GE Nuclear Energy

September 11, 1992

Mr. Shou-Nien Hou 7F21
U.S Nuclear Regulatory Commission
1155 Rockville Pike
Rockville, MD 20852

Dear Shou:

Enclosed are the responses to Piping Design Audit open items A-10, A-17 and A-28. If you have any questions please call me (488-925-4824) or Maryann Herzog (408-925-1921).

Sincerely,

J. N. Fox

Jack N. Fox
Advanced reactor Programs

cc: Chet Poslusny (NRC)
Giuliano DeGrassi (BNL)

290093

See attached distribution 2222 1/1 per Chet Poslusny

GE-NE
ABWR PROGRAM
MECHANICAL SYSTEM DESIGN
FILE MH-A10

DISTRIBUTION:
JBK,JNF

DATE: SEPTEMBER 8, 1992

TO : M HERZOG

FROM: H L HWANG H Hwang

SUBJECT: AUDIT ITEM A-10
EXPANSION AND CONTRACTION OF ADJQ, RV1 AND OTHER LOADS.

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1) Safety Relief Valve Discharge Load

The contraction and expansion of the time history is equivalent to reducing and increasing the load. The calculated results compare well with the test data performed at Wyle which was provided to NRC and BNL in the meeting*. It is not necessary to reduce or increase the load.

2) ADJQ and Other LOCA Pool Loads.

The condensation oscillation load have been discussed in the meeting and agreed that the load used for analysis is conservative.

The next important load is ADJQ. The current input frequencies are at 5.8, 8.12 and 11.3 Hz. The majority of the load acts on the quencher arm and the quencher body. The lowest natural frequency of the quencher arms and the quencher body is 52 Hz. There is only a small portion of pipe near the pool surface has natural frequency of 12.2 Hz. This indicated that the response of the quencher and pedestal are not sensitive to the frequency variation of the input.

Therefore, it is not necessary to expand or contraction the time history loads for the analysis of the wetwell pool loads.

* July 28, 1992 through July 31, 1992

GE-NE
ABWR PROGRAM
MECHANICAL SYSTEM DESIGN
FILE MH-A17

DISTRIBUTION:
JBK,JNF

DATE: SEPTEMBER 11, 1992

TO : M HERZOG

FROM: H L HWANG *H Hwang*

SUBJECT: AUDIT ITEM A-17
THERMAL STRESSES DUE TO FEEDWATER NOZZLE STRATIFICATION
STRIPPING EFFECT

The temperature gradient stresses due to stripping has been included in the current thermal duty cycle charts. The stripping occurs during hot standby. Attached Figure 1 shows the hot standby event. This figure shows the requirement to calculate the temperature gradients due to step change from 132 to 99 degree C and back from 99 to 132 degree C. Using 2% rated flow during hot standby the calculated temperature gradients ranges from the cycle are as follows:

132-99= 33 deg. C Step
= 59.4 F
DT1 range = 35 deg F.
DT2 range = 12 deg F
DTAB range= 29 deg F

Although the temperature transients step change of 59.4 degrees is not exact the same as the data measuremed from the plant, but the net results are about the same. Based on Leibstadt plant measureed data the maximum temperature change on top of the nozzle is from 375 to 135 degree F in 3.5 minutes. The temperature change at bottom of the nozzle is less than 1/3 of the top of the nozzle.

The worst assumption is to assume 375 to 135 and back to 375 cycling. The temperature gradients time history due to the stripping effect has been calculated. The results are plotted in Figure 2. The temperature gradient ranges are as follows:

375-135= 240 deg. F in 3.5 minutes.
DT1 range = 39 deg F.
DT2 range = 23 deg F
DTAB range= 7 deg F

This shows that the temperature gradients calculated from both cases are about the same. The allowable fatigue cycles for the alternating stress from either case are more than 1000,000 cycles.

This concluded that the current feedwater duty cycle requirement is adequate for the stripping effect.

