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September 9, 1982
EF2 - 59,222

Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555
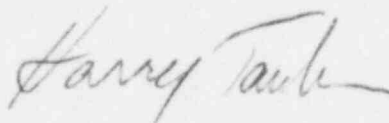
Dear Mr. Youngblood:

Reference: Enrico Fermi Atomic Power Plant, Unit 2
             NRC Docket No. 50-341

Subject: Mark I Containment
             Request For Additional Information

Attached please find our response to your July 19,
1982 request for additional information on the Fermi 2
Plant Unique Analysis Report (PUAR). Due to the time
constraint, the response is submitted in the
question/response format. After you have reviewed and
accepted our response, we will incorporate the
attachment into the PUAR, revising PUAR pages if
applicable.

If you have any questions regarding the above, please
contact Mr. Larry E. Schuerman, (313) 649-7562.

Sincerely,

Harry Tauber

Attachment

cc: Mr. L. L. Kintner
      Mr. J. Ranlet (Brookhaven National Laboratories)
      Mr. W. Seagraves (Franklin Research Institute)

A025

Question 10.1

With regard to suppression chamber analysis, provide
justification for not analyzing a 180° beam segment in-
cluding the torus, columns, and seismic restraints as
required by the criteria for considering the effect of
seismic and other lateral loads. Also, discuss the im-
plications of this approach with regard to stresses in
the suppression chamber in the region surrounding the
support columns.

Response to Question 10.1

The approach used in the Fermi PUAR to evaluate suppression

chamber lateral loads results in total lateral loads which

envelop those which would be obtained by a 180° beam model.

As discussed in PUAR Section 2-2.4.2, maximum accelerations

and dynamic load factors are used to develop bounding values

of lateral loads for seismic loads and for asymmetric torus

shell loads due to SRV discharge and pre-chug, irrespective

of the suppression chamber frequency. Specifically,

the maximum OBE spectral acceleration of 0.23g is used for

seismic loads, the maximum dynamic load factor of 2.60

is used for SRV discharge loads, and the maximum dynamic load

factor of 13.9 is used for pre-chug loads each of which occurs

at a different frequency. The resulting lateral loads for

the seismic, SRV discharge, and pre-chug loadings are added

absolutely to obtain a bounding value of the total suppression

chamber lateral load, which is conservatively assumed

to be transferred by two of the four seismic restraints.

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The total lateral load which would be produced by a 180°
beam model would be less since the response to each loading
would primarily be determined at the dominant lateral frequency
of the suppression chamber.

Lateral loads result in a shear effect and an overturning
moment effect on the suppression chamber. The horizontal shear
effect is the more significant component and is resisted by
the seismic restraints shown in Figure 2-2.1-10. The
overturning moment effect results in vertical loads which are
resisted at each mitered joint by the suppression chamber
columns and mitered joint saddles shown in Figure 2-2.1-4.
The vertical loads on any one column/saddle assembly are
small compared with those caused by the major torus shell
loadings which primarily act in the vertical direction, the
results of which are shown in Table 2-2.5-4. The corresponding
stresses in the suppression chamber shell adjacent to the
column/saddle assembly due to the overturning moment
would also be small.

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Question 10.2

With regard to the assumption that only 20% of the total mass of water in the suppression chamber contributes to lateral seismic loads, provide justification to indicate the applicability of the tests cited in the PUA report to support this assumption.

Response to Question 10.2

For a suppression chamber partially filled with water subjected to a horizontal seismic excitation, a portion of the total water mass acts as a rigidly attached mass while the remaining water mass acts in sloshing modes. The effective weight of water which acts as a rigidly attached mass was determined from 1/30 scale generic tests performed as part of the Mark I program effort. The seismic slosh test facility is identical and the test procedures used to determine the effective water weight are similar to the tests described in General Electric Report NEDC-23702-P, "Mark I Containment Program Seismic Slosh Evaluation", March 1978.

The 1/30 scale model test facility is based on a prototypical Mark I suppression chamber whose geometric characteristics are very close to those of Fermi 2. Tests were performed with three different support stiffnesses (rigid, medium, and flexible), which covered the range of stiffnesses and frequencies for all Mark I plants, including Fermi 2. The analytical model developed for use in the referenced study predicts that 20% of the total mass of water acts as a rigidly attached mass with the suppression chamber. This

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prediction was verified with the 1/30 scale model by comparing the measured frequencies of the test facility with those obtained from the analytical model. This was done by first adjusting the emptied test facility support stiffness to that necessary to obtain the frequency of the empty suppression chamber predicted by the analytical model. The test facility was subsequently filled with water to a height below the equator, and a series of tests were performed to determine the frequency. The resulting frequencies compared favorably with those obtained using the analytical model with the same assumed water height. The test results therefore confirm the analytical results which showed that 20% of the total water mass acts as a rigidly attached mass. These results are considered applicable for use in evaluating the Fermi 2 suppression chamber response to seismic loadings.

