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# LASALLE COUNTY STATION UNIT 2 NSSS NEW LOADS DESIGN ADEQUACY EVALUATION FINAL SUMMARY REPORT

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# UNIT 2
# NSSS NEW LOADS DESIGN ADEQUACY EVALUATION
# FINAL SUMMARY REPORT

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## DISCLAIMER OF RESPONSIBILITY

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## SUMMARY

This report presents a summary of the results of the NSSS New Loads Design Adequacy Evaluation performed for the Commonwealth Edison Company on LaSalle County Station Unit 2 by the General Electric Company. The evaluation was performed to demonstrate that the GE supplied NSSS safety-related equipment design capability retained positive margins when subjected to combinations of seismic and additional hydrodynamic loadings from site unique reactor building structural responses.

The results of the NSSS New Loads Design Adequacy Evaluation for LaSalle Unit 2 have demonstrated equipment adequacy for all evaluation basis new load combinations. The major scope of the NSSS equipment evaluated includes the Reactor Pressure Vessel (RPV), RPV internals and supports, in-vessel safety-related instrumentation, and the Main Steam and Recirculation piping systems.

Contained in this report are brief explanations of the scope, methods and results of the evaluations performed. Comparisons of tested or calculated values versus the allowable load or stress values, for the limiting load combinations at the limiting stress points, are shown for each component or piping system.

# 1. INTRODUCTION

An NSSS New Loads Design Adequacy Evaluation (NLDAE) was performed for the LaSalle project. The evaluation was conducted to assess the design adequacy of essential NSSS equipment when subjected to various dynamic loads and load combinations. These dynamic loads result from seismic events and/or hydrodynamic-related phenomena (new loads). Combinations of loads from various events were evaluated against the appropriate acceptance criteria conditions (e.g., normal, upset, emergency, faulted) based upon the expected occurrence frequency for the particular event combination.

Throughout this summary report, comparisons are made between the calculated "New Loads" and the "Design Basis" loads in order to demonstrate the equipment design adequacy. In order to clarify the usage of these terms, the following amplification is provided.

The design basis loads include the seismic, pressure, thermal, dead weight and other normal/abnormal loads to which the GE-supplied Nuclear Steam Supply System (NSSS) equipment was originally designed to function. In addition, the design basis loads include a bounding load margin which encompasses other site-unique load requirements to facilitate multiplant equipment usage.

For the New Loads Adequacy Evaluation, the loads calculated include not only the design basis loads, but also the LaSalle site-unique suppression pool hydrodynamic and annulus pressurization structural system response loads. These loads were initially compared to the Design Basis in order to demonstrate the new loads design adequacy.

## 1.1 EQUIPMENT EVALUATED

Major equipment groups evaluated include the reactor pressure vessel, RPV internals and supports, in-vessel safety-related instrumentation, and the main steam and recirculation piping systems. The scope of the evaluation extends only to that GE-supplied NSSS safety-related equipment within the reactor building. An itemized list of the equipment evaluated appears in Table 1-1. The scope of the evaluation performed did not include GE-supplied floor-supported plant equipment nor equipment connected to and supported by piping supplied by others. The responsibility for the evaluation of this hardware lies within Commonwealth Edison Company or their agent.

## 1.2 EVALUATION METHODOLOGY

General Electric, in cooperation with Sargent & Lundy Engineers, evaluated the nuclear steam supply system (NSSS) equipment design adequacy for the original design basis loads in combination with the suppression pool hydrodynamic and annulus pressurization structural system response loads. The load combinations and acceptance criteria used for this evaluation are described in Section 1.3 of this summary report.

The structural system responses for the suppression pool hydrodynamic phenomena were generated by Sargent & Lundy Engineers (S&L). These structural system responses were transmitted to General Electric in the form of (1) response spectra and (2) acceleration time-histories at the pedestal to diaphragm floor intersection and shield wall at the stabilizer elevation.

The response spectra for piping attachment points on the reactor pressure vessel, shield wall, and pedestal complex (above the pool area) were generated by General Electric based on the acceleration time-histories supplied by S&L using a detailed lumped mass beam model for the reactor pressure vessel and internals, to include a representation of the structure (see Figures 1-1 and 1-2 for SRV and LOCA examples). For the evaluation of the NSSS primary piping systems (main steam and recirculation), a combination of the General Electric response spectra and S&L developed response spectra (on the containment wall) was used to obtain the input responses for all attachment points of each piping system.

The acceleration time-histories, with the detailed reactor pressure vessel and structure lumped mass beam model, were used to generate the forces, moments and response spectra acting on the reactor pressure vessel (RPV). These forces, moments and response spectra were used by General Electric for the adequacy evaluation of the RPV, RPV supports and RPV internal components. The forces and moments were compared with the design values as the initial step in the adequacy evaluation.