FIGURE 1. DUTY CYCLE

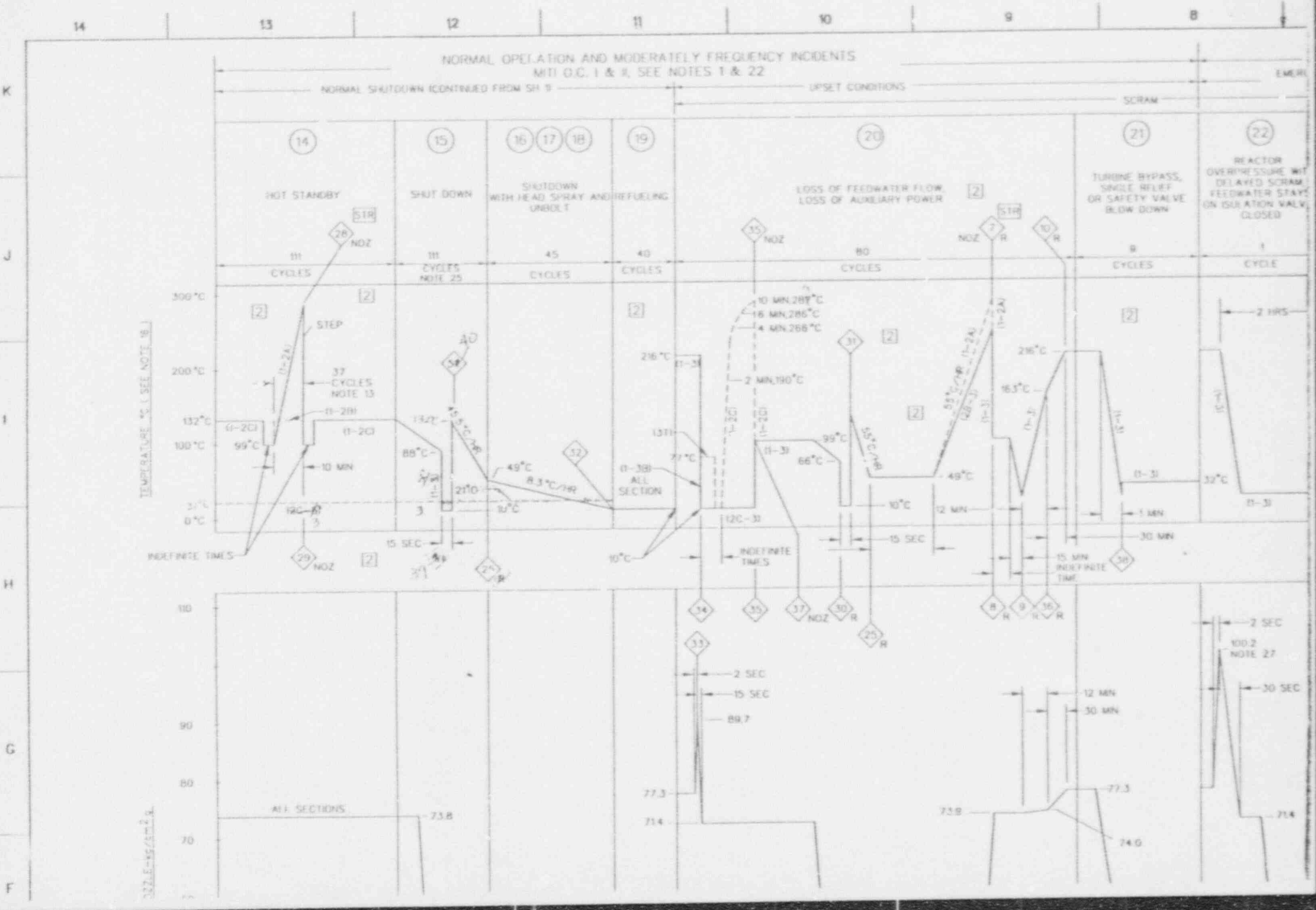
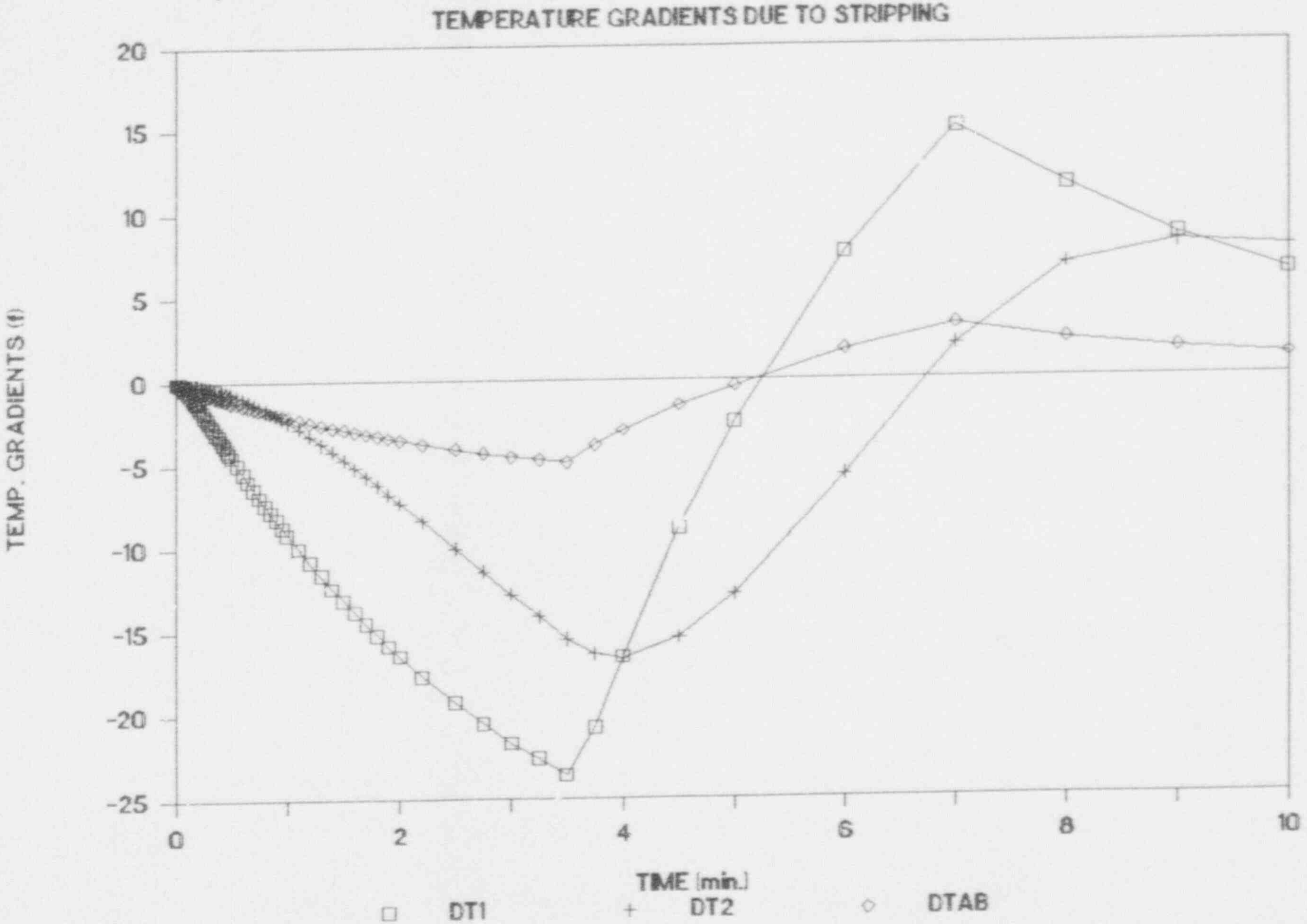


