DET-04-028-3
Revision 1
November 1983

ENRICO FERMI ATOMIC POWER PLANT
UNIT 2
PLANT UNIQUE ANALYSIS REPORT
VOLUME 3
VENT SYSTEM ANALYSIS

Prepared for:
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REVISION CONTROL SHEET
(Continuation)

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EFFECTIVE PAGE(S)	REV	PREPARED	ACCURACY CHECK	CRITERIA CHECK
3-2.109 through 3-2.111	0	RDQ	VK	RAL
3-2.112 through 3-2.132	↓	RAL	RDQ	VK
3-2.133 through 3-2.136	↓	MLF	CST	VK
3-2.137 through 3-2.143	↓	MLF	CST	RDQ
3-2.144 through 3-2.148	↓	RAL	RDQ	VK
3-2.149	↓	KEP	CST	RDQ
3-2.150 through 3-2.158	↓	RAL	RDQ	VK
3-2.159	↓	SQ	CST	RDQ
3-2.160	↓	JDL	[illegible]	RAL
3-2.161 through 3-2.162	↓	KEP	CST	RDQ
3-2.163	↓	[illegible]	TL	CST
3-2.164 through 3-2.167	↓	RAL	RDQ	VK
3-2.168	↓	SQ	RDQ	VK
3-2.169 through 3-2.170	↓	RAL	RDQ	VK
3-2.171	0	MLF	SM	VK
3-2.172	0	MLF	MAR	VK
3-2.173	↓	TL	CST	RDQ
3-2.174	↓	MAR	S.M	RDQ
3-2.175	↓	KEP	MLF	RDQ
3-2.176	↓	ASL	VKRL	CST
3-2.177	↓	MAR	S.M	RDQ
3-2.178	↓	[illegible]	JCH	JCH
3-2.179 through 3-2.181	↓	SQ	CST	RAL
3-2.182 through 3-2.186	↓	RAL	RDQ	VK
3-3.1	0	SQ	VK	RAL
3-iii	1	LDS	VK	VK
3-v	1	↓	↓	↓
3-2.37	1	↓	↓	↓
3-2.70	1	↓	↓	↓
3-2.129	1	↓	↓	↓
3-2.184	1	↓	↓	↓
3-3.1	1	LDS	VK	VK

QEP-001.4-00

components of the vent system located in specified regions above the rising suppression pool. The components located in Region I which are affected include the downcomer bracing members and ring plates, the vacuum breaker and vacuum breaker supports and the SRV piping supports beneath the vent line. The components located in Region II which are affected include the vacuum breaker and vacuum breaker supports. The plant unique QSTF test results adjusted for the vent line longitudinal location show that froth impingement loads on the vent line are negligible.

The procedure used to develop the transient forces and spatial distribution of froth impingement and fallback loads on these components is discussed in Section 1-4.1.4. The resulting magnitudes and distribution of froth impingement and fallback pressures on the downcomer bracing members and ring plates, and the vacuum breaker and vacuum breaker supports are summarized in Table 3-2.2-6. The froth impingement loads acting on the SRV piping and supports located beneath the vent line are presented in Volume 5 of this report. The results shown include the effects of using the plant unique QSTF movies to determine the source velocity, departure angle, and froth density. Pool swell loads do not occur during the SBA and IBA events.

d. Pool Fallback Loads: During the later portion of the pool swell event, transient drag pressures are postulated to act on selected components of the vent system located between the maximum bulk pool height and the downcomer exit. The components affected include the downcomer bracing members and ring plates, and the SRV piping and supports located beneath the vent line. The procedure used to develop transient drag pressures and spatial distribution of pool fallback loads on these components is discussed in Section 1-4.1.4.