The evaluation of the Fermi 2 suppression chamber for horizontal seismic loads is discussed in Section 2-2.4.2 of the PUAR. The seismic lateral load is conservatively calculated assuming that 20% of the total water mass acts at the maximum spectral acceleration of 0.23g. The remaining 80% of water is assumed to act at the maximum accelerations in the range of sloshing frequencies. The methodology accounts for 100% of the water and results in a bounding value for the suppression chamber lateral load due to seismic loads.

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Question 10.3a

Provide detailed calculations to indicate how the modal
correction factors given in Sections 1-4.2.3 and 2-2.4.1
of the PUA report are obtained.

Response to Question 10.3a

Modal correction factors used in calculating the response due to

SRV torus shell loads are obtained by dividing the response

of an initial value or free vibration problem by that of

a transient forced vibration response problem. The physical

representations for the analogs used in developing these

correction factors are shown in Figure 10.3-1. Two representations

of source pressure in a rigid tank are shown. The transient

response problem consists of a rigid torus with a pressure

source, P_B, which is prescribed as a decaying cosine

function. The initial value problem consists of a similar

torus which contains a spring and disk mechanism for

providing an impulse to the surrounding pool water.

The analogs, described in terms of masses and springs, are

shown in Figure 10.3-2 for the transient response or forced

vibration problem and the initial value or free vibration

problem. The torus system is described in terms of a

generalized stiffness, k_s, and a generalized mass, m_s.

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The forced vibration analog is subjected to an applied loading, described as

$$P_B(t) = P_B e^{-\lambda t} \cos \omega_B t$$

where,

P_B = bubble force at time equal to zero

λ = attenuation constant

ω_B = frequency of the SRV bubble

t = time

The free vibration analog incorporates an additional mass and spring, representing the bubble system, which is utilized to establish a frequency of the bubble oscillation. The apparent or effective mass of the bubble is defined as m_B. The numerical value of an apparent bubble mass is estimated by averaging the hydrodynamic mass for the case of an oscillating sphere in a still fluid and a fixed sphere in an oscillating fluid. The bubble stiffness is computed by multiplying the bubble mass by the bubble frequency squared.

Four spherical bubbles are assumed for the T-quencher discharge device. Single bubble stiffnesses are additive since the bubbles are assumed to act in phase (i.e., parallel springs).

The initial conditions for the free vibration analog are prescribed by compressing the spring, k_B, a distance, $\Delta \ell$, such that at time equal to zero the force in the spring is equal to P_B. Therefore, at time equal to zero, both the forced vibration and free vibration analog have the same applied load magnitude.

Damping for the torus system can be described in terms of load attenuation and structural damping. Based upon test observations, it is assumed that the structural response will be decayed in the same manner as the prescribed pressure. Accordingly, a decaying exponential function of the form $e^{-\lambda t}$ is used to represent load attenuation and structural damping in the solution of the forced and free vibration system, respectively.

The equations of motion for the free vibration analog described in Figure 10.3-2 are obtained from free body diagrams for the structure mass and bubble mass as

$$m_s \ddot{X}_s - (k_s + k_B) X_s + k_B X_B = 0$$
$$m_B \ddot{X}_B - k_B X_B + k_B X_s = 0$$

where,

$$\begin{array}{rcl}
X_s & = & \text{structure mass displacement} \\
\ddot{X}_s & = & \text{structure mass acceleration} \\
X_B & = & \text{bubble mass displacement} \\
\ddot{X}_B & = & \text{bubble mass acceleration}
\end{array}$$

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The solution to these equations expressed in terms of the structure response, X_s, is given as the following function,

$$X_s = \frac{P_B}{k_s} e^{-\lambda t} f_1 \left(\frac{\omega_B}{\omega_s}, \frac{k_B}{k_s}, \frac{k_B}{m_s} \right)$$

where,

$$\omega_B = \text{bubble frequency}$$

$$\omega_s = \text{structure frequency}$$

The other variables have been previously defined.

A family of curves which represents dynamic load factors as a function of frequency (ω_B/ω_s) is generated by assuming either (k_B/m_s) or (m_B/m_s) as constant. Based upon estimates of the significant modal characteristics of the torus and the oscillating bubble, a range of values for (k_B/m_s) and (m_B/m_s) is established. The range of (k_B/m_s) values is estimated to be about 160 to 1600. The range of (m_B/m_s) values is estimated to be 0.03 to 0.3.

Figure 10.3-3 contains a comparison of DLF's for the cases with (k_B/m_s) equal to 160 and 1600, assuming a structural frequency of 20 hz. The maximum DLF for the case with (k_B/m_s) equal to 160 is 2.8, whereas for (k_B/m_s) equal to 1600, the maximum DLF is 2.0. It was determined that the DLF's for the case with (k_B/m_s) equal to a constant are about 20 to 60 percent larger than the DLF's for the case with (m_B/m_s) equal to a constant.