FIGURE 2. ABWR FW NOZZLE THERMAL



GE-NE
ABWR PROGRAMS
MECHANICAL SYSTEMS DESIGN
FILE: MH-A17

DISTRIBUTION:
JBK; JNF:

DATE: SEPTEMBER 9, 1992

TO: MARYANN HERZOG

FROM: E.O. SWAIN

SUBJECT: AUDIT ITEM A-17 - CRITERIA FOR CONSIDERATION OF STRATIFICATION

Delete the third paragraph in 3.9.3.1 and replace with the paragrpah below. The present third paragraph erronously states that Table 3.9-2 contains predicted loads and stresses which are compared with allowables. Since predicted loads and stresses are not available this paragraph needs to be deleted. A copy of SSAR Page 3.9-18 showing the Audit Item A-17 change is attached.

New third paragraph in 3.9.3.1:

Thermal stratification of fluids in a piping system is one of the specific operating conditions that is included in the loads and load combinations that are contined in the piping design specifications and design reports. It is known stratification can occur in the feedwater piping during plant startup and when the plant is in hot standby conditions following scram (See Subsection 3.9.2.1.3). If, during design or startup, evidence of thermal stratification is detected in any other piping system, then stratification will be evaluated. If it cannot be shown the stresses in the pipe are low and that movement due to bowing is acceptable, then stratification will be treated as a design load. In general, if temperature differences between the top and bottom of the pipe are less than 50^{o}F., it may be assumed design specification and stress reports need not be revised to include stratification.

