NUCLEAR SAFETY-RELATED

SRV/LOCA HYDRODYNAMIC LOADS

REVISED DESIGN-BASIS SUMMARY REPORT

LA SALLE COUNTY STATION
UNITS 1 AND 2

REPORT PREPARED FOR

COMMONWEALTH EDISON COMPANY

REPORT SL-3876

OCTOBER 1, 1981

SARGENT & LUNDY
ENGINEERS

4373

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October 1, 1981

Mr. B. R. Shelton
Project Engineering Manager
Commonwealth Edison Company
P. O. Box 767, 35 FNW
Chicago, Illinois 60690

Dear Mr. Shelton:

I am including herewith four copies of the following Sargent & Lundy report:

Report SL-3876
SRV/LOCA Hydrodynamic Loads Revised Design Basis
Summary Report, Revision 1
La Salle County Station - Units 1 and 2
Dated October 1, 1981

Additional copies are being distributed in accordance with the Project Distribution List for design criteria.

This report documents the final design basis for the SRV/LOCA hydrodynamic loads for the La Salle County Station. It supersedes Revision 0 of the same report, dated December 3, 1979, which was issued to Commonwealth Edison Company under cover of Mr. G. C. Jones' December 5, 1979, letter to Mr. J. S. Abel.

The format of the report has been revised to agree with that of an S&L engineering report, and to reflect the various changes to the dynamic load definitions and their incorporation into the plant design that have occurred since Revision 0 was issued. A detailed summary of these changes is provided in Section 4 of the report. This section of the report also addresses how the 4TCO Test results were assessed on La Salle, and how we plan to address the generic load definitions provided in NUREG-0808.

Yours very truly,

R. J. Mazza
Project Director

RJM:tr
In duplicate
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COMMONWEALTH EDISON COMPANY

1.0 PURPOSE

The primary purpose of this report is to specifically detail which revisions of the SRV/LOCA hydrodynamic loads are to be considered for the final reanalysis and redesign of the La Salle County Station. Other purposes of this report are: (1) to document the concurrence of Commonwealth Edison Company (CECo) in the version of the SRV/LOCA hydrodynamic loads to be considered; and (2) to ensure that all source information used in the generation and incorporation of these loads in the reanalysis and redesign is properly documented.

Section 2.0 addresses the La Salle County Station structures and components which are not subject to submerged structure loads. The section identifies the SRV/LOCA load definition versions to be used and provides the definitions of the specific response spectra and differential anchor movements that are to be used for the final design. A definition of load combinations and special considerations for each major category of structure and component for the La Salle County Station is also presented. In Section 3.0, structures and components subject to submerged structure loads are considered. Appendix A contains a tabulation of input and output documentation for each type of SRV/LOCA hydrodynamic load which corresponds to the response spectra and differential anchor movement definitions. Appendix A will be utilized to insure that all analysts are using the appropriate load definitions and response spectra.

Any necessary revisions to this report shall be prepared in the same manner as the original report. Since any revisions to this report may result in major reanalysis and redesign, revisions will be made only if technically necessary or to significantly shorten the schedule for reanalysis and redesign. Section 4.0 of the report, "Implementation of Revisions," specifically describes how each necessary revision has been or will be incorporated in the reanalysis and redesign effort.

2.0 STRUCTURES AND COMPONENTS NOT SUBJECT TO SUBMERGED STRUCTURE LOADS

2.1 LOCA BOUNDARY LOADS

LOCA loads occur because of steam and air flow into the suppression pool following a pipe break in the drywell. LOCA loads must be considered in conjunction with appropriate seismic, thermal, SRV discharge, and normal loads. The load combinations used for design of structures, piping and equipment are described in Sections 2.6 through 2.11.

2.1.1 Water Jet

The boundaries are designed to withstand a uniform pressure of 33 psi below the vent exit and linearly attenuated to 0 psi at the pool surface.

2.1.2 Charging Air Bubble

The charging air bubble load is predicted by analysis of the vent air flow transient. This load is defined from the time of water clearing until bubbles from neighboring vents coalesce. These loads meet the requirements of NUREG–0487 and do not exceed the design capability of the containment.

2.1.3 Pool Swell

The compression of the wetwell airspace by the rising pool slug results in pressure loading on the wetwell walls and a transient upward force on the drywell floor. The loads are predicted by MK-II-SWELL (S&L implementation of GE Pool Swell Analytical Model (PSAM)). The bounding uplift pressure on the drywell floor is taken to be 2.5 psi based on 4T results. In addition, an asymmetric load of 22 psi (maximum predicted vent clearing load) has been assessed for static application to a 180° sector of the wetwell (in addition to hydrostatic load). The loads on the walls are bounded by the design load of 45 psig.

2.1.4 Condensation Oscillation

The condensation oscillation load is defined by a modified version (Creare, Inc. and S. Levy, Inc.) of GE trial Specification No. 2. The GE specification is presented in GE letter MK-II-1299-E (June 25, 1979). This load is defined by GE as the combination of three components with various amplitude and frequency range. The vent exit (VE) component is the direct result of the collapse of the steam bubble at the vent tip. It consists of a primary signal at a frequency between 3 and 7 hertz, with lower amplitudes at the second and third harmonics: The vent acoustic (VA) component occurs in a 2-hertz band around the frequency corresponding to the vent acoustic length. The nondeterministic (ND) component is a low amplitude signal which occurs at random frequencies up to 50 hertz.

The modification to this load revises the definition of the nondeterministic component and revises the method of combining the components. (See Creare letter to J. Abel (CECo), October 25, 1979, and R. M. Crawford letter to J. M. Healzer (S. Levy, Inc.) November 14, 1979). The components (including revised nondeterministic, RND) are combined as follows:

$$CO_{LEVY-1} = 0.80\ (VE+0.2VA+RND)$$

$$CO_{LEVY-2} = 0.80\ (0.1VE+VA+0.71\ RND)$$

The two combinations reflect the CO load at different stages of the LOCA transient. When ADS actuation of the SRVs is being considered, only CO_{LEVY-2} is used.

2.1.5 Chugging

Symmetric and asymmetric chugging loads are defined in Revision 3 of the DFFR. The symmetric load is a pressure oscillation of magnitude +4.8/-4.0 psi on the submerged walls and floor uniformly over 360°. The asymmetric load is defined as +20/-14 psi applied at 180° and attenuating to a minimum at 0°. Both symmetric and asymmetric loads are applied uniformly in the radial and vertical directions below the vent exit and attenuate to 0 psi at the pool surface. The time history of the load is defined by a representative 4T chug trace, the predominant frequency of which is varied over a frequency range of 20 to 30 hertz.

2.2 LOCA BOUNDARY LOAD RESPONSE SPECTRA/DIFFERENTIAL ANCHOR MOVEMENTS

(Refer to Appendix A for dates of transmittal memoranda.)

2.2.1 Condensation Oscillation

2.2.1.1 Load Definition - Condensation Oscillation Levy-Creare Recommendation

As defined in Subsection 2.1.4. Response spectra were generated for the two combinations, CO-Levy-1 and CO-Levy-2, as explained in Subsection 2.1.4.

Response Spectra - Transmitted on January 31, 1980.

Anchor Movements - Transmitted on Dec[illegible], 1979.

2.2.2 Chugging

2.2.2.1 Load Definition

Asymmetric chugging with maximum pressure of +20/-14 psi used with 4T traces of 20 and 30 hertz. (Refer to DFFR, Rev. 3 pp. 4-116 x and G.E. Letter No. CGE-585 - April 14, 1976). This load bounds the symmetric load definition in Subsection 2.1.5.

Response Spectra - Transmitted on April 12, 1978.

Anchor Movements - Transmitted on November 5, 1979.

2.2.3 Special Considerations

Attenuation - The effects of pool dynamic loads outside of the reactor building are considered to be insignificant. However, any system or component which is attached to the common reactor building/auxiliary building wall should be assessed for the building response at the appropriate reactor building wall elevation.

2.3 SRV BOUNDARY LOADS

The containment design basis is the T-quencher SRV loads, as described in the LSCS DAR. The quencher device being used is the two-arm T-quencher developed for the Mark II Susquehanna Plant by KWU. The associated load definition is fully documented in the Susquehanna DAR (Chapter 4). LSCS has used this definition with a frequency range slightly extended at the lower end to account for differences in the LSCS SRV discharge configuration in the suppression pool.

2.3.1 All Valves

The all-valve T-quencher load case is given in Chapter 4 of the Susquehanna DAR. This load definition consists of three data traces with the time scale multiplied by factors from 0.9 to 2.0 to give a wide frequency range and the magnitude multiplied by 1.5 to provide bounding amplitude. This load definition was formed to bound all first and subsequent actuation cases and also to bound the range of initial conditions and geometries in the LSCS containment. This load definition assumes that all bubbles oscillate in phase.

2.3.2 ADS

Actuation of the LSCS Automatic Depressurization System (ADS) results in the discharge of seven safety relief valves distributed around the suppression pool. The KWU ADS load definition is very conservative and is essentially the same as the all-valve load definition (Subsection 2.3.1). Use of the all-valve load will provide a very conservative bounding ADS load.

2.3.3 Single Valve

The single-valve load definition is given in Chapter 4 of the Susquehanna DAR. This is a distribution (localized effect) modification of the all-valve case (Section 2.3.1) and bounds subsequent actuation loads.

2.3.4 Asymmetric

The asymmetric load is defined in Chapter 4 of the Susquehanna DAR as the actuation of three adjacent valves. This load is similar to the single valve load in that it is a modification to the distribution of the all-valve case (Section 2.3.1) and will bound subsequent actuation loads.

2.4 SRV BOUNDARY LOAD RESPONSE SPECTRA/DIFFERENTIAL ANCHOR MOVEMENT

2.4.1 All Valves

2.4.1.1 Load Definition - KWU Load Definition

Response Spectra - Transmitted vertical on June 14, 1979 and horizontal on July 23, 1979.

Anchor Movements - Transmitted on November 5, 1979.

2.4.2 ADS

2.4.2.1 Load Definition - KWU Load Definition

Response Spectra - Use envelope of SRV_{ALL} and SRV_{ASYM})

Anchor Movements - (Use envelope of SRV_{ALL} and SRV_{ASYM})

2.4.3 Single Valve

2.4.3.1 Load Definition - KWU Load Definition

Response Spectra - Transmitted on June 20, 1979.

Anchor Movements - Transmitted on November 5, 1979.

2.4.4 Asymmetric

2.4.4.1 Load Definition - KWU Load Definition

Response Spectra - Transmitted on June 19, 1979.

Anchor Movements - Transmitted on November 5, 1979.

2.5 OTHER SRV/LOCA LOADS

2.5.1 Annulus Pressurization

Annulus Pressurization results from a high-energy line break within the sacrificial shield.

2.5.1.1 Pressure Time History

Double ended breaks are assumed at the reactor vessel nozzle safe end for two cases, feedwater line and recirculation pump suction line. The blowdown accounts for system inventory and subcooling effects. The recirculation pump suction line break blowdown is limited by pipe displacement parameters. The feedwater line break, however, is assumed to be a double-ended full guillotine rupture. The RELAP computer code was used to produce time histories of the pressure distribution on the RPV, sacrificial shield wall and shield doors.

2.5.1.2 Response Spectra and Time Histories for Original Shell Model

The sacrificial shield wall pressure distribution was approximated with a Fourier series, and the time dependent Fourier coefficients were utilized in the generation of the response spectra.

Response Spectra - Transmitted for feedwater inlet line on January 11, 1980 and for recirculation outlet line on January 16, 1980

Anchor Movements and Time Histories - Transmitted for feedwater inlet and recirculation outlet lines on February 14, 1980.

2.5.1.3 Response Spectra and Time Histories for Modified Shell Model

Overall shield wall response corresponding to a "stick" model is approximated by cosine one-theta component of the annulus pressurization loads. The resulting response time histories of 0° azimuth represent the overall response of the shield at each break location. Cosine one-theta harmonic acceleration time histories from the original shell analysis are utilized in the generation of the response spectra.

Response Spectra - Transmitted for feedwater inlet and recirculation outlet lines on December 23, 1980.

Anchor Movements and Time Histories - Transmitted for feedwater inlet and recirculation outlet lines on December 23, 1980.

2.6 STRUCTURES

2.6.1 Containment

2.6.1.1 Design Load Combinations

(See Table 2.6-1.)

2.6.1.2 Special Considerations

Containment shall also be assessed for additional loads due to reactions from downcomer bracings and SRV line guides.

2.6.2 Structural Steel

2.6.2.1 Design Load Combinations

(See Table 2.6-2.)

2.6.2.2 Special Considerations

To determine the inertia loads due to self-weight of structural steel, all dynamic loads are combined in an absolute manner. However, structural steel loads resulting from pipe support loads are designed in the same manner as the piping supports, utilizing the load combinations from the piping analysis.

2.6.3 Concrete Structures - Slabs and Walls

2.6.3.1 Design Load Combinations

(See Table 2.6-3.)

2.6.3.2 Special Considerations

All dynamic loads will be combined in an absolute manner.

2.7 PIPING (NONSUBMERGED)

2.7.1 Design Load Combinations

Piping will be analyzed to the load combinations shown in Table 2.7-1. Load combinations considered but not analyzed are shown in Table 2.7-2. These combinations are bounded by the combinations of Table 2.7-1. Damping values are given in Table 2.7-3.