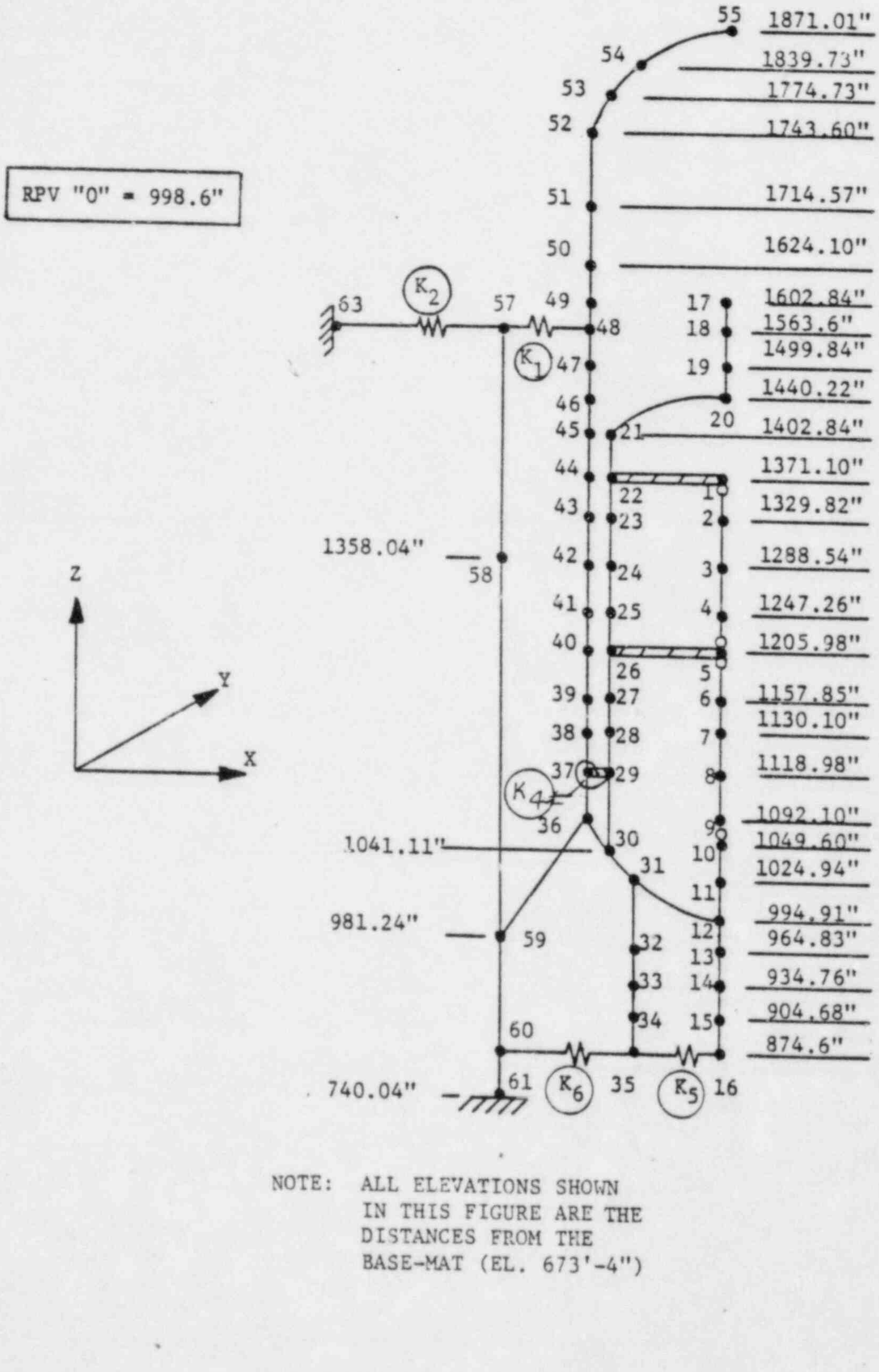
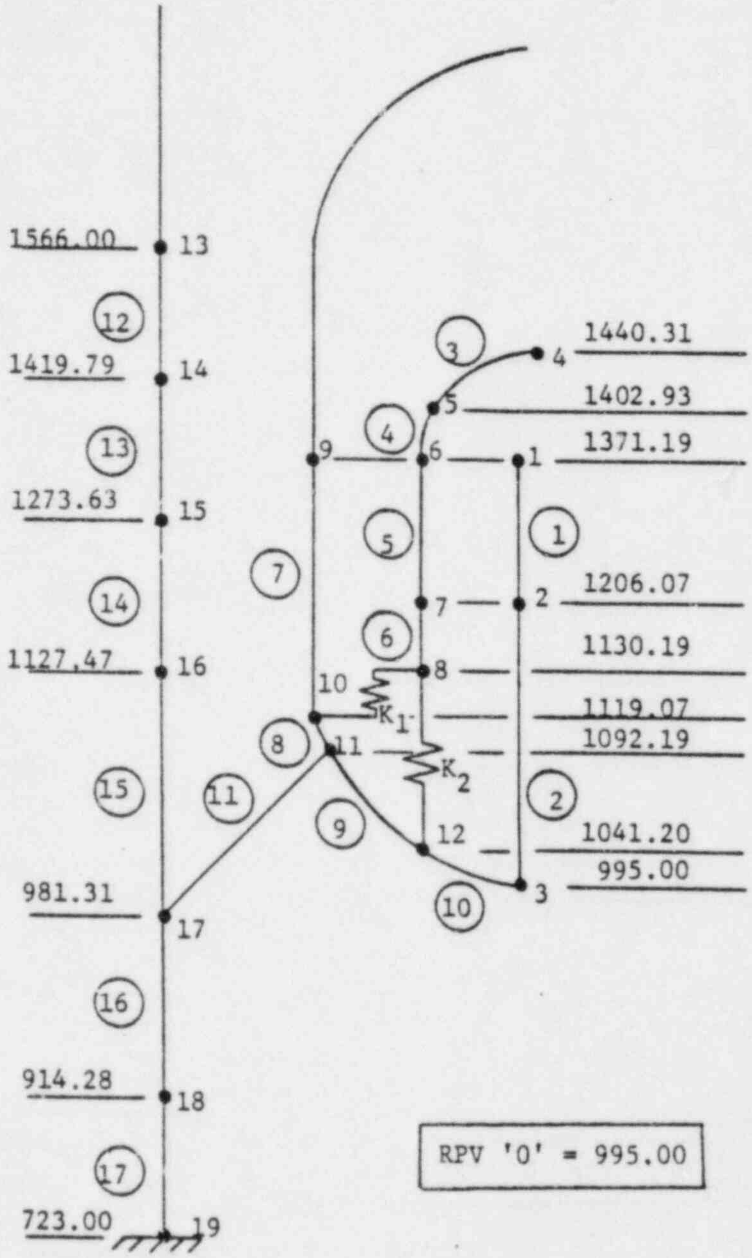