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The equation of motion for the forced vibration analog described in Figure 10.3-2 is obtained from the free body diagram for the structure mass as

$$m_s X_s - k_s X_s = P_B \, e^{-\lambda t} \cos \omega_B t$$

The solution to this equation is given in the following function:

$$X_s = \frac{P_B}{k_s} \, e^{-\lambda t} f_2 (\omega_B, \omega_s, \lambda)$$

Figure 10.3-4 contains DLF's plotted as a function of (ω_B / ω_s). A family of DLF curves is included for structure frequencies of 11, 14, 20 hz. The DLF's for the resonant condition range from 5.4 to 9.9 for structural frequencies between 11 and 20 hz. The forced vibration DLF's are approximately 3 to 5 times the free vibration DLF's.

Correction factors are obtained by dividing the free vibration response to the system by the response of the forced vibration system. The sensitivity of the correction factor to the variables $(k_b / m_s, m_B / m_s, \lambda)$ is evaluated in order to determine a valid set of correction factor curves to be used in design.

Based upon the above evaluation, it was determined that the lower range of (k_B / m_s) should be used for determining conservative design basis modal correction factors. An

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attenuation factor of 6 is selected, since use of this
factor results in correction factors which bound the
response at resonance conditions for all structural fre-
quencies.

A typical correction factor curve is shown in Figure 10.3-5
for a structural frequency of 20 hz. For the plant unique
analysis, a set of enveloping correction factors is gene-
rated for different modal frequencies of interest as shown
in PUAR Figure 2-2.4-5.

Table 10.3-1 contains a comparison of analytical results
obtained using modal correction factors and measured
results for Monticello. The results shown are obtained
by dividing analytical results by test results for key
response parameters. The comparisons show that modal
correction factors provide a conservative basis for cali-
brating the analytical model used to evaluate the response
of the Fermi-2 suppression chamber for SRV torus shell
loads. The modal correction factors are developed at test
conditions and applied at design conditions in accordance
with NUREG-0661.

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Location	Component	Test Condition	
		Cold Pop	Hot Pop
	a) Stress Intensity		
78° From Inside Equator Midbay	Shell Membrane	1.2	1.3
78° From Outside Equator Midbay	Shell Membrane	1.4	2.3
	b) Column Reaction		
Inside Support Column	Upload	3.7	3.0
Inside Support Column	Download	2.8	2.0
Outside Support Column	Upload	4.4	3.5
Outside Support Column	Download	2.7	2.8

Table 10.3-1 - Corrected Transient Response Analysis
Normalized by Test Response

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$$P_B(t) = P_B e^{-\lambda t} \cos \omega_B t$$

$$\text{AT TIME ZERO: } P_B = \frac{k_B \Delta t}{A}$$

$P_B(t)$

P_B
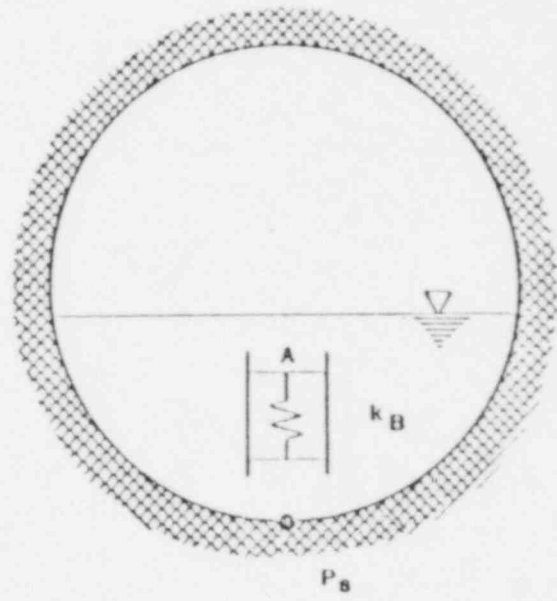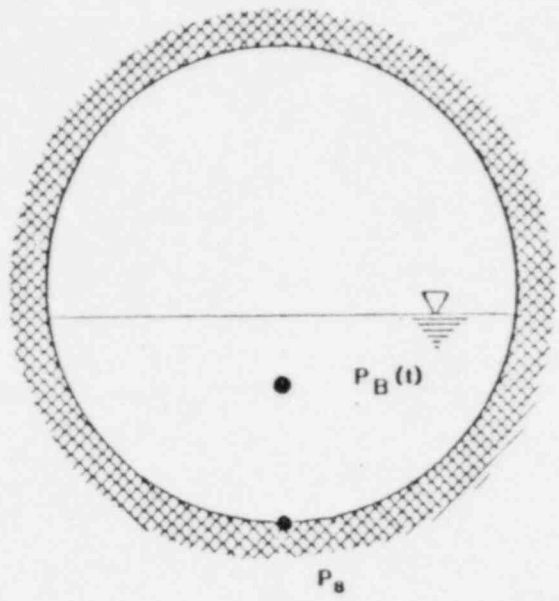
a) TRANSIENT DEFINITION