2.7.2 Special Considerations

2.7.2.1 Functional Capability

All essential systems will meet the functional capability described in Subsection 3.9.3.1 of the FSAR.

2.7.2.2 SRV_{ALL} and SRV_{ADS} Response Spectra

As indicated in Section 2.3.2, the SRV_{ALL} and SRV_{ADS} load definitions are essentially the same. The response spectra for each load are, therefore, identical. The response spectra used are the envelopes of the quencher all-valve discharge and quencher asymmetric (three-valve discharge) response spectra. This enveloping approach is further described in Table 2.7-1.

2.7.2.3 Method of Load Combination

In general, the loads are combined by the SRSS method as shown in Table 2.7-1.

2.8 ELECTRICAL CONDUIT, CABLE PANS, AND SUPPORTS

2.8.1 Design Load Combinations

Refer to Table 2.6-2.

2.9 HVAC DUCTS AND SUPPORTS

2.9.1 Design Basis for Both Inside and Outside Containment

The structural integrity of the safety-related HVAC ducts and supports for all applicable loading combinations is achieved by the following design rules:

a. Determining, and controlling if necessary by modifying the support structure, the frequencies of the duct-support assembly to avoid peak responses.

b. Analyzing the supporting structures for all applicable loadings (in all directions including axial direction) and obtain the resultant stresses in members and connections.

c. Transmitting all calculated loads at the interface between the support and the structural steel to the Structural Department to be used in checking the structural steel.

d. Selecting a set of design limits to be associated with applicable loading combinations (see 2.9.2). These design limits will not permit the stresses to exceed the yielding stress. This will be strictly followed in designing the support members and connections; however, local yielding in the duct may be allowed on a case by case basis after additional studies.

2.9.1.1 Design Load Combinations

The same loading combinations will be used inside and outside the containment. However, it is worth mentioning that some of these loads attenuate considerably outside of the containment. The loading combinations used in the design of ducts and supports are consistent with those used in designing other components. If it seemed that some are slightly different or some have been omitted, it is only because the bounding loading combinations were considered:

	Loading Combination	Stress Limit	Plant Conditions
a.	N + OBE (1% damping) + SRV_{ALL} (1% damping)	$0.9S_y$	Upset
b.	N + SSE (2% damping) + CO_{LEVY-2} (2% damping) + SRV_{ADS} (2% damping)	$1.2S_y$	Emergency
c.	N + SRV_{ADS} (2% damping) + Chugging (2% damping) + SSE (2% damping)	$1.2S_y$	Emergency
d.	N + SSE (2% damping) + AP (2% damping)	$1.2S_y$	Emergency
e.	N + SSE (2% damping + CO_{LEVY-1} (2% damping)	$1.2S_y$	Emergency

The seismic loads are combined with the pool dynamic loads by SRSS method except case (c) and (f) where CO is combined using absolute sum.

Note: SRV_{ALL} = envelope of SRV_{ALL} and SRV_{ASYM}

SRV_{ADS} = envelope of SRV_{ALL} and SRV_{ASYM}

2.9.1.2 Special Considerations

2.9.1.2.1 Axial Restraints

Axial restraints along the direction of ductrun may be placed, if necessary, to provide longitudinal rigidity and strength. A minimum of two-sided attachment between duct and support interface will be used.

2.9.1.2.2 Support Design

The supports on each side of active HVAC component (such as dampers) will be designed to assure that the loads used in qualifying these components would not be exceeded.

2.10 EQUIPMENT

2.10.1 Design Basis for All Components

a. Analysis and/or test shall be done using the loading combinations and design limits shown in 2.10.2.

b. Where qualification is done by analysis the structural integrity and operability where applicable shall be shown by calculating the stresses and deflections at critical sections and comparing them with appropriate allowables.

c. All active instruments shall be qualified by proper vibration testing. The operability of these components shall be verified by monitoring their function before and after the testing.

2.10.2 Design Load Combinations

2.10.2.1 ASME Components

2.10.2.1.1 BOP Components

	Load Combination	Service Limit	Stress Limit
a.	N + OBE (1% damping) + SRV_{ALL} (1% damping)	B (upset)	Per ASME BPVC Sect. III
b.	N + SSE (2% damping) + SRV_{ADS} (2% damping) + CO_{LEVY-2} (2% damping)	C (emergency)	Per ASME BPVC Sect. III
c.	N + SRV_{ADS} (2% damping) + Chugging (2% damping) + SSE	C (emergency)	Per ASME BPVC Sect. III
d.	N + SSE (2% damping) + AP (2% damping)	C (emergency)	Per ASME BPVC Sect. III
e.	N + SSE (2% damping) + CO_{LEVY-1} (2% damping)	C (emergency)	Per ASME BPVC Sect. III

Note: SRV_{ALL} = envelope of SRV_{ALL} and SRV_{ASYM}

SRV_{ADS} = envelope of SRV_{ALL} and SRV_{ASYM}

2.10.2.1.2 NSSS Components

NSSS components were originally qualified to old design basis loads by GE. The requalification to the new loading combinations has been performed by S&L, except for the reactor pressure vessel and internals and the main steam and reactor recirculation system piping. The load combinations and the design limits that will be used in the requalification will be the same as given in Subsection 2.10.2.1.1.

2.10.2.2 Non-ASME Components

2.10.2.2.1 BOP Components

	Loading Combination	Acceptance Criteria: Active Elastic Deflection	Acceptance Criteria: Nonactive and Active (Exact Deflection)
a.	N + OBE (1% damping) + SRV_{ALL} (1% damping)	$\sigma_m \leq 0.6S_y$ $\sigma_t \leq 0.7S_y$	$\sigma_m \leq 0.6S_y$ $\sigma_t \leq 0.9S_y$

Loading Combination	Acceptance Criteria: Active Elastic Defelction	Acceptance Criteria: Nonactive and Active (Exact Deflection)
b. N + SSE (2% damping) + SRV_{ADS} (2% damping)		
c. N + SRV_{ADS} (2% damping) + Chugging + damping) + SSE	$\sigma_m \leq 0.7S_y$ $\sigma_t \leq 0.9S_y$	$\sigma_m \leq 0.9S_y$ $\sigma_t \leq 1.5S_y$
d. N + SSE (2% damping) + AP (2% damping)		
e. N + SSE (2% damping) + CO_{LEVY-1}(2% damping)		

where:

σ_m = membrane stress,

σ_t = membrane + bending stress, and

S_y = yield stress at corresponding temperature.

Note: SRV_{ALL} = envelope of SRV_{ALL} and SRV_{ASYM}

SRV_{ADS} = envelope of SRV_{ALL} and SRV_{ASYM}

2.10.2.2.2 NSSS Components

NSSS components were originally qualified to old design basis loads by GE. The requalification to the new loading combinations is being performed by S&L. The load combinations and the design limits that will be used in the requalification will be the same as given in Subsection 2.10.2.2.1.

2.10.3 Special Considerations

Nonactive fluid system components will be checked for structural integrity using design limits per ASME Section III.

Operability of active fluid system components will be checked using deflection criteria.

The piping reactions on mechanical equipment will be maintained within the equipment vendor allowables. If they exceed the allowables, nozzle local stresses and equipment foundation loads will be checked.

The seismic qualification reports for floor-mounted equipment will be amended to include the new loading combinations.

For Seismic Category I valves, the valve accelerations will be computed from the new piping analysis which considers all LOCA and SRV related loads. The valves will be qualified to meet these dynamic coefficients or a new piping support arrangement will be developed to reduce the dynamic coefficients (accelerations) to acceptable levels. In addition, active valves will undergo a review to assure that the stress allowables are also met.

Equipment foundation loads for floor-mounted equipment and mounting details for locally mounted instruments will be checked using the new loading combinations.

2.11 PIPING PENETRATION ASSEMBLIES

2.11.1 Design Basis

The structural integrity of penetration assemblies shall be assured by using the load conditions/combinations and meeting the stress limits as outlined below.

2.11.2 Load Conditions

All primary containment process and instrumentation penetration assemblies and all ASME class penetrations in other support buildings shall be designed to the load combinations and associated stress limits in Section 2.11.3. The stress limits are in accordance with the ASME B&PV Code, Section III, Divisions 1 and 2, as applicable. The stresses are shown in Table 2.11-1.

2.11.3 Design Loads

For each condition, the applicable loads are:

a) Design Condition:

1. Weight
2. Design Pressure and Temperature
3. OBE
4. Hydraulic Transients

b) Normal and Upset Conditions:

For Expansion Stress Evaluation:

1. Thermal Expansion Loads
2. Relative Dynamic Displacement Loads

For Primary + Secondary Stress Evaluation:

1. Weight
2. Operation Pressure and Temperature
3. Thermal Transients
4. Thermal Expansion Loads
5. Relative Dynamic Displacement Loads
6. Hydraulic Transients
7. OBE
8. SRV

c) Emergency Condition:

1. Weight
2. Operating Pressure & Temperature
3. Hydraulic Transients
4. SSE
5. SRV
6. LOCA

d) Faulted Conditions:

Case 1.

1. Weight
2. Operating pressures & temperatures
3. Pipe Rupture and jet impingement loads

Case 2.

1. Process pipe maximum operating pressure applied in the annulus between the pipe and the penetration sleeve.

2.11.4 Design Load Combinations

Load Combination	Service Limit
a. $W + P_D + \lvert OBE \rvert + \lvert TR \rvert$	Design
b. $THL_{env} + (OBE^2_{DISPL} + PD^2_{DISPL})^{\frac{1}{2}}$	Normal and Upset (Expansion Stresses)
c. $W + P_o + THL_{env} + (OBE^2_{DISPL} + PD^2_{DISPL})^{\frac{1}{2}} + UDL$	Normal and Upset (Primary + Secondary Stresses)

where UDL is the envelope of:

$$A = \text{ØBE}^2 + SRV^2_{ADS} + TR^2$$

$$B = \text{ØBE}^2 + SRV^2_{ALL} + TR^2$$

d. $W + P_o + EDL$	Emergency

where EDL is the envelope of:

$$A+ \sqrt{SSE^2 + SRV^2_{ADS} + CHUG^2 + TR^2}$$

$$B = \sqrt{SSE^2 + SRV^2_{ADS} + TR^2 + C\text{Ø}_{env}}$$

$$C = \sqrt{SSE^2 + SRV^2_{ALL} + TR^2}$$

$$D = \sqrt{SSE^2 + AP^2}$$

Load Combination	Service Limit
e. $P_o + F$	Faulted
f. P_o applied in the process pipe and in the penetration annulus, simultaneously	Faulted

where:

AP	=	Annulus pressurization
CHUG	=	Asymmetric chugging
CO_{env}	=	Envelope of condensation oscillation, Levy definition combinations 1 and 2
F	=	Faulted loads
OBE	=	Operating-Basis Earthquake
OBE_{DISPL}	=	OBE building displacement
PD_{DISPL}	=	Pool dynamic displacement
P_D	=	Design pressure
P_o	=	Operating pressure
SRV_{ADS}	=	All valve discharge - quencher definition enveloped with asymmetric three-valve discharge
SRV_{ALL}	=	All-valve discharge - quencher definition enveloped with asymmetric three-valve discharge
SSE	=	Safe Shutdown Earthquake
THL_{env}	=	Envelope of all thermal expansion loads
TR	=	Hydraulic transient loading
W	=	Weight Loading

3.0 SUBMERGED STRUCTURES AND COMPONENTS

3.1 LOCA DRAG LOADS - GENERAL

Various phases of the LOCA event will cause fluid motion and create drag loads on structures in the suppression pool. The loads are calculated in accordance with NUREG-0487 as described in Appendix C of the LSCS-DAR (Rev. 9).

3.1.1 Vent Clearing

The LOCA water jet load is calculated for structures in the pool below the vent exit using the modified NRC Acceptance Criteria described in Subsection 3.3.2.1 of LSCS DAR (Rev. 9). This model predicts a transient jet with a sphere of fluid at its leading edge. This moving sphere is assumed to create a flow field throughout the pool. Drag loads result from the flow field and from impingement of the jet itself.

3.1.2 Charging Air Bubble

The LOCA air bubble transient predicts the air bubble growth rate. The Method of Images is used to predict the fluid velocity and acceleration at the location of the structure. The duration of this load is from vent clearing until adjacent bubbles touch.

3.1.3 Pool Swell

The pool swell transient is predicted by MK-II-SWELL. The velocities and accelerations are increased by 10% to meet the requirements of NUREG-0487. The deceleration portion of the time history is expanded to give a peak pool swell elevation of 1.5 x Vent Submergence as required by NUREG-0487. The velocity and acceleration are used to calculate drag loads on structures above the vent exit and below the peak pool swell elevation (pool swell zone). Structures in the pool swell zone above the initial pool surface are subject to impact loads. Impact loads are calculated using the methods in DFFR (Rev. 3) and assessed for the methods recommended in NUREG-0487. Because of the size and natural frequency range of the structures in the LSCS suppression pool, the DFFR method provides the most conservative load. Only a small number of structures are located in the pool swell zone in order to minimize the number of affected structures.

3.1.4 Fallback

After the pool swell peak elevation has been reached, the pool swell slug (thickness equal to the vent submergence) falls back into the pool under the influence of gravity. Structures in the pool swell zone are loaded by fluid moving at the predicted falling velocity and gravitational acceleration.