Figure 1-1. Horizontal SRV Model




NOTE: ALL ELEVATIONS SHOWN IN THIS FIGURE ARE THE DISTANCES FROM THE BASE-MAT (EL. 673'-4")

Figure 1-2. Vertical SRV Model

The structural system responses for the Loss of Coolant Accident (LOCA), annulus pressurization (AP) transient asymmetric pressure buildup in the annular region between the biological shield wall and the reactor pressure vessel, were based on pressure time-histories supplied by S&L. These pressure time-histories were combined with jet reaction, jet impingement and pipe whip restraint loads for the evaluation. A time-history analysis output produced accelerations, forces and moment time-histories as well as response spectra at the piping attachment points on the reactor pressure vessel, shield wall, pedestal, pressure vessel supports and external components.

## 1.3 LOADING COMBINATIONS AND ACCEPTANCE CRITERIA

All significant loads were considered, including the original design basis loads, the structural response loads due to suppression pool related phenomena and the dynamic effects on an instantaneous pipe break at the RPV safe end (AP). The load combinations considered as the evaluation basis are listed in Table 1-2. As an evaluation basis, all dynamic loads were combined using the Square Root of the Sum of the Squares (SRSS) method with the results added to the static loads. In addition to the design basis load combinations, more conservative load combinations were considered in the evaluation basis. Specifically, the "OBE + SRV" loads were evaluated against upset criteria (as opposed to emergency criteria, which form the design basis for this load combination). Also, some evaluations were performed combining loads by the absolute sum (ABS) method.

As a supplement to ASME code faulted limits, the NRC has imposed additional criteria to assure the functional capability of piping systems to perform their intended safety function under the stress criteria of limited plastic deformation. Functional capability has been defined by the NRC as the ability of a piping system to deliver rated flow for continued shutdown cooling and heat removal.

The General Electric approach for demonstrating essential reactor component functional capability was to use ASME Service Level D stress criteria and a supplemental evaluation per the deformation and buckling limits of the General Electric Design Safety Standards. The Service Level D stress criteria were used to assure adequate strength and tensile load capability with adequate margin to failure through rupture or collapse. For components where deformation or buckling could have been of concern, special evaluations were performed to assure that adequate margin exists for: (1) the buckling collapse loads defined consistent with ASME Code criteria, and (2) the deformation limits which analysis or tests demonstrate would not result in loss of function. Similar to ASME Code criteria, different safety criteria were applied for upset, emergency and faulted deformation evaluations. The only NSSS pipe-like components that require functional capability are the core spray lines, spargers and the LPCI couplings.

RPV internal pipe-like components are confined by the reactor vessel and shroud, and their displacement is limited to the displacement of the shroud relative to the vessel. These motions are accommodated by the free travel of the ball joints in the LPCI Coupling and the flexing of the core spray lines. No core spray line collapse is possible as a result of these small displacements. Additionally, an analysis of the reactor internal piping components remaining functional during the worst faulted event loads was made to the Rodebaugh criteria. This analysis was performed to provide confirmation within General Electric that the methodology was indeed adequate to demonstrate functional capability. Although they are not required for shutdown cooling and heat removal, the Main Steam and Recirculation piping external to the vessel was also evaluated to assure functional capability, per NEDO-21985, Piping Functional Capability Criteria.

## 1.4 EVALUATION RESULTS

New Loads Design Adequacy Evaluations were performed for all loading combinations for the RPV, RPV internals and associated equipment, in-vessel safety-related instrumentation and the Main Steam and Recirculation piping and pipe-mounted equipment. The NLDAE also included the more conservative evaluation basis combinations and acceptance criteria.

In some cases, the initial analysis did not prove equipment adequacy. For these components, more detailed analyses were performed. In most cases these reanalyses succeeeded in demonstrating the equipment adequacy. The reanalysis, including the required modification, demonstrated the equipment adequacy under all applied loading conditions. In some cases, modifications were made to original designs to ensure that adequate margins were available; yet, these modifications were not directly required as a result of the LaSalle 2 New Loads evaluations performed.

## 1.5 SCOPE, INTERFACE AND EVALUATION HIGHLIGHTS

Information concerning the general evaluation scope, specific analyses performed and interface items of significance are provided below:

- Overview
  The LaSalle Unit 1 NSSS New Loads Design Adequacy Evaluation evolved through numerous phases due to past uncertainties in defining the loads resulting from specific hydrodynamic events. The results summarized in the LaSalle 1 report (NEDO-22133) follow this evolutionary load definition process by representing a compilation of design adequacy evaluations performed in the late 1970's and focusing mainly in 1980, 1981 and 1982. See NEDO-22133 for further history summaries. In total, the summary of the NSSS piping and equipment evaluations contained in this report reflect the incorporation of the progression of input loads as transmitted to General Electric and the analytical techniques improvement.

- CRD System Insert and Withdrawal Piping Loads on CRD Housings
  Due to the loads applied by the clamping of the Control Rod Drive insert and withdrawal lines onto GE-supplied CRD Housings, an additional analysis effort was required. The analysis on the CRD Housings was performed with the S&L transmitted loads in conjunction with the static and dynamic loads considered for the LaSalle 2 new loads analysis. The adequacy of the CRD housings was analytically demonstrated when considering all the loads applied.

