TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

FEB 0 3 1995

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION ON FSAR CHAPTER 3 AS REVISED BY AMENDMENT 79 (TAC NOS. M88488 AND M88489)

This letter provides TVA's response to the NRC's request for additional information (RAI) dated October 11, 1994, concerning the subject FSAR chapter for WBN.

Enclosure 1 provides TVA's response to the NRC's Question 4 concerning the seismic analysis of coupled interior concrete structure and the Nuclear Steam Supply System model. This enclosure also includes TVA's response to the concerns in NRC Question 5.c on increasing allowable stresses.

Enclosure 2 provides proposed FSAR changes as a result of the response to Question 5.c. This enclosure also provides proposed FSAR changes concerning buckling stress as discussed in the NRC's evaluation of Question 5.d of the October 11, 1994 letter, in addition to those incorporated into Amendment 88. These proposed FSAR changes will be incorporated in Amendment 89.

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Change:		Ltr.	Encl.
	BNL Pratt, T	1	1NP
	NOAC	1	1NP
	NRC PDR	1	1NP

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A PDR

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Enclosure 3 list the commitments being tracked by this submittal. If you should have any questions, please telephone John Vorees at (615) 365-8819.

Sincerely,

Dwight E.

Dwight E. Nunn
Vice President
New Plant Completion
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50-390 TVA WATTS BAR 1

REQUEST FOR ADDITIONAL INFORMATION ON FSAR CHAPTER 3 AS REVISED BY AMENDMENT 79.

REC'D W/LTR DTD 02/03/95....9502170185

ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT (FSAR), CHAPTER 3
REQUEST FOR ADDITIONAL INFORMATION (RAI) RESPONSE

The following provides the response to NRC's concerns in Question 4 on seismic analysis of coupled interior concrete structure (ICS) and Nuclear Steam Supply System (NSSS) model and to NRC's concerns in Question 5.c on allowable stresses.

QUESTION 4 CONCERNS

"The staff concludes that the applicant's response is not sufficient. To be acceptable, the applicant should include more detailed discussion of the combined ICS and NSSS models as an appendix to the WBN FSAR. As a minimum, the additional information should include:

1. Geometry and sketches of the model,
2. Engineering data, such as, mass, spring, damping, size and location of the gaps, location of one-way hangers,
3. Description of modelling of gap and one-way hanger and validation of such model,
4. Detailed description of four linearized NSSS support stiffness and a discussion of how such supports adequately represent the nonlinear system being evaluated,
5. Discussion of governing equation of motion and the validation of numerical integration algorism including stability and error estimate as discussed in "Analysis of Numerical Methods," E. Isaacson and H. B. Keller, 1966 .
6. Validation of overall model and
7. Summary of the calculated stresses of the critical members both in concrete structure and piping and supports, corresponding allowable stresses and references from which the allowable stresses are quoted."

RESPONSE

INTRODUCTION

A combined model of the ICS and the NSSS was developed to generate seismic responses and acceleration response spectra (ARS) under Set B and Set C seismic conditions for piping attached to the NSSS. Westinghouse supplied the model of the NSSS components which was included to account for the interaction between the NSSS and the ICS. The coupled model was used only to develop ARS for use in the seismic analyses of piping connected to the NSSS. The actual design basis of the NSSS continues to be based on analyses previously performed by Westinghouse. Westinghouse also confirmed that the existing NSSS design was adequate for the Set B evaluation basis loads.

The NSSS components included in the coupled model for the ICS consists of the Reactor Pressure Vessel (RPV), four loops of primary reactor coolant loop (RCL) piping (hot legs, cold legs, and cross-over legs), the steam generator (SG), and the reactor coolant pump (RCP) associated with each loop. The NSSS models for four loops consist of masses and mass moments of inertia lumped at the nodal points of RPV, RCL piping, SG, and RCP, and interconnected with elastic elements. The stiffness properties of the elastic elements are represented by various 12 x 12 generalized stiffness matrices. The NSSS components are supported on the ICS at the RCL attachment points shown in FSAR Figures 5.5-6 thru 5.5-13 in Attachment 1 of this enclosure. The following supports for each loop are included in the NSSS models as elastic elements represented by a set of 6 x 6 generalized support stiffness matrices.

a. SG lower support (SGLS)
b. SG upper support (SGUS)
c. Cross-over leg restraint SG side (XL SG Side)
d. Cross-over leg restraint RCP side (XL RCP Side)
e. RCP lower support (RCPLS)

f. RCP tie rods #1, #2, and #3
g. Feed water line (FWL)
h. Main steam line (MSL)

The dynamic model data for the NSSS components consists of the nodal geometry, lumped masses, 12 x 12 RCL element stiffness matrices, and 6 x 6 RCL support stiffness matrices and is obtained from Westinghouse Electric Corporation. In coupling the Unit 1 NSSS model to the Unit 1 ICS stick model, the RCL attachment points are connected to the ICS model at the appropriate elevations of the attachment points through rigid links. The details of the seismic analysis model for the ICS are shown on FSAR Figures 3.7-8, 3.7-8A and 3.7-8B (For convenience, see Attachment 1 of this enclosure). The dynamic model for the RPV is shown in the FSAR Figure 3.7-8C (See Attachment 1). The development of the coupled model is documented in WBN Calculations WCG-1-343 and WCG-1-344 (References 2 and 3). These calculations were previously reviewed by the NRC and the conclusion was documented in Reference 4.

1. GEOMETRY AND SKETCHES OF THE MODEL

Figures 1 thru 4 in Attachment 2 of this enclosure, show the analytical models used to represent the NSSS components in the coupled model. Due to the presence of gaps and tension-only tie rods at the NSSS supports, these supports exhibit nonlinear behavior under dynamic loading conditions. However, the use of a complex nonlinear model is impractical for the production of responses and ARS for design usage. Therefore, a conservative linear model was used to develop ARS for the coupled model.

For the purpose of linear response analyses, four linearized NSSS analysis cases, each with a unique set of linearized NSSS support stiffness, are used to bound the nonlinear support behavior under various dynamic loading conditions. These four cases are designated as NSSS Analysis Cases 1, 3, 5, and 6 (Reference 1). Specifically, for each NSSS analysis case, a specific set of NSSS supports with their specified orientations are activated for a particular loading condition and a set of linear support stiffness is developed and provided to represent the active supports. The active NSSS supports for each of the four loops for the Analysis Cases 1, 3, 5, and 6 are shown respectively in Attachment 2 of this enclosure, Figures 1 through 4 and in Tables A-1, A-2, A-3, and A-4. The geometry of the NSSS components is tabulated in Attachment 2 Table A-5. Table A-6 in Attachment 2 tabulates RCL support attachment points. Figure 5 shows SG and RCP support arrangement and Figure 6 shows the crossover leg bumper support arrangement. Figures 7 thru 10 show RCP tie rod and RPV support arrangement under each different NSSS Analysis cases. FSAR Figures 5.2-9 and 5.2-11 in Attachment 1 of this enclosure, show respectively, the lower and upper SG support finite element models used by Westinghouse in generating the support stiffness matrices. The SG lower support model is also shown in FSAR Figure 5.2-9. The RCL support stiffness matrices are developed by Westinghouse and included in Reference 1.

2. *ENGINEERING DATA*

a. Mass and Mass Moments of Inertia

The mass and mass moment of inertia for the NSSS components are listed in this enclosure Attachment 2, Table A-7.

b. Damping Values

The damping values in terms of percent of critical damping for Set B analyses are in accordance with the values specified in the NRC Regulatory Guide 1.61, Revision 0, "Damping Values for Seismic Design of Nuclear Power Plants," and WBN Design Criteria, WB-DC-20-24, "Dynamic Earthquake Analysis of Category I Structures and Earth Embankments." The values for the operating basis earthquake (OBE) and safe shutdown earthquake (SSE) for the structures, equipment, components, and piping systems of the WBN Reactor Building used for Set B analyses are listed as follows:

	Damping (Percent of Critical Condition)	
Item	OBE	SSE
Interior Concrete Structure	4	7
Concrete Shield Building	4	7
Containment Basemat Concrete	4	7
Steel Containment Vessel	2	4
Reactor Pressure Vessel	2	3
Steam Generator	2	3
Reactor Coolant Pump	2	3
Reactor Coolant Loop Piping	2	3
Reactor Coolant Loop Support	2	4

c. Spring

Each elastic support element which is shown as a spring element in the model is actually a complex structure assemblage which can be represented by a 6 x 6 generalized support stiffness matrix obtained through substructure analysis. The 6 x 6 generalized support stiffness matrices are provided by Westinghouse via Reference 1.

d. Size and Location of the Gap

Gaps are provided in NSSS component support arrangements to enable the virtually unrestrained thermal movement of the loops and the components during plant operation. However, the support structures are of welded steel construction and fabricated in such a way that while the supports permit unrestrained thermal growth of the supported systems, the supports would provide restraints to the vertical, lateral and rotational movement resulting from seismic and/or accident conditions. This is accomplished by using (1) pin ended columns for vertical support and (2) girders, bumper pedestals, hydraulic snubbers, and tie rods for lateral support. The detailed description for the NSSS component supports is provided in FSAR Figures 5.5-6 through 5.5-13 (See Attachment 1).

Under the OBE or SSE loading conditions (NSSS Analysis Cases 1, 3, 5 and 6), due to the rapid motion of the earthquake excitation, the restraint function (via the presence of the snubbers) of the support assemblage overrides the gap function and, therefore, the support stiffness matrices provided by Westinghouse can directly be applied in the seismic analysis.

e. Element Property for NSSS Components

Elastic elements are provided to interconnect the nodal points of RPV, RCL piping, SG, and RCP for which masses and mass moments of inertia are lumped at the nodal points. The stiffness properties of the elastic elements are represented by 12 x 12 generalized stiffness matrices. These matrices are generated by Westinghouse and are provided in Reference 1 for direct application in seismic structural analysis.

f. RCP Tie Rod

Three tie rods are provided for each RCP (See Attachment 1 for FSAR Figure 5.5-8). These tie rods are assumed to function in tension only. Therefore, for postulated earthquake motion in each direction, the tie rods are assumed to be ineffective in compression. Eventually, the lateral resistance of the tie-rod assemblage is provided by that portion of the assemblage that experiences tensile loads. Figures 7 thru 10 in Attachment 2 of this enclosure show the active tie rods for Cases 1, 3, 5, and 6. The stiffness of the tie rod is provided by Westinghouse by a set of 6 x 6 generalized support stiffness matrix.

3. *MODELLING OF GAP AND ONE-WAY HANGERS*

See response to Question 2.d. above.

4. LINEARIZATION OF NSSS SUPPORT STIFFNESS

A study has been performed by Westinghouse to investigate different NSSS analysis cases and determine which one of the supports or tie rods will be active under a specific loading condition. Based on the study results, an active support list table was developed by Westinghouse and used by TVA in performing the seismic analysis. Examination of the active support conditions specified in Attachment 2, Tables A-1 through A-4, show that the active support conditions for the NSSS Analysis Cases 1 and 3 are complementary to each other and are primarily for resisting horizontal seismic loads in the plant north-south (NS) directions; similarly, the active support conditions for the NSSS Analysis Cases 5 and 6 are mutually complementary and are primarily for resisting loads in the plant east-west (EW) direction. For the vertical response analyses, the NSSS Analysis Cases 5 and 6 are also used.

Since only a specific set of NSSS supports with their specified orientations are activated for each different loading condition, a linear support stiffness can be developed. Westinghouse provided these linear support stiffness via Reference 1 for the four NSSS analysis cases which were eventually used in the seismic analysis.

5. EQUATIONS OF MOTION AND NUMERICAL ALGORITHM EMPLOYED

The request to discuss governing equations of motion and the validation of the numerical algorithm used to solve those equations appears to be predicated on the assumption that nonlinear methods of analyses were performed. The use of linearized stiffness properties to represent the NSSS support conditions permits the coupled building/NSSS model to be analyzed as a linear, elastic system using the same methodology as employed for the seismic analyses of the other Category I structures for Watts Bar. The methods employed to perform the seismic analyses of civil structures were reviewed and accepted by the NRC during the audits documented in Reference 4. This acceptance is also noted on page 2 of the RAI of October 11, 1994, which notes that "the object of the inspection was earthquake design of civil structures." Since nonlinear methods were not employed in the analysis of the NSSS, TVA does not consider it necessary to repeat the theoretical background of the linear analysis methodology previously accepted by the NRC.

6. VALIDATION OF OVERALL MODEL

The development of linearized stiffness to represent the NSSS support conditions and the use of linear analyses (explained further under Item 7) are commonly accepted techniques routinely employed in the analysis of the Westinghouse NSSS.

7. SUMMARY OF RESULTS

Both Set B and Set C seismic response analyses using the coupled model have been performed for both the OBE and SSE conditions, and for the horizontal NS and EW, and vertical ground motion inputs. Since, as described above in Section 4, different NSSS analysis cases are required in order to simulate the actual NSSS support behavior, the seismic response analyses for any individual case of Set B or Set C, OBE or SSE, and NS, EW, or vertical input, are required to consider different NSSS analysis cases (NSSS Analysis Cases 1, 3, 5 and 6) as applicable.

By limiting the analyses to considering only the primary NSSS analysis cases as described above, the total number of analyses performed for Set B analyses is 12 (2 earthquake input levels, OBE and SSE, x 3 directions of input x 2 primary NSSS analysis cases for each direction); and the total number of analysis cases performed for Set C analyses is 48 (same 12 cases for Set B x 4 time history inputs per case).

A. SEISMIC ANALYSIS RESULTS FOR NSSS COMPONENTS

In the seismic analyses of the Reactor Building, the maximum response parameters obtained for the NSSS components (RCL) from Set B and Set C analyses for the cases consist of the following:

a. Maximum absolute accelerations;
b. Maximum displacements relative to the free-field ground.

To obtain the above maximum response parameters for the NSSS components, the following steps are applied:

1. For each location and response direction on the NSSS, the maximum values of the response parameters are obtained by taking the maximum

value of the time history response for each analysis case.

2. For Set C analyses for which four time histories are used as the input, the maximum values resulting from the four time history inputs are averaged. For Set B analyses, this step does not apply.

3. Maximum values of the response parameters resulting from different NSSS analysis cases are enveloped.

4. Maximum values of the co-directional response resulting from three directions of ground motion input are combined using the square root of the sum of the squares (SRSS) combination rule.

5. Maximum values of the same response parameters for four primary loops are enveloped to obtain the final enveloped maximum value applicable for the four loops.

The development of the final NSSS response ARS curves for each selected location and spectrum damping value considered follows the following steps:

1. For each location and response direction in the NSSS, the ARS values are computed from the absolute acceleration response time history obtained from each analysis case.

2. For Set C analyses for which four time history inputs are used, the ARS values resulting from the four time history inputs are averaged. For Set B analyses, this step does not apply.

3. The ARS values resulting from different NSSS analysis cases are enveloped.

4. The co-directional response ARS values resulting from three directions of ground motion input are combined using the SRSS combination rule applied to each spectral frequency.

5. The ARS at the corresponding locations of the four loops are enveloped to obtain the enveloped ARS applicable for the four loops.

6. The enveloped ARS for each common location for four loops are broadened by ± 15% for Set B analyses, and ± 10% for Set C analyses, to obtain the final Set B and Set C ARS curves, respectively.

7. The final Set B and Set C ARS curves are enveloped to give the final Set B-plus-C ARS curves.

Since the RCL attachment points (RCLA) are rigidly linked to the ICS at the elevations of the attachments points, the maximum response parameters and the response ARS at RCLA are the same as those obtained for the ICS at the attachment point elevations.

B. APPLICATION OF SEISMIC ANALYSIS RESULTS FOR NSSS COMPONENTS AND ICS QUALIFICATION

The evaluation basis Set B spectra at the ICS/NSSS interface locations obtained using the coupled ICS and NSSS model have been evaluated by Westinghouse to determine the potential impact on the qualification of the NSSS components. Westinghouse's review indicates that the new spectra would have no adverse impact on the design basis analysis (Set A) of the NSSS. Therefore, the critical components stresses shown in FSAR Tables 5.2-15 through 5.2-21 (For your convenience, see Attachment 1 of this enclosure) for Set A seismic input are not exceeded and continue to be the basis for the design of the NSSS system.

The Set B and Set C spectra at various elevations in ICS were also generated for ICS evaluation. The result of the evaluation for critical members in the concrete structure are covered in FSAR Section 3.8.3.

8. *REFERENCES*

(1) Westinghouse Electric Corporation - Proprietary Class 2, Contract No. 71C62-54114-1, Document No. 13285, Titled "Lumped Mass + Stiffness Matrix Mathematical Model for the RCL-Unit 2" for TVA-WBN.

(2) WCG-1-343, Rev. 0, Seismic SSI Analysis of ICS + NSSS System

(3) WCG-1-344, Rev. 0, Design Basis Seismic Analysis of ICS + NSSS/SCV/SB

(4) NRC's Inspection Report 50-390, 50-391/89-21 and Civil Calculation Program audit report dated October 10, 1990.

QUESTION 5.c CONCERNS

"The applicant stated that since the personnel locks and hatches were initially designed with a large margin for normal nonseismic loads (0.5 F_y) and normal loads are usually limited to self dead weight, load combinations involving OBE were considered to be upset load. This is the reason why E and E' are considered to be the same. Another reason for the proposed increase provided by the applicant is that assessment of load for the door is more accurate than usual because of the nature of dead loads where no added loads from other sources, such as live loads and pipe attachment loads, are applied, implying, that a lesser safety factor may be used. The staff found that the applicnat's reasoning is not acceptable, since any conservative design should accommodate OBE with increasing allowable stresses, thus, effectively reducing the design margin. Moreover, the applicant's argument does not apply to the crane design (Tables 3.8.6-1 and 3.8.6-2). It is the staff's position that the allowable stress limit for the Category I structures be equal to 0.67 F_y when the load combination includes OBE, live and dead loads."

RESPONSE

The subject, Note (2), which provides the definition Of Earthquake Loading "E" as the larger of OBE or SSE loads, appears in the following tables of FSAR Section 3. In these tables, the allowable stresses for load combinations that include Earthquake Loads "E", are based on increased basic code allowable (i.e., 0.9 F_y for bending of structural components and 0.6 F_y for shear).

TABLE #	COMPONENT(S)
3.8.3-3	Personnel Access Doors in Crane Wall
3.8.3-6	Equipment Access Hatch
3.8.3-7	Escape Hatch - Divide Barrier Floor
3.8.4-3	Control Room Shield Doors
3.8.4-4	Auxiliary Building Railroad Access Hatch Covers

3.8.4-5	Railroad Access Door
3.8.4-6	Manways in RHR Sump Value Room
3.8.4-7	Pressure Confining Personnel Doors
3.8.4-13	Diesel Generator Building Doors and Bulkheads
3.8.4-21	Spent Fuel Pool Gates
3.8.4-23	Watertight Equipment Hatch Covers
3.8.6-1	Polar Crane
3.8.6-2	Auxiliary Building Crane
3.8.1-2	Shield Building Equipment Hatch Doors and Sleeves
3.8E-1	Limiting Values of Allowable Stress

Except for FSAR Tables 3.8.6-1 and 3.8.6-2 discussed later, TVA will revise the tables to add the load combinations with the OBE loading and limit the stress to the basic code allowables, (i.e., 0.6 F_y for Tension/Compression of structural components, or Ultimate/5 for mechanical components, as may be applicable). The notes will be revised to individually define the earthquake loads for OBE and SSE. Proposed FSAR changes of the above tables are provided in Enclosure 2 of this letter.

The loads, their combinations and corresponding allowables in FSAR Tables 3.8.6-1 and 3.8.6-2 are for Seismic Category I(L) Polar Cranes and Auxiliary Building bridge cranes, respectively. NUREG-0554 "Single Failure Proof Cranes for Nuclear Power Plants" requires evaluation of the crane components under the SSE loading only, in accordance with Regulatory Guide 1.29, "Seismic Design Classification," Regulatory Position 2.

ASME NOG-1-1989 "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)," combines both OBE and SSE loads in the same load combinations of "Extreme Environmental Loads" and assigns the same increased allowables (i.e., 0.9 F_y for bending, etc.) for this combination. Therefore, the data presented in Tables 3.8.6-1 and 3.8.6-2 is correct and the tables will be revised to indicate only SSE loads.