3.1.5 Condensation Oscillation

A forcing function to be applied at the vent exit is derived from the condensation oscillation load specification for boundaries (see Subsection 2.1.4). Only the Vent Exit component is used because the Vent Acoustic and Nondeterministic Components are acoustic effects only and create pressure waves which do not cause significant submerged structure loads.

3.1.6 Chugging

The chugging forcing function is derived from 4T test data. The Method of Images is used to determine the effect of a group of chugging downcomers around the submerged structure with worst case phasing. The resultant load is then reduced by applying a probability multiplier (Figure 3.3-1, LSCS-DAR), in compliance with NUREG-0487. The load is given as an amplitude applied to a damped sinusoid of 20-30 hertz (GE supplied sample 4T traces are used).

3.2 SRV DRAG LOADS - GENERAL

SRV discharge creates drag loads from the water jet and from the oscillating air bubble. Water jet loads are required to be calculated only within a cylindrical area with a 5-foot radius concentric with the quencher arms (NUREG-0487). No structures in the LSCS pool are located within this zone. Oscillating air bubble loads use Method of Images to determine velocity and acceleration and calculate drag loads incorporating the methods in Appendix C of the LSCS-DAR (Rev. 7). The T-quencher loads for all the submerged structures listed in Subsections 3.3 through 3.9 are calculated using the magnitude predicted by the DFFR quencher correlation using the

S&L SRV analytical models and the Method of Images. Although all cases are considered, the all-valve and subsequent actuation cases are frequently the bounding cases for SRV submerged structure loads.

3.2.1 All Valves

Submerged structure loads from multiple SRV actuation may be maximized when out-of-phase SRV bubbles are on opposite sides of the structure. The all-valve case most likely to give this result is the resonant sequential symmetric discharge (RSSD). The RSSD case is described in the LSCS-DAR, Revision 7.

3.2.2 ADS

The ADS case (seven valves) yields lower submerged structure loads than the RSSD case because the discharge devices are evenly distributed around the pool and generally have less severe phasing.

3.2.3 Asymmetric

The asymmetric submerged structure case is the subsequent actuation of one of the two low setpoint valves with the initial actuation of an adjacent device.

3.2.4 Single Valve

The single valve actuation case is identical to the subsequent actuation case.

3.2.5 Single Valve - Subsequent Actuation

The subsequent actuation T-quencher loads are calculated using the magnitude predicted by the DFFR quencher correlation for subsequent actuation and the methodology of the S&L SRV analytical models and the Method of Images. The DFFR quencher correlation is assumed to account for all differences between first and subsequent actuation (e.g., pool temperature, water leg, air mass).

3.2.6 Miscellaneous

Several additional load conditions have been addressed and are commented upon in the following subsections.

3.2.6.1 Multiple Valve - Subsequent Actuation

This condition is not applicable for LSCS because of Low-Low Setpoint Logic.

3.2.6.2 Subsequent Actuation During LOCA (SADL)

Assessments have been made of predictions of loads for this case. SADL was found to be bounded by other cases.

3.3 SUPPORT COLUMNS

Each load is calculated for the unique column which is most heavily loaded to generate a bounding load for all columns. These bounding loads are then combined as described in Subsection 3.3.3.

3.3.1 LOCA Drag Loads

3.3.1.1 Vent Clearing

The column is loaded only by drag loads induced by the LOCA water jet (Subsection 3.1.1). The column is not impacted by the jet.

3.3.1.2 Charging Air Bubble

The column is loaded by the net effect of the vents surrounding it. The resultant load is that due to the asymmetries of the vent arrangement since the air bubbles grow simultaneously (Subsection 3.1.2).

3.3.1.3 Condensation Oscillation

The condensation oscillation load (Subsection 3.1.5) is applied assuming symmetric, in-phase loads from neighboring vents.

3.3.1.4 Chugging

The chugging load on support columns was calculated using a Monte Carlo technique. The data base used for the chugging load was the 4T chug library supplied by General Electric. The resulting load was applied as a damped sinusoid. This method gives a design basis which bounds the method described in Subsection 3.1.6.

3.3.2 SRV Drag Loads

3.3.2.1 All Valves

All-valve SRV loads are calculated for the column subjected to the worst phasing situation in the RSSD case (Subsection 3.2.1).

3.3.2.2 Single Valve - Subsequent Actuation

This load is calculated for the column nearest a low setpoint valve (Subsection 3.2.5).

3.3.3 Design Load Combinations

Refer to Table 2.6-1.

3.3.4 Special Considerations

There are no cases which require special consideration.

3.4 DOWNCOMERS

3.4.1 LOCA Drag Loads

3.4.1.1 Vent Clearing

The LOCA Water Jet does not significantly load downcomers.

3.4.1.2 Charging Air Bubbles

Downcomers are loaded by adjacent vents, ignoring the bubble at the downcomer's own exit. The vents are loaded by the asymmetries in the vent arrangement, since all air bubbles grow simultaneously (Subsection 3.1.2).

3.4.1.3 Condensation Oscillation

Downcomers are loaded by adjacent vents, ignoring the condensation oscillation (CO) event at the downcomer's own exit. Vents at the edges of the downcomer array will be exposed to the highest CO loads because all CO events are considered symmetric and in phase (Subsection 3.1.5).

3.4.1.4 Chugging

Downcomers are loaded by drag loads and by a self-induced lateral load during chugging. The drag load is calculated by assuming the worst-case distribution of chugging at neighboring vents and adjusting the resulting load by the probability multiplier (Subsection 3.1.6). The lateral load is calculated following NUREG-0487.

3.4.2 SRV Drag Loads

3.4.2.1 All Valves

All-valve SRV loads are calculated for the downcomer subjected to the worst phasing situation in the RSSD case (Subsection 3.2.1).

3.4.2.2 Single Valve - Subsequent Actuation

This load is calculated for the downcomer nearest a low setpoint valve (Subsection 3.2.5).

3.4.3 Design Load Combinations

See Table 3.4-1 for these combinations.

3.4.4 Special Considerations

Includes consideration of fatigue loads on downcomers.

3.5 LOWER DOWNCOMER BRACING

3.5.1 LOCA Drag Loads

The downcomer bracing is loaded by drag because of the moving suppression pool water in addition to loads transmitted by the downcomers.

3.5.1.1 Vent Clearing

LOCA water jet does not significantly load downcomer bracing.

3.5.1.2 Charging Air Bubble Load

Bracing loads are calculated assuming all bubbles are growing simultaneously (Subsection 3.1.2).

3.5.1.3 Pool Swell

Pool Swell exerts a vertical drag load on the bracing. Interference and blockage effects are considered in conformance with NUREG-0487 (Subsection 3.1.3).

3.5.1.4 Fallback

The bracing is subjected to a downward drag load as the pool swell slug falls back to its original position (Subsection 3.1.4).

3.5.1.5 Condensation Oscillation

Condensation oscillation results in a periodic primarily vertical load when the load definition in Section 3.1.5 is applied.

3.5.1.6 Chugging

The chugging load is applied as described in Subsection 3.1.6.

3.5.2 SRV Drag Loads

3.5.2.1 All Valves

The downcomer bracing load is calculated for the segment of the bracing subjected to the worst phasing situation in the RSSD case (Subsection 3.2.1).

3.5.2.2 Single Valve - Subsequent Actuation

This load is calculated on the sections of the bracing in the vicinity of the low setpoint valves (Subsection 3.2.5).

3.5.3 Design Load Combinations

See Table 3.4-1.

3.5.4 Special Considerations

There are no cases which require special consideration.

3.6 SRV LINES AND SUPPORTS

3.6.1 LOCA Drag Loads

3.6.1.1 Vent Clearing

SRV lines and supports are subject to drag loads from the induced flow field (Subsection 3.1.1).

3.6.1.2 Charging Air Bubble

The SRV lines and supports are loaded by neighboring vents with bubbles growing simultaneously (Subsection 3.1.2).

3.6.1.3 Pool Swell

Impact and drag loads are calculated when applicable horizontal members in the pool swell zone have been avoided if possible (Subsection 3.1.3).

3.6.1.4 Fallback

The SRV lines are not subject to fallback loads. However, the SRV line supports are loaded by fallback (Subsection 3.1.4).

3.6.1.5 Condensation Oscillation

The SRV lines and supports are loaded by condensation oscillation (CO) from neighboring downcomers. All CO events are considered symmetric and in phase (Subsection 3.1.5).

3.6.1.6 Chugging

SRV lines and supports are loaded by chugging from adjacent downcomers as described in Subsection 3.1.6.

3.6.2 SRV Drag Loads

3.6.2.1 All Valves

All-valve SRV loads are calculated for the SRV line and supports subjected to the worst phasing situation in the RSSD case (Subsection 3.2.1).

3.6.2.2 Single Valve - Subsequent Actuation

This load is calculated for the lines and supports associated with the low setpoint valves (Subsection 3.2.5).

3.6.3 Design Load Combinations

The design stress combinations and applicable loadings for the MS-SRV lines are given in Table 3.6-1A. The load combinations for the associated supports are given in Table 3.6-1B. Where certain load combinations are bounded by another load combination, only the bounding combination is considered. A brief description of the loadings used is given in the Abbreviation/Definition portion of the tables. These loadings are discussed further in the applicable sections of this document. The method of load combination is delineated at the bottom of each table.

3.6.4 Special Considerations

Modifications have been made to the wetwell piping systems to increase their capability to sustain the applied loadings. Modifications to the piping include replacing sections of pipe with heavier schedule pipe and rerouting the line when necessary. Modifications to the support systems include both the addition and elimination of restraints along with upgrading, when necessary, the load capacity of existing restraints.

A specific example of the above is the replacements of the original MS-SRV discharge line elbows with Schedule 160 elbows. In addition, lateral guides have been added to the discharge line risers. The effects of the submerged structure loadings on the guide components (rigid struts and clamps) are considered. The discharge lines have been supported exclusively by rigid restraints.

The wetwell portions of the MS-SRV discharge lines will be assessed as to their ability to meet ASME BPVC Section III Class 1 fatigue requirements. These lines are classified as Class 3 piping, and Class 1 requirements will be used only to evaluate the fatigue capacity of the piping.

3.7 SRV QUENCHERS AND SUPPORT BASES

3.7.1 LOCA Drag Loads

3.7.1.1 Vent Clearing

The LOCA water jet load is calculated using the method described in Subsection 3.1.1.

3.7.1.2 Charging Air Bubble

Loads on the quencher are calculated assuming simultaneous growth of all bubbles (Subsection 3.1.2).

3.7.1.3 Pool Swell

Quenchers are not loaded by pool swell.

3.7.1.4 Condensation Oscillation

The quencher is loaded by condensation events at nearby downcomers. Condensation oscillation is assumed to be symmetric and in phase at all vents (Subsection 3.1.5).

3.7.1.5 Chugging

The quencher is loaded by chugging from adjacent downcomers. The method described in Subsection 3.1.6 is used to conservatively estimate the bounding load.

3.7.2 SRV Drag Loads

3.7.2.1 All Valves

The all-valve design load is the most severe loading experienced by any quencher during the RSSD case (Subsection 3.2.1).

3.7.2.2 Single Valve - Subsequent Actuation

Drag loads are calculated for both self-loading and loading of an adjacent quencher during subsequent actuation of a low-setpoint SRV (Subsection 3.2.5).

3.7.3 Other Loads (Thrust)

The quencher body and pedestal are subjected to downward thrust loads due to air and water clearing of the SRV line. These loads are calculated by the Sargent & Lundy (S&L) computer code SRVA. The quencher body, pedestal and arms are subjected to thrust loads due to uneven air and water clearing.

3.7.4 Design Load Combinations

The design load combinations for the quencher are delineated in Table 3.7-1.

3.7.5 Special Considerations

The MS-SRV quenchers and support bases have been analyzed according to the preliminary bounding load requirements given in S&L Design Specification DS-MS-02-LS, Rev. 2, 5/2/79. The analyses of the quenchers were conducted by their manufacturer, Sargent Industries-Airite Division, and the analyses results are presented in the manufacturer's Technical Report R-S-1079000, Rev. A, 5/8/79.

Simplified quencher models have been included in the MS-SRV discharge line analyses; this enables the effects of the interaction between the discharge lines and quenchers to be evaluated. Quencher loads obtained from analyses and revised loading definitions were compared to the loadings given in the S&L design specification to verify that the quencher design loads remain conservative.

3.8 ECCS SUCTION STRAINERS AND SUPPORTS

3.8.1 LOCA Drag Loads

3.8.1.1 Vent Clearing

The 8-inch (RCIC) suction strainer is not close to the LOCA water jet path and is exposed to only negligible drag loads. However, the 24-inch suction strainers (HPCS, LPCS and RHR) are subject to water jet loads.

3.8.1.2 Charging Air Bubble

Charging air bubble loads are calculated assuming all bubbles grow simultaneously (Subsection 3.1.2).

3.8.1.3 Pool Swell

The 24-inch ECCS strainers are not loaded by pool swell due to their orientation in the pool. Loads on the RCIC strainers were calculated as described in Section 3.1.3.

3.8.1.4 Fallback

The 24-inch ECCS strainers are not subjected to fallback loads. Loads on the RCIC strainer were calculated as described in Section 3.1.4.

3.8.1.5 Condensation Oscillation

Strainers are loaded by assuming that nearby vents experience in-phase condensation oscillation (Subsection 3.1.5).

3.8.1.6 Chugging

Chugging loads are calculated in accordance with Subsection 3.1.5.