The results of the data analyses, vibration amplitudes, natural frequencies, and mode shapes are then compared to those obtained from the theoretical analysis.

Such comparisons provide the analysts with added insight into the dynamic behavior of the reactor internals. The additional knowledge gained from previous vibration tests has been utilized in the generation of the dynamic models for seismic and loss of coolant accident (LOCA) analyses for this plant. The models used for this plant are similar to those used for the vibration analysis of earlier prototype BWR plants.

3.9.3 ASME Code Class 1, 2, and 3 Components, Component Supports, and Core Support Structures

3.9.3.1 Loading Combinations, Design Transients, and Stress Limits

This section delineates the criteria for selection and definition of design limits and loading combination associated with normal operation, postulated accidents, and specified seismic and other reactor building vibration (RBV) events for the design of safety-related ASME Code components (except containment components which are discussed in Section 3.8).

This section discusses the ASME Class 1, 2, and 3 equipment and associated pressure retaining parts and identifies the applicable loadings, calculation methods, calculated stresses, and allowable stresses. A discussion of major equipment is included on a component-by-component basis to provide examples. Design transients and dynamic loading for ASME Class 1, 2, and 3 equipment are covered in Subsection 3.9.1.1. Seismic-related loads and dynamic analyses are discussed in Section 3.7. The suppression pool-related RBV loads are described in Appendix 3B. Table 3.9-2 presents the combinations of dynamic events to be considered for the design and analysis of all ABWR ASME Code Class 1, 2, and 3 components, component supports, core support structures and equipment. Specific loading combinations considered for evaluation of each specific equipment are derived from Table 3.9-2 and are contained in the design specifications and/or design reports of the respective equipment. (See Subsection 3.9.7.4 for COL license information)

Thermal stratification of fluids in a piping system is one of the specific operating conditions that is included in the loads and load combinations that are contined in the piping design specifications and design reports. It is known stratification can occur in the feedwater piping during plant startup and when the plant is in hot standby conditions following scram (See Subsection 3.9.2.1.3). If, during design or startup, evidence of thermal stratification is detected in any other piping system, then stratification will be evaluated. If it cannot be shown the stresses in the pipe are low and that movement due to bowing is acceptable, then stratification will be treated as a design load. In general, if temperature differences between the top and bottom of the pipe are less than 50°F., it may be assumed design specification and stress reports need not be revised to include stratification.

The design life for the ABWR Standard Plant is 60 years. A 60 year design life is a requirement for all major plant components with reasonable expection of meeting this design life. However, all plant operational components and equipment except the reactor vessel are designed to be replaceable, design life not withstanding. The design life requirement allows for refurbishment and repair, as appropriate, to assure the design life of the overall plant is achieved. In effect, essentially all piping systems, components and equipment are designed for a 60 year design life. Many of these components are classified as ASME Class 2 or 3 or Quality Group D. *In the event any non-Class 1 components are subjected to cyclic loadings, including operating vibration loads and thermal transients effects, of a magnitude and/or duration so severe that the 60 year design life can not be assured by required Code calculations, applicants referencing the ABWR design will identify these components and either provide an appropriate analysis to demonstrate the required design life or provide designs to mitigate the magnitude or duration of the cyclic loads. Components excluded from this requirement are (1) tees where mixing of hot and cold fluids occurs and thermal sleeves have been provided in accordance with the P&ID's, (2) components, such as the quencher, for which a fatigue analysis has already been performed, providing the component is designed so as to not cause excessive localized stresses, or harmful thermal gradients in the pipe wall, (3) Feedwater piping outside containment that is designed to cyclic loadings and stresses are no more severe than experienced by Class 1 piping inside containment.*

3.9.3.1.1 Plant Conditions

All events that the plant will or might credibly experience during a reactor year are evaluated to establish design basis for plant equipment. These events are divided into four plant conditions. The plant conditions described in the following paragraphs are based on event probability (i.e., frequency of occurrence as discussed in Subsection 3.9.3.1.1.5) and correlated to service levels for design limits defined in the ASME Boiler and Pressure Vessel Code Section III as shown in Tables 3.9-1 and 3.9-2.