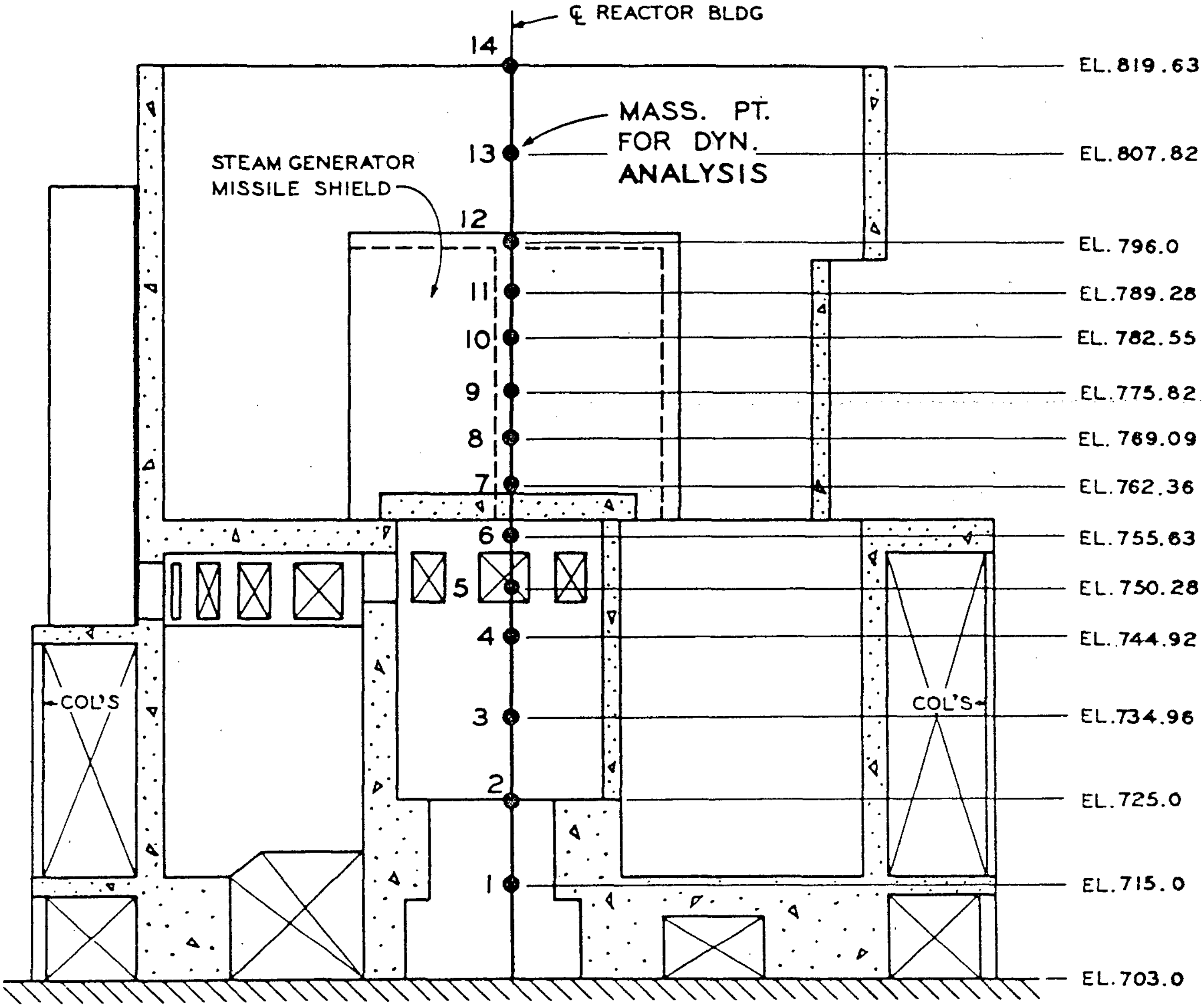
ENCLOSURE 1

ATTACHMENT 1

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FSAR CHAPTER 3, AMENDMENT 79

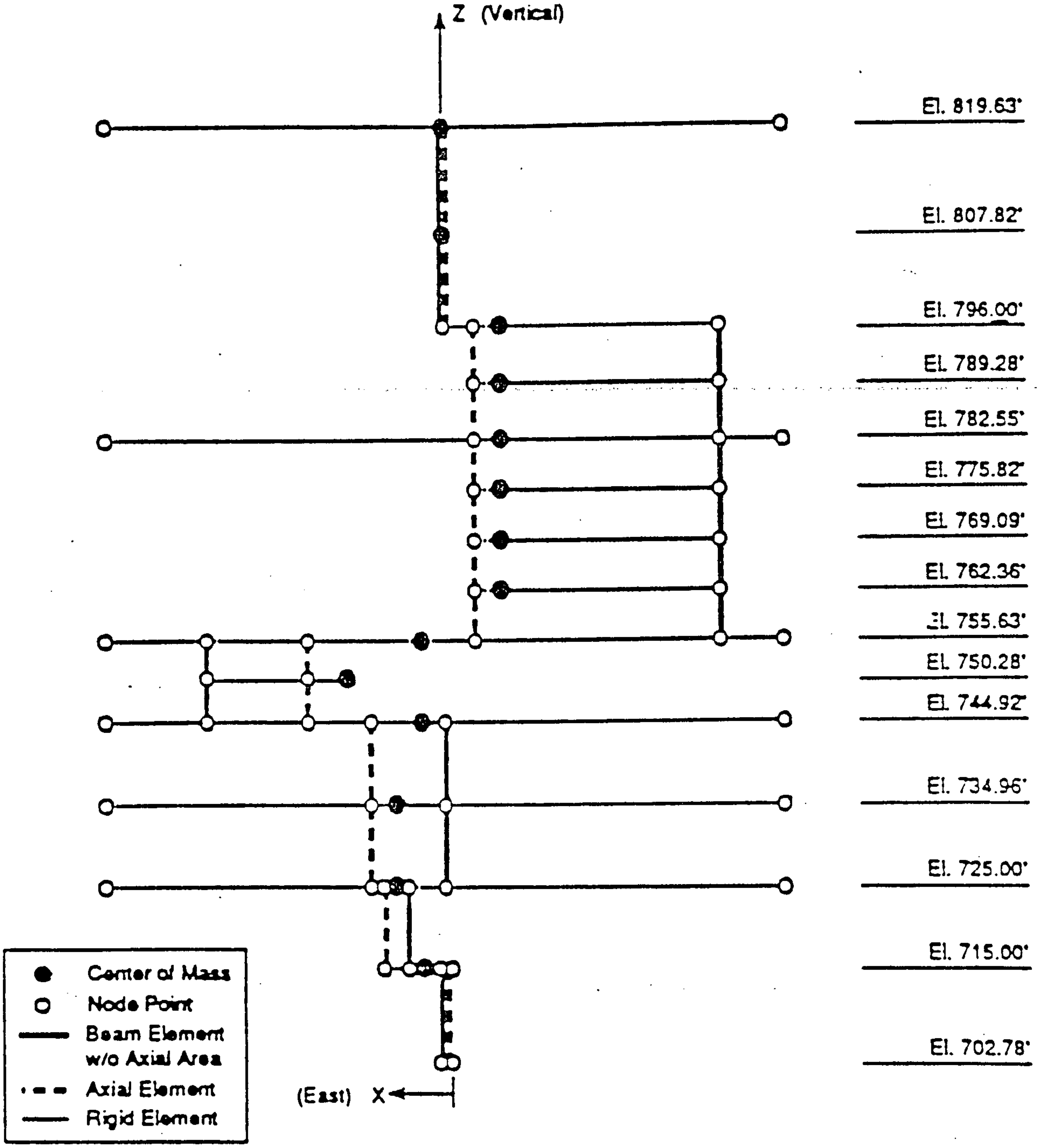
CURRENT FSAR TABLES AND FIGURES

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
REACTOR BUILDING - INTERIOR CONCRETE STRUCTURE



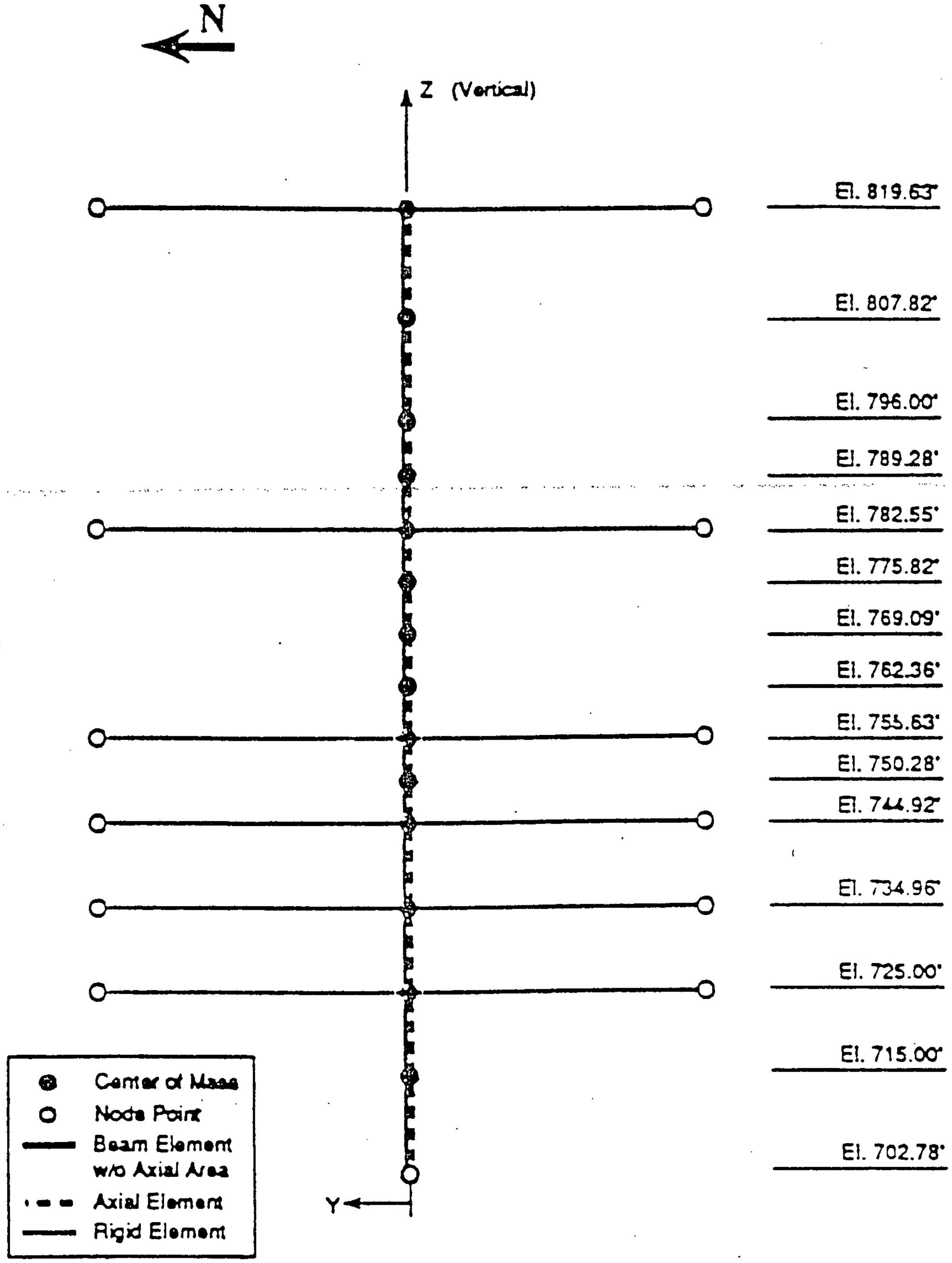
SECTIONAL ELEVATIONAL
LOOKING NORTH
LUMPED MASS MODEL FOR DYNAMIC ANALYSIS

Figure 3.7-8



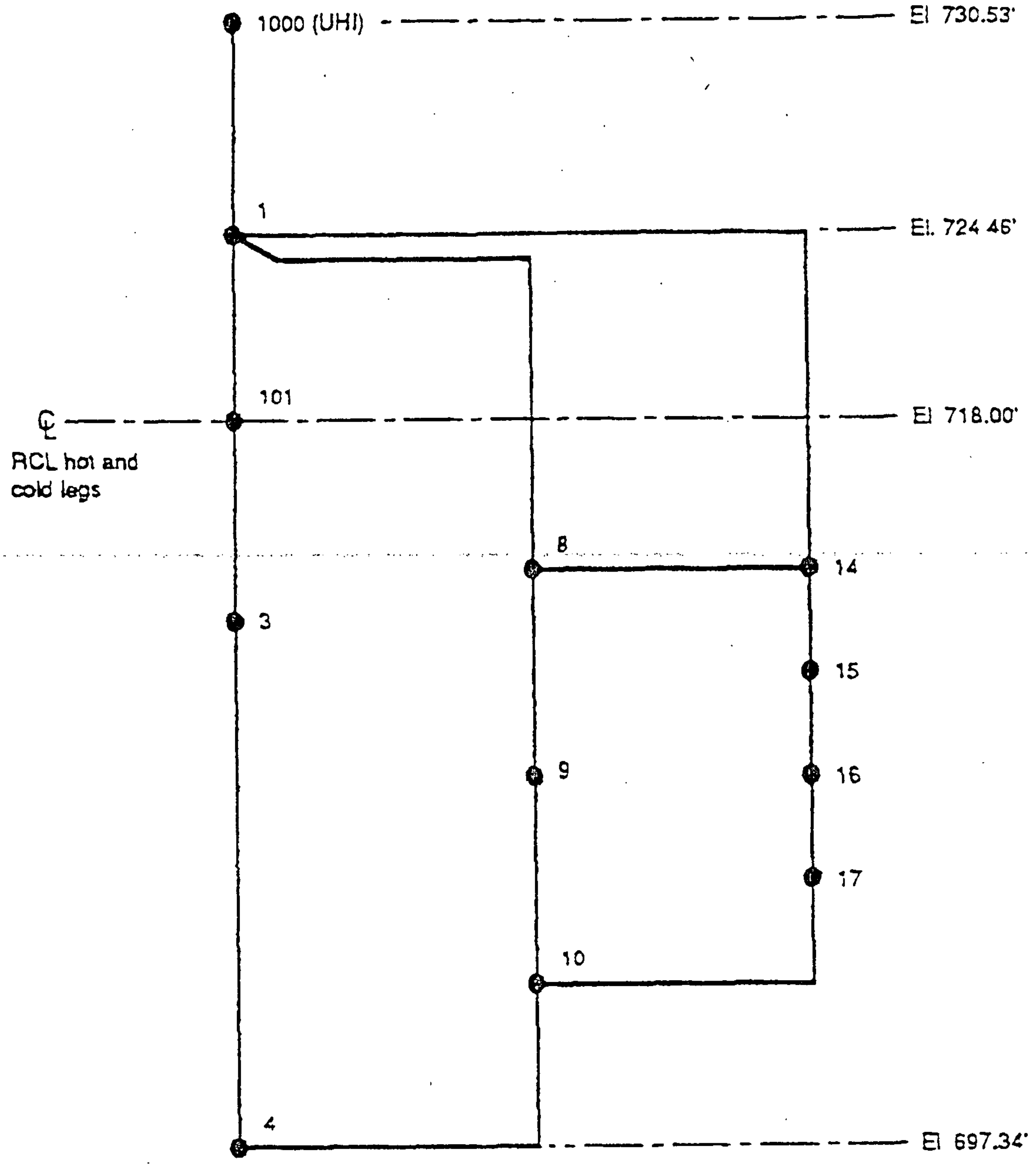
Interior Concrete Structure
Equivalent Beam Stick Model in X-Z Plane
for TVA/WBNP Unit 1

Figure 3.7-8A Seismic Analysis Model for Interior Concrete Structure (Set B and Set C) Amendment 64



Interior Concrete Structure
Equivalent Beam Stick Model in Y-Z Plane
for TVA/WBNP Unit 1

Figure 3.7-8B Seismic Analysis Model for Interior Concrete Structure (Set B and Set C)



AMENDMENT 79

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

DYNAMIC MODEL FOR THE
REACTOR PRESSURE VESSEL (RPV)
Figure 3.7-8C

TABLE 5.2-15

STEAM GENERATOR LOWER SUPPORT MEMBER STRESSES

Member	Member Stresses, Percent of Allowable Loading Condition		
	Normal	Upset	Faulted
17	--	67.7	60.3
18	--	60.2	53.4
19	--	39.6	42.5
20	--	35.1	58.3
22	--	15.2	31.6
23	--	3.2	5.7
24	--	5.5	13.9
26	--	45.1	66.9
27	--	31.2	41.3
28	--	55.7	57.2
29	--	61.7	62.5
38	41.2	68.2	71.5
39	43.3	75.4	68.8
40	55.9	85.5	61.2
41	33.9	74.1	67.0

Added by Amendment 32

TABLE 5.2-16

STEAM GENERATOR UPPER SUPPORT MEMBER STRESSES

Member	Member Stresses, Percent of Allowable Loading Condition		
	Normal	Upset	Faulted
71, 72, 73, 74, 75	--	43.3	33.5
76, 77	--	22.6	52.5
78, 79	--	31.7	33.6
81, 82	--	22.6	56.0

Added by Amendment 32

TABLE 5.2-17

RC PUMP SUPPORT MEMBER STRESSES

	Member Stresses, Percent of Allowable Loading Condition		
Member	Normal	Upset	Faulted
10	--	16.2	56.9
11	--	33.4	91.1
12	--	61.7	98.7
7	59.9	73.3	98.2
8	61.5	51.3	79.9
9	29.0	98.3	82.5

Added by Amendment 32

TABLE 5.2-18

PRIMARY PIPE RESTRAINT LOADS AND STRESSES

Restraint	Loading Condition	Maximum Load (kips)	Stress % of Allowable
Crossover Leg Bumper, SG side	Upset	194	5.8
	Faulted	1985[c]	83.2
Crossover Leg Bumper, RCP side	Upset	147	5.2
	Faulted	1179[c]	70.2
Crossover Leg Vert. Run. Restraint	Upset	0	0.0
	Faulted	1480	41.2
SG Inlet Restraint	Upset	0	0.0
	Faulted	1958	44.8
Primary Shield Wall Restraint Hot Leg	Upset	0	0.0
	Faulted	537[a]	22.0
Primary Shield Wall Restraint Cold Leg	Upset	0	0.0
	Faulted	127[b]	52.1

NOTES:

(a.) This load can act in any direction.
(b.) This load acts horizontally away from hot leg.
(c.) This load is not the maximum, but when applied with the opposite bumper load, the restraint reaches its maximum stress.

TABLE 5.2-19

REACTOR VESSEL SUPPORT LOADS

Loading Condition	Vertical (kips)	Tangential (kips)
Dead Weight	530.	0.
Thermal	290.	0.
Pressure	10.	0.
OBE	1696.	756.
SSE	1696.	756.
LOCA[a]	2900.	3000.
Normal	830.	0.
Upset	2526.	756.
Faulted	4606.	3756.

NOTES:

(a). Includes dead weight

TABLE 5.2-20

REACTOR VESSEL SUPPORT STRESSES

Loading Condition	Actual Stress (ksi)	Allowable Stress (ksi)	Actual Stress, % of Allowable
Normal	$P_M = 3.78$	$S_m = 21.7$	17.4
	$P_M + P_B = 3.98$	$1.5\ S_m = 32.6$	12.2
Upset	$P_M = 5.22$	$S_m = 21.7$	24.1
	$P_M + P_B = 6.67$	$1.5\ S_m = 32.6$	20.5
Faulted	$P_M = 22.60$	$0.7\ S_u = 41.5$	54.5
	$P_M + P_B = 44.51$	$1.05\ S_u = 62.3$	71.4

Added by Amendment 32

TABLE 5.2- 21

CRDM Head Adaptor Bending Moments

	LOCA* (in-kip)	Combination of SSE and LOCA (in-kip)	% of Allowable
Longest CRDM	29.3	120.	69.
Shortest CRDM	52.0	120.	80.

*Maximum moments are from reactor vessel inlet nozzle break.