3.8.2 SRV Drag Loads

3.8.2.1 All Valves

All-valve SRV loads are calculated for the ECCS strainers and supports subjected to the worst phasing situation in the RSSD case (Subsection 3.2.1).

3.8.2.2 Single Valve - Subsequent Actuation

This load is calculated for the strainer and supports nearest a low-setpoint SRV (Subsection 3.2.5).

3.8.3 Design Load Combinations

The design stress combinations and applicable loadings for the ECCS suction strainers are given in Table 3.6-1A. The load combinations for the associated supports are given in Table 3.6-1B. Where certain load combinations are bounded by another load combination, only the bounding combination is considered. A brief description of the loadings used is given in the Abbreviation/Definition portion of the tables.

These loadings are discussed further in the applicable sections of this document. The method of load combination is delineated at the bottom of each table.

3.8.4 Special Considerations

Modifications have been made to the ECCS suction strainer subsystems to increase their capability to sustain the applied loadings. For instance, the piping elbows were replaced with heavier wall elbows, and the original suction strainers were replaced with reinforced strainers. The reinforced strainers have been analyzed according to the preliminary loading requirements given in Acton Environmental Testing Corp. Report No. 14502, Date August 10, 1979. This design report was commissioned by the strainer's manufacturer, Permutit Company, Inc.

Simplified strainer models have been included in the ECCS suction line analyses. Strainer loads obtained from analyses and revised loading definitions were used to reanalyze the strainers and verify their adequacy.

3.9 MISCELLANEOUS WETWELL PIPING AND SUPPORTS

Piping Systems not included in the previous categories were assessed in a similar manner as required by the geometry and location of the piping and supports.

3.9.1 LOCA Drag Loads

3.9.1.1 Vent Clearing

The LOCA water jet does not impact any of this piping. Only minor induced drag loads are present. These loads will be calculated only for piping close to the LOCA water jets.

3.9.1.2 Charging Air Bubble

Loads are calculated assuming all air bubbles grow simultaneously (Subsection 3.1.2).

3.9.1.3 Pool Swell

Impact and drag loads are calculated when applicable. Horizontal pipe runs in the pool swell zone have been avoided if possible (Subsection 3.1.3).

3.9.1.4 Fallback

Horizontal pipe and structures in the pool swell zones are subject to fallback loads (Subsection 3.1.4).

3.9.1.5 Condensation Oscillation

Condensation Oscillation loads are calculated using the load definition in Subsection 3.1.5.

3.9.1.6 Chugging

The method of application of the chugging load is described in Subsection 3.1.6.

3.9.2 SRV Drag Loads

3.9.2.1 All Valves

For each pipe or structure, a calculation is made for the resultant load of the RSSD case for the unique location of that pipe or structure (Subsection 3.2.1).

3.9.2.2 Single Valve - Subsequent Actuation

The load from a single valve actuation is calculated for each pipe or structure (Subsection 3.2.5).

3.9.3 Design Load Combinations

The design stress combinations and applicable loadings for the ECCS discharge lines are given in Table 3.6-1A. The load combinations for the associated supports are given in Table 3.6-1B. Where certain load combinations are bounded by another load combination, only the bounding combination is considered. A brief description of the loadings used is given in the Abbreviation/Definition portion of the tables. The loadings are discussed further in the applicable sections of this document. The method of load combination is delineated at the bottom of each table.

The RTD temperature monitoring tubes have a minimal submergence in the pool and the submerged structure loadings on these lines have been determined to be negligible. These lines are supported according to the applicable design tables generated from the La Salle Small Piping Procedure. In addition to the restraint loads given in the small piping design tables, pool swell and fallback loadings are considered for the affected restraints.

3.9.4 Special Considerations

Modifications have been made to the miscellaneous wetwell piping and supports to increase their capability to sustain the applied loadings. Sections of various ECCS discharge lines were replaced with heavier schedule piping. In addition, for some lines the portion of discharge piping originally routed into the water was cut off. The removal of this piping significantly reduces or eliminates the submerged structure loadings on the balance of the routings. Modifications to the support systems include both the addition and elimination of restraints along with upgrading, when necessary, the load capacity of existing restraints.

4.0 IMPLEMENTATION OF REVISIONS

4.1 SUMMARY OF CHANGES INCLUDED IN REVISION 1

Since the issuance of Revision 0 of this report in December 1979, numerous changes to the original design basis SRV/LOCA hydrodynamic loads have occurred due to the continued Mark II Owner's Group efforts and the NRC acceptance criteria issued by NUREG-0487. Additional changes have been required in order to refine the loads and present them in a format more suited to the needs of the various analytical and design groups. The summary provided in this section documents those changes and provides the basis for their incorporation into the LSCS design.

In addition to the technical changes, many changes of an editorial nature were also required. Changes of this type will not be discussed herein, except to acknowledge here the format change to agree with that of S&L QA Procedure GQ-3.11 and the deletion of references to the CPM task list numbers. The format change was made to ensure proper documentation of review and verify design control. The task list numbers were deleted in order to reflect the fact that the CPM networks are no longer used on the project.

4.1.1 Revisions to Section 1.0

Reference to General Electric's concurrence with this report was deleted as a purpose of the report. General Electric established their own design control documents and would not accept this report for that purpose. All other changes were editorial.

4.1.2 Revisions to Section 2.0

a. For clarity, the description of the asymmetric load during vent clearing was moved from Subsection 2.1.2 to Subsection 2.1.3. This change had no impact on plant design, since the load was bounded by the design pressure load on the containment walls.

b. Reference to the original design basis condensation oscillation load defined in DFFR, Revision 3 was deleted from Subsection 2.1.4. The Levy definition described in the remaining portion of Subsection 2.1.4 is established as the only design-basis CO load for LSCS.

c. Again, reference to the CO boundary load defined in DFFR, Revision 3 was deleted, as described in item (b), from Subsection 2.2.1. The transmittal dates for the response spectra and anchor movements were also updated. In both cases, the basis of the updated loads remained the same as that previously transmitted, and the only change was a format clarification to the interfacing design organization. The design basis was unchanged by this updated version, and no design changes resulted.

d. All reference to the rams head SRV loads has been deleted from Subsection 2.3. In this case, the LSCS design basis was changed from SRV rams head to SRV KWU T-quencher. All necessary design changes and analyses have been revised to reflect this revised design basis.

e. Reference to rams head loads and the associated transmittal dates of response spectra and anchor movements has been deleted from Subsection 2.4. As discussed in item (d), the KWU load definition is the LSCS final design basis.

f. References to annulus pressurization loads for an original shell model and a modified shell model have been added to Subsection 2.5. In the case of the original shell model, the references to the response spectra, anchor movements and displacement time histories have been updated to reflect a revised design basis from that originally established in Revision 0 of this report. All design and analysis, except that utilizing the modified shell model, has been updated to reflect this revised design basis. This load forms the basis for the design of most of the large-bore piping for LSCS.

   The description and transmittal dates of the modified shell model annulus pressurization loads have been added to the report. This load was utilized in developing the support guidelines for the small-bore piping and has been utilized in reconciling the installed condition of the piping subsystems with their design-basis analysis.

Both of these loads form the design basis for LSCS. It is a matter of timing as to which particular load is utilized for a specific structure, component, or subsystem. The original shell model load represents a very conservative approach that had to be utilized in some cases because of schedule demands. The modified shell model load represents a more refined and lower-magnitude load that could be utilized for design or reconciliation of those structures, components, or subsystems that were finalized after the availability of this reduced load. Both are acceptable design bases, and both have been utilized in various portions of the LSCS design as the design basis.

g. Reference to inertia loads due to the self-weight excitation of structural steel under dynamic loading was added to Subsection 2.6. Again, this is a revised design basis from that originally called out in Revision 0 of the report, and all required design modifications and analyses have been implemented.

h. Reference to the absolute method of combination of the CO load with other dynamic piping loads has been deleted from Subsection 2.7. NUREG-0487 acknowledged that the SRSS method of load combination was acceptable for this dynamic load also. Therefore, the LSCS design basis was revised to reflect this. Table 2.7-1 has also been revised to reflect this change from absolute to SRSS methodology.

i. Reference to the absolute combination of the CO load has been deleted from Subsection 2.8 for the same reasons outlined under item (h).

j. Subsection 2.11, which addresses piping penetration assemblies, was added to the report. Subsection 2.10 on components did not meet the specialized needs of the piping penetration assemblies. Therefore, this subsection was added, and forms the design basis for these components for LSCS. All design modifications and analyses have been done to reflect this basis.

4.1.3 Revisions to Section 3.0

a. References to the LSCS-DAR have been updated to address Revision 9 rather than Revision 7 referenced in Revision 0 of this report. These DAR revisions have been made to reflect the revised design basis, such as the adoption of the KWU T-Quencher load definition, and do not change the basis from that outlined herein.

b. Section 3.2 has been revised to reflect the consideration of the subsequent actuation-during-LOCA loads. The assessment for these loads did not change the LSCS design basis and is acknowledged herein for information purposes only.

c. Section 3.6 has been revised to reflect that the LOCA submerged structure loads do act on the SRV discharge lines and supports. This revised design basis has been reflected in the plant design, and all required plant modifications and analyses have been implemented.

d. Section 3.8 has been revised to reflect that the LOCA submerged structure loads do act on the 24-inch ECCS suction strainers. This revised design basis has also been fully incorporated into the plant design and analysis.

4.1.4 Revisions to Appendix A

Appendix A has been added. This appendix specifically identifies the load transmittal dates, describes the interface inputs and outputs between the various analytical organizations, and reflects the final design-basis information.

4.1.5 Revisions to Appendix B

Appendix B was deleted, since its original purpose of identifying bounded load combinations was accomplished in the text of the report, instead of in the special Appendix. Reference to Appendix B has also been deleted from the report.

4.2 ASSESSMENT FOR 4TCO TEST RESULTS

Subsequent to the adoption of the design basis described in this report, the Mark II Owners' Group conducted a series of steam condensation tests in the 4T Test Facility to confirm the adequacy of the CO load definition. The results of these tests indicated that the CO and chugging loads appear to be somewhat different than the LSCS design-basis steam condensation loads. Due to the difference between the characteristics of the design basis and the observed data from the test, no direct load comparison could be made. Therefore, a plant assessment was performed and reported as Appendix H to the LSCS-DAR to ensure the adequacy of the LSCS design for the 4TCO test condensation oscillation and chugging loads.

The results of this assessment clearly show that the steam condensation loads observed in the 4TCO tests were less severe than the loads used in the LSCS design. At each of the representative locations, the response spectrum with a load derived from the 4TCO test results was less than the response spectrum used in the design of the plant.

This result confirms that sufficient conservatism has been incorporated into the LSCS design to accommodate load redefinition due to additional test results which may become available. No additional analysis or design work is required to establish the adequacy of the LSCS design for hydrodynamic loads.

4.3 ASSESSMENT FOR NUREG-0808

In a letter from D. G. Eisenhut to L. O. DelGeorge dated September 24, 1981, the NRC transmitted NUREG-0808, "Mark II Containment Program Load Evaluation and Acceptance Criteria."

This letter required that LSCS perform a confirmatory review for the condensation oscillation, chugging load, suppression downcomer vent lateral load and drywell floor reverse pressure load, as described in NUREG-0808. This confirmatory review is to be completed and submitted to the NRC by September 24, 1982.

It is intended to address these revised loads in the same manner as the 4TCO Test Loads were addressed (see Section 4.2). An assessment of these revised loads will be made, and the results will be reported to the NRC as an additional appendix to the LSCS-DAR.

As stated for the 4TCO loads, it is the firm consensus that the LSCS design basis will again be found to bound the loads specified in NUREG-0808, and that no additional analysis or design work beyond the assessment will be required to establish the adequacy of the LSCS design.