A

k_B

P_B

b) INITIAL VALUE DEFINITION

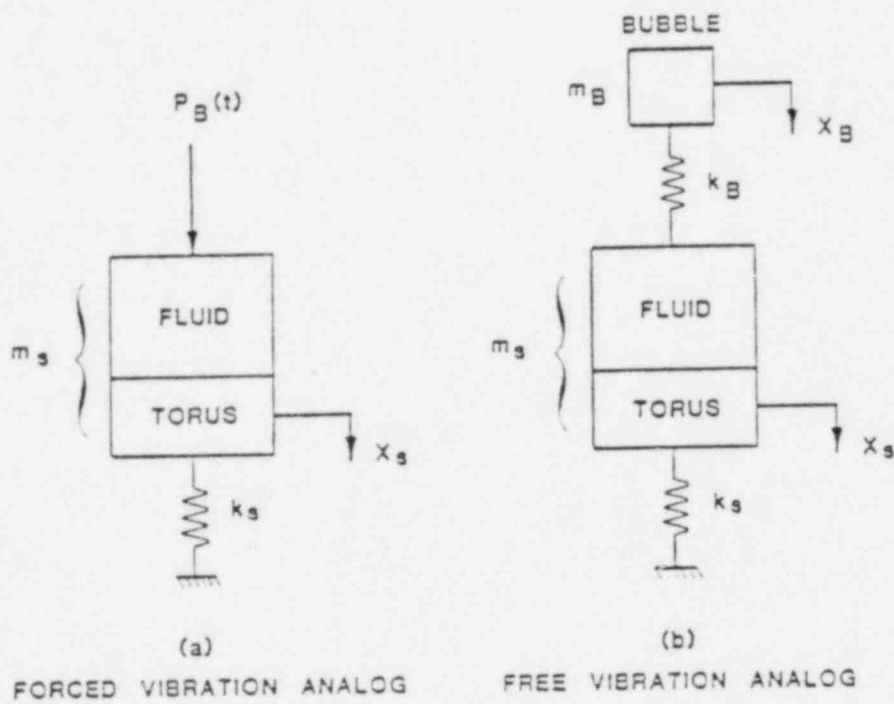Figure 10.3-1 - SRV Load Definition
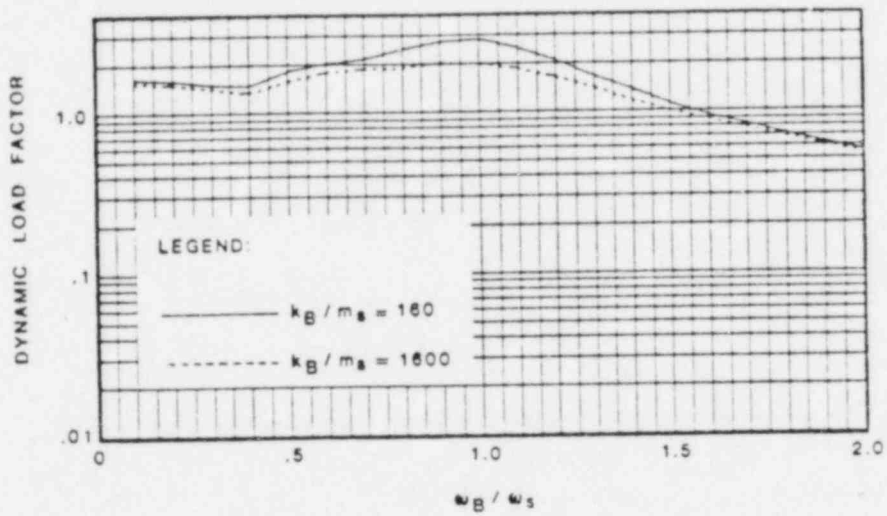
Figure 10.3-2 - Structural Response Analogs