Added by Amendment 32

11,706-3

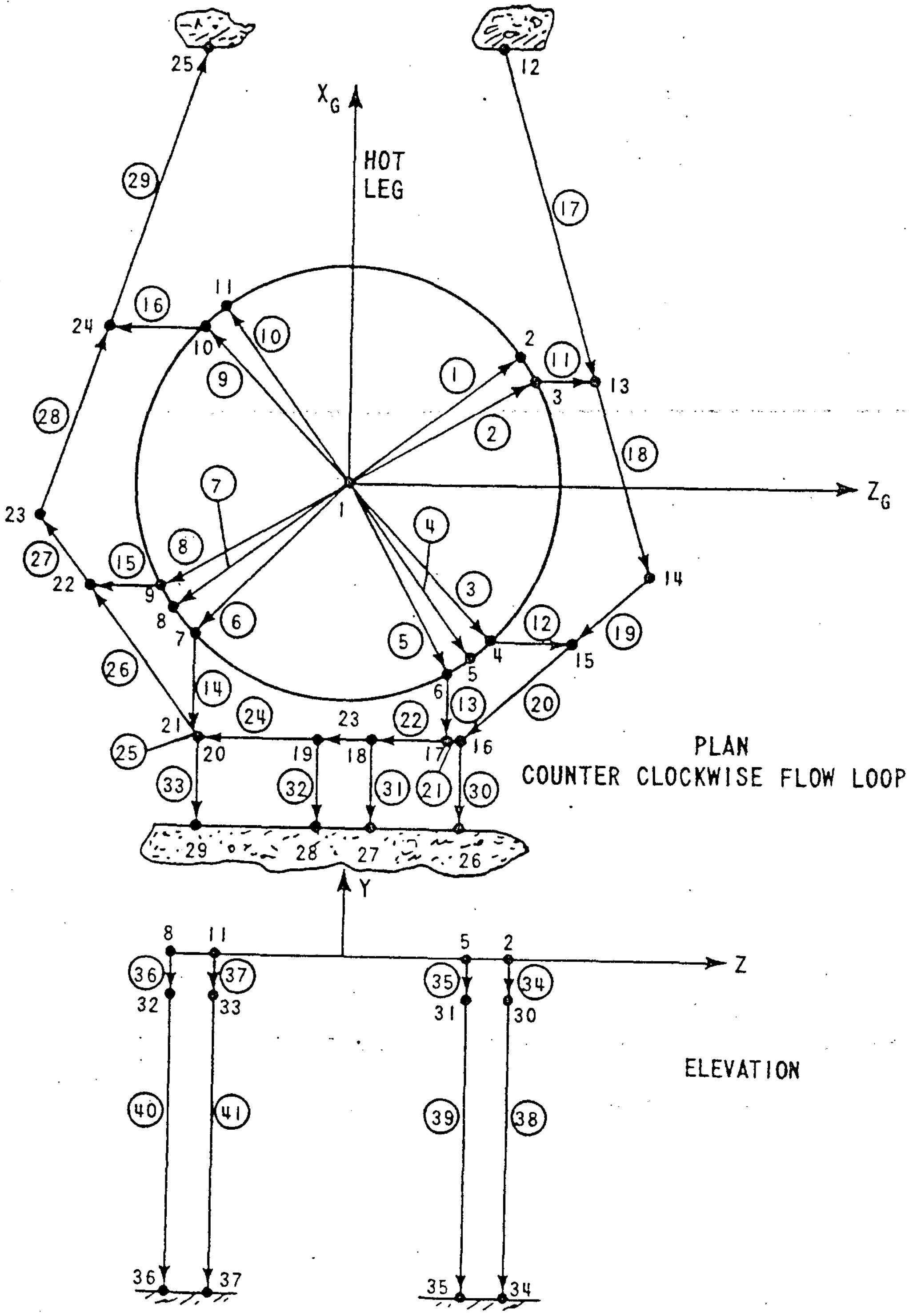


Figure 5.2-9 Steam Generator Lower Support Model

Added by Amendment 31

11,706-5

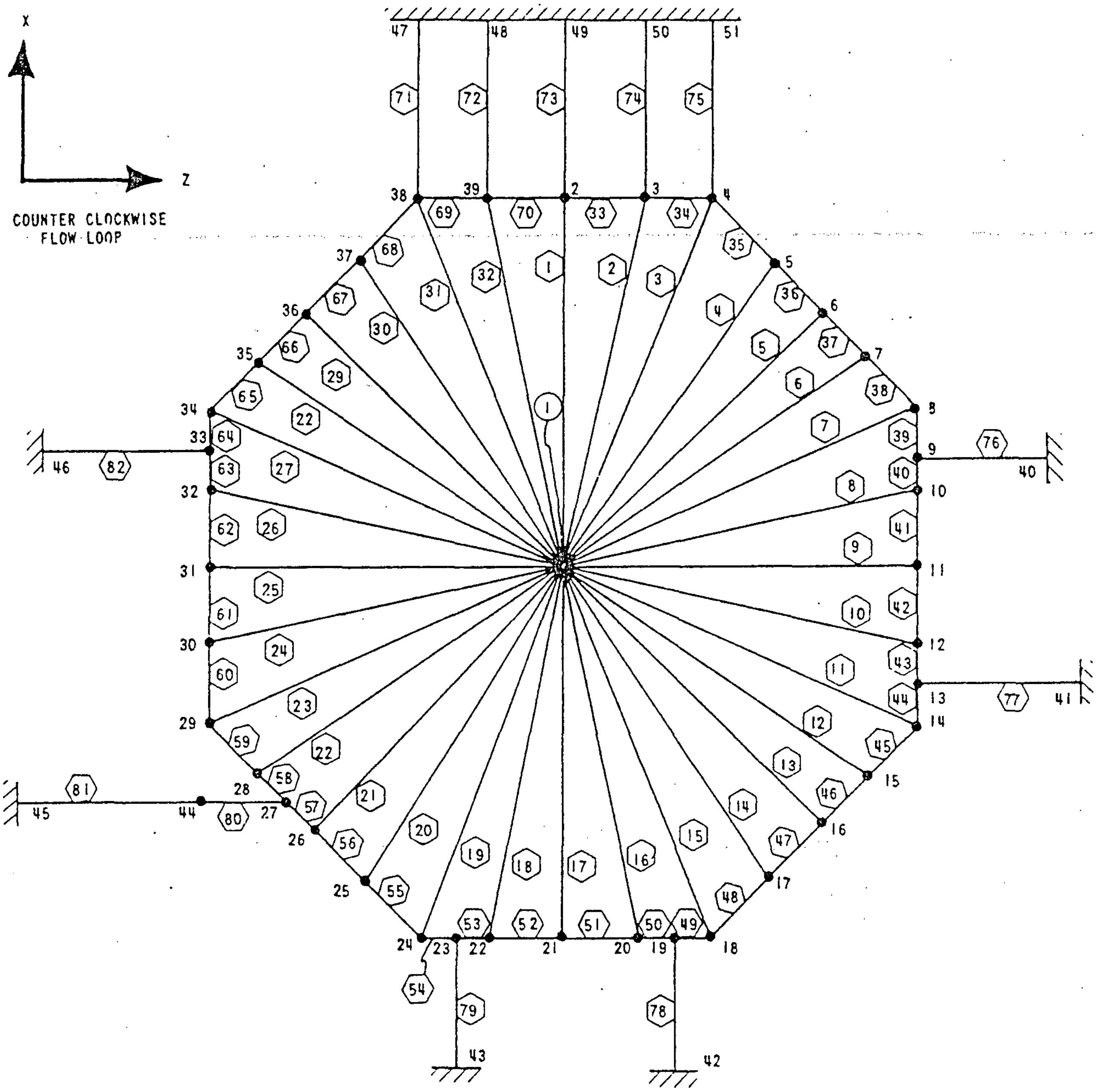


Figure 5.2-11 Steam Generator Upper Model

Added by Amendment 31

8555-29

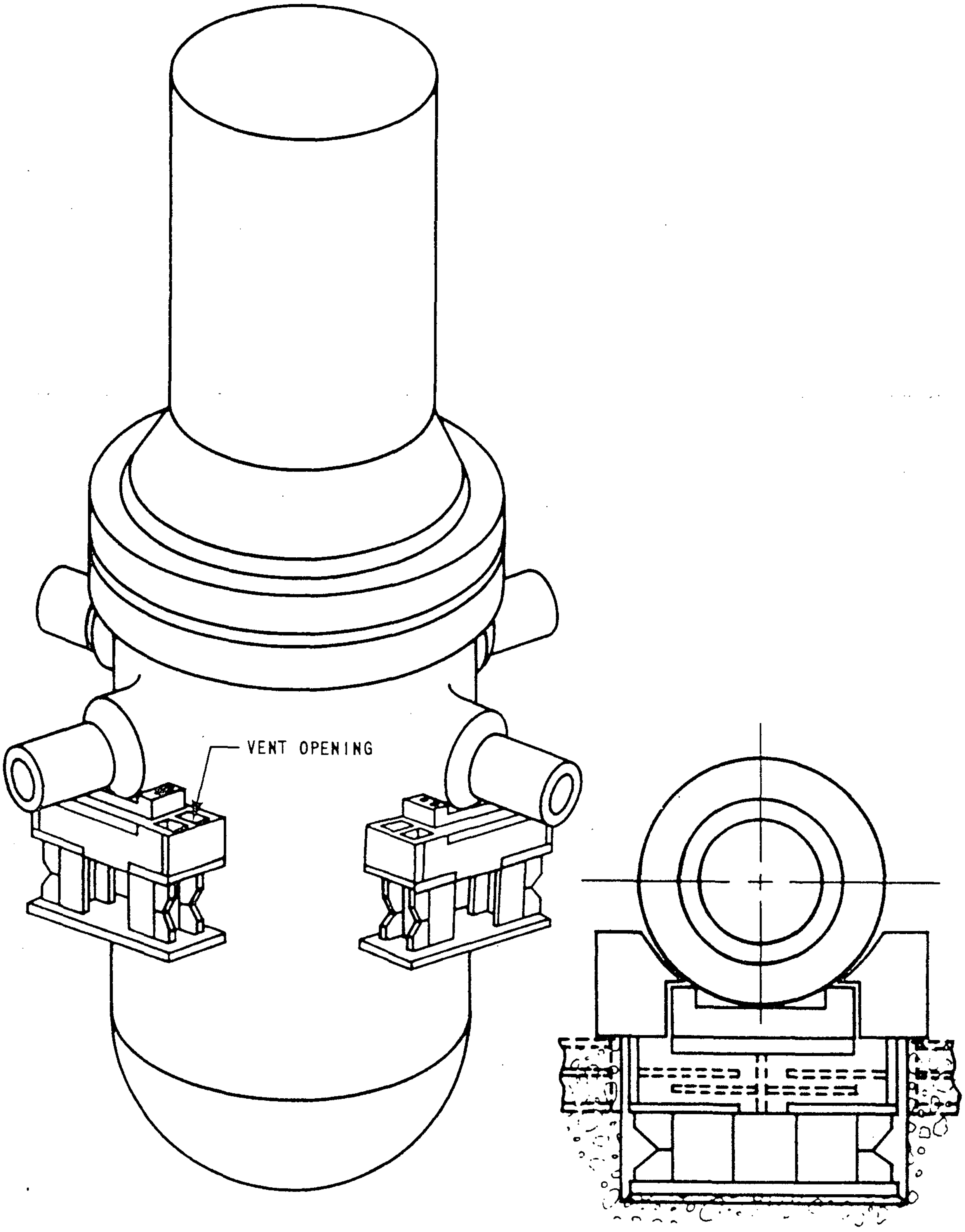


Figure 5.5-6 Reactor Vessel Supports

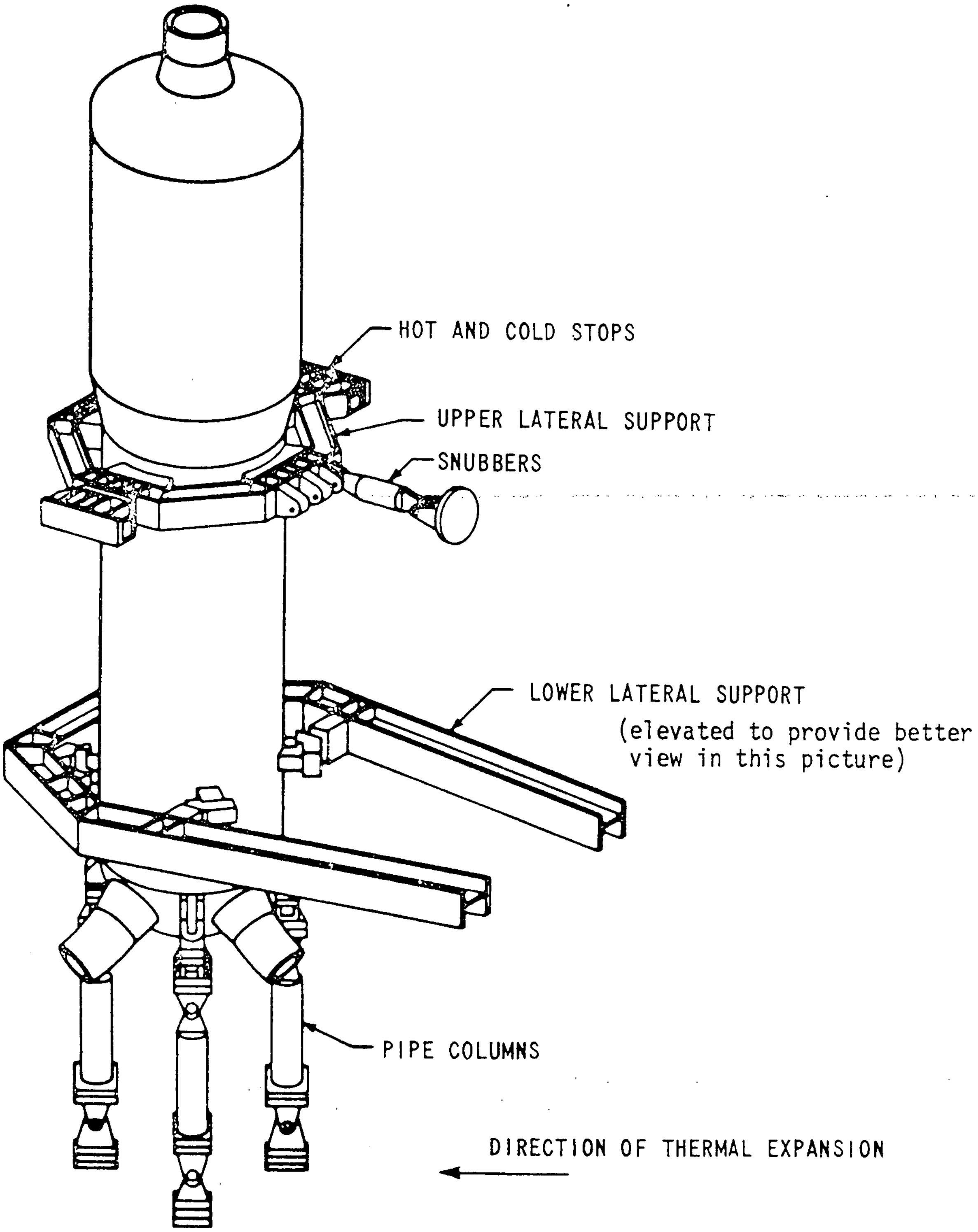


Figure 5.5-7 Ice Condenser Steam Generator Supports

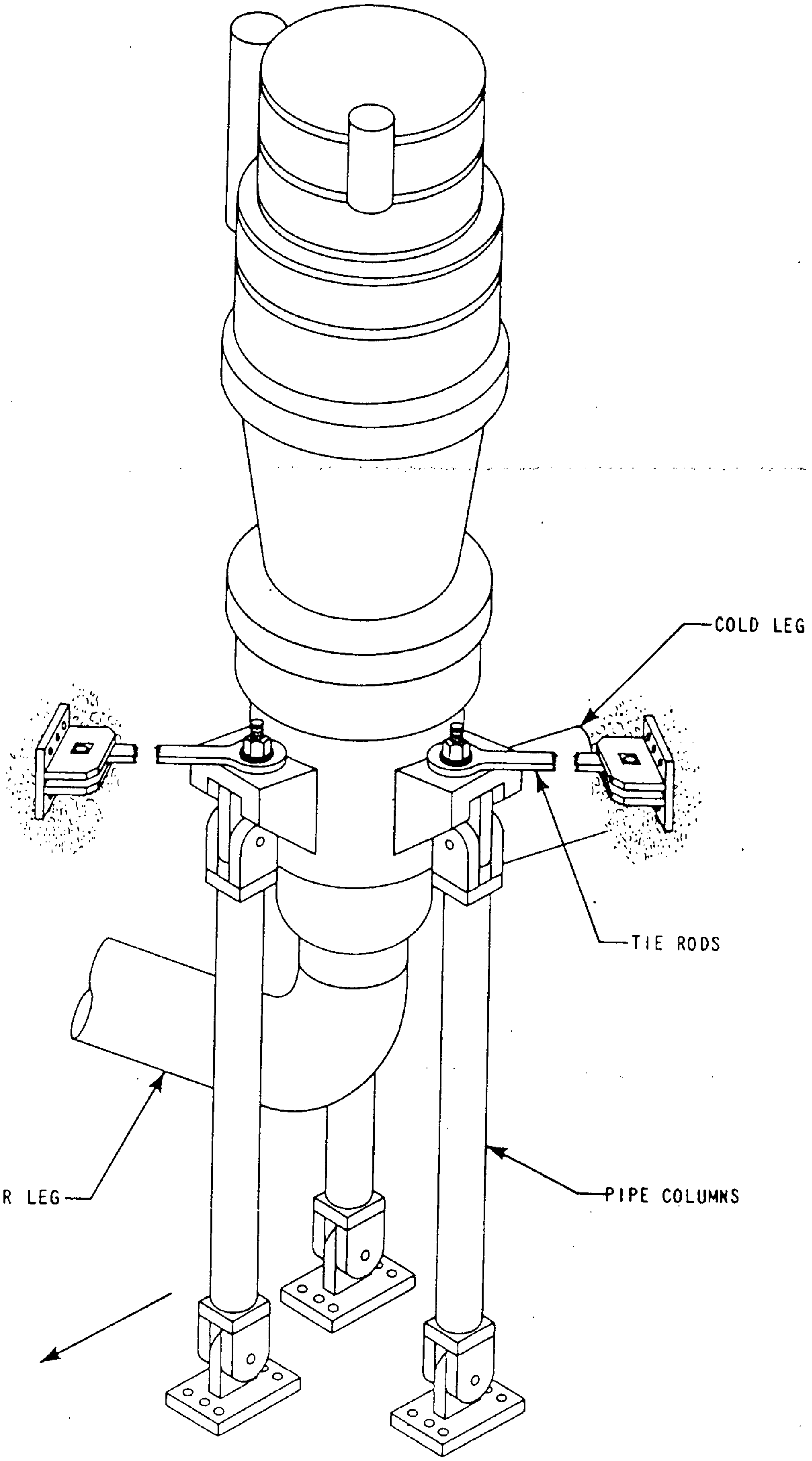


Figure 5.5-8. Reactor Coolant Pump Supports.