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TABLES

STRUCTURAL DESIGN LOAD COMBINATIONS

EQN	LOAD COND	D	L	F	P_O	T_O	R_O	E_O	E_{SS}	P_B	P_A	T_A	R_A	R_R	SRV	ADS	ALL	ASYM	SINGLE I. ACT	SINGLE II. ACT
1	Normal w/o Temp	1.4	1.7	1.0	1.0	-	-	-	-	-	-	-	-	-	1.5	0	X	X		
2	Normal w/Temp	1.0	1.3	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	1.3	0	X	X		
3	Normal Sev. Env.	1.0	1.0	1.0	1.0	1.0	1.0	1.25	-	-	-	-	-	-	1.25	0	X	X		
4	Abnormal	1.0	1.0	1.0	-	-	-	-	-	1.25	-	1.0	1.0	-	1.25	X	0	X		
4a		1.0	1.0	1.0	-	-	-	-	-	-	1.25	1.0	1.0	-	1.0	0	0	0	X	X
5	Abnormal Sev. Env.	1.0	1.0	1.0	-	-	-	1.1	-	1.1	-	1.0	1.0	-	1.1	X	0	X		
5a		1.0	1.0	1.0	-	-	-	1.1	-	-	1.1	1.0	1.0	-	1.0	0	0	0	X	X
6	Normal Ext. Env.	1.0	1.0	1.0	1.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	0	X	X		
7	Abnormal Ext. Env.	1.0	1.0	1.0	-	-	-	-	1.0	1.0	-	1.0	1.0	1.0	1.0	X	0	X		
7a		1.0	1.0	1.0	-	-	-	-	1.0	-	1.0	1.0	1.0	1.0	1.0	0	0	0	X	

LOAD DESCRIPTION

D = Dead Loads
L = Live Loads
F = Prestressing Loads
T_O = Operating Temperature Loads
R_O = Operating Pipe Reactions
P_O = Operating Pressure Loads
SRV = Safety/Relief Valve Loads
E_O = Operating Basis Earthquake
E_{SS} = Safe Shutdown Earthquake
P_B = SBA and IBA LOCA Loads
T_A = Pipe Break Temperature Load
R_A = Pipe Break Temperature Reaction Loads
P_A = DBA LOCA Loads
R_R = Reactions and Jet Forces Due to Pipe Break

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TABLE 2.6-1
SL-3876

LOCA AND SRV DESIGN LOAD COMBINATIONS - STRUCTURAL STEEL ELASTIC DESIGN

EQN	LOAD COND	D	L*	S	P_O	T_O	R_O	E_O	E_{SS}	P_B	P_A	T_A	R_A	R_R	SRV**	ADS	ALL	ASYM-MET-RICAL	SINGLE	DESIGN STRESS
1	Normal w/o Temp	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-	1.0	0	X	X		AISC Allowable
2	Normal w/Temp	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	1.0	0	X	X		AISC Allowable
3	Normal Sev. Env.	1.0	1.0	-	1.0	1.0	1.0	1.0	-	-	-	-	-	-	1.0	0	X	X		AISC Allowable
4	Abnormal	1.0	1.0	1.0	-	-	-	-	-	1.0	-	1.0	1.0	-	1.0	X	0	X		1.6 AISC
4a		1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.0	-	1.0	0	0	0	X	Allowable ≤ .95 Fy
5	Abnormal Sev. Env.	1.0	1.0	-	-	-	-	1.0	-	1.0	-	1.0	1.0	-	1.0	X	0	X		1.6 AISC
5a		1.0	1.0	-	-	-	-	1.0	-	-	1.0	1.0	1.0	-	1.0	0	0	0	X	Allowable ≤ .95 Fy
6	Normal Ext. Env.	1.0	1.0	-	1.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	0	X	X		1.6 AISC Allowable ≤ .95 Fy
7	Abnormal Ext. Env.	1.0	1.0	-	-	-	-	-	1.0	1.0	-	1.0	1.0	1.0	1.0	X	0	X		1.6 AISC Allowable
7a		1.0	1.0	-	-	-	-	-	1.0	-	1.0	1.0	1.0	1.0	1.0	0	0	0	X	≤ .95 Fy

LOAD DESCRIPTION

D = Dead Loads
L = Live Loads
S = Stability Loads
P_O = Operating Pressure Differential Load
T_O = Operating Temperature Loads
R_O = Operating Pipe Reactions
P_V = Operating Pressure Loads
SRV = Safety/Relief Valve Loads
EO = Operating Basis Earthquake
* = Varies in Magnitude and Intensity

E_{SS} = Safe Shutdown Earthquake
P_B = SBA and IBA LOCA Loads
T_A = Pipe Break Temperature Load
R_A = Pipe Break Temperature Reactions Loads
P_A = DBA LOCA Loads
R_R = Reactions and Jet Forces Due to Pipe Break
** = Only One SRV Should be Combined at One Time

NOTE: In loading Combinations 2 and 3, the design stress is 1.5 AISC Allowable when T_O is considered.

LOCA AND SRV DESIGN LOAD COMBINATIONS - REINFORCED CONCRETE STRUCTURES OTHER THAN CONTAINMENT

EQN	LOAD COND	D	L*	F	P_O	T_O	R_O	E_O	E_{SS}	P_B	P_A	T_A	R_A	R_R	SRV**	ADS	ALL	ASYM-MET-RICAL	SINGLE	DESIGN STRENGTH
1	Normal w/o Temp	1.4	1.7	1.0	1.0	-	-	-	-	-	-	-	-	-	1.5	0	X	X		ACI 318-71
2	Normal w/Temp	1.0	1.3	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	1.3	0	X	X		ACI 318-71
3	Normal Sev. Env.	1.0	1.0	1.0	1.0	1.0	1.0	1.25	-	-	-	-	-	-	1.25	0	X	X		ACI 318-71
4	Abnormal	1.0	1.0	1.0	-	-	-	-	-	1.25	-	1.0	1.0	-	1.25	X	0	X		Yield Limit
4a		1.0	1.0	1.0	-	-	-	-	-	-	1.25	1.0	1.0	-	1.0	0	0	0	X	
5	Abnormal Sev. Env.	1.0	1.0	1.0	-	-	-	1.1	-	1.1	-	1.0	1.0	-	1.1	X	0	X		Yield Limit
5a		1.0	1.0	1.0	-	-	-	1.1	-	-	1.1	1.0	1.0	-	1.0	0	0	0	X	
6	Normal Ext. Env.	1.0	1.0	1.0	1.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	0	X	X		ACI 318-71
7	Abnormal Ext. Env.	1.0	1.0	1.0	-	-	-	-	1.0	1.0	-	1.0	1.0	1.0	1.0	X	0	X		Yield Limit
7a		1.0	1.0	1.0	-	-	-	-	1.0	-	1.0	1.0	1.0	1.0	1.0	0	0	0	X	

LOAD DESCRIPTION

D = Dead Loads

L = Live Loads

F = Prestressing Loads

P_O = Normal Operating Pressure Differential Load

T_O = Operating Temperature Loads

R_O = Operating Pipe Reactions

SRV = Safety/Relief Valve Loads

E_O = Operating Basis Earthquake

E_{SS} = Safe Shutdown Earthquake

P_B = SBA and IBA LOCA Loads

T_A = Pipe Break Temperature Load

R_A = Pipe Break Temperature Reactions Loads

P_A = DBA LOCA Loads

R_R = Reactions and Jet Forces Due to Pipe Break

* = Varies in Magnitude and Intensity

** = Only One SRV Load should be Combined at One Time

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PIPING LOAD COMBINATIONS*

	SERVICE LEVEL
1. $N + (OBE^2 + SRV_{ALL/ASY}^2 + TR^2)^{1/2}$	B (UPSET)
2. $N + (OBE^2 + TR^2 + SRV_{ALL/SIN}^2 + CO_{LEVY-1}^2)^{1/2}$	C (EMERGENCY)**
3. $N + (SSE^2 + TR^2 + SRV_{ALL/SIN}^2 + CO_{LEVY-1}^2)^{1/2}$	C (EMERGENCY)**
4. $N + (OBE^2 + TR^2 + SRV_{ADS/ASY}^2 + CO_{LEVY-2}^2)^{1/2}$	C (EMERGENCY)**
5. $N + (SSE^2 + TR^2 + SRV_{ADS/ASY}^2 + CO_{LEVY-2}^2)^{1/2}$	C (EMERGENCY)**
6. $N + (OBE^2 + TR^2 + SRV_{ADS/ASY}^2 + CHUG^2)^{1/2}$	C (EMERGENCY)**
7. $N + (SSE^2 + TR^2 + SRV_{ADS/ASY}^2 + CHUG^2)^{1/2}$	C (EMERGENCY)**
8. $N + (SSE^2 + AP^2)^{1/2}$	C (EMERGENCY)**

where:

N	=	Normal Loads
OBE	=	Operating Basis Earthquake
SSE	=	Safe Shutdown Earthquake
$SRV_{ALL/ASY}$	=	Envelope of All and Asymmetric Valve Discharges - Quencher Definition
$SRV_{ADS/ASY}$	=	ADS Valves Discharging - Same Envelope as $SRV_{ALL/ASY}$
TR	=	Hydraulic Transient Load Where Applicable
CO_{LEVY-1}	=	Condensation Oscillation, Levy Definition Combination 1 .80 (VE+0.2VA+RND)

* These combinations may be obtained by either a response spectrum analysis of each load followed by the combination of the results or by using a single response spectrum combined from the response spectra for the individual loads.

**Faulted service level limits shall apply for determining the allowable stress in the piping for systems not required to meet the functional capability criteria (nonessential) and for support design of all systems.

CO_{LEVY-2}	=	Condensation Oscillation, Levy Definition Combination 2 .80 (0.1VE+VA+0.7RND)
CHUG	=	Asymmetric Chugging
AP	=	Annulus Pressurization
$SRV_{ALL/SIN}$	=	Envelope of One and All Valve Discharge - Quencher Definition

PIPING LOAD COMBINATIONS BOUNDED BY ANALYZED COMBINATIONS

BOUNDED LOAD COMBINATIONS	SERVICE LEVEL	BOUNDED BY LOAD COMBINATIONS NO. (TABLE 2.7-1)
$N + (OBE^2 + SRV_{ALL/ASY}{}^2 + TR^2)^{1/2}$	C	1
$N + (OBE^2 + TR^2)^{1/2}$	B	1
$N + (SSE + TR^2)^{1/2}$	C	3
N	A	1
$N + (SSE^2 + TR^2 + CO_{LEVY\text{-}2}{}^2)^{1/2}$	C	5
$N + (SSE^2 + SRV_{ALL/ASY}{}^2 + TR^2)^{1/2}$	C	7

DAMPING VALUES FOR PIPING ANALYSIS

LOAD	NSSS DAMPING VALUE[3]	BALANCE OF PLANT DAMPING VALUE
OBE	1/2%	1/2%
SSE	1%	1%
$SRV_{ALL/ASY}$	1,2%[4]	1,2%[1]
$SRV_{ADS/ASY}$	1,2%[4]	2%
CO_{LEVY-1}, CO_{LEVY-2}	1,2%[4]	2%
CHUGGING	1,2%[4]	2%
ANNULUS PRESSURIZATION	1,2%[4]	2%[2]
$SRV_{ALL/SIN}$	1,2%[4]	2%

Footnotes:

(1) - Damping values for Service Level B (Upset) and C (Emergency) respectively.

(2) - When Response Spectra Loading rather than Time Histories are used.

(3) - Reference G.E. Design Report 22A7429, "Main Steam Piping and Equipment Loads."

(4) - For 12-inch NPS and smaller piping, 1% damping is used. For piping larger than 12-inch, 2% damping is used.

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TABLE 2.11-1
SL-3876

PIPING PENETRATION ASSEMBLIES ALLOWABLE STRESS

CECo
LSCS 1 & 2
SRV/LOCA HYDRODYNAMIC LOADS REVISED
DESIGN-BASIS SUMMARY REPORT

PROJECT: 4266/4267
REVISION 1
DATE: 10-01-81

STRESS CATEGORY		ALLOWABLE STRESS VALUES FOR EACH LOADING CONDITION (NOTE 1)			
		NORMAL AND UPSET	DESIGN (NOTE 3)	EMERGENCY (NOTE 3)	FAULTED (NOTES 3 & 4)
PRIMARY STRESSES	GENERAL MEMBRANE (P_m)	(Note 2)	S_m	The larger of $1.2S_m$, or S_y	The larger of $0.7S_u$, or $S_y + \frac{S_u - S_y}{3}$
PRIMARY STRESSES	LOCAL MEMBRANE (P_L)	(Note 2)	$1.5S_m$	The larger of $1.8S_m$, or $1.5S_y$	The larger of $1.05S_u$, or $1.5S_y + \frac{S_u - S_y}{2}$
PRIMARY STRESSES	MEMBRANE + BENDING $(P_L + P_b)$	(Note 2)	$1.5S_m$	The larger of $1.8S_m$, or $1.5S_y$	The larger of $1.05S_u$, or $1.5S_y + \frac{S_u - S_y}{2}$
SECONDARY STRESSES	EXPANSION STRESSES (P_e)	$3S_m$			
SECONDARY STRESSES	PRIMARY + SECONDARY $(P_L + P_B + P_e + Q)$	$3S_m$			
PEAK STRESSES	(F)	(Note 5)			

NOTES

1. Values for S_m, S_y, and S_u shall be temperature-dependent and taken from Section III Tables, as follows: S_y from Tables I-2.0; S_u from Tables I-3.0; Design Stress Intensity values from tables I-1.0, 7.0, 8.0 or 10.0 as applicable.
2. There are no specific limits established on the Primary stresses that result from Operating Conditions.
3. Design, Emergency and Faulted Conditions do not require Secondary and Peak stress evaluation.
4. The specified stress limits for Faulted Conditions are applicable for System inelastic and Component elastic evaluation.
5. Used in combination with all Primary and Secondary stresses for calculating alternating stresses (for Fatigue evaluation).