- General Analyses of Other Safety-Related NSSS Equipment and Components

  The equipment and component analyses summarized in this report represent a specific scope of evaluation effort as required due to the magnitude of the LaSalle site-unique loads and/or the design margins available in the equipment procured. Due to the multiplant applicability of a specific amount of GE-supplied equipment and components, generic analyses were performed to verify the design adequacy of other passive and active safety-related items not described in this summary report. These generic analyses demonstrated the equipment or component design adequacy by either:

  (1) evaluating for conservative bounding input loads;

  (2) determining that the equipment was not subjected to non-seismic dynamic loads when performing its essential function; or

  (3) by demonstrating that capability is proven to far exceed load requirements.

  Appendix B lists that equipment and those components applicable to the LaSalle project for which generic analyses demonstrated design adequacy.

- Fuel Lift Analysis

  At the request of Commonwealth Edison Company, a summary of the Fuel Lift Analysis model, methodology and generic results was included in NEDO-21175-3-P. For this evaluation, the fuel assemblies evaluation, as well as other reactor pressure vessel component evaluations, used the Plant unique fuel lift analysis output load results along with other dynami loads as input loadings to demonstrate the component's design adequacy.

Table 1-1

NSSS PIPING AND EQUIPMENT EVALUATION

o Reactor Pressure Vessel System

| | |
|---|---|
| B13-D003 | Reactor Vessel |
| - | RPV Support Skirt |
| - | RPV Shroud Support |
| - | CRD Penetrations |
| - | In-Core Housing Penetrations |
| - | Steam Dryer Brackets |
| - | RPV Stabilizer Brackets |
| - | RPV Nozzles |
| B13-D005 | Steam Dryer |
| B13-D006 | Jet Pumps |
| B13-D007 | Jet Pumps |
| B13-D008 | Control Rod Drives |
| B13-D010 | Control Rod Guide Tubes |
| B13-D012 | Control Rod Drive Housings |
| B13-D013 | Control Rod Drive Housing |
| B13-D014 | Control Rod Drive Housing |
| B13-D015 | Control Rod Drive Housing |
| B13-D016 | In-Core Housings |
| B13-D017 | In-Core Guide Tubes |
| B13-D018 | Shroud Head Bolts |
| B13-D021 | Differential Pressure and Liquid Control Line |
| B13-D022 | LPCI Couplings |
| B13-D023 | Core Spray Line |
| B13-D024 | Core Spray Line |
| B13-D026 | Jet Pump Riser Braces |
| B13-D027 | Jet Pump Adapters |
| B13-D030 | Orificed Fuel Supports |
| B13-D031 | Orificed Fuel Supports |
| B13-D032 | Orificed Fuel Supports |
| B13-D033 | Orificed Fuel Supports |
| B13-D034 | Orificed Fuel Supports |
| B13-D035 | Orificed Fuel Supports |
| B13-D036 | Orificed Fuel Supports |

Table 1-1 (Continued)

| | |
|---|---|
| B13-D037 | Orificed Fuel Supports |
| B13-D038 | Orificed Fuel Supports |
| B13-D041 | Clamps |
| B13-D053 | Hexagon Head Bolts |
| B13-D068 | Core Support Bolts |
| B13-D071 | Core Support |
| B13-D074 | Top Guide |
| B13-D118 | Core Spray Sparger |
| B13-D189 | Flanges |
| B13-D191 | Dry Tubes |
| B13-D193 | Power Range Detectors |
| B13-D212 | Seismic Pins |
| B13-D237 | Core Spray Line Bracket |
| B13-D277 | Holddown Clamps |
| B13-U001 | Reactor Vessel Supports |
| B13-U002 | RPV STabilizers |
| B13-U007 | CRD Housing Restraint Beam |
| J11-D001 | Fuel Bundles |
| J11-D002 | Fuel Bundles |
| J11-D003 | Channels |
| J11-D004 | Channel Fasteners |
| J11-D005 | Fuel Bundles |

o NSSS Piping Systems

| | |
|---|---|
| B21-G001 | Main Steam Piping |
| B21-G002 | Main Steam Pipe Suspension |
| B21-G006 | Main Steam Pipe Suspension |
| B21-F013 | Main Steam Safety/Relief Valves (SRV) |
| B21-F022 | Main Steam Isolation Valves (MSIV) |
| B21-F028 | Main Steam Isolation Valves (MSIV) |
| B33-G001 | Recirculation Loop Piping |
| B33-G002 | Recirculation Loop Suspension |
| B33-G003 | Recirculation Loop Piping Restraints |
| B33-G006 | Recirculation Loop Suspension |
| B33-F023 | Recirculation Gate Valves |

Table 1-1 (Continued)

| | |
|---|---|
| B33-F060 | Recirculation Flow Control Valves |
| B33-F067 | Recirculation Gate Valves |
| E33-C001 | Recirculation Pumps and Motors |

Table 1-2

LOAD COMBINATIONS AND ACCEPTANCE CRITERIA FOR NSSS PIPING AND EQUIPMENT

| Load Case(1) | N | $SRV_X$ (4) | $SRV_{ADS}$ | OBE | SSE | SBA/IBA (3) | DBA (6,7) | Acceptance Criteria |
|---|---|---|---|---|---|---|---|---|
| 1 | X | X | | | | | | Upset B |
| 2 | X | X | | X | | | | Upset B (5) |
| 3 | X | X | | | X | | | Faulted D (2) |
| 4 | X | | X | | | X | | Emergency C (2) |
| 5 | X | | X | X | | X | | Faulted D (2) |
| 6 | X | | X | | X | X | | Faulted D (2) |
| 7 | X | | | | X | | X | Faulted D (2) |
| 8 | X | | | | | | | Normal A |
| 9 | X | | | X | | | | Upset B |

Notes:

(1) See legend at the end of table for definition of terms.