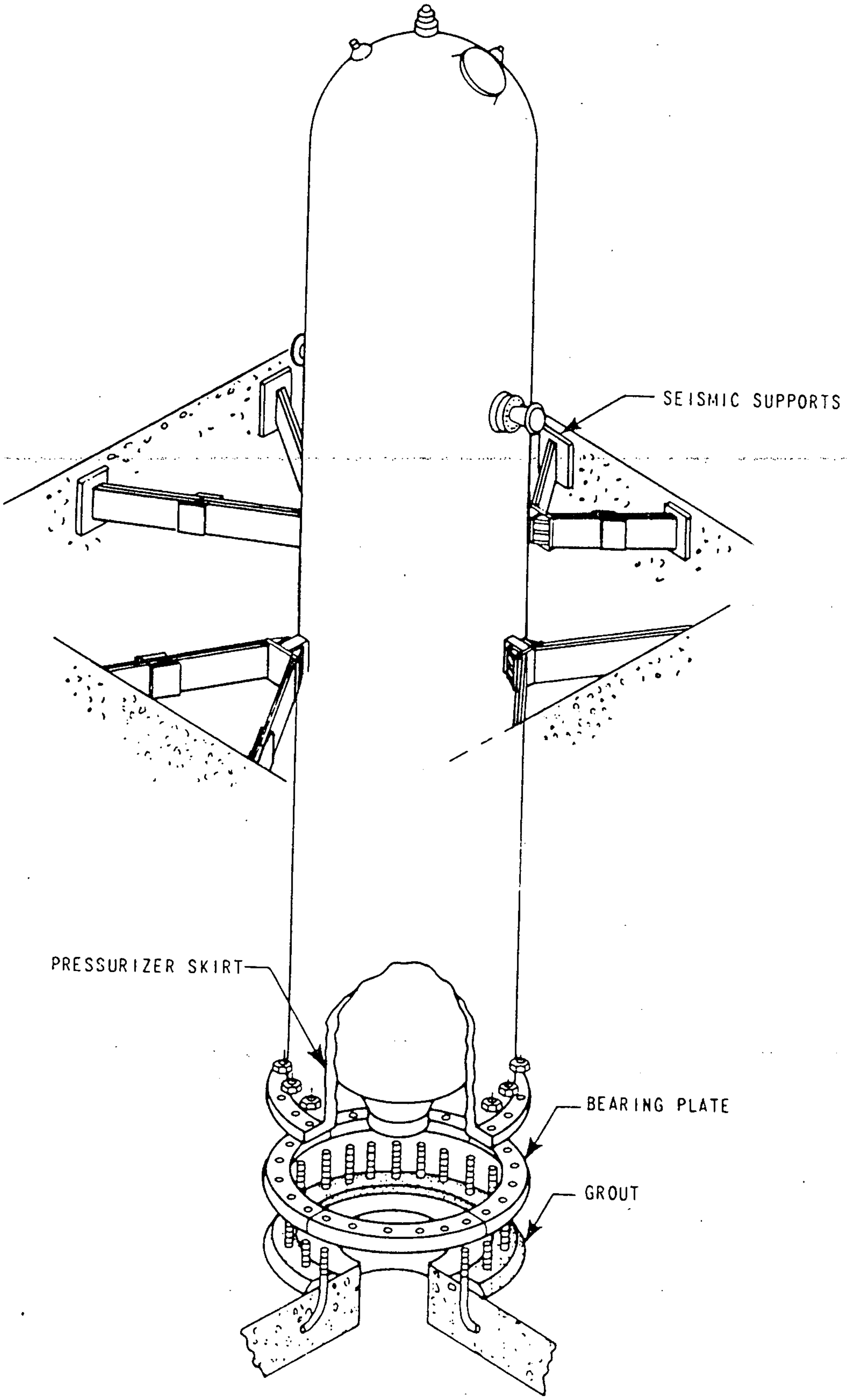


Figure 5.5-9. Pressurizer Supports

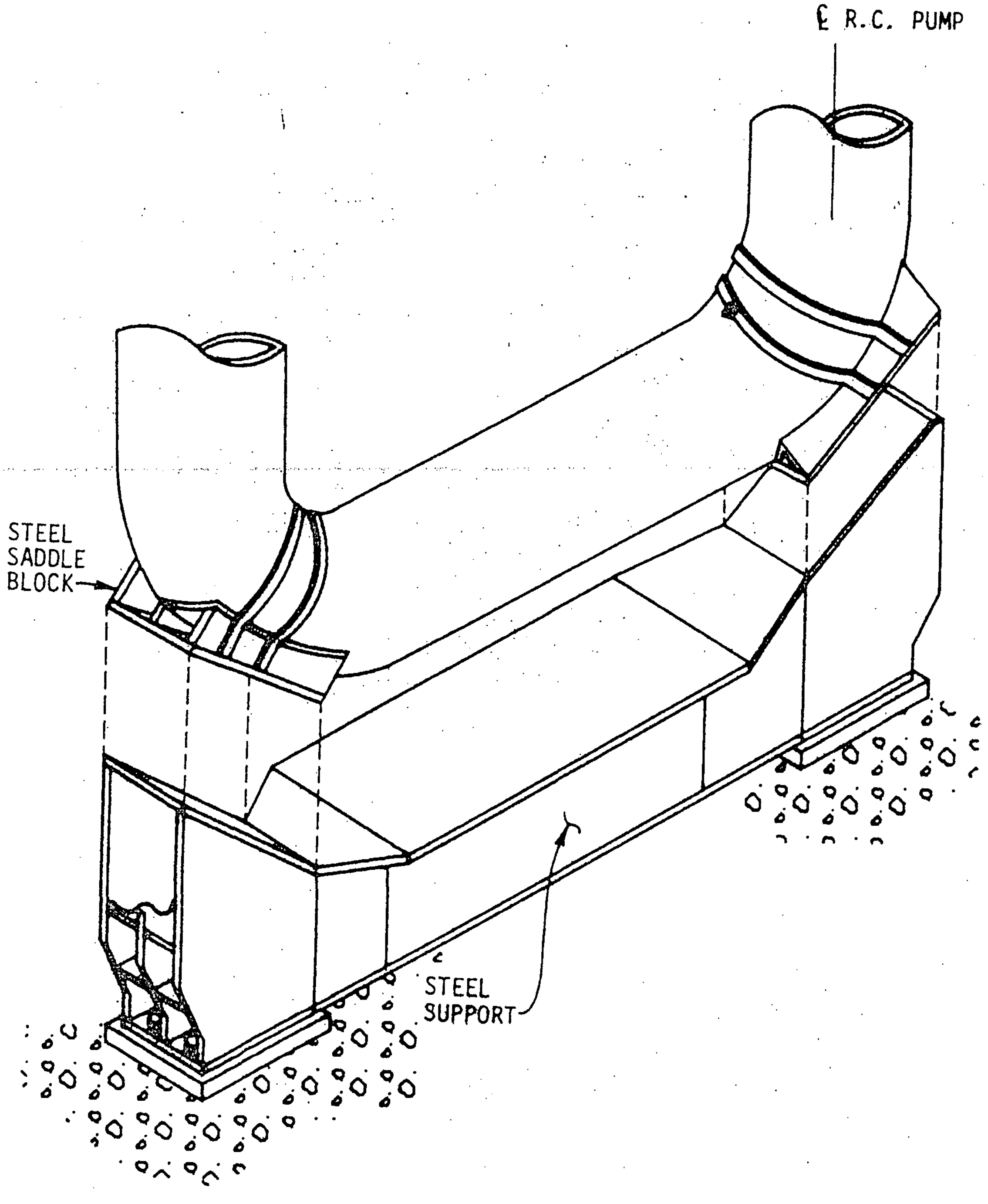


FIGURE 5.5-10
CROSSOVER LEG RESTRAINTS

Revised by Amendment 52

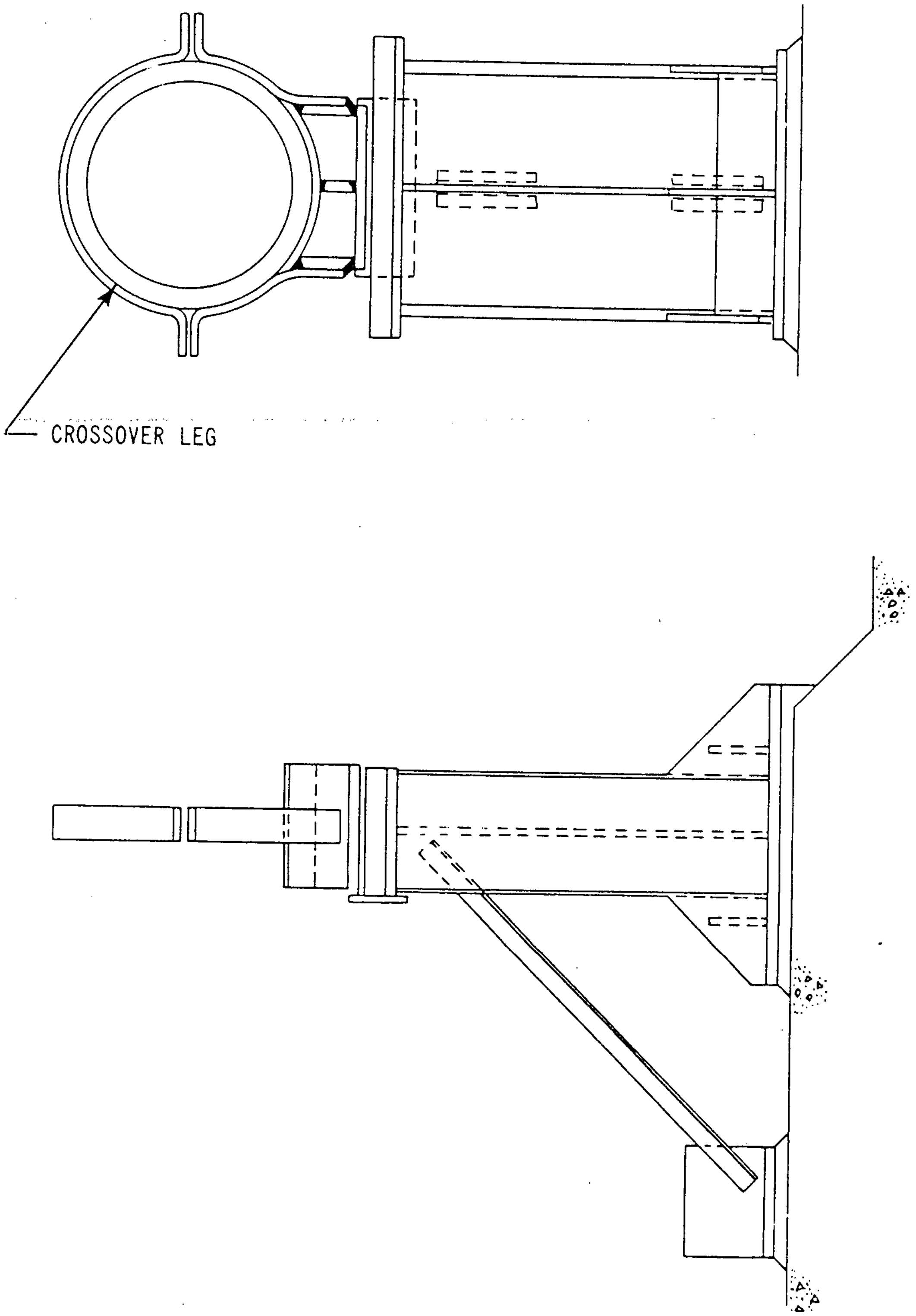


Figure 5.5 11. Crossover Leg Vertical Run Restraint.

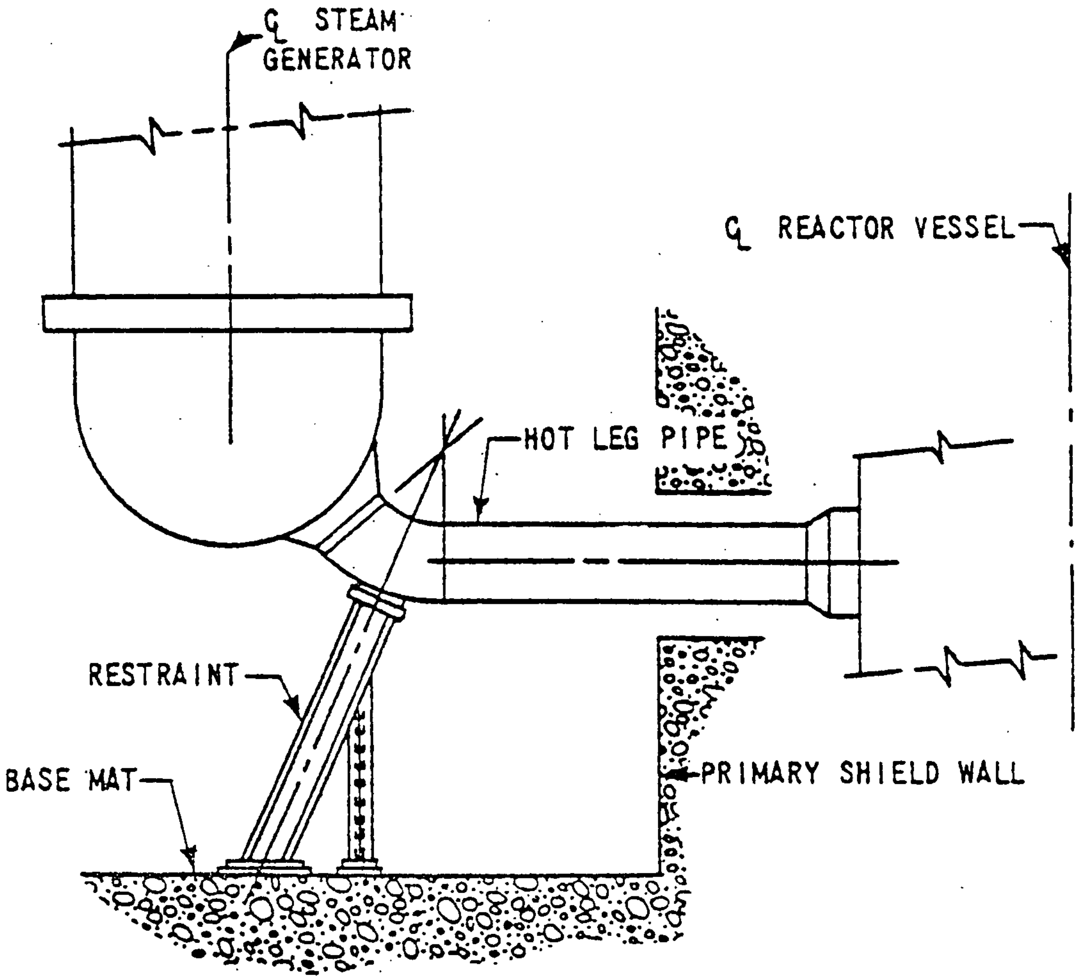
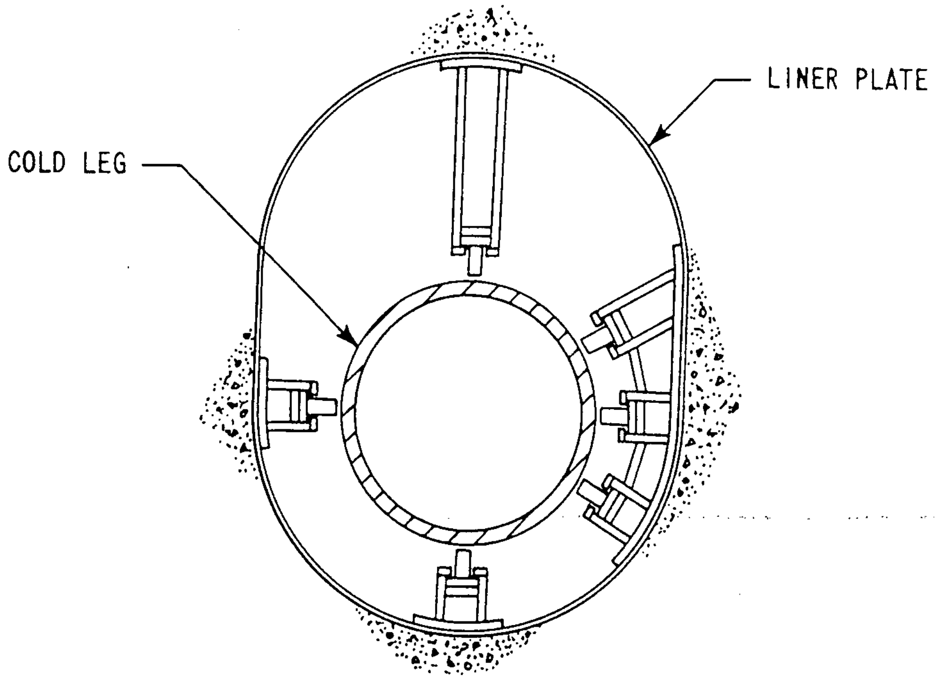
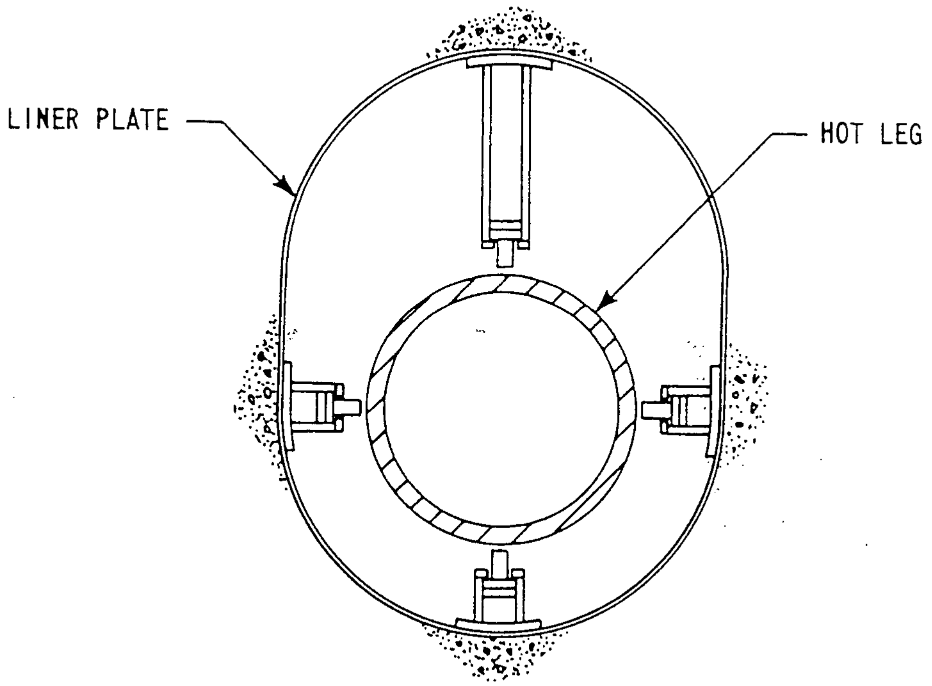


Figure 5.5-12. Steam Generator Inlet Restraints

Added by Amendment 43



COLD LEG SHIELD-WALL PENETRATION



HOT LEG SHIELD-WALL PENETRATION

Figure 5.5-13. Primary Shield-Wall Restraints.

ENCLOSURE 1
ATTACHMENT 2

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FSAR CHAPTER 3, AMENDMENT 79

ADDITIONAL TABLES AND FIGURES

TABLE A-1
SHEET 1 of 4

Table 6-12

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 1 - LOOP 1

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4					X	
SGLS Case 6						X
SGUS Case 5	133	233	333	433		X
SGUS Case 6					X	
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

Note: The node point number underlined identifies the active support point.

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TABLE A-1
SHEET 2 of 4

Table 6-12 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 1 - LOOP 2

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8					x	
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-1

SHEET 3 of 4

Table 6-12 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 1 - LOOP 3

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8					x	
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-1
SHEET 4 of 4

Table 6-12 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS
ANALYSIS CASE 1 - LOOP 4

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4					X	
SGLS Case 6						X
SGUS Case 5	133	233	333	433		X
SGUS Case 6					X	
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-2

SHEET 1 of 4

Table 6-13

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 3 - LOOP 1

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8					X	
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

Note: The node point number underlined identifies the active support point.

TABLE A-2

SHEET 2 of 4

Table 6-13 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 3 - LOOP 2

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4					X	
SGLS Case 6						X
SGUS Case 5	133	233	333	433		X
SGUS Case 6					X	
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-2

SHEET 3 of 4

Table 6-13 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 3 - LOOP 3

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4					X	
SGLS Case 6						X
SGUS Case 5	133	233	333	433		X
SGUS Case 6					X	
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

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TABLE A-2
SHEET 4 of 4

Table 6-13 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 3 - LOOP 4

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8					X	
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

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TABLE A-3

SHEET 1 of 4

Table 6-14

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 5 - LOOP 1

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7					X	
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

Note: The node point number underlined identifies the active support point.

TABLE A-3

SHEET 2 of 4

Table 6-14 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 5 - LOOP 2

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7					X	
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-3

SHEET 3 of 4

Table 6-14 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 5 - LOOP 3

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420	X	
SGLS Case 4						X
SGLS Case 6						X
SGUS Case 5	133	233	333	433	X	
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-3

SHEET 4 of 4

Table 6-14 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 5 - LOOP 4

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420	X	
SGLS Case 4						X
SGLS Case 6						X
SGUS Case 5	133	233	333	433	X	
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-4

SHEET 1 of 4

Table 6-15

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 6 - LOOP 1

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420	X	
SGLS Case 4						X
SGLS Case 6						X
SGUS Case 5	133	233	333	433	X	
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

Note: The node point number underlined identifies the active support point.

TABLE A-4

SHEET 2 of 4

Table 6-15 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 6 - LOOP 2

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420	X	
SGLS Case 4						X
SGLS Case 6						X
SGUS Case 5	133	233	333	433	X	
SGUS Case 6						X
SGUS Case 7						X
SGUS Case 8						X
XL SG Side	153	253	353	453	X	
XL RCP Side	163	263	363	463		X
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471		X
RCP Tie Rod #2	172	272	372	472		X
RCP Tie Rod #3	170	270	370	470		X
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-4
SHEET 3 of 4

Table 6-15 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS
ANALYSIS CASE 6 - LOOP 3

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7					X	
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-4

SHEET 4 of 4

Table 6-15 (Continued)

WBNP NSSS ACTIVE SUPPORT SPECIFICATIONS

ANALYSIS CASE 6 - LOOP 4

Support Case	Support Attachment Node Point				Active	Inactive
RPV Support	104	297	304	497	X	
SGLS Case 2	120	220	320	420		X
SGLS Case 4						X
SGLS Case 6					X	
SGUS Case 5	133	233	333	433		X
SGUS Case 6						X
SGUS Case 7					X	
SGUS Case 8						X
XL SG Side	153	253	353	453		X
XL RCP Side	163	263	363	463	X	
RCPLS	168	268	368	468	X	
RCP Tie Rod #1	171	271	371	471	X	
RCP Tie Rod #2	172	272	372	472	X	
RCP Tie Rod #3	170	270	370	470	X	
FWL Dyn.	132	232	332	432	X	
MSL Dyn.	139	239	339	439	X	

TABLE A-5

WESTINGHOUSE PLANT ENGINEERING DIVISION

SHEET 1 of 5

TITLE APPENDIX A.1 - MODEL DEFINITION			PAGE 12 OF 27
PROJECT WATTS BAR #2	AUTHOR DATE [illegible]	CHK'D. BY DATE 1/24/85	CHK'D. BY DATE — N R —
S.O. WJIJ/134	CALC. NO.	FILE NO. WAT/145/12	GROUP SSA

TABLE A.1(b)
MASS POINT COORDINATES;
TVA GLOBAL COORDINATE SYSTEM

Node Point Number	Loop Number	Coordinates - Global System X_G	Y_G	Z_G
101	RPV	0.0	0.0	0.0
1	RPV	0.0	0.0	6.46
1000	RPV	0.0	0.0	12.5325
3	RPV	0.0	0.0	-7.10
4	RPV	0.0	0.0	-20.66
8	RPV	0.0	0.0	-4.12
9	RPV	0.0	0.0	-10.87
10	RPV	0.0	0.0	-17.62
14	RPV	0.0	0.0	-4.12
15	RPV	0.0	0.0	-7.495
16	RPV	0.0	0.0	-10.87
17	RPV	0.0	0.0	-14.245

REV. NO.	REV. DATE	AUTHOR DATE	CHK'D. BY DATE	CHK'D. BY DATE

WESTINGHOUSE FORM 58041

TABLE A-6

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WESTINGHOUSE PLANT ENGINEERING DIVISION

TITLE APPENDIX A.1 - MODEL DEFINITION			PAGE 22 OF 27
PROJECT WATTS BAR #2	AUTHOR DATE 1/18/85	CHK'D. BY DATE 1/24/85	CHK'D. BY DATE — NR —
S.O. WJIJ/134	CALC. NO.	FILE NO. WAT/145/12	GROUP SSA

TABLE A.4 - RCL Support Attachment Points

Support Designator	Attachment Points				Rigid Transformation Required
	Loop 1	Loop 2	Loop 3	Loop 4	
RPVS	104	297	304	497	No
SGLS	120	220	320	420	Yes
SGUS	133	233	333	433	No
XL SG Side	153	253	353	453	No
XL RCP Side	163	263	363	463	No
RCPLS	168	268	368	468	No
RCP Tie Rod #1	171	271	371	471	Yes
RCP Tie Rod #2	172	272	372	472	Yes
RCP Tie Rod #3	170	270	370	470	Yes
FWL Dyn.	132	232	332	432	No
MSL Dyn.	139	239	339	439	No

REV. NO.	REV. DATE	AUTHOR DATE	CHK'D. BY DATE	CHK'D. BY DATE

TABLE A-7

WESTINGHOUSE PLANT ENGINEERING DIVISION

SHEET 1 of 2

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TITLE APPENDIX A.1 - MODEL DEFINITION			PAGE 19 OF 27
PROJECT WATTS BAR #2	AUTHOR / DATE	CHK'D. BY / DATE 1/24/85	CHK'D. BY / DATE —— NC —
S.O. WJIJ/134	CALC. NO.	FILE NO. WAT/145/12	GROUP SSA

Page 1 of 2

TABLE A .2(b)
LUMPED MASS VALUES
GLOBAL COORDINATE SYSTEM

Mass Point Node Number(s)	M_X (lb_f)	M_Y (lb_f)	M_Z (lb_f)	I_{XX} (lb_f-in^2)	I_{YY} (lb_f-in^2)	I_{ZZ} (lb_f-in^2)
101	50.0	50.0	50.0	100.0	100.0	100.0
1	656069.	656069.	1556076.	0.0	0.0	1.128E10
1000	50.0	50.0	50.0	100.0	100.0	100.0
3	286438.	286438.	0.0	0.0	0.0	0.0
4	234429.	234429.	0.0	0.0	0.0	0.0
8	165959.	165959.	424924.	0.0	0.0	0.0
9	61283.	61283.	0.0	0.0	0.0	0.0
10	212095.	212095.	0.0	0.0	0.0	0.0
14	50.0	50.0	50.0	100.0	100.0	100.0
15	70943.	70943.	0.0	0.0	0.0	0.0
16	70943.	70943.	0.0	0.0	0.0	0.0
17	70943.	70943.	0.0	0.0	0.0	0.0
104, 304	50.0	50.0	50.0	100.0	100.0	100.0
109, 209, 309, 409	13.17E3	13.17E3	13.17E3	0.0	0.0	0.0
113, 213, 313, 413	5.301E3	5.301E3	5.301E3	0.0	0.0	0.0
119, 219, 319, 419	237.8E3	237.8E3	0.0	6.528E8	6.528E8	0.0
132, 232, 332, 432	50.0	50.0	50.0	100.0	100.0	100.0
133, 233, 333, 433	501.7E3	501.7E3	817.E3	148.04E8	148.04E8	29.066E8
139, 239, 339, 439	77.5E3	77.5E3	0.0	3.716E8	3.716E8	0.0
143, 243, 343, 443	4337.	4337.	0.0	0.0	0.0	0.0
149, 249, 249, 449	5314.	5314.	19822.	0.0	0.0	0.0
153, 253, 353, 453	10171.	10171.	0.0	0.0	0.0	0.0
159, 259, 359, 459	4.139E3	4.139E3.	4.139E3	0.0	0.0	0.0
163, 263, 363, 463	12.955E3	12.955E3	12.955E3	0.0	0.0	0.0
169, 269, 369, 469	114.4E3	114.4E3	114.4E3	0.0	0.0	0.0

REV. NO.	REV. DATE	AUTHOR / DATE	CHK'D. BY / DATE	CHK'D. BY / DATE

TABLE A-7

WESTINGHOUSE PLANT ENGINEERING DIVISION

SHEET 2 of 2

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PROJECT WATTS BAR #2	AUTHOR / DATE	CHK'D. BY / DATE RKnigan 1/24/85	CHK'D. BY / DATE — NR —
S.O. WJIJ/134	CALC. NO.	FILE NO. WAT/145/12	GROUP SSA

TABLE A .2(b)

LUMPED MASS VALUES

GLOBAL COORDINATE SYSTEM

Page 2 of 2

Mass Point Node Number(s)	M_X (lb_f)	M_Y (lb_f)	M_Z (lb_f)	I_{XX} (lb_f-in^2)	I_{YY} (lb_f-in^2)	I_{ZZ} (lb_f-in^2)
168, 268, 368, 468	50.0	50.0	50.0	100.0	100.0	100.0
179, 279, 379, 479	87.8E3	87.8E3	87.8E3	0.0	0.0	0.0
183, 283, 383, 483	17.162E3	17.162E3	17.162E3	0.0	0.0	0.0
189, 289, 389, 489	1.806E3	1.806E3	1.806E3	0.0	0.0	0.0
297, 497	50.0	50.0	50.0	100.0	100.0	100.0