LOCA AND SRV DESIGN LOAD COMBINATIONS - DOWNCOMERS AND DOWNCOMER BRACING

EQN	LOAD COND	D	L*	S	P_O	T_O	R_O	E_O	E_{SS}	P_B	P_A	T_A	R_A	R_R	SRV**	ADS	ALL	ASYM	I. ACT	II. ACT	DESIGN STRESS
1	Normal w/o Temp	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-	1.0	0	X	X			Operating
2	Normal w/Temp	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	1.0	0	X	X			Operating
3	Normal Sev. Env.	1.0	1.0	-	1.0	1.0	1.0	1.0	-	-	-	-	-	-	1.0	0	X	X			Upset
4	Abnormal	1.0	1.0	1.0	-	-	-	-	-	1.0	-	1.0	1.0	-	1.0	X	0	X			Emergency
4a		1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.0	-	1.0	0	0	0	X	X	
5	Abnormal Sev. Env.	1.0	1.0	-	-	-	-	1.0	-	1.0	-	1.0	1.0	-	1.0	X	0	X			
5a		1.0	1.0	-	-	-	-	1.0	-	-	1.0	1.0	1.0	-	1.0	0	0	0	X	X	Emergency
6	Normal Ext. Env.	1.0	1.0	-	1.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	0	X	X			Emergency
7	Abnormal Ext. Env.	1.0	1.0	-	-	-	-	-	1.0	1.0	-	1.0	1.0	1.0	1.0	X	0	X			Emergency
7a		1.0	1.0	-	-	-	-	-	1.0	-	1.0	1.0	1.0	1.0	1.0	0	0	0	X	X	

LOAD DESCRIPTION

D = Dead Loads
L = Live Loads
S = Stability Loads
P_O = Operating Pressure Differential Load
R_O = Operating Pipe Reactions

T_O = Operating Temperature Loads
SRV = Safety/Relief Valve Loads
E_O = Operating Basis Earthquake
* = Varies in Magnitude and Intensity
E_{SS} = Safe Shutdown Earthquake
P_B = SBA and IBA LOCA Loads

T_A = Pipe Break Temperature Load
R_A = Pipe Break Temperature Reactions Loads
P_A = DBA LOCA Loads
R_R = Reactions and Jet Forces Due to Pipe Break
** = Only One SRV Should be Combined at One Time

LOAD COMBINATION	LOADS(1)										SERVICE LEVEL	APPLICABLE CODE EQ.(5)
	TH	P	W	TR(2)	SRV	OBE	SSE(3)	PSF	CO(4)	CHUG		
1		X	X								A (Normal)	Eq. 8
2		X	X	X	X	X					B (Upset)	Eq. 9
3		X	X	X	X		X				C (Emergency)	Eq. 9
4		X	X	X			X	X			C (Emergency)(6)	Eq. 9
5		X	X	X	X		X		X		C (Emergency)(6)	Eq. 9
6		X	X	X	X		X			X	C (Emergency)(6)	Eq. 9
7	X										N/A	Eq. 10(7)
8	X	X	X								N/A	Eq. 11
Combination Method	+	+	+	*	*	*	*	*	*	*		

LIMITING STRESS COMBINATIONS FOR
WETWELL PIPING AND PIPING COMPONENTS
CONSIDERING HYDRODYNAMIC LOADS

SARGENT & LUNDY ENGINEERS

LOAD COMBINATION	LOADS[1]									SERVICE LEVEL
	TH[8]	W	TR[2]	SRV	OBE	SSE[3]	PSF	CO[4]	CHUG	
1	X	X	X	X	X					B (Upset)
2	X	X	X	X		X				C (Emergency)
3	X	X	X			X	X			C (Emergency)[6]
4	X	X	X	X		X		X		C (Emergency)[6]
5	X	X	X	X		X			X	C (Emergency)[6]
Combination Method	+	+	*	*	*	*	*	*	*	

LIMITING LOAD COMBINATIONS FOR WETWELL PIPING SUPPORTS CONSIDERING HYDRODYNAMIC LOADS

SARGENT & LUNDY ENGINEERS

TABLES 3.6-1A & B (Cont'd)

ABBREVIATION	DEFINITION (Applicable to Tables 3.6 - 1A & 1B)
TH	Thermal Expansion Loads
P	Pressure
W	Weight
TR	Hydraulic Transient Loads
SRV	Main Steam safety relief valve discharge loads, KWU quencher load definition. Building response consists of the envelope of response spectra for all valve and asymmetric valve actuation cases. Submerged structure loads consist of the bounding load case for single valve subsequent actuation (SVSA) and all-valve resonant sequential symmetric discharge (RSSD) Building response and submerged structure reactions are added together via SRSS.
OBE	Operating Basis Earthquake: Building Response
SSE	Safe Shutdown Earthquake: Building Response
PSF	Pool Swell or Fallback Loadings. The load combination includes the governing reactions from pool swell impact and drag loadings or pool fallback drag loadings.
CO	Condensation Oscillation Loads. Building response consists of the envelope of response spectra derived from CO_{LEVY-1} and CO_{LEVY-2} load combinations. Submerged structure loads consist of bounding loads resulting from the vent exit component of CO. Building response and submerged structure reactions are added together via SRSS.
CHUG	Chugging Loads. Building response consists of response spectra for asymmetric chugging.

ABBREVIATION	DEFINITION
CHUG-cont'd	Submerged structure loads consist of bounding loads derived from 4T test data. The shape of the submerged structure forcing function is obtained from a sample 4T trace. The frequency content of the trace is modified to represent frequencies in the range of 20-30 Hz. Building response and submerged structure reactions are added together via SRSS.
+	Indicates load is added via Absolute SUM (ABS) to other loads in the load case.
*	Indicates load is added via Square Root Sum of the Squares (SRSS) to other loads in the load case.

NOTES:

1) In the dynamic analyses of submerged structures 1% damping is used for upset conditions and 2% damping is used for Emergency and Faulted conditions. Note that Water Jet and Charging Air Bubble loads are not considered in the load combinations because they are bounded by other loadings.

2) Hydraulic transient loads are not combined with PSF for the main steam safety relief valve discharge piping.

3) If SSE response spectra are less than OBE then OBE spectra are used.

4) The design basic stress reports conservatively add via absolute sum CO loads to the balance of the loads in the load case. Subsequent reports and assessments add CO loads via SRSS.

5) Stress equations from ASME BPVC Sec. III NC-3600 or ND-3600.

6) Functional Capability requirements (ref. LSCS-FSAR 3.9.3.1) are met in addition to Service Level C (Emergency) stress limits for essential systems. Service Level D (Faulted) stress limits are used for non-essential systems.

7) The requirements of either Eq. 10 or 11 must be met.

8) The piping support load combinations are performed with and without the piping thermal expansion loads. This is done to envelope to total possible range of loading.

QUENCHER DESIGN LOAD COMBINATIONS

		LOAD COMBINATION AND ACCEPTANCE CRITERIA																							
		NORMAL						UPSET						EMERGENCY						FAULTED					
	Weight + Thermal	X	X	X				X	X	X				X	X	X				X	X	X	X		
	Seismic - OBE							X	X	X															
	Seismic - SSE													X	X	X				X	X	X	X		
MSRV Loads	Internal Pressure	X	X	X				X	X	X				X	X	X				X	X	X			
MSRV Loads	Water Clearing	X						X						X						X					
MSRV Loads	Air Clearing	X	X					X	X					X	X					X	X				
MSRV Loads	Self Imposed Drag		X						X						X						X				
MSRV Loads	Multiple Multiple SRV Drag	X						X						X						X					
MSRV Loads	Intermittent Condensation			X						X						X						X			
MSRV Loads	Inertia Loads	X	X					X	X					X	X					X	X				
LOCA Loads	Chugging Drag - SBA													X	X	X				X-1	X-1	X-1			
LOCA Loads	Condensation Oscillation Drag - IBA																			X-1	X-1	X-1			
LOCA Loads	Downcomer Jet Drag - DBA																						X		
LOCA Loads	Charging Air Bubble Drag - DBA																						X		
LOCA Loads	Inertia - SBA													X	X	X				X-3	X-3	X-3			
LOCA Loads	Inertia - IBA																			X-3	X-3	X-3			
LOCA Loads	Inertia - DBA																						X		
Thermal	Transient	X	X					X	X					X	X					X	X				
Thermal	Intermittent Condensation			X						X						X						X			

NOTES:
1. Use SBA, IBA, whichever governs.
2. Use SBA inertia or IBA inertia, whichever governs.
3. IBA Intermediate Break Accident.
4. DBA Design Basis Accident.

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APPENDIX A
SRV/LOCA
HYDRODYNAMIC LOAD
DEFINITION DOCUMENTATION

Responsible Dept./Div.	Design Basis Report Reference	Structure	Load Type	Input Data Documentation Reference Document	Output Data Documenta ion Reference Document	NRC Acceptance Criteria Reference/Status	Comments
STRUCT/SES	2.1.1	Boundary	LOCA Water Jet	DFFR, Rev. 2	Not required since load is not bounding. No interface output.	NUREG-0487, Section III.B.2 (Acceptable)	Bounded by containment design pressure load of 45 psig.
STRUCT/SES	2.1.2	Boundary	Charging Air Bubble	DFFR, Rev. 2	Not required since load is not bounding. No interface output.	NUREG-0487, Sec. III.B.3.a.1 and Supp. 1 Sec. II.A.3	Bounded by containment design pressure load of 45 psig.
MECH/NSLD to STRUCT/SES	2.1.3	Boundary	Pool Swell Wall Pressure	Memo dated 10-20-78 from W. Choudhury to R. Cheboub	Not required since load is not bounding. No interface output.	NUREG-0487, Sec. III.B.3.b (Acceptable)	Bounded by containment design pressure load of 45 psig.
MECH/NSLD to STRUCT/SES	2.1.3	Drywell Floor	Uplift Pressure	Memo dated 03-14-79 from S. Yassin to R. Cheboub	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.B.3.d.2 (Acceptable)	Bounded by drywell floor assessment of 9 psid upward acting pressure.
STRUCT/SAD to STRUCT/SDD MECH/EMD MECH/CQD	2.1.4	Boundary	Condensation Oscillation	DFFR, Rev. 3 CREARE letter to J. Abel, 10-25-79, and R. M. Crawford letter to J. M. Healtzer, 11-14-79	Response Spectra-Memo dated 01-31-80 from D. C. Gupta/V. Kumar to E. R. Weaver Anchor displacements-Memo dated 12-03-79 from D. C. Gupta/V. Kumar to E. R. Weaver	NUREG-0487, Supplement 2 (Acceptable)	LEVY/CREARE Modified version Trial Spec. #2
STRUC/SAD to STRUCT/SPE to GE	2.1.4	Boundary	Condensation Oscillation	Memo dated 02-01-80 from D. C. Gupta/V. Kumar to R. Srinivasan	Unwidened .esponse spectra transmitted by letter dated 02-28-80 from E. R. Weaver to H. R. Peffer	NUREG-0487, Supplement 2 (Acceptable)	

CECo
LSCS 1 & 2
SRV/LOCA HYDRODYNAMIC LOADS REVISED
DESIGN-BASIS SUMMARY REPORT

PROJECT 4266/4267
REVISION 1
DATE 10-01-81

Responsible Dept./Div.	Design Basis Report Reference	Structure	Load Type	Input Data Documentation Reference Document	Output Data Documentation Reference Document	NRC Acceptance Criteria Reference/Status	Comments
STRUCT/SES to STRUCT/SDD MECH/EMD MECH/CQD	2.1.5	Boundary	Chugging	GE application memorandum, 04-14-76	Response Spectra-Memo from R. Cheboub/R. Marshalla to E. R. Weaver, et.al., dated 04-12-78. Anchor Movements-Memo from J. Carrasco to S. D. Killian and D. E. Olson, dated 11-05-79. Acceleration Time Histories (ATH)-Memo from B. Henley to D. E. Olson dated 10-23-79.	NUREG-0487, Suppelment 2 (Acceptable)	
STRUCT/SES to STRUCT/SPE to GE	2.1.5	Boundary	Chugging	Response Spectra-Memo from R. Cheboub/ R. Marshalla to E. R. Weaver, et.al., dated 04-12-78 ATH (Vertical)-Memo from R. Cheboub/ J. Carrasco to E. R. Weaver dated 02-25-80. ATH (Horizontal)-Memo from B. Henley to E. R. Weaver dated 04-11-80.	Response Spectra-Letter from V. Reklaitis to H. R. Peffer dated 04-20-78. ATH (Vertical)-Letter from E. R. Weaver to H. R. Peffer dated 02-25-80. ATH (Horizontal)-Letter from E. R. Weaver to H. R. Peffer dated 04-11-80.	NUREG-0487, Supplement 2 (Acceptable)	

Responsible Dept./Div.	Design Basis Report Reference	Structure	Load Type	Input Data Documentation Reference Document	Output Data Documentation Reference Document	NRC Acceptance Criteria Reference/Status	Comments
MECH/NSLD to STRUCT/SES	3.3.1.1	Support Column	LOCA Water Jet	3C7-0278-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 06-12-81, and corrections with memo from B. Obersnel to R. Cheboub dated 07-08-81.	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1 Sec. II.C.1 (Acceptable)	Corrections of 07-08-81 do not affect this load. Bounding load with its time history is provided.
MECH/NSLD to STRUCT/SES	3.3.1.2	Support Column	Charging Air Bubble	3C7-0278-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 06-12-81, and corrections with memo from B. Obersnel to R. Cheboub dated 07-08-81.	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1 Sec. II.C.2 (Acceptable)	Corrections of 07-08-81 do not affect this load. Time histories are provided for bounding tangential load component and for bounding radial load component.
MECH/NSLD to STRUCT/SES	3.3.1.3	Support Column	Condensation Oscillation	3C7-0278-002, Rev. 2 with memo from B. Obersnel to R. Cheboub, dated 06-12-81, and corrections with memo from B. Obersnel to R. Cheboub, dated 07-08-81.	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2 load definition. Load magnitude provided for bounding tangential and bounding radial load components. Corrections of 07-08-81 do not affect this load.
MECH/NSLD to STRUCT/SES	3.3.1.4	Support Column	Chugging	3C7-0278-002, Rev. 2 with memo from B. Obersnel to R. Cheboub, dated 06-12-81, and corrections with memo from B. Obersnel to R. Cheboub, dated 07-08-81	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim chugging load definition. Load magnitude, reported in 3C7-0278-002, Rev. 0, transmitted from BO to RC 04-26-78, confirmed by Monte Carlo simulation. (See memo from R. J. Hammersley to R. Cheboub dated 06-29-81). SES used this load magnitude with GE supplied 4T traces for frequency range 20 to 30 Hz.
MECH/NSLD to STRUCT/SES to MECH/EMD	3.4.1.1	Downcomer	LOCA Water Jet	3C7-0181-002, Rev. 1, with memo from B. Obersnel to R. Cheboub dated 08-13-81.	No interface output required; see comments	NUREG-0487, Sec. III.D.1.a and Supp. 1 Sec. II.C.1 (Acceptable)	Calculated net load less than 200 lb.; loads are not reported.