(2) (a) For essential piping systems, faulted allowables are acceptable if functional capability is demonstrated. Essential systems are systems required to mitigate the consequences of the postulated events which cause the loading conditions.

(b) For the reactor vessel and internals, faulted allowables will be used; however, deformation and buckling will be evaluated.

(3) SBA or IBA, whichever is greater.

(4) $SRV_1$, $SRV_2$, $SRV_{LSPA}$, $SRV_{ALL}$ (whichever is controlling) will be used.

(5) Not considered in the fatigue evaluation.

(6) DBA includes $LOCA_1$ through $LOCA_7$.

(7) From rated power initial conditions.

LOAD DEFINITION LEGEND

Normal (N) - Normal and/or abnormal loads depending on acceptance criteria

OBE - Operational basis earthquake loads.

SSE - Safe Shutdown earthquake loads.

$SRV_1$ - Safety/relief valve discharge induced loads from a single valve, second actuation.

Table 1-2 (Continued)

$SRV_2$ - Safety/relief valve discharge induced loads from two adjacent valves. SRV asymmetric loads.

$SRV_{ALL}$ - The loads induced by actuation of all safety/relief valves which activate within milliseconds of each other (e.g., turbine trip operational transient). Envelope of SRV Symmetric and Asymmetric loads.

$SRV_{ADS}$ - The loads induced by the actuation of safety/relief valves associated with Automatic Depressurization System which actuate within milliseconds of each other during the postulated small or intermediate size pipe rupture. Envelope of SRV Symmetric and Asymmetric loads.

$SRV_{LSPA}$ - Safety/relief valve discharge induced loads from Low Setpoint Actuation.

LOCA - The loss-of-coolant accident associated with the postulated pipe rupture of large pipes (e.g., main steam, feedwater, recirculation piping).

$LOCA_1$ - Pool swell drag/fallout loads on piping and components located between the main vent discharge outlet and the suppression pool water upper surface.

$LOCA_2$ - Pool swell impact loads on piping and components located above the suppression pool water upper surface.

$LOCA_3$ - Oscillating pressure-induced loads on submerged piping and components during condensation oscillations.

$LOCA_4$ - Building motion induced loads from chugging.

$LOCA_5$ - Building motion induced loads from main vent air clearing.

$LOCA_6$ - Vertical and horizontal loads on main vent piping.

$LOCA_7$ - Annulus pressurization loads.

SBA - The abnormal transients associated with a Small Break Accident.

IBA - The abnormal transients associated with an Intermediate Break Accident.

# 2. REACTOR PRESSURE VESSEL SYSTEM EVALUATION

## 2.1 EQUIPMENT EVALUATED

A design adequacy evaluation was performed for the LaSalle Unit 2 reactor pressure vessel system. The following components were evaluated:

Reactor Pressure Vessel
RPV Internal Components
RPV Support Components

## 2.2 LOAD COMBINATIONS AND ANALYSIS METHOD

The dynamic loads used to perform the evaluation were selected from the load combinations listed in Table 2-1. These combinations were derived from the load combinations described in Section 1.3 and Table 1-2 to more clearly describe the normal and abnormal pressure differences that coincide with the postulated events. Conservative methods were frequently used in the evaluation in order to simplify or reduce the required analysis effort. For example, in some cases the absolute sum value of the highest load case was compared to the original design load. This highly conservative procedure was used as a means of eliminating the need to assess SRSS loads and nongoverning load combinations and should not be construed as a requirement.

The suppression pool dynamic loads, annulus pressurization, and seismic events impart loads on the containment structures and accelerations on the reactor building equipment. The accelerations on the equipment were based on structural system response data developed using a composite soil-structure interaction model with a representation of the reactor pressure vessel. The resulting acceleration time-histories were used for a local system analysis.

The local system analysis was based on a composite lumped mass model of the pedestal, shield wall and a detailed representation of the reactor pressure vessel complex. The excitation inputs for the local system analysis were based on acceleration time-histories for the suppression pool hydrodynamic

Table 2-1

REACTOR SYSTEM DETAILED LOAD COMBINATIONS

REQUIRED LOAD COMBINATIONS:

| Condition | Loads |
|---|---|
| Upset | NL + (N-DELTA P) + OBE |
| Upset | NL + (U-DELTA P) + SRV$_{(ALL)}$ |
| Upset | NL + (U-DELTA P) + OBE + SRV$_{(ALL)}$ |
| Emergency | NL + (U-DELTA P) + CHG + SRV$_{(ADS)}$ |
| Faulted | NL + (A-DELTA P) + JR + VC + SSE |
| Faulted | NL + (A-DELTA P) + JR + AP + SSE |
| Faulted | NL + (A-DELTA P) + CHG + SRV$_{(ADS)}$ + SSE |
| Faulted | NL + (A-DELTA P) + $CO_1$ + SRV$_{LSPA)}$ + SSE |
| Faulted | NL + (A-DELTA P) + $CO_2$ + SRV$_{(ADS)}$ + SEE |
| Faulted | NL + (U-DELTA P) + AC + SSE |
| Faulted | NL + (A-DELTA P) + JR + SCRAM + SSE |
| Faulted | NL + (U-DELTA P) + SRV$_{(ALL)}$ + SSE |
| Faulted | NL + (I-DELTA P) + JR + AP |
| Faulted | NL + (I-DELTA P) + JR + VC |

STEAM DRYER LOAD COMBINATIONS:

| Condition | Loads |
|---|---|
| Faulted | NL + (A-DELTA P) + SSE |
| Faulted | NL + (I-DELTA P) |

Table 2-1

REACTOR SYSTEM DETAILED LOAD COMBINATIONS (Continued)

DEFINITIONS:

NL - Metal + Water Weight

OBE - Operating Basis Earthquake

SSE - Safe Shutdown Earthquake

CHG - Chugging Loads

$SRV_{(ALL)}$ - Safety/Relief Valve Discharge Caused Loads Induced by the Actuation of All Safety Relief Valves. Envelope of Symmetric and Asymmetric loads.