REV. NO.	REV. DATE	AUTHOR / DATE	CHK'D. BY / DATE	CHK'D. BY / DATE

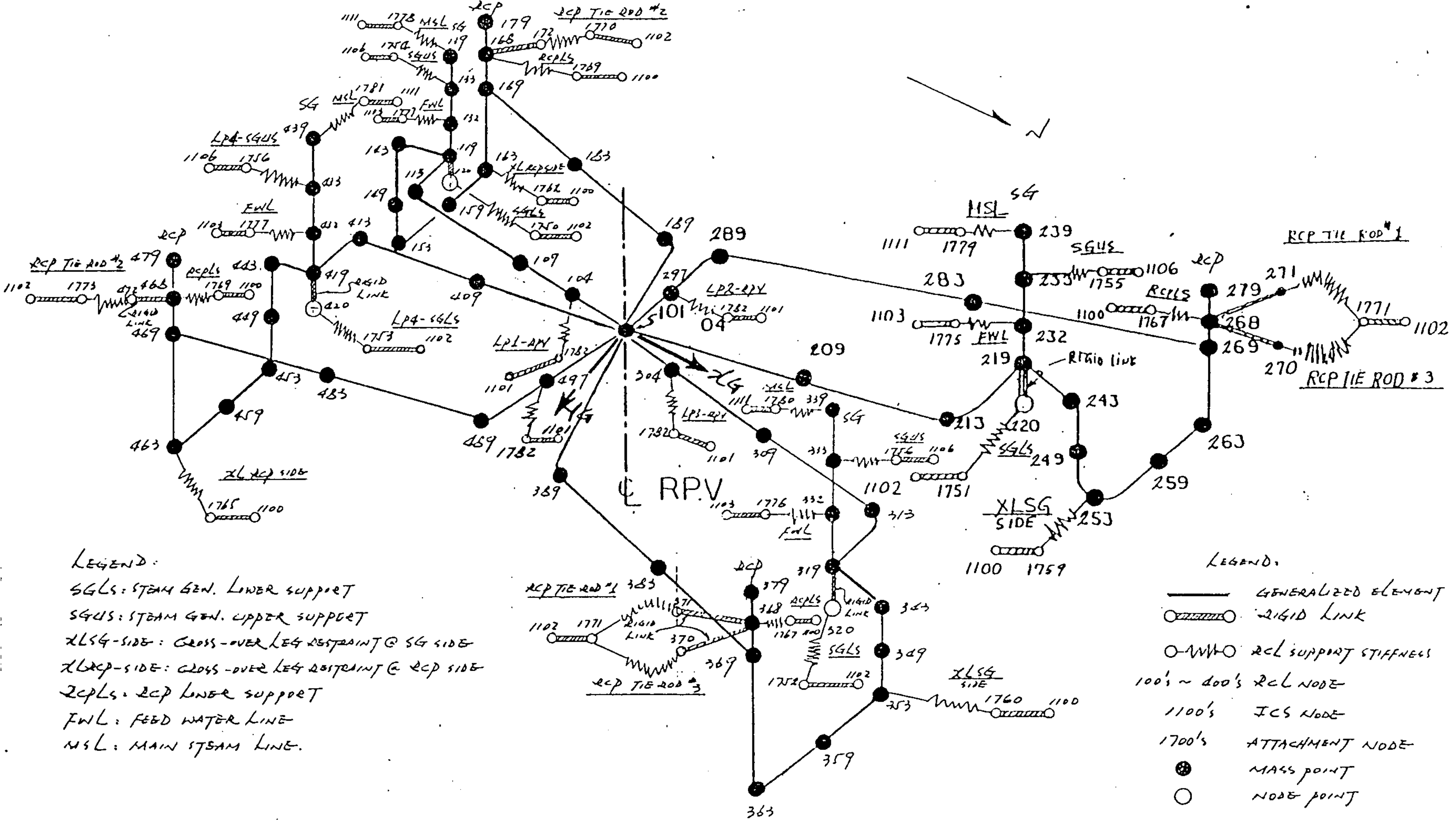
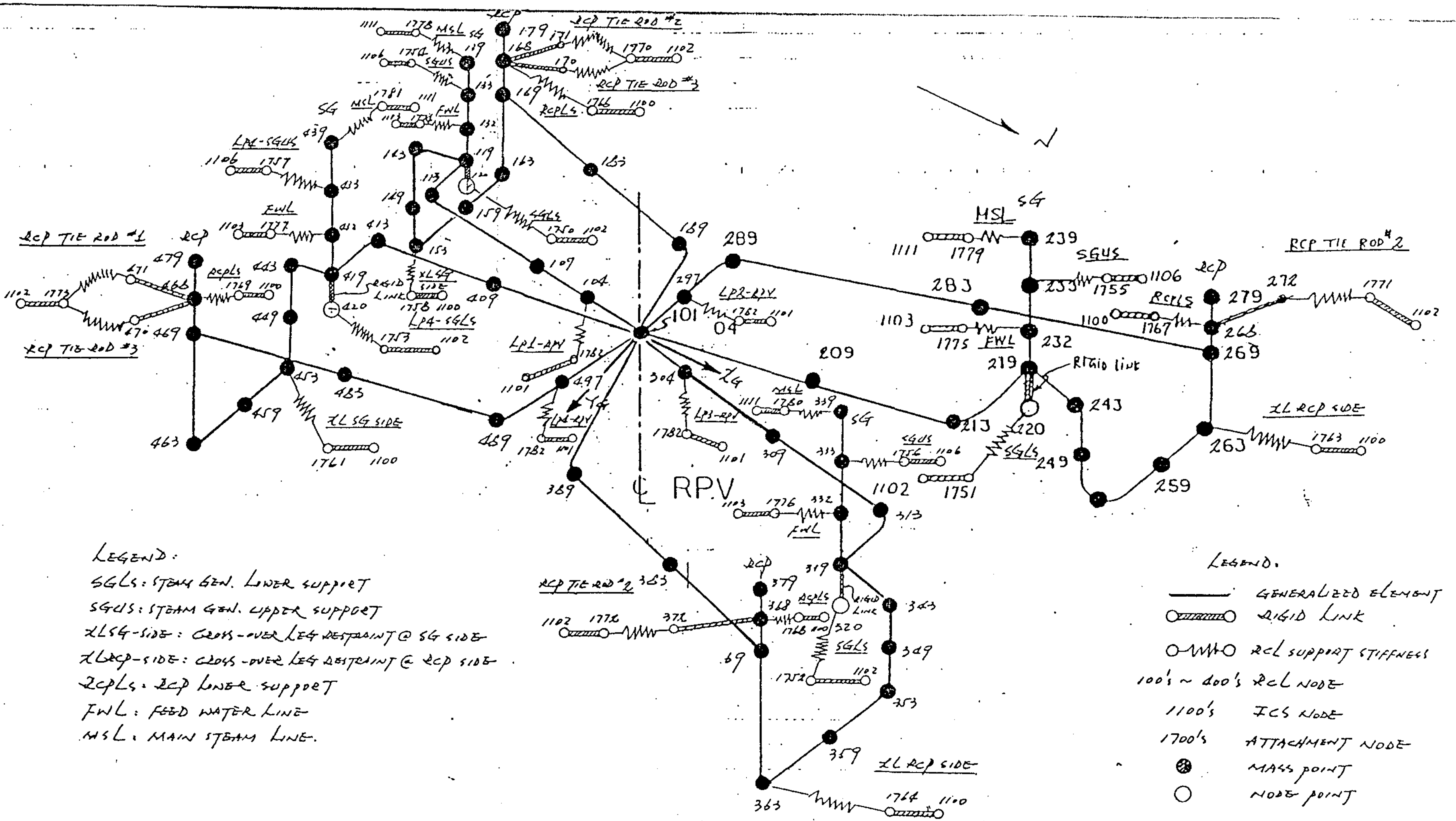


FIG. 1. GEOMETRY OF NSSS MODEL (CASE NO. 1) & ICS" INTERFACE NODES

581D/7-87

FIGURE 1

FIGURE 2



LEGEND:

SGLS: STEAM GEN. LOWER SUPPORT
SGUS: STEAM GEN. UPPER SUPPORT
XLSG-SIDE: CROSS-OVER LEG RESTRAINT @ SG SIDE
XLRCP-SIDE: CROSS-OVER LEG RESTRAINT @ RCP SIDE
RCPLS: RCP LOWER SUPPORT
FWL: FEED WATER LINE
MSL: MAIN STEAM LINE.

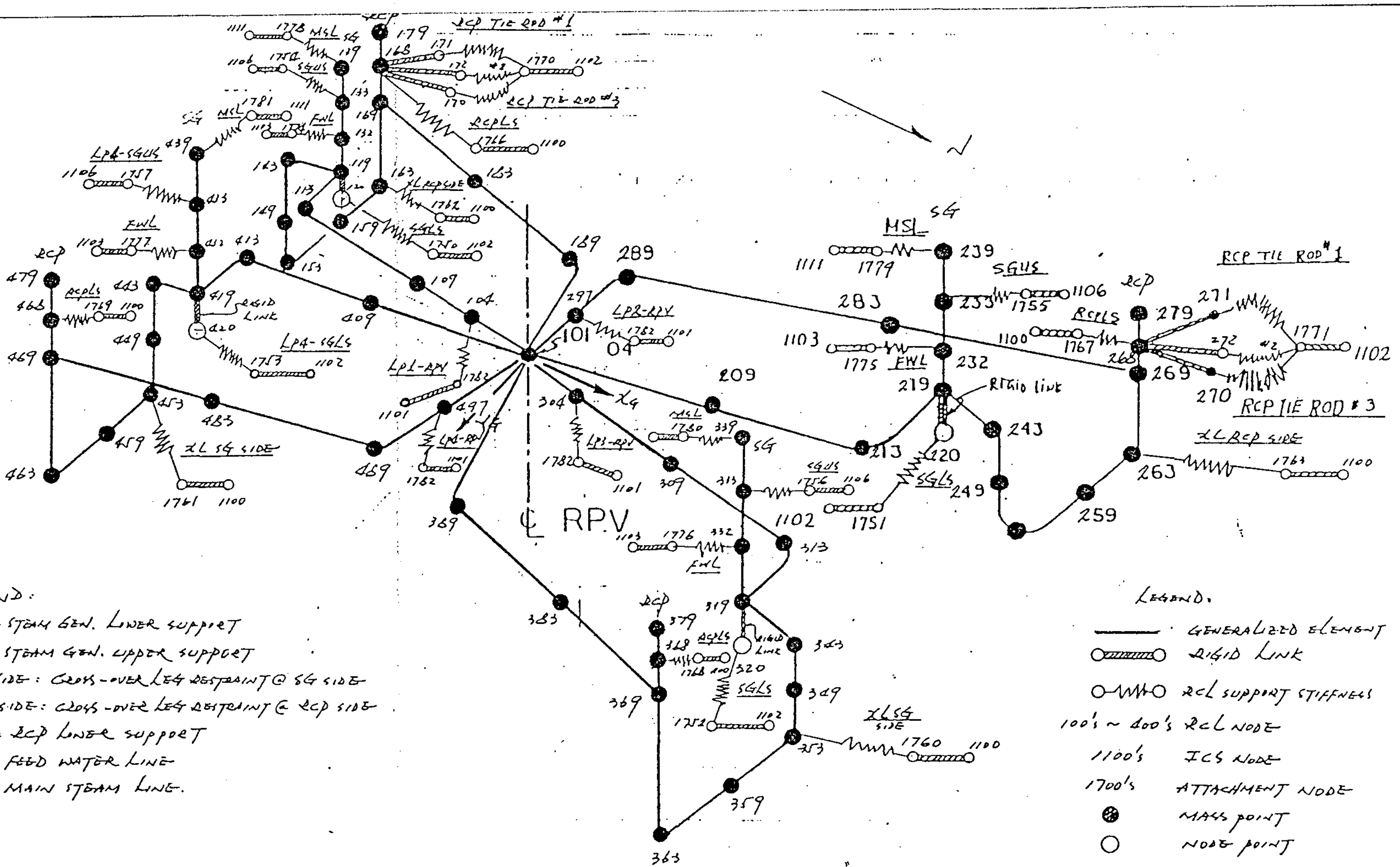
LEGEND.

———	GENERALIZED ELEMENT
O▨▨▨O	RIGID LINK
O-WW-O	RCL SUPPORT STIFFNESS
100's ~ 400's	RCL NODE
1100's	ICS NODE
1700's	ATTACHMENT NODE
●	MASS POINT
○	NODE POINT

FIG. 2. GEOMETRY OF NSSS MODEL (CASE NO. 3) & ICS INTERFACE NODES

581D/7-87

FIGURE 3



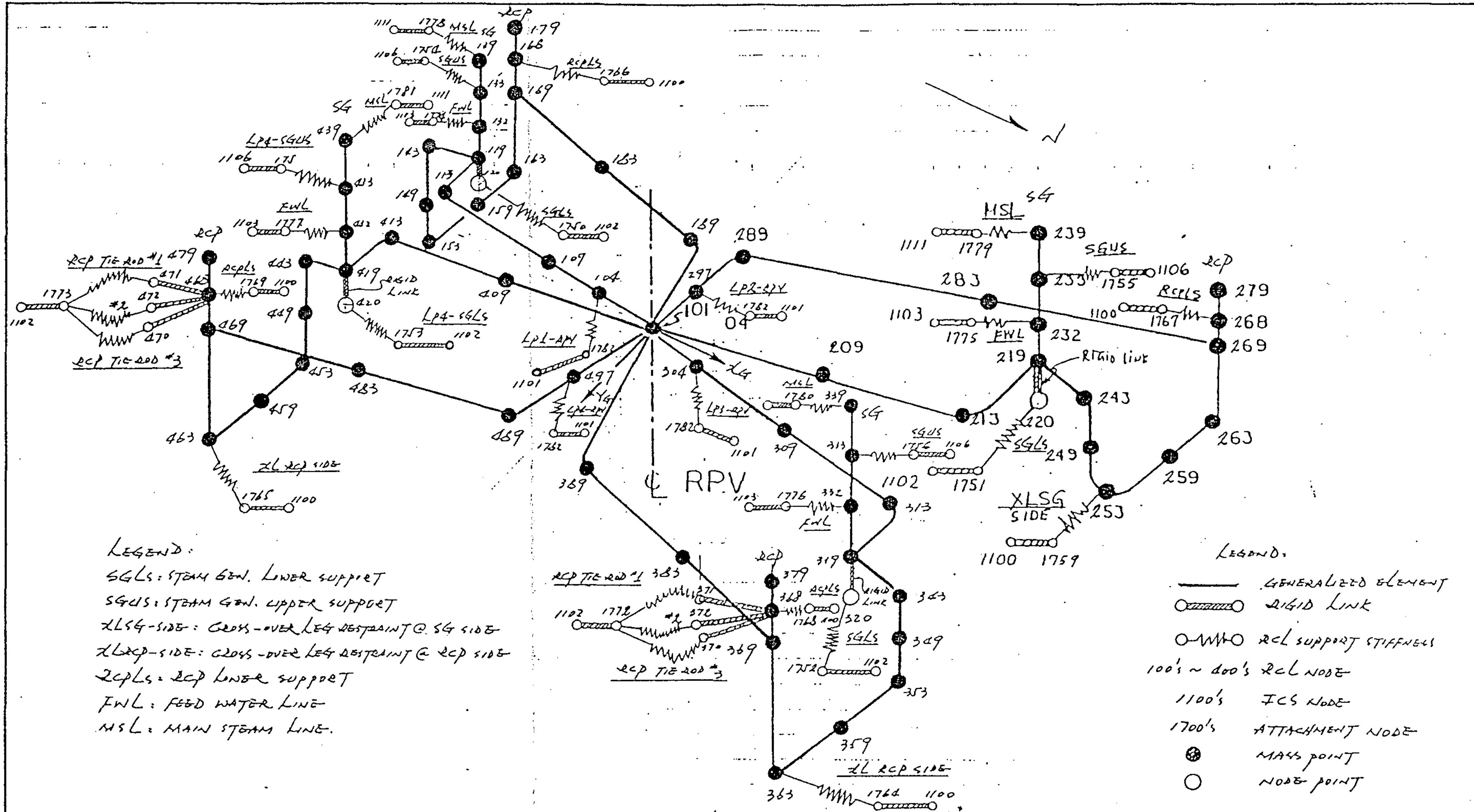
LEGEND:
SGLS: STEAM GEN. LOWER SUPPORT
SGUS: STEAM GEN. UPPER SUPPORT
XLSG-SIDE: CROSS-OVER LEG RESTRAINT @ SG SIDE
XLRCP-SIDE: CROSS-OVER LEG RESTRAINT @ RCP SIDE
RCPLS: RCP LOWER SUPPORT
FWL: FEED WATER LINE
MSL: MAIN STEAM LINE

LEGEND.
——— GENERALIZED ELEMENT
O▬▬O RIGID LINK
O-WW-O RCL SUPPORT STIFFNESS
100's ~ 400's RCL NODE
1100's ICS NODE
1700's ATTACHMENT NODE
● MASS POINT
○ NODE POINT

FIG. 3. GEOMETRY OF NSSS MODEL (CASE NO. 5) & ICS INTERFACE NODES

881D/7-87

SUBJECT



LEGEND:
SGLs: STEAM GEN. LOWER SUPPORT
SGUS: STEAM GEN. UPPER SUPPORT
XLSG-SIDE: CROSS-OVER LEG RESTRAINT @ SG SIDE
XLRCP-SIDE: CROSS-OVER LEG RESTRAINT @ RCP SIDE
RCPLs: RCP LOWER SUPPORT
FWL: FEED WATER LINE
MSL: MAIN STEAM LINE.

LEGEND:
— GENERALIZED ELEMENT
O▨▨▨O RIGID LINK
O-WW-O RCL SUPPORT STIFFNESS
100's ~ 400's RCL NODE
1100's ICS NODE
1700's ATTACHMENT NODE
● MASS POINT
○ NODE POINT

FIG. 4 GEOMETRY OF NSSS MODEL (CASE NO. 6) & ICS INTERFACE NODES

FIGURE 4

FIGURE 5

WESTINGHOUSE PLANT ENGINEERING DIVISION

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AUTHOR T.M. [illegible] DATE 1/18/85
CHK'D. BY [illegible] DATE 1/24/85
CHK'D. BY — NR — DATE
S.O. WJIJ/134
CALC. NO.
FILE NO. WAT/145/12
GROUP SSA