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MECH/NSLD to STRUCT/SES to MECH/EMD	3.4.1.2	Downcomer	Charging Air Bubble	3C7-0181-002, Rev. 1 with memo from B. Obernsel to R. Cheboub dated 08-13-81.	Memo from B. Henley to D. E. Olson dated 06-26-80 (input for fatigue analysis)	NUREG-0487, Sec. III.D.2.a and Supp. 1 Sec. II.C.2 (Acceptable)	Load time history is reported for each downcomer in two sectors.
MECH/NSLD to STRUCT/SES to MECH/EMD	3.4.1.3	Downcomer	Condensation Oscillation	3C7-0181-002, Rev. 1 with memo from B. Obernsel to R. Cheboub dated 08-13-81.	Memo from B. Henley to D. E. Olson dated 06-26-80 (input for fatigue analysis)	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2 load definition. Reported are loads on each downcomer in two sectors.
MECH/NSLD to STRUCT/SES to MECH/EMD	3.4.1.4	Downcomer	Chugging	3C7-0181-002, Rev. 1, with memo from B. Obernsel to R. Cheboub, dated 08-13-81.	Memo from B. Henley to D. E. Olson dated 06-26-80. (Input for fatigue analysis)	NUREG-0487, Sec. III.D.3 (Acceptable)	Loads on individual downcomers are generated so that the sector loads (radial and tangential components, resultant) are maximized. Self-induced lateral load is not reported.
MECH/NSLD to STRUCT/SES	3.5.1.1	Downcomer Bracing and Gusset Plates	LOCA Water Jet	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required; see comments	NUREG-0487, Sec. III.D.1.a and Supp. 1 Sec. II.C.1	Loads found insignificant and were not reported.
MECH/NSLD to STRUCT/SES	3.5.1.2	Donwcomer Bracing and Gusset Plates	Charging Air Bubble	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required. SES performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1 Sec. II.C.2 (Acceptable)	
MECH/NSLD to STRUCT/SES	3.5.1.3	Downcomer Bracing and Gusset Plates	Pool Swell	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required. SES performs final analysis.	NUREG-0487, Sec. III.B.3 and Supp. 1 Sec. II.A.2 (Acceptable)	Methodology of Calculation No. 3C7-1075-001, Rev. 5 was used.
MECH/NSLD to STRUCT/SES	3.5.1.4	Downcomer Bracing and Gusset Plates	Fallback	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required. SES performs final analysis.	NUREG-0487, Sec. III.D.2.a (Acceptable)	Methodology of Calculation No. 3C7-1075-001, Rev. 5 was used.

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MECH/NSLD to STRUCT/SES	3.5.1.5	Downcomer Bracing and Gusset Plates	Condensation Oscillation	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2
MECH/NSLD to STRUCT/SES	3.5.1.6	Downcomer Bracing and Gusset Plates	Chugging	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required; SES performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim chugging load methodology.
MECH/NSLD to MECH/EMD	3.6.1.1	SRV Lines	LOCA Water Jet	3C7-1078-004, Rev. 0, with memo from B. Obersnel to D. E. Olson, dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1, Sec. II.C.1 (Acceptable)	
MECH/NSLD to MECH/EMD	3.6.1.2	SRV Lines	Charging Air Bubble	3C7-1078-004, Rev. 0, with memo from B. Obersnel to D. E. Olson, dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	
MECH/NSLD to MECH/EMD	3.6.1.3	SRV Lines	Pool Swell	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Cheboub and D. E. Olson, dated 10-09-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.B.3 and Supp. 1, Sec. II.A.2 (Acceptable)	
MECH/NSLD to MECH/EMD	3.6.1.4	SRV Lines	Fallback	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Cheboub and D. E. Olson, dated 10-09-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a (Acceptable)	

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MECH/NSLD to MECH/EMD	3.6.1.5	SRV Lines	Condensation Oscillation	3C7-1078-004, Rev. 0, with memo from B. Obersnel to D. E. Olson, dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2
MECH/NSLD to MECH/EMD	3.6.1.6	SRV Lines	Chugging	3C7-1079-001, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 12-18-80; corrected page 9 transmitted by 02-19-81 memo.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim chugging load definition. Boundings loads were calculated for inner/outer ring.
MECH/NSLD to MECH/EMD	3.6.1.1	SRV Line Supports	LOCA Water Jet	3C7-1080-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-04-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1, Sec. II.C.1 (Acceptable)	
MECH/NSLD to MECH/EMD	3.6.1.2	SRV Line Supports	Charging Air Bubble	3C7-1080-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-04-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	
MECH/NSLD to MECH/EMD	3.6.1.3	SRV Line Supports	Pool Swell	3C7-1080-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-04-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.B.3 and Supp. 1, Sec. II.A.2 (Acceptable)	Methodology of Calculation No. 3C7-1075-001, Rev. 5 was used.

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MECH/NSLD to MECH/EMD	3.6.1.4	SRV Line Supports	Fallback	3C7-0180-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-04-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a (Acceptable)	Methodology of calculation No. 3C7-1075-001, Rev. 5 was used.
MECH/NSLD to MECH/EMD	3.6.1.5	SRV Line Supports	Condensation Oscillation	3C7-0180-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-04-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2
MECH/NSLD to MECH/EMD	3.6.1.6	SRV Line Supports	Chugging	3C7-0180-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-04-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim Chugging Load Definition.
MECH/NSLD to MECH/EMD	3.7.1.1	Quencher	LOCA Water Jet	3C7-1078-004, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1, Sec. II.C.1 (Acceptable)	
MECH/NSLD to MECH/EMD	3.7.1.2	Quencher	Charging Air Bubble	3C7-1078-004, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	
MECH/NSLD to MECH/EMD	3.7.1.4	Quencher	Condensation Oscillation	3C7-1078-004, Rev. 0 with memo from B. Obersnel to D. E. Olson dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	

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MECH/NSLD to MECH/EMD	3.7.1.5	Quencher	Chugging	3C7-1078-004, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 12-18-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim Chugging Load Definition. Bounding loads on inner/outer ring.
MECH/NSLD to MECH/EMD	3.7.3	Quencher	Uneven Air & Water Clearing	3C7-0181-004, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 05-01-81.	No interface output required; EMD performs final analysis.	NUREG-0487 does not address these loads on T-quencher.	Susquehanna DAR describes load basis.
MECH/NSLD to MECH/EMD to MECH/CQD	3.8.1.1	ECCS Suction Strainers	LOCA Water Jet	3C7-1079-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 09-30-81.	EMD Accession No. 022351 and 022025, EMD calculations number RH42, Rev. 0, dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Sec. III.D.1.a and Supp. 2, Sec. II.C.1 (Acceptable)	Loads on 8" strainer negligible and are not reported.
MECH/NSLD to MECH/EMD to MECH/CQD	3.8.1.2	ECCS Suction Strainers	Charging Air Bubble	3C7-1079-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 09-30-81 .	EMD Accession No. 022351 and 022025, EMD calculations number RH42, Rev. 0, dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	
MECH/NSLD to MECH/EMD to MECH/CQD	3.8.1.3	ECCS Suction Strainers	Pool Swell	3C7-1075-001, Rev. 6, with memo from B. Obersnel to D. E. Olson dated 09-30-81.	EMD Accession No. 022351 and 022025, EMD calculations number RH42, Rev. 0, dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Sec. III.B.3 and Supp. 1, Sec. II.A.2 (Acceptable)	

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MECH/NSLD to MECH/EMD to MECH/CQD	3.8.1.4	ECCS Suction Strainers	Fallback	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Cheboub and D. E. Olson, dated 10-09-81.	EMD Accession No. 022351 and 022025, EMD calculation numbers RH42, Rev. 0 dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Sec. III.D.2.e (Acceptable)	
MECH/NSLD to MECH/EMD to MECH/CQD	3.8.1.5	ECCS Suction Strainers	Condensation Oscillation	3C7-1079-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 09-30-81.	EMD Accession No. 022351 and 022025, EMD calculation numbers RH42, Rev. 0 dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2 Bounding loads for 8" and 24" strainers, respectively.
MECH/NSLD to MECH/EMD to MECH/CQD	3.8.1.6	ECCS Suction Strainers	Chugging	3C7-1079-002, Rev. 2, with memo from B. Obersnel to D. E. Olson, dated 09-30-81.	EMD Accession No. 022351 and 022025, EMD calculation numbers RH42, Rev. 0, dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim chugging load definition. Bounding loads for 8" and 24" strainers, respectively.
MECH/NSLD to MECH/EMD	3.9.1.1	Non-SRV Lines	LOCA Water Jet	3C7-1178-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 05-20-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1, Sec. II.C.1 (Acceptable)	Loads found negligible and are not reported.
MECH/NSLD to MECH/CQD	3.9.1.2	Non-SRV Lines	Charging Air Bubble	3C7-1178-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 05-20-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	Load on 1RI32C-2 found negligible and it is not reported.
MECH/NSLD to MECH/EMD	3.9.1.3	Non-SRV Lines	Pool Swell	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Cheboub and D. E. Olson dated 10-09-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.B.3 and Supp. 1, Sec. II.A.2 (Acceptable)	

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MECH/NSLD to MECH/EMD	3.9.1.4	Non-SRV Lines	Fallback	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Chehoub and D. E. Olson dated 10-09-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a (Acceptable)	
MECH/NSLD to MECH/EMD	3.9.1.5	Non-SRV Lines	Condensation Oscilliation	3C7-1178-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 05-20-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2 loads reported for individual lines. Load on 1RI32C-2 found negligible and it is not reported.
MECH/NSLD to MECH/EMD	3.9.1.6	Non-SRV Lines	Chugging	3C7-1178-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 05-20-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim chugging load definition. Load on 1RI32C-2 found negligible and are not reported.
MECH/NSLD to MECH/EMD	3.9.1.1	Non-SRV Line Supports	LOCA Water Jet	3C7-0880-002, Rev. 0, with memo from B. Obersnel to D. E. Olson, dated 08-18-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1, Sec. II.C.1 (Acceptable)	Loads found negligible.
MECH/NSLD to MECH/EMD	3.9.1.2	Non-SRV Line Supports	Charging Air Bubble	3C7-0880-002, Rev. 0, with memo from B. Obersnel to D. E. Olson, dated 08-18-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	

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MECH/NSLD to MECH/EMD	3.9.1.1	Non-SRV Line Support Clamps	LOCA Water Jet	3C7-0480-001, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 01-27-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.1.a and Supp. 1, Sec. II.C.1 (Acceptable)	Loads found negligible.
MECH/NSLD to MECH/EMD	3.9.1.2	Non-SRV Support Clamps	Charging Air Bubble	3C7-0480-001, Rev. 0 with memo from B. Obersnel to D. E. Olson dated 01-27-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a and Supp. 1, Sec. II.C.2 (Acceptable)	
MECH/NSLD to MECH/EMD	3.9.1.3	Non-SRV Line Supports and Clamps	Pool Swell	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Cheboub and D. E. Olson dated 10-09-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.B.3 and Supp. 1, Sec. II.A.2 (Acceptable)	
MECH/NSLD to MECH/EMD	3.9.1.4	Non-SRV Line Supports and Clamps	Fallback	3C7-1075-001, Rev. 6, with memo from B. Obersnel to R. Cheboub and D. E. Olson dated 10-09-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.2.a (Acceptable)	
MECH/NSLD to MECH/EMD	3.9.1.5	Non-SRV Line Supports	Condensation Oscillation	3C7-0880-002, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 03-18-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Trial Spec. #2
MECH/NSLD to MECH/EMD	3.9.1.6	Non-SRV Line Supports	Chugging	3C7-0880-002, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 03-18-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Sec. III.D.3 (Acceptable)	Interim chugging load definition.

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MECH/NSLD to MECH/EMD	3.9.1.5	Non-SRV Line Support Clamps	Condensation Oscillation	3C7-0480-001, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 01-27-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Section 111.D.3 (Acceptable)	Trial Spec. #2
MECH/NSLD to MECH/EMD	3.9.1.6	Non-SRV Line Support Clamps	Chugging	3C7-0480-001, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 01-27-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Section 111.D.3 (Acceptable)	Interim chugging load definition.