$SRV_{(ADS)}$ - Safety/Relief Valve Loads Associated with the Automatic Depressurization System. Envelope of Symmetric and Asymmetric loads.

N-DELTA P - Normal Delta Pressure Force

A-DELTA P - Accident LOCA Delta Pressure Force

U-LELTA P - Upset Delta Pressure Force

I-DELTA P - Interlock Delta Pressure Force

$CO_1$ - High Mass Flux Condensation Oscillation Loads

$CO_2$ - Low Mass Flux Condensation Oscillation Loads

$SRV_{(LSPA)}$ - Actuation of Lowest Setpoint Group of Valves. Factor of Symmetric, Single SRV loads.

JR - Jet Reaction

AP - Annulus Pressurization Loads

AC - Acoustic Pressure Loads

VC - Vent Clearing Loads

SCRAM - Loads Produced by the Sudden Shutdown of a Nuclear Reactor as a Result of the Rapid Insertion of the Control Rods forcing functions, seismic vibratory motions, and pressure time-histories from annulus pressurization due to postulated pipe breaks.

The acceleration time-histories with the detailed reactor pressure vessel and pedestal shield wall structural lumped mass model were used to generate the forces and moments acting on the reactor pressure vessel, supports, and internal components. The calculated forces and moments were used to perform the adequacy evaluation of the reactor pressure vessel and associated equipment. As a first step in the evaluation, these forces and moments were compared with the design values. In cases where the newly calculated load was found to be less than the original design basis load, the equipment design adequacy for primary stresses was assured and further stress evaluation was unnecessary. If the calculated loads exceeded the design basis loads, a stress analysis was performed. The resulting stresses were then compared with the stress allowables to determine design adequacy. Stress categories are listed in Table 2-2.

A fatigue evaluation of the RPV, RPV internals and supports was also conducted for SRV cyclic duty loads. The equipment requiring fatigue evaluations was analyzed for the fatigue usage due to SRV load cycles based upon the loading during SRV events. The fatigue usage factor is the ratio of the number of SRV load cycles to the number of allowable cycles, and the total cumulative usage factor is the sum of all usages calculated for all upset events. The duty cycle basis for this evaluation is described in Table 2-3. Conservatively, seven stress cycles per SRV actuation were considered for the reactor pressure vessel evaluation.

## 2.3 EVALUATION RESULTS

### 2.3.1 Reactor Pressure Vessel (RPV)

The RPV components discussed in this section are those which are attached to the pressure vessel. They are:

RPV Shroud Support
RPV Support Skirt

Table 2-2

STRESS CATEGORIES

P = Primary

Q = Secondary

$P_M$ = Primary membrane

$P_B$ = Primary bending

$P_L$ = Primary local

$Q_M$ = Secondary membrane

$Q_B$ = Secondary bending

Table 2-3

TOTAL NUMBER OF SRV ACTUATIONS [a] (40 YEARS)

| Number of SRVs Lifting Simultaneously | Total Number of SRV Actuations |
|---|---|
| 1 | 2550 |
| 2 | - |
| many | 253 (220) [b] |
| Total | 2803 (2770) [b] |

[a] Seven load cycles per actuation.

[b] For vessel and piping.

CRD Penetrations
In-Core Housing Penetrations
Steam Dryer Brackets
RPV Stabilizer Brackets
RPV Nozzles

The new loads evaluation of the RPV components was performed by first comparing the calculated new loads to the design basis loads. If the new loads exceeded the design loads, a stress analysis was then performed, to include a primary stress evaluation and a fatigue evaluation. Table 2-2 lists the stress categories used in these evaluations.

The results of the evaluations of the RPV components are presented in the following subsections.

2.3.1.1 RPV Shroud Support

For the evaluation of the RPV Shroud Support, the calculated loads exceeded the design basis loads in the upset, emergency and faulted loading conditions. A stress analysis was performed which demonstrated that the calculated stresses were within the allowable limits when using the SRSS method of summation (Table 2-4).

The maximum cumulative fatigue usage factor was calculated to be 0.89 at the vessel bottom head, which is less than the 1.0 allowable.

2.3.1.2 RPV Support Skirt

For the evaluation of the RPV support skirt in the upset and emergency loading conditions, the calculated vertical loads exceeded the design basis loads for the ABS method of summation. In the faulted condition, the calculated vertical and horizontal loadings exceeded the design basis loads for the ABS method of summation (Table 2-5). When the loads were combined, however, the effective vertical loads were less than the design basis loads for the ABS method of summation (Table 2-6). A stress analysis was performed for the faulted loading condition cases which demonstrated that the calculated stresses were within the allowable limits (Table 2-7).

Table 2-4

RPV SHROUD SUPPORT STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (SRSS) | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 17,350 | 23,300 |
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 31,283 | 34,950 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M$ | 21,893 | 28,125 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 37,790 | 42,187 |
| NL + (A-ΔP) + CHG + $SRV_{(ADS)}$ + SSE | Faulted | $P_M$ | 21,893 | 28,125* |
| NL + (A-ΔP) + CHG + $SRV_{(ADS)}$ + SSE | Faulted | $P_M + P_B$ | 37,790 | 42,187 |

Maximum Cumulative Fatigue Usage Factor: 0.089

*Faulted stresses are conservatively compared to emergency condition allowable.