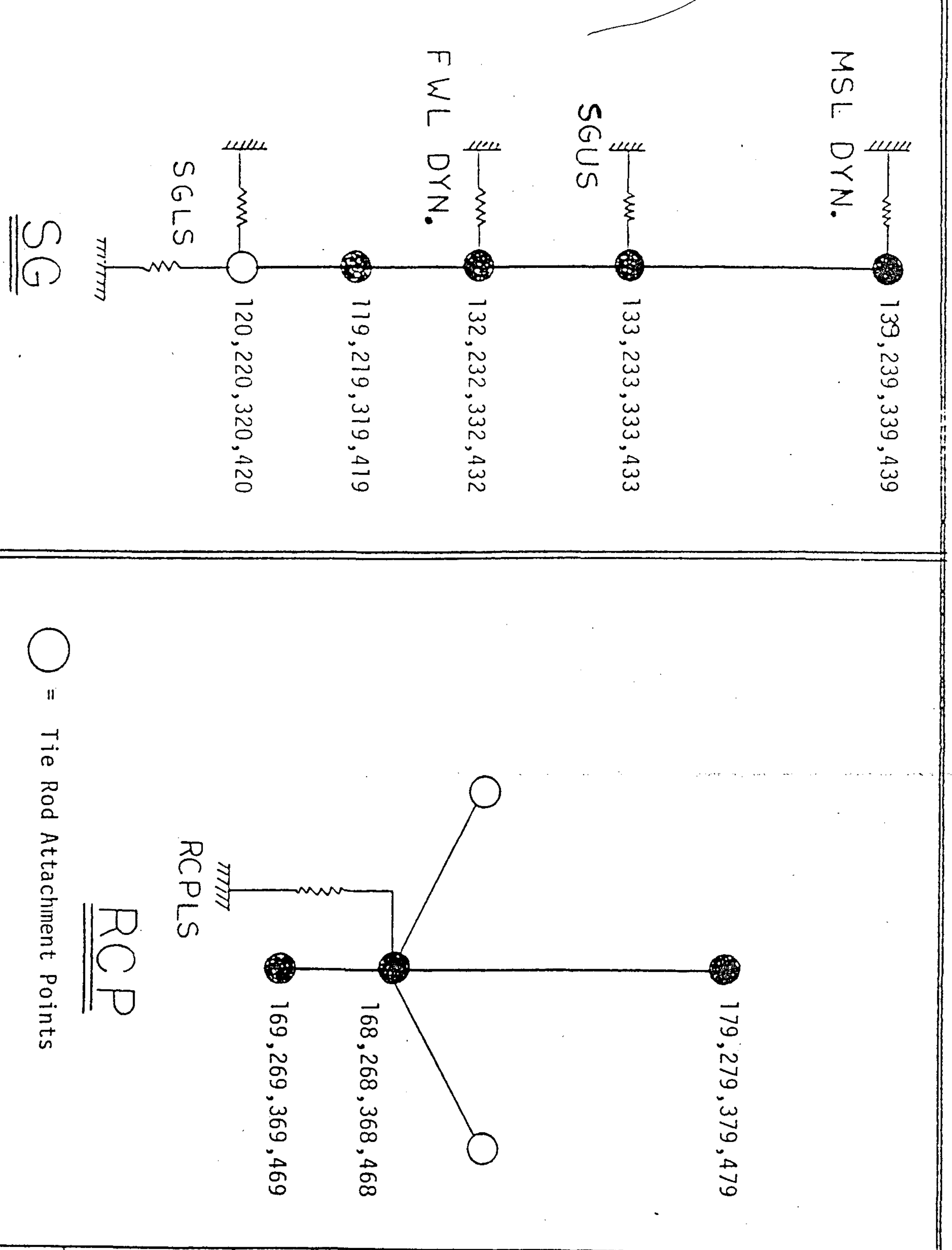

FIGURE A.8 - SG and RCP Support Arrangement

REV. NO.
REV. DATE
AUTHOR DATE
CHK'D. BY DATE
CHK'D. BY DATE

WESTINGHOUSE FORM 58041

WESTINGHOUSE PLANT ENGINEERING DIVISION

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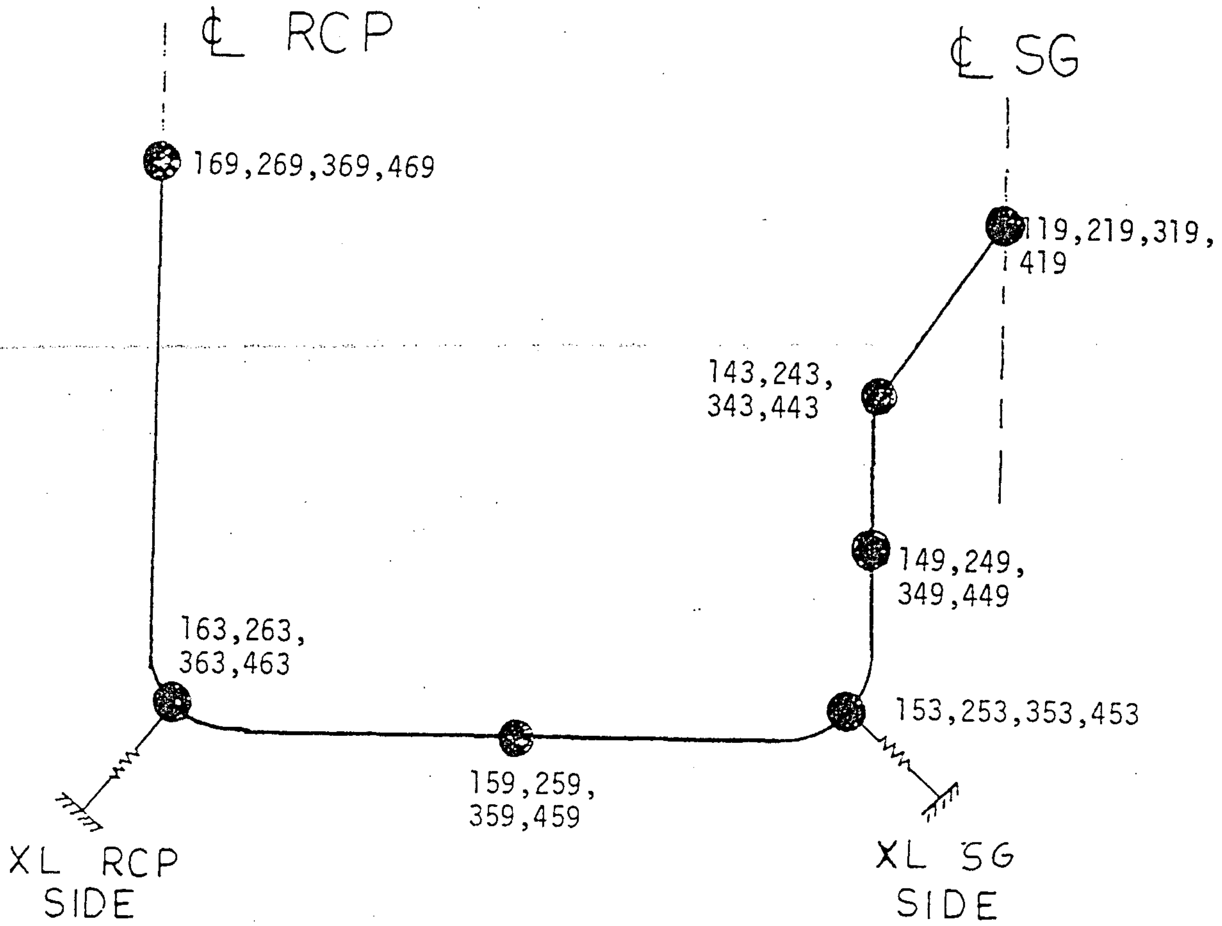

FIGURE A.9 - Crossover Leg Bumper Support Arrangement

REV. NO.	REV. DATE	AUTHOR DATE	CHK'D. BY DATE	CHK'D. BY DATE

FIGURE 6

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JOB NO.	CALC. NO.	REV NO.	SHEET NO.
18968-812	WCG-1-344	0	29

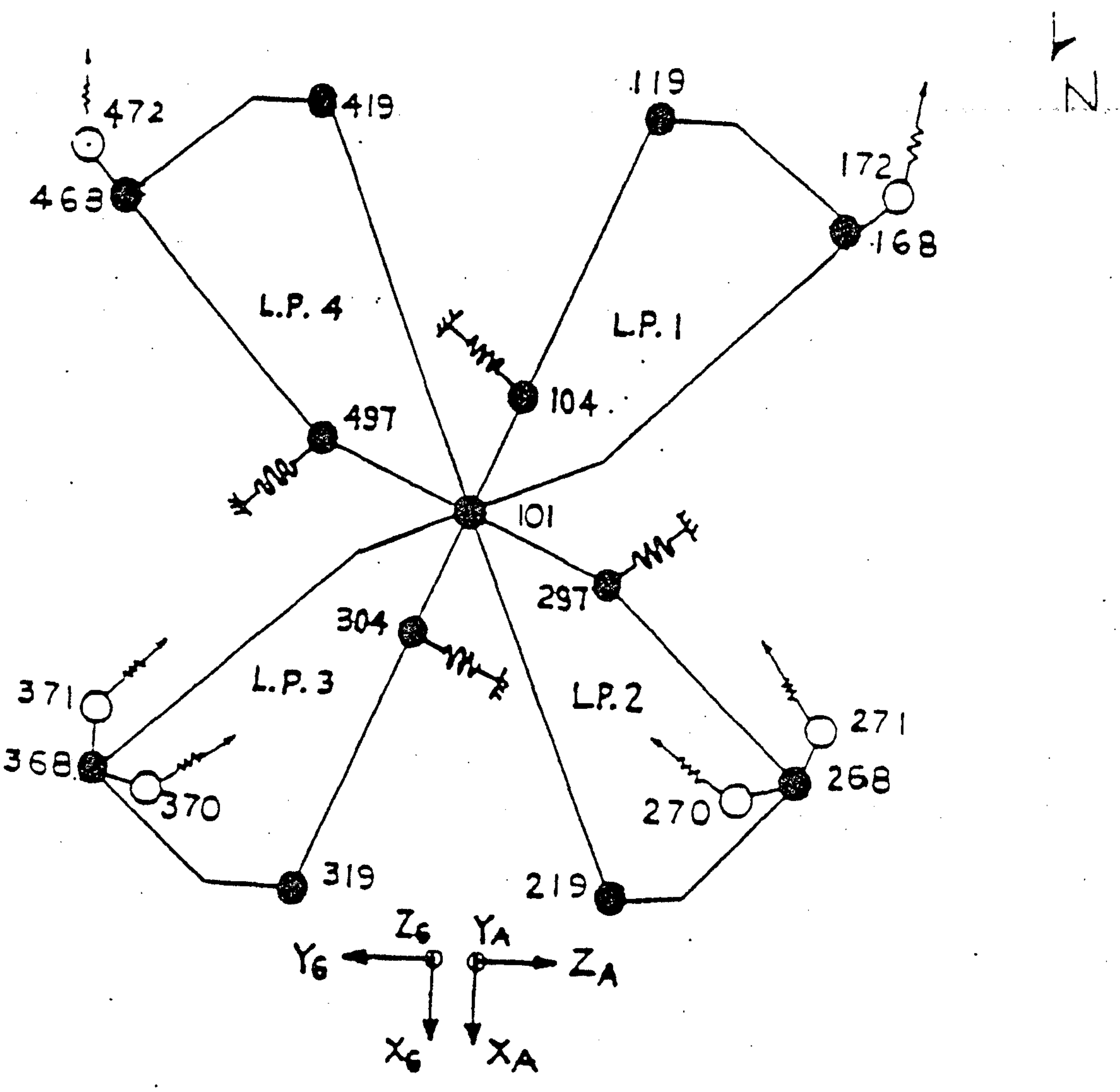
ORIGINATOR	DATE	CHECKED	DATE
T.W.MA TWMA	2/9/89 2-9-89	J.O. J.O.	2/14/89 2-14-89

SUBJECT : TVA-WBN-UNIT-1 DESIGN BASIS SEISMIC ANALYSIS OF ICS + NSSS /SCV /SB

4.2 (cont)

CASE 1

UNIT 1 - RCP Tie Rod and RPV Support Arrangement



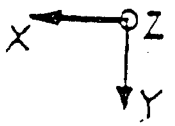


Fig. 4.2.6
UNIT-1 RCP TIE ROD AND RPV SUPPORT ARRANGEMENT - CASE 1

FIGURE 7

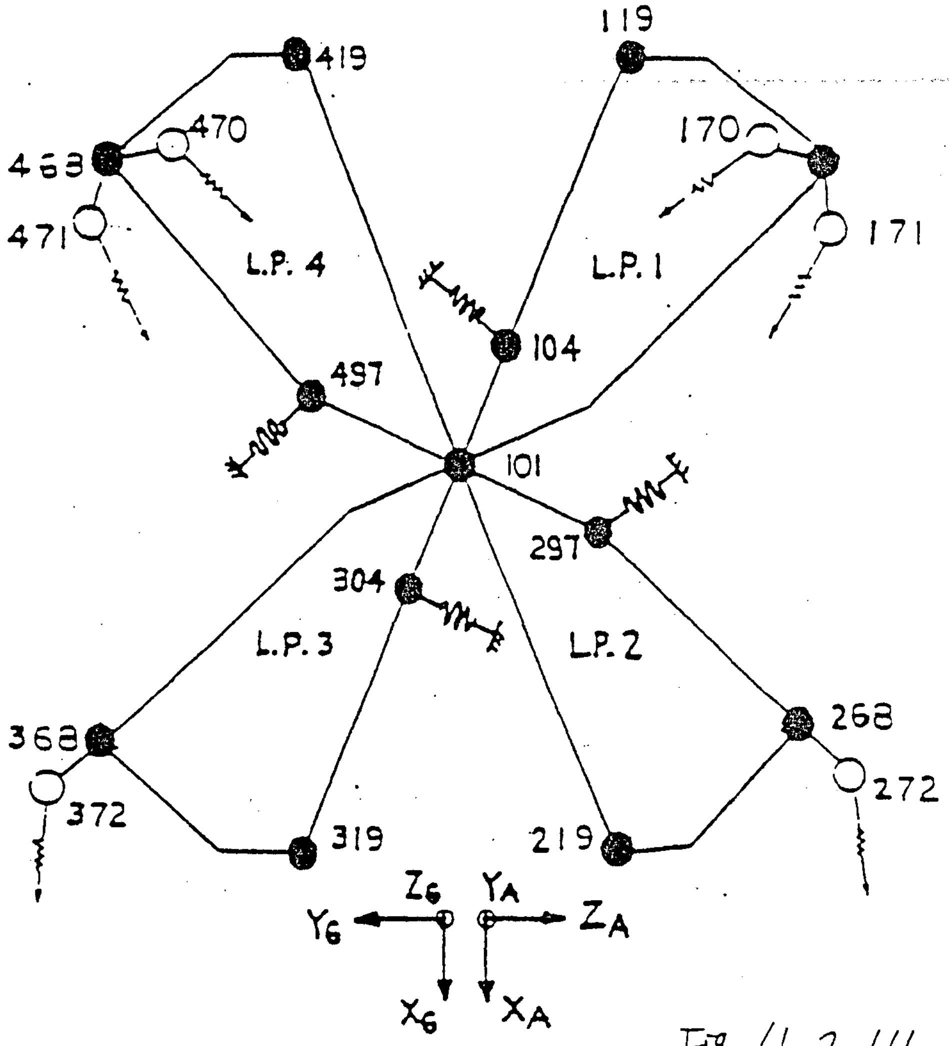
JOB NO.	CALC. NO.	REV NO	SHEET NO.
18968-812	WCG-1-344	0	37

ORIGINATOR	DATE	CHECKED	DATE
T.W.MA TWMA	2/9/89 2-9-89	7.0. 7.0.	2-14-89 2-14-89

SUBJECT : TVA-WBN-UNIT-1 DESIGN BASIS SEISMIC ANALYSIS OF ICS + NSSS / SCV / SB

4.2 (cont.)
CASE 3

UNIT 1 · RCP Tie Rod and RPV Support Arrangement



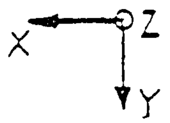


Fig. 4.2.14 - UNIT-1 RCP TIE ROD AND RPV SUPPORT ARRANGEMENT - CASE 3

FIGURE 8

JOB NO.	CALC. NO.	REV NO	SHEET NO
18968-812	WCG-1-344	0	45

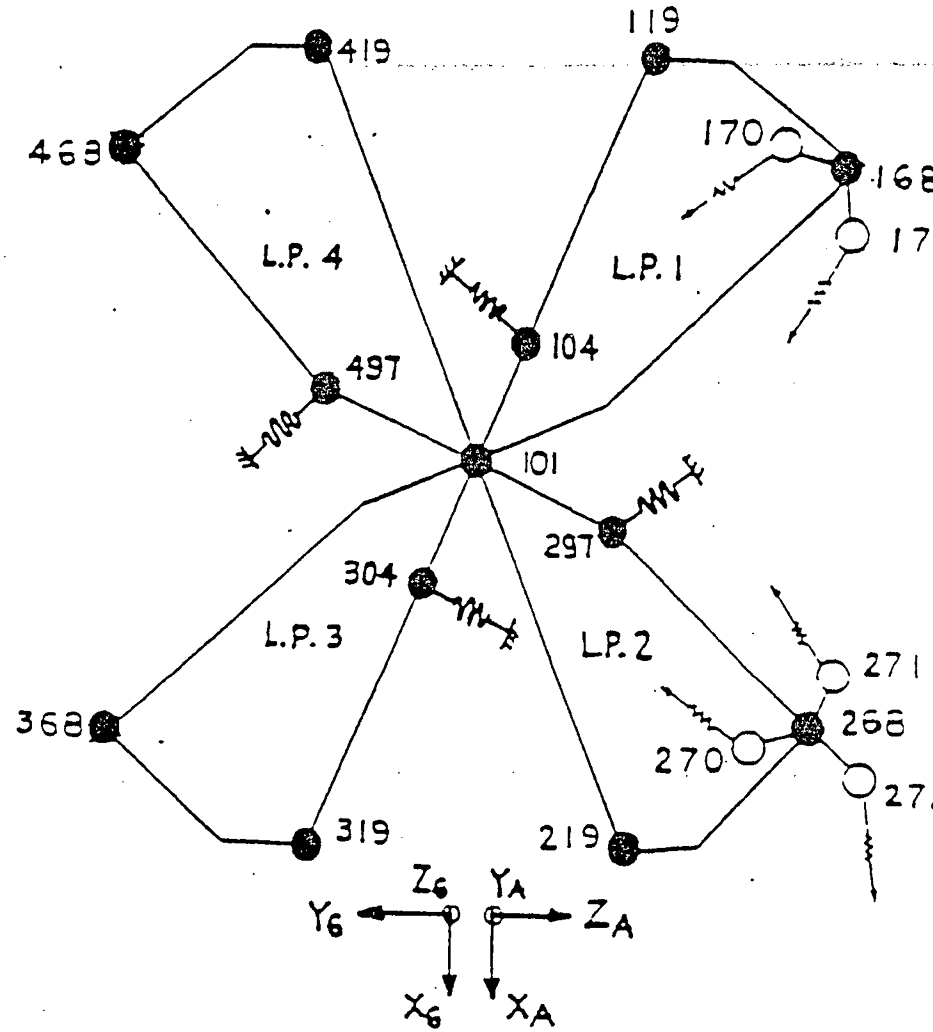
ORIGINATOR	DATE	CHECKED	DATE
T.W.MA TWMA	2/9/89 2-9-89	J.O. J-O.	2-14-89 2-14-89

SUBJECT : TVA-WBN-UNIT-1 DESIGN BASIS SEISMIC ANALYSIS OF ICS + NSSS / SCV / SB

4.2 (CONT.)

CASE 5

UNIT 1 - RCP Tie Rod and RPV Support Arrangement



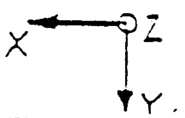


Fig. 4.2.21.
UNIT 1 RCP TIE ROD AND RPV SUPPORT ARRANGEMENT - CASE 5

FIGURE 9

JOB NO. 18:968-812	CALC. NO. WCG-1-344	REV NO 0	SHEET NO 53
ORIGINATOR T.W.MA ~~TWMA~~ DATE 2/9/89 2-9-89	CHECKED J.O. J-O.	DATE 2-14-89 2-14-89	

SUBJECT : TVA-WBN-UNIT-1 DESIGN BASIS SEISMIC ANALYSIS OF ICS + NSSS / SCV / SB

4.2 (cont'd)

CASE 6

UNIT 1 - RCP Tie Rod and RPV Support Arrangement

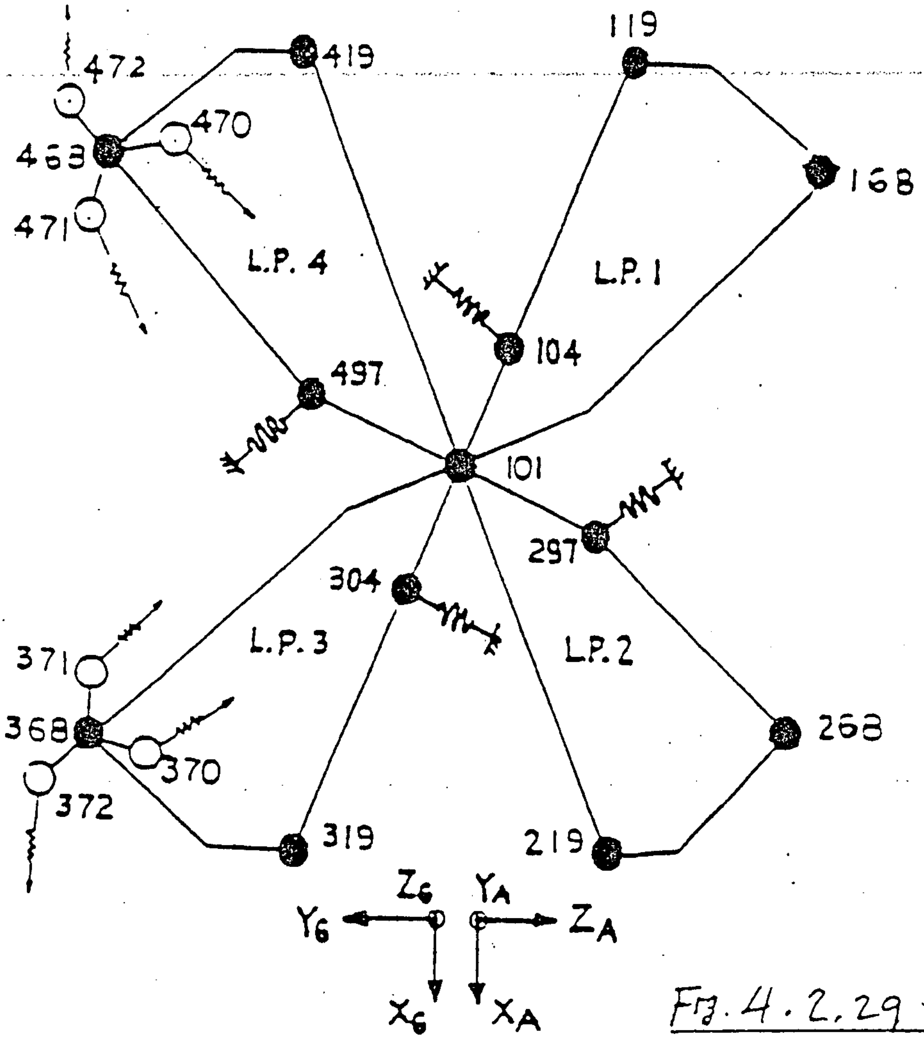


Fig. 4.2.29 - UNIT-1 RCP TIE ROD AND RPV SUPPORT ARRANGEMENT - CASE 6

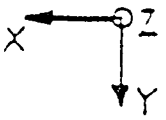


FIGURE 10

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FSAR CHAPTER 3, AMENDMENT 79

PROPOSED FSAR REVISIONS

The uplift on the equipment from the LOCA combined with the SSE controlled the design of the base slab.

Minimum steel requirements of 0.65 square inches per foot (minimum steel ratio of 0.0015 in each face and in both vertical and horizontal directions) controlled the inside face vertical steel requirements throughout the shell and the inside face horizontal steel requirements above grade.

The SSE in load combination 8 controlled the design of the outside face vertical reinforcement at the base of the cylinder wall. Due to earth and hydrostatic pressure, outside face horizontal reinforcement requirements were greatest 16 feet above the base of the cylinder wall at elevation 713.0.

The construction loading controlled the reinforcement design in the dome and the upper portion of the cylinder wall.

The SSE produced a maximum tangential shear stress at the base of the wall of 189.7 psi which was 76.8% of the allowable.

The effects of repeated reactor shutdowns and startups during the plant's life will not degrade the above margins of safety because the Shield Building is minimally affected by these operations. The only effects from normal operations are from interior temperature changes which are insignificant compared to normal exterior temperature variations.

<u>Equipment Hatch Doors and Sleeves</u>

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.1-2. For normal load conditions, the allowable stresses provide safety factors of 1.67 ($F_y/0.6\ F_y$) to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting condition~~s~~ such as ~~an Operating Basis Earthquatke (OBE) or~~ a Safe Shutdown Earthquake (SSE), stresses do not exceed 0.9 yield.

3.8.1.6 Materials, Quality Control and Special Construction Techniques

General

The principal materials used in the construction of the Shield Building base slab, wall, and dome were concrete and reinforcing steel. Concrete was placed, inspected, and tested based upon the requirements in TVA General Construction Specification No. G-2 for Plain and Reinforced Concrete and to TVA QCP-2.2 Concrete Placement and Documentation (until 1975) and TVA WBN-QCP-2.02 (1975 and after). Steel is used for the structural parts of the equipment hatch doors and sleeves with rubber used for the seals.

3.8.1.6.1 Materials

Concrete

Cement conformed to ASTM Specification C150-72 Type I. The guaranteed 28-day mortar strength was 5025 psi with a guaranteed standard deviation of 395 psi and a guaranteed maximum tricalcium aluminate content of 9.5%.

Aggregates conformed to ASTM Specification C-33-71a and were manufactured of crushed limestone.