GE-NE
ABWR PROGRAMS
MECHANICAL SYSTEMS DESIGN
FILE: MH-A28

DISTRIBUTION:
JBK; JNF;

DATE: SEPTEMBER 1, 1992

TO: MARYANN HERZOG

FROM: E.O. SWAIN

SUBJECT: AUDIT ITEM A-28 - FEEDWATER STRATIFICATION MONITORING PROGRAM

Below is my recommended addition to 3.9.2 to cover Audit Item A-28. This addition consists of a new paragraph beginning on Page 3.9-7, see below, and as shown on the SSAR markup of pages 3.9-7 and 3.9-8. I will make recommendations for additions to Chapter 14 the subject of a separate letter. (See letter dated 9/4/92)

3.9.2.1.3 Thermal Stratification in Feedwater Piping

This is a special test to be performed as part of the startup program to monitor the conditions and effects of temperature stratification that may exist during certain operating conditions in: (1) the feedwater piping header inside and the piping outside containment, and (2) the short horizontal runs of the riser piping inside containment where feedwater enters the vessel nozzles.

Stratification in the feedwater piping can occur during plant startup when hot RWCU is added to the cold feedwater line. The hot RWCU flows on top of the colder water in the feedwater line and does not mix with the colder water until mixing of the two stream occurs at the outer swing check isolation valve. Stratification for this condition can thus effect only the feedwater piping outside containment.

A second condition of plant operation which can cause stratification in the feedwater piping is when the plant is in hot standby condition following scram. After scram, the temperature of the entire feedwater line is hot. When cold water is introduced to make up for decay heat boiloff in the RPV, the colder water flows along the bottom of the large diameter horizontal feedwater pipe at low flow rate, creating stratification. The temperature difference between top and bottom of the pipe will decrease along the pipe in the direction of flow, but stratification could still exist in the feedwater piping inside containment since the swing check valves are not effective in mixing the cold water flowing along the bottom of the pipe.

The test program will consist of measurement of (1) temperature around the circumference of the feedwater pipe at various locations inside and outside containment, (2) strains at points of highest stress inside containment, and (3) measurement of pipe displacements and movements inside and outside containment due to pipe bowing because of stratification.

This test will be performed in accordance with the general requi ements of Regulatory Guide 1.68 and the more specific requirements in ANSI/ASME OM7. Detailed test procedures will be prepared in ac:ordance with these documents . The development and specifications of the types of measurements required, the systems and locations to be monitored, the test acceptance criteria, and the corrective actions that may be necessary are as discussed in **Paragraph 3.9.2.1.2 Thermal Expansion Testing.**

The feedwater thermal stratification test is not required if the appiicant can show a test performed at a previous plant meets the requirements of this paragraph and is applicable to his plant.

cilitate assessment of the test while it is in progress. Limits of thermal expansion displacements are established prior to start of piping testing to which the actual measured displacements are compared to determine acceptability of the actual motion. If the measured displacement does not vary from the acceptance limits values by more than the specified tolerance, the piping system is responding in a manner consistent with the predictions and is therefore acceptable. The piping response to test conditions shall be considered acceptable if the review of the test results indicates that the piping responds in a manner consistent with the predictions of the stress report and/or that piping stresses are within ASME Code Section III (NB-3600) limits. Acceptable thermal expansion limits are determined after the completion of piping systems stress analysis and are provided in the piping test specifications. Level 1 criteria are bounding criteria based on ASME-III Code stress limits. Level 2 criteria are stricter criteria based the predicted movements using the calculated deflections plus a selected tolerance.

210.31

3.9.2.1.2.4 Reconciliation and Corrective Actions

During the course of the tests, the remote measurements will be regularly checked to verify compliance with acceptance criteria. If trends indicate that criteria may be violated, the measurements should be monitored at more frequent intervals. The test will be held or terminated as soon as criteria are violated. As soon as possible after the test hold or termination appropriate investigative and corrective actions will be taken. If practicable, a walkdown of the affected piping and suspension system should be made in an attempt to identify potential obstruction to free piping movement. Hangers and snubbers should be positioned within their expected cold and hot settings. All signs of damage to piping or supports shall be investigated.

210.31

Instrumentation indicating criteria failure shall be checked for proper operation and calibration including comparison with other instrumentation located in the proximity of the out-of-bounds movement. Assumptions, such as piping temperature, used in the calculations that generated the applicable limits should be compared with actual test conditions. Discrepancies noted should be accounted for in the criteria limits including possible reanalysis.