Table 2-5

RPV SUPPORT SKIRT LOAD COMPARISON

MAXIMUM LOAD VS DESIGN LOADS (ABS)

| | V(kip) | | H(kip) | | M (in.-kip x 1000) | |
|---|---|---|---|---|---|---|
| Loading Condition | Calculated Load | Allowable Load | Calculated Load | Allowable Load | Calculated Load | Allowable Load |
| Upset | 6,831.53 | 6,817 | 642.5 | 1,560 | 116.77 | 840 |
| Emergency | 8,606.03 | 7830 | 642.5 | 3,120 | 116.77 | 1,660 |
| Faulted | 10,985.36 | 7830 | 4,942.9 | 3,632 | 311.04 | 1790.3 |

Table 2-6

RPV SUPPORT SKIRT EFFECTIVE VERTICAL LOAD* (KIP) (ABS)

| Loading Condition | Calculated Load (ABS) | Allowable Load |
|---|---|---|
| Upset | 8,692.44 | 20,203.45 |
| Emergency | 10,466.94 | 34,284.18 |
| Faulted | 15,941.92 | 36,360.68 |

*$V_{eff} = V + 2M/R$

Table 2-7

RPV SUPPORT SKIRT STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (SRSS) | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 15,477 | 19,150 |
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 21,942 | 28,725 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M$ | 24,252 | 29,425 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 34,996 | 44,150 |
| NL + (U-ΔP) + JR + AP + SSE | Faulted | $P_M$ | 24,252 | 29,425 |
| NL + (U-ΔP) + JR + AP + SSE | Faulted | $P_M + P_B$ | 34,996 | 44,150 |

Maximum Cumulative Fatigue Usage Factor: 0.23 at skirt knuckle to bottom head juncture.

*Faulted stresses are conservatively compared to emergency condition allowables.

The maximum cumulative fatigue usage factor was calculated to be 0.23 at the skirt to base junction, which is less than the 1.0 allowable.

2.3.1.3 CRD Penetrations

The loads on the CRD penetrations are a result of the loads from the upper and lower CRD housings. A stress analysis was performed which demonstrated that the calculated stresses for the penetrations at the CRD housings and stub tubes were within the allowable limits (Tables 2-8 and 2-9).

The maximum cumulative fatigue usage factor was calculated to be 0.268 at the CRD Housing Penetrations.

2.3.1.4 In-Core Housing Penetrations

A load comparison was performed on the in-core housing penetrations, which demonstrated that the combined LaSalle 2 loads were less than the combined loads contained in a previously performed generic analysis. Therefore, the design adequacy of the in-core housing penetrations were verified, using the SRSS method of summation.

2.3.1.5 Steam Dryer Brackets

For the evaluation of the steam dryer brackets in the loading conditions, the calculated vertical and horizontal loads did not exceed the design basis loads for the SRSS method of summation. However, in the faulted loading condition, the horizontal loads exceeded the design basis loads for the ABS method of summation. The load comparison is shown in Table 2-10. A stress analysis was also performed for the loading condition cases which demonstrated that the calculated stresses were within the allowable limits (Table 2-11).

For fatigue, since the calculated loads in the upset condition were less than the design basis loads and the alternating stresses due to the SRV loads did

Table 2-8

CRD PENETRATION STRESS COMPARISON AT CRD HOUSING (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (SRSS) | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 11,840 | 16,660 |
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 11,480 | 24,990 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M$ | 13,550 | 19,992 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 13,200 | 29,988 |
| NL + (U-ΔP) + JR + SCRAM + SSE | Faulted | $P_M$ | 13,550 | 39,984 |
| NL + (U-ΔP) + JR + SCRAM + SSE | Faulted | $P_M + P_B$ | 13,200 | 59,976 |

Maximum Cumulative Fatigue Usage Factor: 0.268 at housing.

Table 2-9

CRD PENETRATION STRESS COMPARISON AT STUB TUBE (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (SRSS) | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 7,970 | 20,000 |
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 27,700 | 30,000 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M$ | 8,990 | 24,100 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 29,640 | 36,150 |
| NL + (U-ΔP) + JR + SCRAM + SSE | Faulted | $P_M$ | 8,990 | 48,000 |
| NL + (U-ΔP) + JR + SCRAM + SSE | Faulted | $P_M + P_B$ | 29,640 | 72,000 |

Maximum Cumulative Fatigue Usage Factor: 0.183 at stub tube.

Table 2-10

STEAM DRYER BRACKET LOAD COMPARISON (KIP)

| | SRSS | | | | ABS | | | |
|---|---|---|---|---|---|---|---|---|
| | V(kip) | | H(kip) | | V(kip) | | H(kip) | |
| Condition | Calculated Load | Design Load | Calculated Load | Design Load | Calculated Load | Design Load | Calculated Load | Design Load |
| Upset | 45.5 | 93.0 | 17.9 | 47.0 | 49.3 | 93.0 | 21.7 | 47.0 |
| Emergency | 56.5 | 93.0 | 4.9 | 47.0 | 67.2 | 93.0 | 6.9 | 47.0 |
| Faulted | 0.0 | 93.0 | 46.0 | 47.0 | 0.0 | 93.0 | 64.3 | 47.0 |

Table 2-11

STEAM DRYER BRACKET STRESS COMPARISON (KSI)

| | Stress Categories | | | | | |
|---|---|---|---|---|---|---|
| | Maximum Shear | | Primary Membrane | | Primary Local Plus Bending | |
| Loading Condition | Calculated Stress (ABS) | Allowable Stress | Calculated Stress (ABS) | Allowable Stress | Calculated Stress (ABS) | Allowable Stress |
| Upset | 15.48 | 18.64 | 0.94 | 23.3 | 32.55 | 34.95 |
| Emergency | 15.48 | 18.64 | 0.94 | 23.3 | 32.55 | 34.95 |
| Faulted | 15.48 | 18.64 | 1.29 | 23.3 | 32.55 | 34.95 |

Maximum Cumulative Fatigue Usage Factor: 0.050

not exceed the fatigue endurance limit, the maximum fatigue usage factor remains less than the 1.0 allowable as documented in the vessel stress report.