TABLE 3.8.1-2

(Sheet 1 of 2)

SHIELD BUILDING EQUIPMENT HATCH DOORS AND SLEEVES LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Structural

No.	Load Combinations	Allowable Stresses (psi)		
		Tension	Compression****	Shear
I	Dead load plus 2-psi pressure	0.50 Fy	0.47 Fy	0.33 Fy
II	Dead load plus 3-psi pressure inside	0.90 Fy	0.90 Fy	0.60 Fy
III	Dead load plus 2-psi pressure outside plus *OBE	0.60 ~~0.90~~ Fy	0.60 ~~0.90~~ Fy	0.40 ~~0.60~~ Fy
IV	Dead load plus 2-psi pressure outside plus *SSE	0.90 Fy	0.90 Fy	0.60 Fy
**V	Dead load plus *OBE	0.60 ~~0.90~~ Fy	0.60 ~~0.90~~ Fy	0.40 ~~0.60~~ Fy
**VI	Dead load plus *SSE	0.90 Fy	0.90 Fy	0.60 Fy

Mechanical

No.	Load Combinations	Allowable Stresses (psi)	
		Tension & Compression~~****~~	Shear
**I	Dead load	$\frac{\text{Ult}}{5}$	$\frac{2 \times \text{Ult}}{15}$
**Ia	Dead load plus* OBE	0.60 ~~0.90~~ Fy	0.40 ~~0.60~~ Fy
***II	Dead load plus *SSE	0.90 Fy	0.60 Fy

TABLE 3.8.1-2

(Sheet 2 of 2)

SHIELD BUILDING EQUIPMENT HATCH DOORS AND SLEEVES
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES (Cont'd)

III	Dead load plus 2-psi pressure outside	$\frac{\text{Ult}}{5}$	$\frac{2 \times \text{Ult}}{15}$
IV	Dead load plus 3-psi pressure inside	0.90 Fy	0.6 Fy
V	Dead load plus 2-psi pressure outside plus *OBE	0.60 ~~0.90~~ Fy	0.40 ~~0.60~~ Fy
VI	Dead load plus 2-psi pressure outside plus *SSE	0.90 Fy	0.6 Fy

* Acts in one horizontal direction only at any given time and acts in the vertical and horizontal directions simultaneously.

** Door open.

*** For hinges only with doors open.

**** The value given for allowable compression stress is the maximum value permitted, assuming that buckling does not control. The critical buckling stress shall be used in place of Fy when buckling controls.

**** The value indicated for the allowable compression stresses is the maximum value permitted when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2 C_c^{\,2}} \right] \quad \text{when } \frac{Kl}{r} \leq C_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \quad \text{when } \frac{Kl}{r} > C_c$$

3.8.3.5.9 Penetrations Through the Divider Barrier

Canal Gate and Control Rod Drive (CRD) Missile Shield

Loading combinations 1 through 7 in Table 3.8.3-1 were examined. During the original design (construction permit) phase with calculated values of LOCA pressure load increased by 40%, the controlling load combination is "Abnormal/Severe Environmental." See Table 3.8.3-2.

Reactor Coolant Pump and Lower Compartment Access Hatches

Loading combinations 1 through 7 in Table 3.8.3-1 were examined. During the original design (construction permit) phase with calculated values of LOCA pressure load increased by 40%, the controlling load combination is "Abnormal/Severe Environmental."

Escape Hatch

Loading combinations 1 through 7 in Table 3.8.3-1 were examined. During the original design (construction permit) phase with calculated values of LOCA pressure load increased by 40%, the controlling load combination is "Abnormal/Severe Environmental."

3.8.3.5.10 Personnel Access Doors in Crane Wall

Allowable stresses for noncollapsible members for load combinations used for the various parts are given in Table 3.8.3-3. Normal load conditions are shown for mechanical members only. Loads on structural members during normal conditions are negligible and therefore are not shown on Table 3.8.3-3. For normal load conditions, factors of safety for mechanical parts are 5 to 1 on ultimate. For limiting conditions such as ~~an OBE or~~ SSE ~~for mechanical and structural members~~ and a pipe rupture accident, ~~for structural members only~~, stresses do not exceed 0.9 yield. ~~Pipe rupture accidents apply to structural members only, since forces from jets and missiles are taken by the structural frame.~~

For collapsible members during a pipe rupture accident, stresses exceed yield and members are plastically deformed. Plastic deformation of energy absorbing members does not affect the sealing integrity of the doors.

3.8.3.5.11 Seals Between Upper and Lower Compartments

Under normal and earthquake conditions, there are no loads on the seals. However, the seals are subject to radiation, as outlined previously, during normal operating conditions. The seal has been tested under accident pressures and temperatures after undergoing heat aging to 40 years equivalent age, and irradiation to 40 years normal operation plus accident integrated doses in order to qualify it for the life of the plant.

TABLE 3.8.3-3

(Sheet 3 of 4)

PERSONNEL ACCESS DOORS IN CRANE WALL

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES (Cont'd)

Structural Door and Frame Assembly

		Allowable stresses (psi)$^{(1)}$		
No.	Load Combinations	Tension	Compression$^{(3)}$	Shear
I.	With door closed or open: Dead load plus OBE	0.6 F_y	0.6 F_y	0.4 F_y
II. ~~I.~~	With door closed or open: Dead load plus ~~$E^{(2)}$~~ SSE	0.9 F_y	0.9 F_y	0.6 F_y
III. ~~II.~~	With door closed: Dead load plus ~~$E^{(2)}$~~ SSE plus 12 psig from inside of crane wall	0.9 F_y	0.9 F_y	0.6F_y
IV. ~~III.~~	With door closed: Dead load plus ~~$E^{(2)}$~~ SSE plus Load from maximum jet hitting doors at 615 psi	0.9F_y	0.9 F_y	0.6 F_y
V. ~~IV.~~	With door closed: Dead load plus ~~$E^{(2)}$~~ SSE plus Load from missile with maximum energy (6900 lbft) hitting door plus jet from that missile source at 295 psi	0.9 F_y	0.9 F_y	0.6 F_y

Mechanical Parts

		Allowable Stresses (psi)$^{(1)}$		
No.	Load Combination	Tension	Compression$^{(3)}$	Shear
I.	With door closed or open: Dead load plus Operator force of 75 pounds	$\frac{\text{Ult}}{5}$	$\frac{\text{Ult}}{5}$	$\frac{2 \times \text{Ult}}{15}$
III. ~~II.~~	With door closed or open: Dead load plus ~~$E^{(2)}$~~ SSE	0.9F_y	0.9F_y	0.6F_y
II.	With door closed or open: Dead load plus OBE	0.6F_y	0.6F_y	0.4F_y

TABLE 3.8.3-3

(Sheet 4 of 4)

PERSONNEL ACCESS DOORS IN CRANE WALL

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES (Cont'd)

Structural Door and Frame Assembly

Mechanical Parts

No.	Load Combinations	Allowable Stresses (psi)$^{(1)}$ Tension	Compression$^{(3)}$	Shear
IV. ~~III.~~	With door closed: Dead load plus ~~$E^{(2)}$~~ SSE plus Load from maximum jet hitting doors at 615 psi	$0.9F_y$	$0.9F_y$	$0.6F_y$
V. ~~IV~~	With door closed: Dead load plus ~~$E^{(2)}$~~ SSE plus Load from missile with maximum energy (6900 lb/ft) hitting door plus jet from that missile source at 295 psi	$0.9F_y$	$0.9F_y$	$0.6F_y$

NOTES:

(1) Listed allowable stresses are for non-collapsible members only. Collapsible members are plastically deformed.

(2) ~~E - The greater of OBE or SSE loads.~~ Earthquake loads ~~A~~ct~~s~~ in one horizontal direction only at any given time and act~~s~~ in vertical and horizontal directions simultaneously.

(3) The value indicated for the allowable compression stresses is the maximum value permitted when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of Fy when buckling controls.

$$F_{cr} = F_y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2 C_c^2}\right] \quad \text{when } \frac{Kl}{r} \le C_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \quad \text{when } \frac{Kl}{r} > C_c$$

TABLE 3.8.3-6

EQUIPMENT ACCESS HATCH

SUMMARY OF ALLOWABLE STRESSES FOR DESIGN CONDITION

	I[2], II[2] Allowable	III[2] ~~II[2]~~ Allowable
Bending stress in structural shapes and plates (F_y = 36,000 psi)	21,600 psi (0.60 F_y)	32,400 psi (0.90 F_y)
Shear stress in structural shapes and plates (F_y = 36,000 psi)	14,400 psi (0.40 F_y)	21,600 psi (0.60 F_y)
Tensile stress in anchor bolts (F_y = 36,000 psi)	19,800 psi (0.55F_y)	31,700 psi (1.6(0.55)F_y)
Bearing stress under anchor bolt end plate (Fc' = 5,000 psi)	1,250 psi (0.25 Fc'(1))	

Notes:

(1) See Table 1002(a), ACI 318-63 Code

(2) I = DL + L1 or DL + L2

II = DL + L1 + OBE ~~E~~ or DL + L2 + OBE ~~E~~

III = DL + L1 + SSE or DL + L2 + SSE

L1 = Live load of 14,000 lb (loaded weight of forklift)

L2 = Live load of 15 psi pressure from below (LOCA)

~~E = The greater of OBE and SSE loads~~

TABLE 3.8.3-7

ESCAPE HATCH - DIVIDER BARRIER FLOOR

LOAD COMBINATIONS - ALLOWABLE STRESSES

Structural Parts - (F_y - 36,000 psi)

No.	Load Combinations	Allowable Stress (psi) Tension	Allowable Stress (psi) Compression$^{(2)}$	Allowable Stress (psi) Shear
	Hatch Closed			
I.	Dead load Live load at 100 lb/ft^2 Load from latching device	18,000 (0.5 F_y)	18,000 (0.5 F_y)	12,000 (0.33F_y)
III ~~II.~~	Dead load Live load of 15 psi from below, Load from latching device ~~E$^{(1)}$~~ SSE$^{(1)}$	25,900 (0.72 F_y)	25,900 (0.72 F_y)	17,300 (0.48 F_y)
IV ~~III.~~	Dead load ~~E$^{(1)}$~~ SSE	25,900 (0.72 F_y)	25,900 (0.72 F_y)	17,300 (0.48 F_y)
II	Dead load OBE$^{(1)}$	22,000 (0.6 F_y)	22,000 (0.6 F_y)	14,400 (0.4 F_y)

Mechanical Parts (Excluding Springs)

No.	Load Combinations	Allowable Stress (psi) Compression$^{(2)}$	Allowable Stress (psi) Shear	Tension
	Hatch Closed			
I.	Dead load Live load at 100 lb/ft^2 Load from latching device	$\frac{\text{Ultimate}}{5}$	$\frac{2}{3} \times \frac{\text{Ultimate}}{5}$	$\frac{\text{ultimate}}{5}$
II.	Dead load Live load of 15 psi from below, Load from latching device ~~E$^{(1)}$~~ SSE	0.72 yield	$\frac{2}{3} \times$ 0.72 yield	0.72 yield

NOTES:

(1) Acts in one horizontal direction only at any given time and acts in vertical and horizontal directions simultaneously. ~~E - The greater of OBE or SSE loads.~~

(2) The value given for allowable compression stress is the maximum value permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2 C_c^2} \right] \quad \text{when} \quad \frac{Kl}{r} \le C_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \quad \text{when} \quad \frac{Kl}{r} > C_c$$

Earthquake loads used in design of the hoist supports and enclosure were the loads due to accelerations at the hoist platform, elevation 773.0, produced by a SSE. These accelerations were determined by dynamic analysis of the Auxiliary Building structure. These accelerations were used as static loads for determining component and member sizes. After establishing the component and member sizes, a dynamic analysis, using appropriate response spectra, was made of the door, embedded frame, door track, and hoisting unit enclosure to determine that allowable stresses had not been exceeded.

Manways in the (RHR) Sump Valve Room

In the closed position, each door was considered as a structure supported around the periphery. In the open position, each door was considered as a cantilevered structure with the hinges and hinge anchorages being designed for their loading from the door in the open position. Each embedded frame was considered as being rigidly supported by concrete. Loads from the embedded frame are transferred to the concrete by embedded anchors.

Earthquake loads used in designing the manways were the forces due to accelerations determined for the sump valve room walls at the center of the manways by dynamic analysis of the Auxiliary Buildings for an OBE or SSE. These forces were used as static loads since the manways are rigid and firmly secured to the walls when closed.

Pressure Confining Personnel Doors

Structural members for the doors, in the closed position, were designed as simple beams with end reactions carried by the outside members to the frames which were considered as being rigidly supported by concrete. Loads are transferred to the concrete through embedded anchors or bolt anchors.

In the open position, the doors were designed as cantilever structures with resultant concentrated loads being used for design of the hinge members. For design, the earthquake loads for the various doors consisted of the loads produced by ~~a~~ an OBE or SSE.

Earthquake forces due to building accelerations at the elevation of the center of gravity of the various doors were used as static loads for determining door component and member sizes. The building accelerations were determined by dynamic analysis including amplification through the supporting structures. After establishing the component and member sizes, a dynamic analysis, using appropriate response spectra, was made of the doors to determine that allowable stresses had not been exceeded.

Fuel Pool Gates

The gates are designed for a waterhead load of 25.0 feet imposed from the fuel pool side as measured from the centerline of the horizontal bottom seal to the normal pool level at elevation 749.13. The gates are constructed of welded corrosion resistant steel. When dewatering the fuel transfer canal or handling the fuel cask over the fuel cask pit, inflatable elastomer seals provide a watertight seal between the skin plate and the pool wall liner face.

TVA has generally installed, and will continue to install fillet welds to meet the minimum weld size specifications of Table 1.17.5 of AISC Manual of Steel Construction. Where TVA drawings have specified fillet welds below the minimum sizes specified by AISC, these welds do meet the allowable stress requirements identified above. Weld qualification testing has demonstrated the adequacy of all fillet welds that were installed below minimum AISC specifications.

The Additional Diesel Generator Building structural steel was proportioned to meet the applicable codes discussed in Appendix 3.8E and load combinations in Section 3.8.4.3.

Structural steel and miscellaneous steel, which is highly restrained and is located in a high temperature environment, is evaluated for effects of thermal loads.

3.8.4.5.3 Miscellaneous Components of the Auxiliary Building

Control Room Shield Doors

Allowable stresses for all load combinations used for the various parts of the door and dogs are given in Table 3.8.4-3. For normal load conditions the allowable stresses provide a safety factor of 2 to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For the limiting condition of ~~an OBE or~~ SSE, stresses do not exceed 0.9 yield.

Watertight Equipment Hatch Covers

Allowable stresses for normal loading combinations are based on the AISC specification (see Section 3.8.4.2). For limiting conditions, such as OBE, SSE, tornado, and flood, stresses do not exceed 0.9 yield.

Railway Access Hatch Covers

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.4-4. For normal load conditions, the allowable stresses provide safety factors of 2 ~~1.67 ($F_y/0.6\ F_y$)~~ to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions, such as an OBE or SSE, stresses do not exceed 0.9 yield.

Railroad Access Door

Allowable stresses for all load combinations used for the various parts of the door, embedded frame, and hoist enclosure are given in Table 3.8.4-5. For normal load conditions the allowable stresses provide a safety factor of 2 to ~~1.67 ($F_y/0.6\ F_y$) to~~ 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions such as an OBE or SSE and hoist stall, stresses do not exceed 0.9 yield.

Allowable stresses for load combinations used for the various parts are given in Table 3.8.4-23.

Manways in RHR Sump Valve Room

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.4-6. For limiting conditions, such as ~~an OBE or~~ a SSE, stresses do not exceed 0.9 yield.

Pressure Confining Personnel Doors

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.4-7. For normal load conditions, the allowable stresses provide safety factors of 2 to 1 on yield on structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions, such as an SSE, flood, and tornado loadings, stresses do not exceed 0.9 yield.

Fuel Pool Gates

Allowable stresses for all load combinations used for the gates are given in Table 3.8.4-21. For normal load conditions the allowable stresses do not exceed 0.6 of yield. For limiting conditions, such as the ~~OBE or~~ SSE, the stresses do not exceed 0.90 of yield, ~~since load case 4 is the governing condition.~~

3.8.4.5.4 Intake Pumping Station Traveling Water Screens

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.4-11. For normal load conditions, the allowable stresses provide safety factors of ~~2~~ 1.79 $(F_y/0.56F_y)$ to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions, such as a safe shutdown earthquake, stresses do not exceed 0.9 yield.

3.8.4.5.5 Diesel Generator Building Doors and Bulkheads

Load combinations and allowable stresses for all combinations are given in Table 3.8.4-13. For missile impact, yield point of material will be exceeded and the member practically deform. For normal load condition, the allowable stresses provide safety factors of ~~2~~ 1.67 $(F_y/0.6F_y)$ to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions, except for missile impact, stresses do not exceed 0.9 yield.

3.8.4.5.6 Additional Diesel Generator Building Missile Barriers

Design of missile barriers for the Additional Diesel Generator Building is discussed in Section 3.5.3.1.

3.8.4.6 Materials, Quality Control, and Special Construction Techniques

General

See Section 3.8.1.6.

TABLE 3.8.4-3

CONTROL ROOM SHIELD DOORS

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Door and Jamb Shield Assemblies
Structural Parts

No.	Load Combinations	Allowable Stresses (psi)		
		Tension	Compression$^{(2)}$	Shear
	Doors Open or Closed			
I	Dead	$0.50F_Y$	$0.47F_Y$	$0.33F_Y$
II	Dead + OBE$^{(1)}$	$0.60 F_y$	$0.60 F_y$	$0.40 F_y$
III	Dead + SSE$^{(1)}$ ~~E$^{(1)}$~~	$0.9F_Y$	$0.9F_Y$	$0.6F_Y$

Mechanical Parts

No.	Load Combinations	Allowable Stresses (psi)		
		Tension	Compression$^{(2)}$	Shear
	Doors Open or Closed			
I	Dead	$\frac{\text{Ultimate}}{5}$	$\frac{\text{Ultimate}}{5}$	$\frac{\text{Ultimate}}{7.5}$
II	Dead + OBE$^{(1)}$	$0.6 F_y$	$0.6 F_y$	$0.4 F_y$
III	Dead + SSE$^{(1)}$ ~~E$^{(1)}$~~	$0.9F_Y$	$0.9F_Y$	$0.6F_Y$

Notes:

(1) ~~E = the greater of OBE or SSE loads.~~ Acts in any one horizontal direction only at any given time and acts in vertical and horizontal directions simultaneously.

(2) The value given for allowable compression stress is the maximum value permitted when buckling does not control. The ~~critical buckling stress~~, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2 C_c^2} \right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

TABLE 3.8.4-4

(Sheet 1 of 2)

AUXILIARY BUILDING RAILROAD ACCESS HATCH COVERS LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Cover Structure and Embedded Frame

No.	Load Combinations	Allowable Stresses (psi) Tension	Compression$^{(2)}$	Shear
	Covers Closed			
I	Dead load plus live load at 100 lb/ft^2	$0.50F_Y$	$0.47F_Y$	$0.33F_Y$
II	Dead load plus live load at 100 lb/ft^2 plus OBE	$0.60 F_y$	$0.60 F_y$	$0.40 F_y$
III ~~II~~	Dead load plus live load at 100 lb/ft^2 plus ~~E$^{(1)}$~~ SSE	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$
	Covers Open			
IV ~~III~~	Dead load plus hoist pull	$0.50F_Y$	$0.47F_Y$	$0.33F_Y$
V	Dead load plus hoist pull plus OBE	$0.60F_y$	$0.60F_y$	$0.40 F_y$
VI ~~IV~~	Dead load plus hoist pull plus ~~E$^{(1)}$~~ SSE	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$

Mechanical Parts on Covers and Frame

No.	Load Combinations	Allowable Stresses (psi) ~~(2)~~ (1) Tension and Compression	Shear
	Covers Closed		
I	Dead load plus live load at load lb/ft^2	$\frac{\text{Ult}}{5}$	$\frac{2 \times \text{Ult}}{15}$
II	Dead load plus live load at 100 lb/ft^2 plus OBE	$0.6 F_y$	$0.4 F_y$
III	Dead load plus live load at 100 lb/ft^2 plus ~~E$^{(1)}$~~ SSE	$0.9F_Y$	$0.6F_Y$
	Covers Open		
IV ~~III~~	Dead load plus hoist pull	$\frac{\text{Ult}}{5}$	$\frac{2 \times \text{Ult}}{15}$
V	Dead load plus live load of 100 lb/ft^2 plus OBE	$0.6 F_y$	$0.4 F_y$
VI ~~IV~~	Dead load plus hoist pull plus ~~E$^{(1)}$~~ SSE	$0.9F_Y$	$0.6F_Y$

Note~~s~~:

~~(1) E - The greater of OBE or SSE loads~~

(1) ~~(2)~~ The value given for allowable compression stress is the maximum value, F_{cr}, permitted when buckling does not control. The critical buckling stress shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\,C_c^2} \right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

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WBNP -

TABLE 3.8.4-4 (Continued)
(Sheet 2 of 2)

AUXILIARY BUILDING RAILROAD ACCESS HATCH COVERS

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Hoist Unit Supports

No.	Load Combinations	Allowable Stresses (psi) Tension	 Compression	 Shear
	Hatch Opening			
I	Dead load Hoist pull	18,000	17,000	12,000
II	Dead load Stall	32,400	32,400	21,600

Other Mechanical Parts

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression	 Shear
	Covers Open		
I	Dead load Hoist pull	$\frac{\text{Ult}}{5}$	$\frac{2 \times \text{Ult}}{15}$
II	Dead load Stall	$0.9F_Y$	$2/3 \times 0.9F_Y$

Insert Note

~~Sheet 2~~

TABLE 3.8.4-5

(Sheet 1 of 2)

RAILROAD ACCESS DOOR

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Door, Embedded Frame and Door Track

		Allowable Stresses (psi)		
No.	Load Combinations	Tension	Compression^2	Shear
	Door Closed			
I	Dead load plus windload at 10 lb/ft^2	$0.50F_Y$	$0.47F_Y$	$0.33F_Y$
II	Dead load plus windload at 30 lb/ft^2	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$
III	Dead load plus windload at 10 lb/ft^2 plus OBE	$0.60F_y$	$0.60F_y$	$0.40F_y$
IV ~~III~~	Dead load plus windload at 10 lb/ft^2 plus ~~$E^{(1)}$~~ SSE	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$
	Door Open			
V ~~IV~~	Dead load plus hoist pull	$0.50F_Y$	$0.47F_Y$	$0.33F_Y$
VI	Dead load plus hoist pull plus OBE	$0.60F_y$	$0.60F_y$	$0.40F_y$
VII ~~V~~	Dead load plus hoist pull plus ~~$E^{(1)}$~~ SSE	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$