Should the investigation of instrumentation and calculations fail to reconcile the criteria violations or should the visual inspection reveal an unintended restraint, then physical corrective actions may be required. This might include complete or partial removal of an interfering structure; replacing, readjusting or repositioning piping system supports; modifying the pipe routing; or, modifying system operating procedures to avoid the temperature conditions that resulted in the unacceptable thermal expansion.

3.9.2.1.3 Thermal Stratification in Feedwater Piping

This is a special test to be performed as part of the startup program to monitor the conditions and effects of temperature stratification that may exist during certain operating condition in: (1) the feedwater piping header inside and outside containment, and (2) the short horizontal runs of the of the riser piping inside containment where feedwater enters the vessel nozzles.

Stratification in the feedwater piping can occur during plant startup when hot RWCU is added to the cold feedwater line, the hot RWCU flows on top of the colder water in the feedwater line and does not mix with the colder water until mixing of the two stream occurs at the outer swing check isolation valve. Stratification for this condition can thus effect only the feedwater piping outside containment.

A second condition of plant operation which can cause stratification in the feedwater piping is when the plant is in hot standby condition following scram. After scram, the temperature of the entire feedwater line is hot when cold water is introduced to make up for decay heat boiloff in the RPV. The colder water flows along the bottom of the large diameter horizontal feedwater pipe at low flow rate, creating stratification. The temperature difference between top and bottom of the pipe will decrease along the pipe in the direction of flow, but stratification could still exist in the feedwater piping inside containment since the swing check valve are not effective in mixing the cold water flowing along the bottom of the pipe.

The test program will consist of measurement of (1) temperature around the circumference of the feedwater pipe at various locations inside and outside

containment, (2) strains at points of highest stress inside containment, and (3) measurement of pipe displacements and movements inside and outside containment due to pipe bowing because of stratification.

This test will be performed in accordance with the general requirements of Regulatory Guide 1.68 and the more specific requirements in ANSI/ASME OM7. Detailed test procedures will be prepared in [illegible] with these documents. The development [illegible]ns of the types of measurements require[illegible]ms and locations to be monitored, the tes[illegible] criteria, and the corrective actions [illegible]sary are as discussed in **Paragraph [illegible]pansion Testing.**

[illegible]ermal stratification test is not [illegible] applicant can show a test performed at a previous plant meets the requirements of this paragraph and is applicable to his plant.

lank

GE-NE
ABWR PROGRAMS
MECHANICAL SYSTEMS DESIGN
FILE: MH-A28r

DISTRIBUTION:
JBK; JNF;

DATE: SEPTEMBER 4, 1992

TO: MARYANN HERZOG

FROM: E. O. SWAIN

SUBJECT: AUDIT ITEM A-28 - FEEDWATER STRATIFICATION MONITORING PROGRAM - CHAPTER 14, SSAR

Below are my revised recommendations for changes to Chapter 14 to add the feedwater stratification monitoring program. This letter supplements my letter of September 1, on changes to Section 3.9.3 of the SSAR on the same subject. SSAR markups are attached.

1. On page 14.2-59

Replace "14.2.12.2.10 System Expansion" with:

14.2.12.2.10 System Thermal Expansion and Feedwater Stratification.

The movement of piping systems due to thermal expansion and fluid temperature stratification is monitored during the start up test program. The thermal expansion test program applies to those piping systems identified in Paragraph 14.2.12.2.10.1 (3). The fluid temperature stratification test applies only to the feedwater piping.

14.2.12.2.10.1 System Thermal Expansion

2. Add new paragraph to cover the feedwater stratification test as follows:

14.2.12.2.10.2 Feedwater Stratification.

(1) Purpose

The purpose of the feedwater stratification test is to confirm the vertical temperature gradients that can occur in the feedwater piping, either inside or outside containment, during certain operational modes do not, when combined with thermal expansion, produce pipe stresses, pipe movements or RPV nozzle loads in excess of design allowables.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedures and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. The applicable instrumentation shall be checked or calibrated as is appropriate.

Satisfactory completion of the thermal expansion test is a prerequisite to the stratification test. This insures the piping is free of obstruction that could constrain free pipe movement.

(3) Description

The feedwater piping stratification test consists of measuring displacement, temperatures and strains of the feedwater piping during these two operating modes:

(a) During plant startup when hot RWCU is added to the cold feedwater line. The hot RWCU flows on top of the colder water in the feedwater line and does not mix with the colder water until mixing of the two stream occurs at the outer swing check isolation valve. Stratification for this condition can thus effect only the feedwater piping outside containment.