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Figure 10.3-3 - Free Vibration Analog Dynamic Load Factors
For (k_B/m_S) Constant
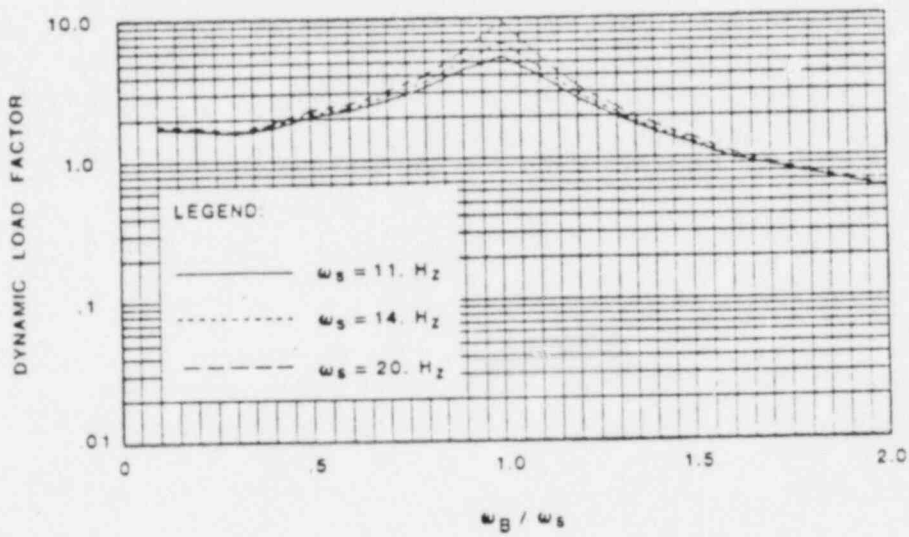
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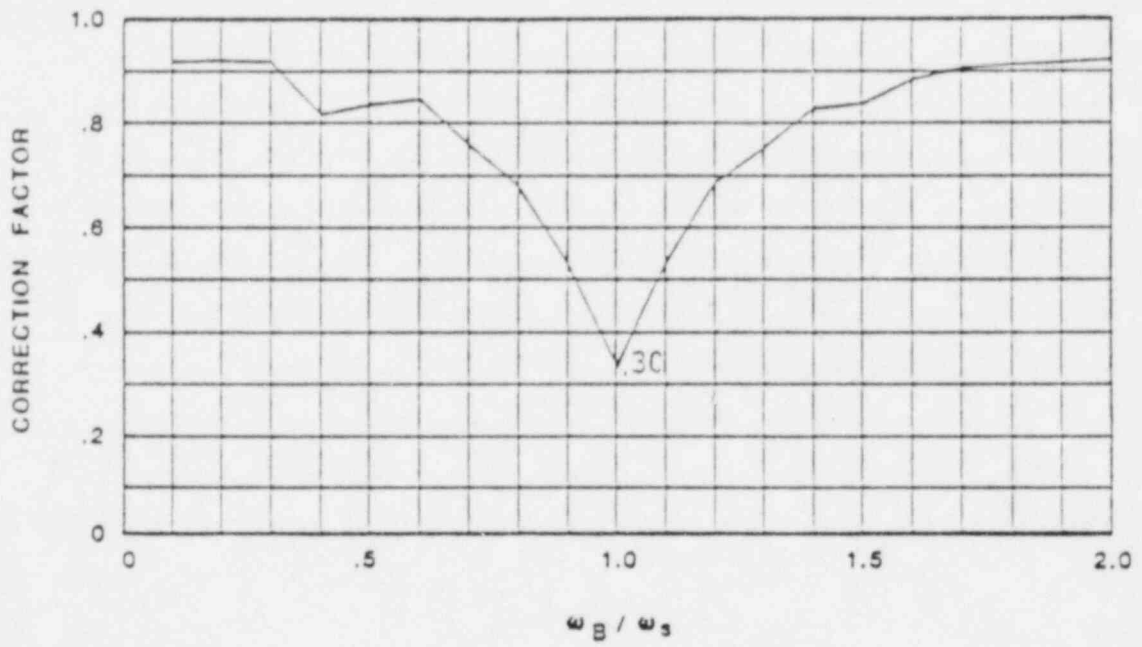Figure 10.3-4 - Forced Vibration Analog Dynamic Load Factors

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Figure 10.3-5 - Typical Modal Correction Factor

Question 10.3b

Provide justification for the applicability of these factors
to "multidegree of freedom" systems since the factors were
developed using simple "one degree of freedom" systems.

Response to Question 10.3b

The transient response of the Fermi 2 suppression chamber

due to SRV torus shell loads is obtained using the modal

superposition method. Using this approach, the equations of

motion for a multi-degree of freedom system, such as the

suppression chamber, are decoupled into a set of equivalent

single degree of freedom systems. Each structural frequency

or mode is represented by a single degree of freedom system.

The responses of each single degree of freedom system

are summed to obtain the total response of the suppression

chamber.

During the summation process, modal correction factors

obtained from PUAR Figure 2-2.4-5 are applied to the response

of each single degree of freedom system for each suppression

chamber frequency. As discussed in the response to question

10.3a, the modal correction factors are developed using

single degree of freedom systems and are compatible for

use in the modal superposition method since this method is

completely linear.

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Question 10.4

Provide justification for not considering the effect of
bending moments in column analysis using interaction for-
mulae.