Hoist Unit & Enclosure

		Allowable Stresses (psi)		
No.	Load Combinations	Tension	Compression^2	Shear
I	Dead load plus hoist pull	$0.50F_Y$	$0.47F_Y$	$0.33F_Y$
II	Dead load plus stall	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$
III	Dead load plus hoist stall plus OBE	$0.60F_y$	$0.60F_y$	$0.40F_y$
IV ~~III~~	Dead load plus hoist pull plus ~~$E^{(1)}$~~ SSE	$0.90F_Y$	$0.90F_Y$	$0.60F_Y$

TABLE 3.8.4-5

(Sheet 2 of 2)

RAILROAD ACCESS DOOR

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES (Cont'd)

Mechanical Parts on Door

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression(2)	Allowable Stresses (psi) Shear
	Door Open		
I	Dead load plus windload at 10 lb/ft^2	$\frac{\text{Ult}}{5}$	$\frac{\text{2x Ult}}{15}$
II	Dead load plus windload at 10 lb/ft^2	$0.6F_y$	$0.4F_y$
III	Dead load ~~plus windload at 10 lb/ft^2~~ plus ~~E(1)~~ SSE	$0.9F_Y$	$0.6F_Y$

Other Mechanical Parts

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression(2)	Allowable Stresses (psi) Shear
	Door Open		
I	Dead load Hoist pull	$\frac{\text{Ult}}{5}$	$\frac{\text{2 x Ult}}{15}$
II	Dead load Stall	$0.9F_Y$	$0.6F_Y$

NOTE:

(1) Acts in one horizontal direction only at any given time and acts in the horizontal and vertical directions simultaneously. ~~"E" is the larger of SSE or OBE.~~

(2) The value given for allowable compression stress is the maximum value permitted when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of Fy when buckling controls.

$$F_{cr} = F_y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2C_c^2} \right] \quad \text{when} \quad \frac{Kl}{r} \leq C_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \quad \text{when} \quad \frac{Kl}{r} > C_c$$

TABLE 3.8.4-6

MANWAYS IN RHR SUMP VALVE ROOM

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Structural Parts

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression(2)	Shear
	Manway Closed		
I	Dead load plus OBE(1)	$0.6F_y$	$0.4F_y$
II	Dead load plus ~~E(1)~~ SSE(1)	$0.9F_Y$	$0.6F_Y$
III	Dead load plus 19 psi from outside (design basis flood water to Elev. 738.1)	$0.9F_Y$	$0.6F_Y$
	Manway Open		
IV	Dead load plus OBE(1)	$0.6F_y$	$0.4F_y$
V ~~III~~	Dead load plus ~~E(1)~~ SSE(1)	$0.9F_Y$	$0.6F_Y$

Mechanical Parts

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression(2)	Shear
	Manway Closed		
I	Dead load plus OBE(1)	$0.6F_y$	$0.4F_y$
II	Dead load plus ~~E(1)~~ SSE(1)	$0.9F_Y$	$0.6F_Y$
III	Dead load plus 19 psi from outside (design basis flood water to Elev. 738.1)	$0.9F_Y$	$0.6F_Y$
	Manway Open		
IV	Dead load plus OBE(1)	$0.6F_y$	$0.4F_y$
V ~~III~~	Dead load plus ~~E(1)~~ SSE(1)	$0.9F_Y$	$0.6F_Y$

NOTES:

(1) ~~E - The greater of OBE or SSE loads.~~ Acts in one horizontal direction only at any given time and acts in vertical and horizontal directions simultaneously.

(2) The values given for allowable compression stress is the maximum value permitted when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_Y when buckling controls.

$$F_{cr} = F_Y\left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\,C_c^2}\right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

TABLE 3.8.4-7

(Sheet 1 of 5)

PRESSURE CONFINING PERSONNEL DOORS
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES[1]

(All Doors except A55, A57, C20, C26, A101, A105, A216, and A217)

Structural Parts

		Allowable Stresses (psi)		
No.	Load Combinations	Tension	Compression[2]	Shear
	Doors Open or Closed			
I	DL + Load from Door Closers	0.50 F_y	0.47 F_y	0.33 F_y
II	DL + ~~E~~ SSE + Load from Door Closers	0.90 F_y	0.90 F_y	0.60 F_y
	DL + OBE + Load from Door Closers	0.60 F_y	0.60 F_y	0.40 F_y
	Doors Closed			
III[3]	DL + 3-psi pressure (bidirectional where applicable)	0.90 F_y	0.90 F_y	0.60 F_y
IV[4]	DL + ~~E~~ SSE + 2-psi toward annulus	0.90 F_y	0.90 F_y	0.60 F_y
	DL + OBE + 2-psi toward annulus	0.60 F_y	0.60 F_y	0.40 F_y
V[5]	DL + 3 inches of water pressure on either side of door	0.50 F_y	0.47 F_y	0.33 F_y
VI[6]	DL + Flood to elevation 738.6	0.90 F_y	0.90 F_y	0.60 F_y

~~E – The greater of OBE or SSE loads.~~

---

1. Thermal load effects are insignificant and hence need not be considered in the design of doors.
2. The values indicated for the allowable compression stresses are the maximum values permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y\left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\,C_c^2}\right] \text{ when } \frac{kl}{r} \le c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

3. Applies to all doors except A64, A65, A77, A78, A56, A60, A111, A113, A114, A117, A118, A122, A125, A130, A133, A151, A160, A162, A183, A192, A206, A207, A208, A209, A212, A213, C37, C49, C50, C53, C60, DE1, DE4 and DE5.
4. Applies to doors A64, A65, A77, and A78 only.
5. For doors A56, A60, A65, A78, A94, A99, A111, A122, A123, A125, A130, A132, A133, A151, A152, A159, A160, A161, A162, A183, A192, A206, A207, A208, A209, A212, A213, A214, A215, DE1, DE4, and DE5, the load combination is:

   DL + 1/2" water pressure on either side of door.

   For doors C36, C37, C49, C50, C53, C54 and C60, the load combination is:

   DL + 1/8" water pressure on either side of door.
6. Applies to doors A65 and A78 only.

TABLE 3.8.4-7

(Sheet 2 of 5)

PRESSURE CONFINING PERSONNEL DOORS
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES[1] (Cont'd)

(All Doors except A55, A57, C20, C26, A101, A105, A216, and A217)

Mechanical Parts

		Allowable Stresses (psi)	
No.	Load Combinations	Tension and Compression[2]	Shear
	Doors Open or Closed		
I	DL + Load from door closers	$F_u/5$	$2\ F_u/15$
II	DL + ~~E~~ SSE + load from door closers	$0.90\ F_y$	$0.60\ F_y$
	DL + OBE + load from door closers	$0.60\ F_y$	$0.40\ F_y$
	Doors Closed		
III[3]	DL + 3-psi pressure (bidirectional where applicable)	$0.90\ F_y$	$0.60\ F_y$
IV[4]	DL + ~~E~~ SSE + 2-psi toward annulus	$0.90\ F_y$	$0.60\ F_y$
	DL + OBE + 2-psi toward annulus	$0.60\ F_y$	$0.40\ F_y$
V[5]	DL + 3 inches of water pressure on either side of door	$F_u/5$	$2\ F_u/15$
VI[6]	DL + Flood to elevation 738.6	$0.90\ F_y$	$0.60\ F_y$

~~E = The greater of OBE or SSE loads.~~

---

1. Thermal load effects are insignificant and hence need not be considered in the design of doors.
2. The values indicated for the allowable compression stresses are the maximum values permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\ C_c^2} \right] \quad when\ \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \quad when\ \frac{Kl}{r} > c_c$$

3. Applies to all doors except A64, A65, A77, A78, A56, A60, A111, A113, A114, A117, A118, A122, A125, A130, A133, A151, A160, A162, A183, A192, A206, A207, A208, A209, A212, A213, C37, C49, C50, C53, C60, DE1, DE4 and DE5.
4. Applies to doors A64, A65, A77, and A78 only.
5. For doors A56, A60, A65, A78, A94, A99, A111, A113, A114, A122, A123, A125, A130, A132, A133, A151, A152, A159, A160, A161, A162, A183, A192, A206, A207, A208, A209, A212, A213, A214, A215, DE1, DE4, and DE5, the load combination is:
   DL + 1/2" water pressure on either side of door.
   For doors C36, C37, C49, C50, C53, C54, and C60, the load combination is:
   DL + 1/8" water pressure on either side of door.
6. Applies to doors A65 and A78 only.

TABLE 3.8.4-7

(Sheet 3 of 5)

PRESSURE CONFINING PERSONNEL DOORS
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES[1] (Cont'd)

(Doors A55, A57, C20, C26, A101, and A105)

Structural Parts

No.	Load Combinations	Allowable Stresses (psi) Tension	 Compression[2]	 Shear
	Doors Open			
I	DL + Load from Door Closers	$0.50\ F_y$	$0.47\ F_y$	$0.33\ F_y$
II	DL + ~~E~~ SSE + Load from Door Closers	$0.90\ F_y$	$0.90\ F_y$	$0.60\ F_y$
	DL + OBE Load from Door Closers	$0.60\ F_y$	$0.60\ F_y$	$0.40\ F_y$
	Doors Closed			
III[3]	DL + CCWS flood + E + 3-psi pressure (bidirectional where applicable)	$0.90\ F_y$	$0.90\ F_y$	$0,60\ F_y$
IV[4]	DL + ~~E~~ SSE + Pressure from valve rooms	$0.90\ F_y$	$0.90\ F_y$	$0.60\ F_y$
	DL + OBE + Pressure from valve rooms	$0.60\ F_y$	$0.60\ F_y$	$0.40\ F_y$

~~E = The greater of OBE or SSE loads.~~

---

1. Thermal load effects are insignificant and hence need not be considered in the design of doors.

2. The values indicated for the allowable compression stresses are the maximum values permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\ C_c^2} \right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

3. The CCWS flood condition does not apply to doors A101 and A105, and differential pressure load due to tornado need not be considered simultaneously with seismic load.

4. Applies to doors A101 and A105 only.

TABLE 3.8.4-7

(Sheet 4 of 5)

PRESSURE CONFINING PERSONNEL DOORS
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES[1] (Cont'd)

(Doors A55, A57, C20, C26, A101, and A105)

Mechanical Parts

		Allowable Stresses (psi)	
No.	Load Combinations	Tension and Compression[2]	Shear
	Doors Open		
I	DL + Load from door closers	$F_u/5$	$2\ F_u/15$
II	DL + ~~E~~ SSE + load from door closers	$0.90\ F_y$	$0.60\ F_y$
	DL + OBE + load from door closers	$0.60\ F_y$	$0.40\ F_y$
	Doors Closed		
III[3]	DL + CCWS flood + 3-psi pressure (bidirectional where applicable)	$0.90\ F_y$	$0.60\ F_y$
IV[4]	DL + ~~E~~ SSE + Pressure from valve room	$0.90\ F_y$	$0.60\ F_y$
	DL + OBE + Pressure from valve room	$0.60\ F_y$	$0.40\ F_y$

~~E – The greater of OBE or SSE loads.~~

---

1. Thermal Load effects are insignificant and hence need not be considered in the design of doors.

2. The values indicated for the allowable compression stresses is the maximum value permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y\left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\ C_c^2}\right] \text{ when } \frac{kl}{r} \le c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

3. The CCWS flood condition does not apply to doors A101 and A105, and differential pressure load due to tornado need not be considered simultaneously with seismic load.

4. Applies to doors A101 and A105 only.

TABLE 3.8.4-7

(Sheet 5 of 5)

PRESSURE CONFINING PERSONNEL DOORS LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES[1] (Cont'd)

(Doors A216 and A217)

Structural Parts

		Allowable Stresses (psi)		
No.	Load Combinations	Tension	Compression[2]	Shear
I	DL + P	0.50 F_y	0.47 F_y	0.33 F_y
II	DL + P + ~~E~~ SSE	0.90 F_y	0.90 F_y	0.60 F_y
III	DL + P + OBE	0.60 F_y	0.60 F_y	0.40 F_y

Mechanical Parts

		Allowable Stresses (psi)	
No.	Load Combinations	Tension and Compression[2]	Shear
I	DL + P	$F_u/5$	2 $F_u/15$
II	DL + P + ~~E~~ SSE	0.90 F_y	0.60 F_y
III	DL + P + OBE	0.60 F_y	0.40 F_y

~~E - The greater of OBE or SSE loads.~~

DL - Stresses generated by dead loads and door closer loads.

P - Stresses generated by a pressure differential of 1/2 inch of water acting to open doors.

1. Thermal Load effects are insignificant and hence need not be considered in the design of doors.

2. The values indicated for the allowable compression stresses is the maximum value permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_y when buckling controls.

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\, C_c^{\,2}} \right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

TABLE 3.8.4-13

DIESEL GENERATOR BUILDING DOORS AND BULKHEADS

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

Structural Parts

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression[4]	 Shear
	Door Open or Closed		
I	Dead load	0.6 F_y	0.4 F_y
II	Dead load plus ~~E[1]~~ SSE	0.9 F_y	0.6 F_y
III	Dead load plus OBE	0.6 F_y	0.4 F_y

Mechanical Parts

No.	Load Combinations	Allowable Stresses (psi) Tension and Compression[4]	 Shear
	Door Open or Closed		
I	Dead load	$\frac{Ult}{5}$	$\frac{2 \times Ult}{15}$
	Door Closed		
II	Dead load plus ~~E[1]~~ SSE	0.9 F_y	0.6 F_y
III	Dead load plus OBE	0.6 F_y	0.4 F_y

Concrete Bulkheads

No.	Load Combinations	Allowable Stresses Concrete	 Reinforcing Steel
I	Dead Load	1.0 ACI 318	1.0 ACI 318
II	Dead Load plus Wind[2] or OBE	1.0 ACI 318	0.5 F_y
III	Dead Load plus ~~E[1]~~ SSE	1.67 ACI 318	0.9 F_y
IV	Dead Load plus Tornado[2]	(3)	(3)

Notes:

(1) Acts in one horizontal direction only at any given time and acts in vertical and horizontal directions simultaneously.
~~E - The greater of OBE or SSE.~~

(2) The steel doors and steel bulkheads are protected from wind, snow, ice, rain, tornado, and wind and tornado missiles by precast concrete bulkheads as discussed in Section 3.8.4.1.2.

(3) The structure may be allowed to yield for load combination IV when considering impactive loads from missiles.

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(4) The value ~~given~~ for allowable compression stress is the maximum value permitted when buckling does not control. The critical buckling stress, F_{cr}, ~~stress~~ shall be used in place of Fy when buckling controls.

$$F_{cr} = F_y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2C_c^2} \right] \quad \text{when } \frac{Kl}{r} \le C_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \quad \text{when } \frac{Kl}{r} > C_c$$

TABLE 3.8.4-21

SPENT FUEL POOL GATES

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

		Allowable Stresses lb/in^2	
		Loading Conditions	
No.	Load Combinations(1)	Bending	Shear
1	D+L	.6 F_y	.4 F_y
2	D+L+~~E(2)~~ OBE	.~~9~~6 F_y	.~~6~~4 F_y
3	D+L+W	.6 F_y	.4 F_y
4	D+L+T_o+R_o+~~E(2)~~ SSE	.9 F_y	.6 F_y
5	D+L+T_o+R_o+W_t	.9 F_y	.6 F_y
6	D+L+T_a+R_a+P_a	.9 F_y	.6 F_y

Notes:

(1) T_o, R_o, T_a, R_a, P_a = 0

~~(2) E = The greater of OBE or SSE loads.~~

TABLE 3.8.4-23

(Page 1 of 2)

WATERTIGHT EQUIPMENT HATCH COVERS

LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

No.	Load Combination	Allowable Stresses (psi) Tension	 Compression*	 Shear
Hatch Closed				
I	D + 200 psf live load	0.6Fy	0.6Fy	0.4Fy
II	$D + L_1$	0.9Fy	0.9Fy	0.6Fy
III	$D + L_2$	0.9Fy	0.9Fy	0.6Fy
IV	$D + L_2 + OBE$	$0.6F_y$	$0.6F_y$	$0.4F_y$
~~I~~V	$D + L_2 +$ ~~E~~ SSE	0.9Fy	0.9Fy	0.6Fy

Where:

D - Dead Loads or their related internal moments and forces including permanent equipment
L_1 - Live Load due to flood to El 711.0
L_2 - Live Load due to pressure of 3 psi from below
OBE - Loads due to the operating basis earthquake
SSE - Loads due to the safe shutdown earthquake
~~E - Maximum of OBE or SSE~~

* The value indicated for the allowable compression stresses is the maximum value permitted when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of Fy when buckling controls.

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\, C_c^2} \right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

TABLE 3.8.6-1

(Sheet 1 of 3)

POLAR CRANES
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

No.	Load Combinations	Allowable Stresses (psi)		
		Tension	Compression(2)	Shear
		Bridge Structure		
I	Dead Live Impact Trolley tractive	0.50 F_y	0.48 F_y	0.33 F_y
II	Dead Live Impact Bridge tractive	0.50 F_y	0.48 F_y	0.33 F_y
III	Dead Live Trolley collision	0.62 F_y	0.59 F_y	0.41 F_y
IV	Dead Trolley weight Stall at 275% capacity	0.90 F_y	0.90 F_y	0.50 F_y
V	Dead Live at 100% capacity ~~E(1)~~ SSE	0.90 F_y	0.90 F_y	0.50 F_y

TABLE 3.8.6-1

(Sheet 3 of 3)

POLAR CRANES
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES (Cont'd)

No.	Load Combinations	Allowable Stresses (psi)	
		Tension and Compression[2]	Shear
	Wheel Axles and Connecting Pins (Continued)		
III	Dead Stall at 275% capacity	0.40 F_Y	0.50 F_Y
IV	Dead Live at 100% capacity ~~E(1)~~ SSE	0.90 F_Y	0.50 F_Y

Notes:

(1) Acts in one horizontal direction at any given time and acts in the vertical and horizontal directions simultaneously. ~~E – The greater of OBE or SSE loads.~~

(2) The value given for allowable compression stress is the maximum value permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_Y when buckling controls.

$$F_{cr} = F_Y\left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\,C_c^2}\right] \text{ when } \frac{kl}{r} \le c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

(3) For sheave frames, cross girts, and their respective connections

(4) For all other members

TABLE 3.8.6-2

(Sheet 1 of 3)

AUXILIARY BUILDING CRANE
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES

No.	Load Combinations	Allowable Stresses (psi)		
		Tension	Compression(2)	Shear
		Bridge Structure		
I	Dead Live Impact Trolley tractive	0.50 F_y	0.48 F_y	0.33 F_y
II	Dead Live Impact Bridge tractive	0.50 F_y	0.48 F_y	0.33 F_y
III	Dead Live Trolley collision	0.62 F_y	0.59 F_y	0.41 F_y
IV	Dead Live Bridge collision	0.62 F_y	0.59 F_y	0.41 F_y
V	Dead Trolley weight Stall at 275% capacity	0.90 F_y	0.90 F_y	0.50 F_y
VI	Dead Live at 100% capacity ~~E(1)~~ SSE	0.90 F_y	0.90 F_y	0.50 F_y

TABLE 3.8.6-2

(Sheet 3 of 3)

AUXILIARY BUILDING CRANE
LOADS, LOADING COMBINATIONS, AND ALLOWABLE STRESSES (Cont'd)

No.	Load Combinations	Allowable Stresses (psi)	
		Tension and Compression[(2)]	Shear
	Wheel Axles and Connecting Pins (Continued)		
IV	Dead Live at 100% capacity ~~E(1)~~ SSE	$0.9\ F_Y$	$0.50\ F_Y$

Notes:

(1) Acts in one horizontal direction at any given time and acts in the vertical and horizontal directions simultaneously. ~~E - The greater of OBE or SSE loads.~~

(2) The value given for allowable compression stress is the maximum value permitted, when buckling does not control. The critical buckling stress, F_{cr}, shall be used in place of F_Y, when buckling controls,

$$F_{cr} = F_Y \left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2\ C_c^{\,2}} \right] \text{ when } \frac{kl}{r} \leq c_c$$

or

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{Kl}{r}\right)^2} \text{ when } \frac{Kl}{r} > c_c$$

(3) For sheave frames, cross girts, and their respective connections

(4) For all other members

TABLE 3.8E-1

(Sheet 1 of 2)

LIMITING VALUES OF ALLOWABLE STRESS

Loading Combinations	Tension on Net Section	Shear on Gross Section	Compression on Section	Bending
(1), (2), (3)	$0.60F_y$	$0.40F_y$	See Note 1	See Note 2
(1a), (2a), (3a) (4) through (9)	$0.90F_y$	$\frac{0.90F_y}{\sqrt{3}}$	See Note 3	$0.90F_y$

Note 1 - Varies with slenderness ratio, see AISC "Manual of Steel Construction," 7th Edition, Table 1-36, Page 5-84.

Note 2 - Varies, see Section 1.5.1.4, "Bending", of Item 3.8E.1.b

Note 3 - Varies with slenderness ratio. The allowable stress was obtained from AISC Specification Section 1.5, using formula 1.5-1 or 1.5-2 and 1.5-3 with modifications, as shown below:

Main and secondary members where $K\ell/r \le C_c$: $F_a = 0.9\ F_y\left[1 - \frac{(K\ell/r)^2}{2C_c^2}\right]$ (Formula A)

Main members where $C_c < K\ell/r < 200$: $F_a = \frac{0.9\pi^2 E}{\left(\frac{K\ell}{r}\right)^2}$ (Formula {B})

Secondary members where $120 < K\ell/r \le 200$: $F_{as} = \frac{F_a\text{[by Formula (A) or (B)]}}{1.6 - \frac{\ell}{200r}}$

Where:

$C_C = \sqrt{\frac{2\pi^2\ E}{F_y}}$

E = Modulus of elasticity of steel (29,000 kips per square inch)

ENCLOSURE 3

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FSAR CHAPTER 3, AMENDMENT 79

LIST OF COMMITMENTS

ENCLOSURE 3

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FSAR CHAPTER 3, AMENDMENT 79

COMMITMENT LIST

Proposed FSAR revisions as a result of the response to NRC Concern 5.c and additional proposed FSAR changes concerning buckling stress (NRC Concern 5.d), will be incorporated in Amendment 89.

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