(b) The plant is in hot standby condition following scram. After scram, the temperature of the entire feedwater line is hot. When cold water is introduced to make up for decay heat boiloff in the RPV, the colder water flows along the bottom of the large diameter horizontal feedwater pipe at low flow rate, creating stratification. The temperature difference between top and bottom of the pipe will decrease along the pipe in the direction of flow, but stratification could still exist in the feedwater piping inside containment since the swing check valves are not effective in mixing the cold water flowing along the bottom of the pipe.

The test consist of measurement of (a) temperature around the circumference of the feedwater pipe at various locations inside and outside containment, (b) strains at points of highest stress inside containment, and (c) measurement of pipe displacements and movements inside and outside containment due to pipe bowing because of stratification.

(4) Criteria

Acceptance criteria are established for temperature measurements around the circumference of the pipe and for the strain measurements at the high stress points in the piping. Acceptance criteria is not provided for the displacement measurements because of the uncertainities involved with interpreting the test data which include displacements caused by both thermal expansion and stratification. The acceptance criteria for temperature are based on the measured values not exceeding actual values used for design and maximum values allowed without overstressing the feedwater pipe. The acceptance criteria for strains are based on the measured strains due to thermal expansion plus stratification not exceeding strains predicted by analysis and the maximum strains allowed by Code. The locations to be monitored and the aacceptance criteria for temperatures and strains for the monitored locations in each plant will be provided by the applicable design or testing specification.

tion at various plant operating conditions in order to validate design assumptions and identify any operational limitations that may exist.

(2) Prerequisites

The applicable preoperational testing has been completed and plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete.

(3) Description

During plant heatup and power ascension pertinent parameters such as reactor coolant temperature, vessel dome pressure, vessel water level, and core flow will be monitored at selected intervals and plant conditions. This data will be used to verify proper instrument response to changing plant conditions and to document the relationships amongst these parameters and with other important parameters such as reactor power, feedwater flow and steam flow. The data will also be used to validate design assumptions such as those used in the calibration of vessel level or core flow indication. Additionally, the data will be used to help identify potential operational condition limitations such as excessive coolant temperature stratification in the vessel bottom head region.

(4) Criteria

The various nuclear boiler process instrumentation shall operate as designed in response to changes in plant conditions. The observed process characteristics shall be conservative relative to applicable safety analysis assumptions and should be consistent with design expectations.

14.2.12.2.10 System Thermal Expansion and Feedwater Stratification.

The movement of piping systems due to thermal expansion and fluid temperature stratification is monitored during the start up test program. The thermal expansion test program applies to those piping systems identified in Paragraph 14.2.12.2.10.1 (3). The fluid temperature stratification test applies only to the feedwater piping.

14.2.12.2.10.1 System Thermal Expansion

(1) Purpose

The purpose of the thermal expansion test is to confirm that the pipe suspension system is working as designed and the pipeing is free of obstructions that could constrain free pipe movement caused by thermal expansion.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedures and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. The applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

The thermal expansion tests consist of measuring displacements and temperatures of piping during various operating modes. The first power level used to verify expansion shall be as low as practicable. Thermal movement and temperature measurements shall be recorded at at least the following test points (following a suitable hold period to assure steady state temperatures):

(a) during reactor pressure vessel heatup at at least one intermediate temperature prior to reaching normal operating temperature, including an inspection of the piping and its suspension for obstructions or inoperable supports;

(b) following reactor pressure vessel heat up to normal operating temperature;

(c) following heatup of other piping systems to normal operating temperature (those systems whose heatup cycles differ from (2) above); and

(d) on subsequent heatup/cooldown cycles, as specified, at the applicable operating and shutdown temperatures, to measure possible shakedown effects.

Thermal expansion shall be conducted on plant systems of the following classifications:

(a) ASME Code Class 1, 2, and 3 systems;

(b) high energy piping systems inside Seismic Category I structures;

(c) high energy portions of systems whose failure could reduce the functioning of any Seismic Category I plant features to an unacceptable level; and

(d) Seismic Category I portions of moderate energy piping systems located outside containment.

