NRC Question No. 7.20

Section 5.15 of the LRA indicates that in order to stay within the design basis, corrective action is initiated well in advance of the CUF approaching one or the number of cycles approaching the design allowable. Describe the specific criteria used to determine when corrective actions will be initiated.

BGE Response

Please see the response to question 7.13 above.

NRC Question No. 7.21

Section 5.15 of the LRA indicates that BGE identified the potential for thermal stratification in the piping between the SI tank check valves and the loop inlet check valves. The LRA also indicates that BGE will complete an engineering review of the industry task group reports regarding thermal stratification to determine whether SI piping changes are necessary, and to determine the impact of such changes on fatigue usage parameters used by the FMP. Indicate whether the plans for the engineering review includes re-analysis for thermal stratification. Describe the manner by which the TLAA for these fatigue analyses will satisfy 10 CFR 54.21(c). Also provide the schedule for completion of these fatigue analyses.

BGE Response

The engineering review of the SI piping between the SI tank check valves and the loop inlet check valves does include a re-analysis for thermal stratification. This review will determine if the components are bounded by other components in the FMP. If they are not bounded, they will be added to the FMP.

The current bounding locations for the SI piping are the SI nozzles. These nozzles are part of the RCS piping. The management of NSSS fatigue effects meets the requirements of 10 CFR 54.21(c)(1)(iii). Managing fatigue effects in the RCS piping will continue as stated in Section 2.1.3.3 and described on pages 5.2-15 through 17 of the LRA. Furthermore, if additional bounding locations are identified during the engineering review, they will be added to the FMP and will meet the requirements of 10 CFR 54.21(c)(1)(iii) that are stated in Section 2.1.3.3 and described on pages 15.15-31 and 32.

The new analysis and potential modifications to the FMP will be complete by the end of 2003.

NRC Question No. 7.22

Section 5.15 of the LRA indicates that environmental effects do not apply to the SI components because of the low oxygen concentrations and the stainless steel components materials used in fabrication of the affected piping and valve subcomponents. Discuss the applicability and impact of the latest stainless steel fatigue correlation from ANL on this conclusion.

BGE Response

Per Reference (1), the NRC staff is redirecting this question and issuing it to the Nuclear Energy Institute for an industry response.

References

1. Letter from Mr. D. L. Solorio (NRC) to Mr. C. H. Cruse (BGE), dated November 2, 1998, Clarification Regarding Selected Request for Additional Information for the Review of the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 & 2, Integrated Plant Assessment on Metal Fatigue (TAC Nos. MA0601, MA602, M99227, MA1016, MA1017, M99223, MA1108, MA1109, and M99222)
2. NRC IE Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification," dated December 20, 1988
3. Metals Handbook, Ninth Edition, 1986, Volume 11, Failure Analysis and Prevention, Fatigue Failures
4. Mechanical Engineering Reference Manual, Lindeburg, Fourth Edition, 1990
5. Metals Handbook, Ninth Edition, 1986, Volume 13, Corrosion, Corrosion Testing and Evaluation