Response to Question 10.4

Consideration of column bending moments using the interaction

formula is necessary when compressive stresses or column

buckling is a concern. Since the suppression chamber support

columns for Fermi 2 are heavily reinforced and braced

continuously along their length, as shown in Figure 2-2.1-7

of the PUAR, the effects of buckling are negligible. Further-

more, bending moments in the support columns are small since

the columns are permitted to slide horizontally at their

base. The support column loads shown in Table 2-2.5-4

are substantially below the allowable compressive loads for

the support column wide flange sections with cover plates.

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Question 10.5

With regard to the suppression chamber columns, provide
justification and/or additional information to indicate
why a nonlinear time history analysis was not performed
as required by the criteria when net tensile forces are
produced in the columns. Table 2-2.5-2 of PUA report
indicates that net tensile forces are produced in the
columns.

Response to Question 10.5

The criteria requirements for performing a non-linear

time history analysis are applicable for plants in which

the suppression chamber and its supports are not anchored

to the basemat. Such a condition would result in gross

non-linear behavior if uplift loads exceeded the weight

of the suppression chamber and contained water.

The Fermi 2 suppression chamber is fully anchored to the basemat

at each mitered joint column and saddle base plate location,

as shown in PUAR Figures 2-2.1-7 and 2-2.1-8. Although

tensile forces are produced in the column and saddle supports,

the tensile forces are less than the allowable anchorage

capacity of the support system, as shown in PUAR Table

2-2.5-4. The requirements for a non-linear analysis, therefore,

need not be evaluated for Fermi 2 since the suppression chamber

is fully anchored to the basemat and the effects of non-linearities

on the overall suppression chamber response have been minimized.

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Question 10.6

Provide justification for using two different temperatures, 173°F for suppression chamber and vertical support systems and 100°F for the base plate of the support system, for calculating the respective allowable stresses.

Response to Question 10.6

The allowable stresses for the suppression chamber and its vertical supports are conservatively determined at 173°F since this is the maximum temperature specified for any LOCA event, as shown in PUAR Figures 2-2.2-4 through 2-2.2-6. The allowable stresses for the vertical support system base plates are determined at 100°F which bounds the maximum temperatures of the base plate expected during the specified events. There may be long term conditions which result in higher base plate temperatures, however base plate temperatures higher than 100°F are not expected to occur during times of peak transfer of hydrodynamic loads to the suppression chamber vertical support system. Furthermore, the allowable stresses at 100°F and 173°F are not significantly different.

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Question 11.1

Provide justification for using SRSS method to combine the
SSE and LOCA responses for SRV piping analysis instead of
the absolute sum or cumulative distribution function
approaches as required by the criteria.

Response to Question 11.1

The method of combining responses due to LOCA and SSE loads

for SRV piping described in Section 5-2.2.3 of the Plant

Unique Analysis Report (PUAR) is based on NRC document NUREG-

0484, Revision 1, "Methodology for Combining Dynamic Responses",

published in May, 1980. The original issue of NUREG-0484 justified

combination of responses due to LOCA and SSE within the reactor

coolant pressure boundary using the SRSS technique. The current

Revision 1 has extended the application of this combination

technique to include ASME Section III, Class 1,2, and 3 systems,

components and supports. As described in Revision 1, use of the

SRSS technique provides a non-exceedance probability of 84 percent

or higher. Since the Fermi 2 SRV piping is Class 2, the use of

the SRSS method is acceptable based on Revision 1 of NUREG-0484.

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Question 11.2

Provide justification for using Markl's equation for fatigue analysis of SRV piping instead of the SN curve given in ASME Code Section III, Division 1 Appendices.

Response to Question 11.2

The methodology for evaluating Fermi 2 SRV piping fatigue was originally presented to the NRC during a meeting in June of 1981 and was followed by a letter submitted to the NRC shortly thereafter (Reference 11.2-1). Section 3.9.3 of Supplement 1 of the Fermi 2 Safety Evaluation Report (NUREG-0798) references the required fatigue evaluation and the proposed methodology.

Since the SRV piping is a Class 2 system, the approach outlined in the presentation and letter was to evaluate fatigue using ASME Class 2 piping rules as a guideline. The proposed methods included extension of the Class 2 equations and curves used for thermal fatigue evaluation to include all cyclic loads. A comparison of the extended Class 2 method to a Class 1 fatigue analysis was also provided which showed that the two methods yield similar results.

Using the proposed methods, a fatigue usage factor is determined for each of the cyclic loadings. For Mark I LOCA related loads, estimates of total stress cycles during plant life would be determined and associated fatigue usage would be calculated. Since only very conservative estimates of the number of SRV

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discharge related stress cycles were available, the approach proposed that SRV actuations would be monitored to assure that the allowable fatigue usage was not exceeded.

Following Detroit Edison Company's commitment to the NRC to perform an SRV piping fatigue evaluation, the matter was discussed between the NRC and the Mark I Owner's Group. These discussions resulted in a commitment by the Mark I utilities to perform fatigue evaluations for SRV piping in the torus and for torus attached piping systems as part of the plant unique analyses.