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MECH/NSLD to STRUCT/SES to STRUCT/SDD MECH/EMD MECH/CQD	2.3.1	Boundary	SRV All Valves	3C7-0379-001, Rev. 0, with memo from S. Yassin to R. Cheboub, dated 03-22-79.	Response Spectra (Horizontal)-Memo from B. Henley to E. R. Weaver dated 07-23-79, Response Spectra (Sym. Vertical)-Memo from B. Henley to E. R. Weaver dated 06-14-79. ATH-Memo from B. Henley to D. E. Olson dated 10-23-79. Anchor Displacements-Memo from J. Carrasco to S. D. Killian and D. E. Olson dated 11-05-79. Digitized Response Spectra (Horizontal)-Memo from B. Henley to S. D. Killian dated 07-24-79. Digitized Response Spectra (Sym. Vert.)-Memo from B. Henley to S. D. Killian dated 07-11-79.	NUREG-0487, Supplement 1, Section II.B.5 with NUREG-0519, P. 6-20 for frequency range (Acceptable)	KWU Report R14-25/1978, Rev. 1

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STRUCT/SES to STRUCT/SPE to GE	2.3.1	Boundary	SRV All Valves	Memo from R. Cheboub/ G. Ehlert to E.R.Weaver, dated 02-20-80	ATH (Vertical)- Letter from E. R. Weaver to H. R. Peffer, dated 02-26-80.	NUREG-0487, Supplement 1, Section 11.B.5 with NUREG-0519, p.6-20 for frequency range. (Acceptable)	
Identical to SRV-all Valves Case	2.3.2	Boundary	SRV ADS	Identical to SRV-all valves case.	Idential to SRV-all valves case.		Identical to SRV-all valves case.
MECH/NSLD to STRUCT/SES to STRUCT/SDD MECH/EMD MECH/CQD	2.3.3	Boundary	SRV single valve	3C7-0379-001, Rev. 1 with memo from S. Yassin to R. Cheboub, dated 03-22-79.	Response Spectra-Memo from B. Henley to E. R. Weaver, dated 06-20-79. ATH-Memo from B. Henley to D. E. Olson, dated 10-23-79. Anchor Displacements-Memo from J. Carrasco to S. D. Killian and D. E. Olson dated 11-05-79. Digitized Response Spectra-Memo from B. Henley to S. D. Killian, dated 07-12-79.	NUREG-0487, Supplement 1, Section 11.B.5 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Reported are KWU loads for single valve first actuation case, which bounds single valve subsequent actuation case. KWU Report R14-25/1978, Rev. 1

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STRUCT/SES to STRUCT/SPE to GE	2.3.3	Boundary	SRV single valve-	ATH (Vertical)-Memo from R. Cheboub/ G. Ehlert to E.R.Weaver, dated 02-22-80. ATH (Horizontal)-Memo from B. Henley to E.R.Weaver, dated 04-16-80	ATH (Vertical)-letter from E. R. Weaver to H. R. Peffer dated 02-26-80. ATH (Horizontal)-letter from E. R. We- er to H. R. Peffer dated 04-18-80.	NUREG-0487, Supplement 1, Section 11.B.5 with NUREG-0519, p. 6-20 for frequency range.(Acceptable)	KWU Report R14-25/1978,Rev. 1
MECH/NSLD to STRUCT/SES to STRUCT/SDD MECH/EMD MECH/CQD	2.3.4	Boundary	SRV Asymmetric	3C7-0379-001, Rev. 0, with memo from S. Yassin to R. Cheboub dated 03-22-79.	Response Spectra-Memo from B. Henley to E. R. Weaver, dated 06-19-79. Digitized Response Spectra-Memo from B. Henley to S. D. Killian, dated 07-12-79. ATH-Memo from B. Henley to D. E. Olson, dated 10-23-79. Anchor Displacements-Memo from J. Carrasco to S. D. Killian, dated 11-05-79.	NUREG-0487, Supplement 1, Section 11.B.5 with NUREG-0519, p. 6-20 for frequency range.(Acceptable)	KWU Report R14-25/1978,Rev. 1
STRUCT/SES to STRUCT/SPE to GE	2.3.4	Boundary	SRV Asymmetric	ATH (Horizontal)-Memo from B. Henley to E.R.Weaver, dated 04-16-80 ATH (Vertical)-Memo from R. Cheboub/ G.Ehlert to E.R.Weaver, dated 02-22-80	ATH (Horizontal)-letter from E.R.Weaver to H.R. Peffer dated 04-18-80 ATH (Vertical)-letter from E.R.Weaver to H.R. Peffer, dated 02-26-80	NUREG-0487, Supplement 1, Section 11.B.5 with NUREG-0519, p. 6-20 for frequency range.(Acceptable)	KWU Report R14-25/1978,Rev. 1

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SRV/LOCA HYDRODYNAMIC LOADS REVISED
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DATE 10-01-81

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MECH/NSLD to STRUCT/SES	3.3.2.1	Support Column	SRV-all Valves	3C7-0278-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 06-12-81; and corrections with memo from B. Obersnel to R. Cheboub dated 07-08-81.	No interface output required; SES performs final analysis.	NUREG-0487, Supplement 1, Section II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Resonant sequential symmetric discharge bounding load to be applied to all columns.
MECH/NSLD to STRUCT/SES	3.3.2.2	Support Column	Single Valve Subsequent Actuation	3C7-0278-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 06-12-81; and corrections with memo from B. Obersnel to R. Cheboub dated 07-08-81.	No interface output required; SES performs final analysis.	NUREG-0487, Supplement 1, Section II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Discharge through "low-low" setpoint valves. Load applicability limited to the columns near the low-low setpoint valves.
MECH/NSLD to STRUCT/SES to MECH/EMD	3.4.2.1	Downcomer	SRV-all Valves	3C7-0181-002, Rev. 1, with memo from B. Obersnel to R. Cheboub, dated 08-13-81.	Memo from B. Henley to D. E. Olson, dated 06-26-80. (Input for fatigue analysis)	NUREG-0487, Supplement 1, Section II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Resonant sequential symmetric discharge load time histories for individual downcomers of the two sectors, based on X-Quencher load definition. Load reduction factor converting load base to KWU load definition is provided.

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MECH/NSLD to STRUCT/SES to MECH/EMD	3.4.2.2	Downcomer	Single Valve Subsequent Actuation	3C7-0181-002, Rev. 1, with memo from B. Obersnel to R. Cheboub, dated 08-13-81.	Memo from B. Henley to D. E. Olson dated 06-26-80. (Input for fatigue analysis)	NUREG-0487, Supplement 1, Section 11.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Each valve within the two sectors treated as a low-low setpoint valve. Load time histories, based on X-Quencher load definition, are calculated for individual downcomers of the two sectors. Load reduction factor converting load base to KWU load definition is provided.
MECH/NSLD to STRUCT/SES	3.5.2.1	Downcomer Bracing and Gusset Plates	SRV All Valves	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required; SES performs final analysis.	NUREG-0487, Supplement 1, Section 11.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Resonant sequential symmetric discharge max. loads on the inboard and outboard bracing pipes and gusset plates. Load reduction factor converting load base to KWU load definition is provided.
MECH/NSLD to STRUCT/SES	3.5.2.2	Downcomer Bracing and Gusset Plates	Single Valve Subsequent Actuation	3C7-1179-002, Rev. 2, with memo from B. Obersnel to R. Cheboub dated 08-14-81.	No interface output required; SES performs final analysis.	NUREG-0487, Supplement 1, Section 11.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Low-low setpoint valve discharge max. loads on the inboard and outboard bracing pipes and gusset plates. Loads are based on X-Quencher load definition. Load reduction factor converting base to KWU load definition is provided.
MECH/NSLD to MECH/EMD	3.6.2.1	SRV Lines	SRV All Valves	3C7-0979-001, Rev 0, with memo from B. Obersnel to D. E. Olson dated 12-23-80.	No interface output required; SES performs final analysis.	NUREG-0487, Supplement 1, Section 11.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Resonant sequential symmetric discharge bounding resultant load, for inner and outer ring, respectively.

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MECH/NSLD to MECH/EMD	3.6.2.2	SRV Lines	Single Valve Subsequent Actuation	3C7-0979-001, Rev. 0 with memo from B. Obersnel to D. E. Olson, dated 12-23-80.	No interface output required; SES performs final analysis.	NUREG-0487, Supp. 1. Sec. II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Low-low setpoint valve discharge bounding component load for inner and outer ring, respectively.
MECH/NSLD to MECH/EMD	3.7.2.1	Quencher	SRV all valves	3C7-0979-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 02-24-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1, Sec. II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Resonant sequential symmetric dischage.
MECH/NSLD to MECH/EMD	3.7.2.2	Quencher	Single valve subsequent actuation	3C7-0979-001, Rev. 1, with memo from B. Obersnel to D. E. Olson dated 02-24-80.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1 Sec.II.C.2 with NUREG-0519, p. 6-20 for frequency range (Acceptable)	Low-low setpoint valve discharge.
MECH/NSLD to MECH/EMD to MECH/CQD	3.8.2.1	ECCS suction strainers	SRV all valves	3C7-1079-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 09-30-81.	EMD Accession Numbers 022351 and 022025; EMD calculation numbers RH42, Rev. 0, dated 11-07-80 and RI69, Rev. 0, dated 11-07-80.	NUREG-0487, Supp. 1 Sec. II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Resonant sequential symmetric discharge.
MECH/NSLD to MECH/EMD	3.7.3	Quencher	Uneven air and water clearing	3C7-0181-004, Rev. 1, with memo from B. Obersnel to D. E. Olson, dated 05-01-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1 Sec. II.C.2 with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	

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MECH/NSLD to MECH/EMD to MECH/CQD	3.8.2.2	ECCS suction strainers	Single valve subsequent actuation	3C7-1079-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 09-30-81	EMD Accession Numbers 022351 and 022025; EMD calculation numbers RH42, Rev. 0, dated 11-07-80 and RI69, Rev. 0, dated 11-07-80	NUREG-0487, Supplement 1, Section II.C.2 with NUREG-0519, p. 6-20 for frequency range.	Loads found to bound by all valve case and are not reported.

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MECH/NSLD to MECH/EMD	3.9.2.1	Non-SRV Line	SRV All Valves	3C7-1178-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 05-20-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1, Sec. II.C.2, with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	Loads on individual lines. Load on 1RI32C-2 found negligible and it is not reported.
MECH/NSLD to MECH/EMD	3.9.2.2	Non-SRV Line	Single valve subsequent actuation	3C7-1178-002, Rev. 2, with memo from B. Obersnel to D. E. Olson dated 05-20-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1 Sec. II.C.2, with NUREG-0519, p. 6-20 for frequency range. (Acceptable)	
MECH/NSLD to MECH/EMD	3.9.2.1	Non-SRV Line Supports	SRV All Valves	3C7-0880-002, Rev. 0, with memo from B. Obersnel t D. E. Olson dated 03-18-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1 Sec. II.C.2, with NUREG-0159, p. 6-20 for frequency range. (Acceptable)	RSSD peak loads on individual support pipe.
MECH/NSLD to MECH/EMD	3.9.2.2	Non-SRV Line Supports	Single valve subsequent actuation	3C7-0880-002, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 03-18-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supp. 1 Sec. II.C.2, with NUREG-0159, p. 6-20 for frequency range. (Acceptable)	Peak loads on individual support pipe.

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MECH/NSLD to MECH/EMD	3.9.2.1	Non-SRV Line Support Clamp	SRV All Valves	3C7-0480-001, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 01-27-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supplement 1, Section II.C.2, with NUREG 0519, p.6-20 for frequency range. (Acceptable)	RSSD peak loads on individual support pipe.
MECH/NSLD to MECH/EMD	3.9.2.2	Non-SRV Line Support Clamp	Single valve subsequent actuation	3C7-0480-001, Rev. 0, with memo from B. Obersnel to D. E. Olson dated 01-27-81.	No interface output required; EMD performs final analysis.	NUREG-0487, Supplement 1, Section II.C.2. with NUREG 0519, p.6-20 for frequency range. (Acceptable)	Peak loads on individual support pipe.

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MECH/NSLD to STRUCT/SES to MECH/EMD STRUCT/SDD MECH/CQD	2.5.1.2	Sacrificial Shield Wall	Annulus Press.- Pressure to Recirc. pump suction line break.	3C7-0477-003, Rev. 1, memo from S. Yassin to R. Cheboub dated 10-23-79.	Original Shell Model Response Spectra-Memo dated 01-16-80 from B. Henley to S. M. Kazmi, et.al. ATH and Displacement T-H-Memo from B. Henley to S. D. Killian, et.al., dated 02-14-80. Digitized Response Spectra-Memo dated 02-14-80 from B. Henley to S. D. Killian.	Not Applicable	
					Modified Shell Model Response Spectra, ATH, Displacement T-H and Digitized Data-Memo from H. Kosherick to C. Podczerwinski, dated 12-23-80.		Overall shield response corresponding to a "stick" model is approximated by the cosine one theta component of the annulus pressurization loads at break locations per memo from B. A. Erler to E. B. Branch, dated 11-20-80. Response spectra and time histories are generated in accordance with the requirements specified in the 11-25-80 memo from C. Podczerwinski to R. Cheboub.

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MECH/NSLD to STRUCT/SES to MECH/EMD STRUCT/SDD MECH/CQD	2.5.1.2	Sacrificial Shield Wall	Annulus Pressurization-Pressure due to feedwater line break.	3C7-0477-004, Rev. 1, with memo from S. Yassin to R. Cheboub dated 10-19-79.	Original Shell Model Response Spectra-Memo dated 01-11-80 from B. Henley to S. M. Kazmi, et.al. All other references same as recirc break on page A-22.	Not Applicable	
MECH/NSLD to MECH/PMD to GE	2.5.1.2	Sacrificial Shield Wall	Annulus Pressurization-Pressure due to recirc. and feedwater line breaks.	3C7-0477-002, Rev. 0, dated 04-27-77.	Letter from G. C. Jones to B. R. Peffer, dated 05-09-77.		

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