(4) Criteria

The thermal expansion acceptance criteria are based upon the actual movements being within a prescribed tolerance of the movements predicted by analysis. Measured movements are not expected to precisely correspond with those mathematically predicted. Therefore, a tolerance is specified for differences between measured and predicted movement. The tolerances are based on consideration of measurement accuracy, suspension free play, and piping temperature distributions. If the measured movement does not vary from the predictions by more than the specified tolerance, the piping is expanding in a manner consistent with predictions and is therefore acceptable. Tolerances should be the same for all operating test conditions. The locations to be monitored and the predicted displacements for the monitored locations in each plant will be provided by the applicable

14.2.12.2.10.2 Feedwater Stratification.

(1) Purpose

The purpose of the feedwater stratification test is to confirm the vertical temperature gradients that can occur in the feedwater piping, either inside or outside containment, during certain operational modes do not, when combined with thermal expansion, produce pipe stresses, pipe movements or RPV nozzle loads in excess of design allowables.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedures and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. The applicable instrumentation shall be checked or calibrated as is appropriate.

Satisfactory completion of the thermal expansion test is a prerequisite to the stratification test. This insures the piping is free of obstruction that could constrain free pipe movement.

(3) Description

The feedwater piping stratification test consists of measuring displacement, temperatures and strains of the feedwater piping during these two operating modes:

(a) During plant startup when hot RWCU is added to the cold feedwater line. The hot RWCU flows on top of the colder water in the feedwater line and does not mix with the colder water until mixing of the two stream occurs at the outer swing check isolation valve. Stratification for this condition can thus effect only the feedwater piping outside containment.

(b) The plant is in hot standby condition following scram. After scram, the temperature of the entire feedwater line is hot. When cold water is introduced to make up for decay heat boiloff in the RPV, the colder water flows along the bottom of the large diameter horizontal feedwater pipe at low flow rate, creating stratification. The temperature difference between top and bottom of the pipe will decrease along the pipe in the direction of flow, but stratification could still exist in the feedwater piping inside containment since the swing check valves are not effective in mixing the cold water flowing along the bottom of the pipe.

The test consist of measurement of (a) temperature around the circumference of the feedwater pipe at various locations inside and outside containment, (b) strains at points of highest stress inside containment, and (c) measurement of pipe displacements and movements inside and outside containment due to pipe bowing because of stratification.

(4) Criteria

Acceptance criteria are established for temperature measurements around the circumference of the pipe and for the strain measurements at the high stress points in the piping. Acceptance criteria is not provided for the displacement measurements because of the uncertainities involved with interpreting the test data which include displacements caused by both thermal expansion and stratification. The acceptance criteria for temperature are based on the measured values not exceeding actual values used for design and maximum values allowed without overstressing the feedwater pipe. The acceptance criteria for strains are based on the measured strains due to thermal expansion plus stratification not exceeding strains predicted by analysis and the maximum strains allowed by Code. The locations to be monitored and the aacceptance criteria for temperatures and strains for the monitored locations in each plant will be provided by the applicable design or testing specification.

NEW

14.2.12.2.11 System Vibration

(1) Purpose

To verify that the vibration of critical plant system components and piping is within acceptable limits during normal steady state power operation and during expected operational transients.

(2) Prerequisites

The applicable preoperational phase testing is complete and plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled test iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. The required remote monitoring instrumentation shall be calibrated and operational.

(3) Description

Vibration testing during the power ascension phase will be limited to those systems that could not be adequately tested during the preoperational phase. Systems within the scope of this testing are therefore the same as mentioned in Subsection 14.2.12.1.51. However, the systems that remain to be tested will primarily be those exposed to and affected by steam flow and high rates of core flow. Due to the potentially high levels of radiation present during power operation, the testing will be performed using remote monitoring instrumentation. Displacement, acceleration, and strain data will be collected at various critical steady state operating conditions and during significant transients such as turbine or generator trip, main steamline isolation, SRV actuation and RIP trip (if not already performed). Steady state and transient vibration affecting the RCIC steamline will also be monitored.

(4) Criteria

Criteria will be calculated for those points monitored for vibration for both steady state and transient cases. Two levels of criteria will be generated, one level for predicted vibration and one level based on acceptable values of displacement and acceleration and the associated stress to assure that there will be no failures from fatigue over the life of the plant. Failures to remain within the predicted levels of vibration should be investigated but do not necessarily preclude the continuation of further testing. However, failure to meet the criteria based on stress limits will require immediate investigation and resolution while the plant or affected system is placed in a safe condition.