The resulting magnitudes and distribution of pool fallback loads on the downcomer bracing members and ring plates are summarized in Table 3-2.2-7. The pool fallback loads on the SRV piping and supports located beneath the vent line are presented in Volume 5 of this report. The results shown include the effects of maximum pool displacements measured in

Table 3-2.2-14

MAXIMUM DOWNCOMER CHUGGING LOAD MAGNITUDE DETERMINATION

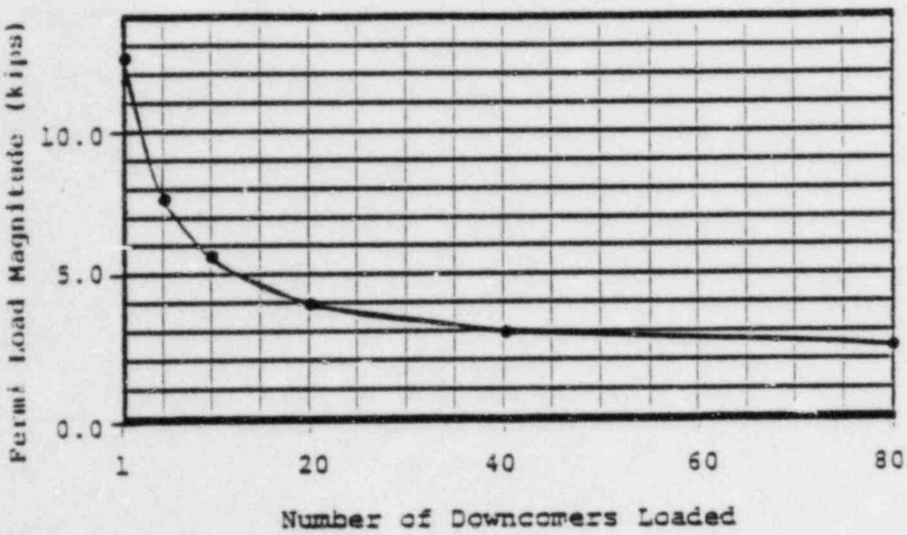
Maximum Chugging Load for Single Downcomer
FSTF Maximum Load Magnitude: P_1=3.046 kips Tied Downcomer Frequency: f_1=2.9 Hz Pulse Duration: t_d= 0.003 sec. Dynamic Load Factor: $DLF_1 = \pi f_1 t_d = 0.027$ Fermi 2 Downcomer Frequency: f=12.4 Hz Dynamic Load Factor: $DLF = \pi f t_d = 0.117$ Maximum Load Magnitude (In any direction): $P_{max} = P_1 \left(\frac{DLF}{DLF_1}\right) = (3.046)(4.276) = 13.02$ kips

Note:

1. See Figure 3-2.4-6 for Fermi downcomer frequency determination.

Table 3-2.2-15

MULTIPLE DOWNCOMER CHUGGING LOAD MAGNITUDE DETERMINATION



Chugging Loads for Multiple Downcomers (kips)				
Number of Downcomers	Number of Chugs	Probability of Exceedance	FSTF Load Per Downcomer	Fermi Load Per Downcomer
5	344	2.91×10^{-3}	1.77	7.57
10	688	1.45×10^{-3}	1.26	5.39
20	1375	7.27×10^{-4}	0.91	3.89
40	2751	3.64×10^{-4}	0.68	2.91
80	5502	1.82×10^{-4}	0.57	2.44

FSTF

Chugging duration: $T_{c_1} = 512$ sec
Number of downcomers: $n_{dc_1} = 8$
Number of chugs: $N_{c_1} = 313$

Fermi

Chugging duration: $T_c = 900$ sec
Number of downcomers: $n_{dc} = 2$ to 80

Number of chugs: $N_c = \frac{N_{c_1}}{T_{c_1} \times n_{dc_1}} \times T_c \times n_{dc}$

Probability of exceedance: $P_{ex} = 1/N_c$

NOTE:

1. SEE THE RESPONSE TO NRC QUESTION 4 IN APPENDIX A FOR ADDITIONAL INFORMATION ON THE MULTIPLE DOWNCOMER CHUGGING LATERAL LOADS.

f. DBA Condensation Oscillation Submerged Structure Loads: An equivalent static analysis is performed for the DBA condensation oscillation submerged structure loads on the support columns. These loads are shown in Table 3-2.2-13. The loads include dynamic amplification factors which are computed using the methodology described for LOCA air clearing submerged structure loads in load case 5e. The DBA condensation oscillation submerged structure loads acting on the submerged portion of the SRV piping are also applied.