Discussions among Mark I Owners and their AE's followed and a task force was formed to develop a generic approach for fatigue evaluation. The approach agreed upon was a method which extended the Class 2 piping fatigue rules similar to the methods initially proposed for Fermi.

Refinements to the proposed Fermi 2 methods which have been incorporated into the generic approach consist of the following:

o Fatigue usage is evaluated based on considering
   critical loading combinations instead of on an
   individual load basis.

o   Total cumulative fatigue usage for all cyclic
    loadings is calculated in lieu of monitoring
    SRV actuations.

o   The allowable number of stress cycles is determined
    by using Markl's equation (Reference 11.2-2) in
    lieu of the Class 2 thermal fatigue equation basis.
    (Markl's equation forms the basis for Class 2 piping
    fatigue and was used in developing the Class 2 piping
    Stress Intensification Factors).

o   Actual stress cycles for a given response time-history
    are converted into equivalent full stress cycles using
    the methodology defined in Section NC-3611.(e)(3) of
    the Code.

The SRV piping fatigue evaluation performed for Fermi-2
and documented in Volume 5 of the PUAR includes the extended
Class 2 approach originally proposed for Fermi-2 and incor-
porates the additional refinements included in the generic
Mark I approach. The refinements result in a more practical,
comprehensive method of evaluation for fatigue.

Reference 11.2-1 - Detroit Edison Company Letter EF2-53,824
to NRC dated June 22, 1981.

Reference 11.2-2 - Markl, A.R.C., "Fatigue Test of Piping
Components", Transactions ASME, Volume 74.

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Question 11.3

Provide justification for not using Equation 11 of ASME
Code Section III, Subsection NB for calculating the fatigue
stresses, and explain the method used.

Response to Question 11.3

Justification for not using Equation 11 of ASME Code

Section III, Subsection NB (Class 1 Piping) is provided in

the response to Question 11.2. Equation 11 of Subsection

NC (Class 2 Piping) of the ASME Code provides combination

methods for thermal and other sustained loads used in evalu-

ating for fatigue. The methods applied in the Fermi Plant

Unique Analysis Report extended traditional usage of Equation

11 to combination of stresses due to dynamic cyclic loadings,

using the same method of absolute summation of stresses.

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Question 11.4

Provide justification and reference for the maximum-stress cycle factors given in Table 5-2.4-4 of the PUA report.

Response to Question 11.4

See the response to Question 11.2 for a description of the methodology for evaluating Fermi-2 SRV piping fatigue. The basis for developing R factors used to determine maximum equivalent full stress cycles is derived from the Class 2 piping thermal fatigue techniques defined in Section NC-3611.2(e)(3) of the Code. R factors for individual dynamic cyclic loadings also take into account consideration of loading characteristics such as frequency, time-history and random phasing of load components.

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Question 11.5

Provide the magnitudes of the dynamic load factors used
in Tables 5-3.2-1 to 5-3.2-3 of the PUA report and the
justification.

Response to Question 11.5

The dynamic load factors (DLF) included in the loads specified

in Tables 5-3.2-1 through 5-3.2-3 of the PUAR are summarized

in the attached Table 11.5-1.

The loading functions for water jet impingement loads, T-quencher

thrust loads, and T-quencher end cap thrust loads are

defined as rectangular pulse loadings. The maximum DLF

specified by standard structural dynamics handbooks for

this type of load function is 2.0.

DLF's for SRV air bubble drag loads were determined using

Monticello in-plant test data as permitted by NUREG-0661.

The criteria states that actual measured pressure wave

forms determined in tests may be used to develop a maximum

structural amplification for resonant conditions. Using

the measured Monticello pressure waveforms, a maximum DLF

of 3.0 at resonant conditions was developed and is used

for structures whose natural frequency is within the 4.0

to 14.0 Hz frequency range of the SRV air bubble drag

loads. For structures whose natural frequency is well

above the maximum air bubble drag load frequency a DLF of

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2.0 is conservatively used. The natural frequencies of the T-quencher and its supports and the submerged SRV piping are sufficiently above the maximum air bubble drag load frequency, as shown in PUAR Figures 5-3.4-3 through 5-3.4-6.

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Table 11.5-1

PUAR Dynamic Load Factors for SRV Piping, T-quenchers, and T-quencher Supports

Load Type	PUAR Table Number	Dynamic Load Factor (DLF)
SRV water jet impingement	5-3.2-1	2.0
SRV air-bubble drag	5-3.2-1 and 5-3.2-3	2.0
T-quencher and end cap thrust load	5-3.2-2	2.0

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Question 11.6

Provide the results of the analysis of bolted or welded
connections associated with the SRV piping.