7. Chugging Loads

a. Chugging Downcomer Lateral Loads: A harmonic analysis of the downcomers is performed to determine the dominant downcomer frequency for use in calculating the maximum chugging load magnitude. The harmonic analysis results are shown in Figure 3-2.4-6. The resulting chugging load magnitudes are shown in Table 3-2.2-14. A static analysis using the 1/16th beam model is performed for chugging downcomer lateral load cases 8 through 22. These load cases are shown in Tables 3-2.2-16 and 3-2.2-17. An additional static analysis using the 180° beam model is performed for boundary displacements and associated concentrated forces generated for load cases 1 through 7.

A static analysis is also performed for the maximum chugging load shown in Table 3-2.2-18, applied to a single downcomer in the in-plane and out-of-plane directions. The results of this analysis are used in evaluating fatigue.

Reference 7 provides additional information on the Fermi 2 design margins for the single downcomer chugging lateral load.

b. Chugging Vent System Pressures: An equivalent static analysis is performed for the chugging vent system pressures applied to the unreacted areas of the vent system. These loads are shown in Table 3-2.2-19. The dominant vent line and vent header frequencies are determined from the harmonic analysis results shown in Figure 3-2.4-7.

have a rated capacity of 500 cycles at maximum displacement, their adequacy for fatigue is assured.

The vent system fatigue usage factors shown in Table 3-2.5-8 are computed for the controlling events, which are Normal Operating plus SBA and Normal Operating plus IBA. The governing vent system component for fatigue is the vent header at the downcomer-vent header intersection. The magnitudes and cycles of downcomer lateral loads are the primary contributors to fatigue at this location.

The governing vent system weld for fatigue is the nozzle to gusset weld at the SRV penetration to the vent line. SRV temperature and thrust loads and the number of SRV actuations are the major contributors to fatigue at this location.

Fatigue effects at other locations in the vent system are less severe than at those described above, due primarily to lower stresses and a lesser number of stress cycles.

Results of studies to analyze and modify the Fermi 2 wetwell-to-drywell vacuum breakers are described in References 8 and 9.

3-2.5.2 Closure

The vent system loads described and presented in Section 3-2.2.1 are conservative estimates of the loads postulated to occur during an actual LOCA or SRV discharge event. Applying the methodology discussed in Section 3-2.4 to examine the effects of the governing loads on the vent system results in bounding values of stresses and reactions in vent system components and component supports.

The load combinations and event sequencing defined in Section 3-2.2.2 envelop the actual events postulated to occur during a LOCA or SRV discharge event. Combining the vent system responses to the governing loads and evaluating fatigue effects using this methodology results in conservative values of the maximum vent system stresses, support reactions, and fatigue usage factors for each event or sequence of events postulated to occur throughout the life of the plant.

The acceptance limits defined in Section 3-2.3 are at least as restrictive, and in many cases more restrictive, than those used in the original containment design documented in the plant's FSAR. Comparing the resulting

3-3.0 LIST OF REFERENCES

1. "Mark I Containment Long-Term Program," Safety Evaluation Report, NRC, NUREG-0661, July 1980.

2. "Mark I Containment Program Load Definition Report," General Electric Company, NEDO-21888, Revision 2, December 1981.

3. "Mark I Containment Program Plant Unique Load Definition," Enrico Fermi Atomic Power Plant Unit 2, General Electric Company, NEDO-24568, Revision 1, June 1981.

4. Enrico Fermi Atomic Power Plant Unit 2, Final Safety Analysis Report (FSAR), Detroit Edison Company, Section 3.8, Amendment 12, June 1978.

5. "Mark I Containment Program Structural Acceptance Criteria Plant Unique Analysis Application Guide, Task Number 3.1.3," General Electric Company, NEDO-24583-1, October 1979.

6. ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1977 Edition with Addenda up to and including Summer 1977.

7. Letter EF2-61,658 from Harry Tauber (Detroit Edison) to B. J. Youngblood (NRC), "Downcomer Chugging Lateral Loads," dated February 11, 1983.

8. Detroit Edison Letter EF2-59,061 to NRC, "Evaluation of the Enrico Fermi 2 Drywell-to-Wetwell Vacuum Breakers," dated August 18, 1982.

9. Letter EF2-60,296 from Harry Tauber (Detroit Edison) to L. L. Kintner (NRC), "Submittal of Reports for the Fermi 2 Vacuum Breakers," dated November 9, 1982.