Response to Question 11.6

The tables in the PUAR which contain analysis results for wetwell

SRV piping major support connections and welds are shown

in the attached Table 11.6-1. The referenced tables

show that SRV piping wetwell support connection stresses

are within allowable limits.

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Table 11.6-1

PUAR Table References for Wetwell SRV Piping Support

Connections and Welds

Support Connection/Weld Stress	PUAR Table Number
Vent Line-SRV Piping Penetration and Welds	3-2.5-6
SRV Piping Vent Line and Vent Header Supports	5-2.5-5
Ramshead and T-quencher Arm Supports and Welds	5-3.5-4

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Question 12.1

Provide justification for the method of lumping additional
fluid masses along the ringbeam, quencher beam (Page 2-2.103
of PUA report), submerged length of SRV piping, T-Quencher
and supports (Page 5-3.49 of PUA report) as indicated in the
PUA report.

Response to Question 12.1

The hydrodynamic masses used for evaluating submerged

structures are calculated using the relationships con-

tained in PUAR Table 1-4.1-1 which are taken from LDR

Table 4.3.4-1 (Reference 12.1-1). For the SRV piping,

ramshead, T-quencher arms, 6 in. diameter lateral sup-

port members, and 20 in. diameter lateral support beam,

the hydrodynamic mass equations for a circular cyclinder

were used. The hydrodynamic mass for the T-quencher arm

ring plate supports are calculated using the equation for

a circular disk. For the ring beam and vertical quencher

support beam, the hydrodynamic mass is calculated using

the equation for a plate in the lateral direction and an

I-beam in the vertical direction.

Reference 12.1-1 - General Electric Report NEDO-21888,

Revision 2, "Mark I Containment Program Load Definition

Report", dated December, 1981.

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Question 12.2

Provide justification for not considering the loads
indicated in Table 1 which are required in the analysis
according to NUREG-0661.

Response to Question 12.2

All loads specified by NUREG-0661 were addressed in the PUAR.

The loads identified in Table 1 which are not included in

Table 1-4.3-1 of the PUAR can be categorized as being negligible,

not applicable to the Fermi plant, or are considered in the

analysis. The loads circled in Table 1 are discussed in

the paragraphs which follow.

4.3.5 Froth Impingement. The froth impingement loads on the
torus shell are negligible as indicated in LDR
Section 4-3.5-1. The torus support system will
also have negligible effects due to the froth
impingement. For SRV piping, the portion below
the vent header is protected from pool swell impact
loads by the vent header deflector. The portion
below the vent line experiences negligible loads
due to froth impingement.

4.3.8 LOCA Bubble Drag. The vent header support columns are
the only structures above the bottom of the downcomers
and below the normal water level. The LOCA bubble
drag loads on these columns are contained in
PUAR Table 3-2.2-9.

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4.5.3   Chugging Vent System Loads. The chugging loads on the main vent and vent header were considered in the analysis and are contained in PUAR Table 3-2.2-19.

5.2.5   T-Quencher Air Bubble Drag. The SRV air bubble drag loads on these structures were considered in the PUAR. The SRV air bubble drag loads on the downcomers are given in PUAR Table 3-2.2-22. The SRV air bubble drag loads on the T-Quencher and the SRV piping are given in PUAR Table 5-3.2-3, and the SRV air bubble drag loads on the T-Quencher supports and vent header support columns are given in PUAR Tables 5-3.2-1 and 3-2.2-23, respectively.

5.2.6   Thrust loads on T-Quencher arms. The thrust loads on T-Quencher arms are given in PUAR Table 5-3.2-2.

5.2.7   SRVDL Environmental Temperatures. The SRV discharge line environmental temperature loads are discussed on page 5-3.17 of the PUAR.

5.3   Ramshead Loads. Ramshead loads are not applicable for Fermi 2 since the SRV Lines are equipped with the T-Quencher discharge devices rather than the ramsheads.

Question 12.3

Provide information on the analysis of the attachment
welds of regions connecting the internal structures to
the torus shell, indicating whether the criteria require-
ments have been satisfied.

Response to Question 12.3

The internal structure attachment welds to the torus

shell have been evaluated in accordance with the criteria

requirements. The attached Table 12.3-1 shows the most

highly stressed catwalk and monorail support pad plate

attachment welds to the torus shell. The load combinations

for which the welds are evaluated are presented in PUAR

Table 4-2.2-2. The welds are evaluated using the ASME Code

criteria contained in Subsection NE for Class MC components.

As can be seen from the attached table, the internal

structure attachment weld stresses are within allowable

limits.

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Table 12.3-1

Catwalk and Monorail Support Pad Plate Weld Stresses

Item	Calculated Stress (ksi)	Allowable Stress (ksi)	Calculated / Allowable
Catwalk Pad Plate Weld	3.46	15.01	0.23
Monorail Pad Plate Weld	0.49	15.01	0.03

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