2.3.1.6 RPV Stabilizer Brackets

The calculated loads on the stabilizer brackets were less than the design basis loads for all loading conditions using the SRSS and ABS method of summation. Therefore, no further evaluation was required (Table 2-12).

For fatigue, since the calculated loads were less than the design basis loads, the maximum fatigue usage factor at the bracket to vessel attachment remains as documented in the vessel stress report.

2.3.1.7 RPV Nozzles

For the RPV nozzles, to include thermal sleeves, where GE-supplied piping and vessel internal components applied dynamic loadings, load comparisons, and in some cases stress analyses, were performed to demonstrate the nozzles' adequacy. Specifically, design adequacy was demonstrated for the following RPV nozzles and thermal sleeves:

Main Steam Nozzles
Recirc Inlet Nozzle
LPCI Nozzle
Recirc Nozzle Thermal Sleeves
Feedwater Nozzle Thermal Sleeve
Core Spray Nozzle Thermal Sleeve
Differential Pressure and Liquid Control Line Thermal Sleeve

For the RPV nozzles where S&L supplied piping reaction loadings, if the nozzle allowables, as provided on the vessel loading diagram, were not exceeded, then the adequacy of the nozzles was verified by the vessel stress report.

Table 2-12

RPV STABILIZER BRACKET LOAD COMPARISON (KIP/BRACKET)

| Loading Condition | Calculated Load | | Allowable Load |
|---|---|---|---|
| | SRSS | ABS | |
| Upset | 267.7 | 365.0 | 480 |
| Emergency | 233.2 | 247.8 | $\geq$480 |
| Faulted | 560.0 | 703.9 | 1,324 |

In specific cases, the S&L piping reaction loads on the RPV nozzles exceeded the vessel loading diagram allowables. For these cases, General Electric conducted analyses using the actual nozzle loads. The design adequacy of the nozzles was analytically demonstrated for the applied loads.

### 2.3.2 RPV Internal Components

The RPV internal components discussed in this section are:

- Core Spray Sparger
- Core Spray Line (In-Vessel) Piping
- Steam Dryer
- Shroud
- Shroud Head Assembly
- Core Support Plate
- Top Guide
- Control Rod Drives
- Control Rod Drive Housings
- Control Rod Guide Tubes
- In-Core Housings and Guide Tubes
- Jet Pumps and Jet Pump Riser Braces
- Core Differential Pressure and Liquid Control Line
- Fuel Assemblies

SRM and IRM Dry Tubes
LPRM Detectors
LPCI Couplings
Orificed Fuel Supports

The new loads evaluation of the RPV internal components was performed by first comparing the calculated new loads to the design basis loads. If the new loads exceeded the design loads, a stress analysis of the equipment was then performed, to include a primary stress evaluation and a fatigue evaluation. Table 2-2 lists the stress categories used in these evaluations.

The results of the evaluations on the RPV internal components are presented in the following subsections.

2.3.2.1 Core Spray Sparger

The stress analysis performed on the core spray sparger compared the total static and dynamic stresses to the allowable stresses (Table 2-13). The loads were combined by both SRSS and ABS methods of summation and found to be within the allowable limits for all cases. The governing load case for all loading conditions was the upset condition NL + (U-ΔP) + OBE + SRV.

The maximum cumulative fatigue usage factor was calculated to be 0.20 at the tee junction, which is less than the 1.0 allowable.

2.3.2.2 Core Spray Line (In-Vessel) Piping

The stress analysis performed on the core spray line piping, to include the clamp and hex head bolt, demonstrated that the calculated stresses were within the allowable limits when using the SRSS and ABS methods of summmation (Table 2-14). The governing load case for all loading conditions was the upset condition NL + (U-ΔP) + OBE + SRV.

The maximum cumulative fatigue usage factor was calculated to be 0.969 at the elbow, which is less than the 1.0 allowable.

Table 2-13

CORE SPRAY SPARGER STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress SRSS | Calculated Stress ABS | Allowable Stress |
|---|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 6.00 | 6.56 | 21.45 |

Table 2-14

CORE SPRAY LINE STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress SRSS | Calculated Stress ABS | Allowable Stress |
|---|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 16.7 | 20.0 | 21.45 |

2.3.2.3 Steam Dryer

The acceleration comparison performed on the steam dryer demonstrated that the calculated acceleration for the worst case faulted load combinations were acceptable thereby assuring the steam dryer adequacy. The results of the load comparison are seen in Table 2-15.

2.3.2.4 Shroud

The stress analysis of the shroud demonstrated that the calculated stresses were less than the allowable limits using the ABS method of summation. The most highly stressed location was calculated to be at the top guide wedge to shroud junction (Table 2-16).

Table 2-15

STEAM DRYER ACCELERATION COMPARISON

| Limiting Load Combination | Loading Condition | Calculated Acceleration | Acceleration Acceptable |
|---|---|---|---|
| Horizontal | | | |
| NL + (A-ΔP) + SSE | Faulted | 0.821 | 1.50 |
| Vertical | | | |
| NL + (I-ΔP) | Faulted | 0.169 | 0.40 |

Table 2-16

SHROUD STRESS COMPARISON (KSI)

(At Top Guide Wedges)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS) | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 19.79 | 21.45 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 0.72 | 32.17 |
| NL + (A-ΔP) + CHG + $SRV_{(ADS)}$ + SSE | Faulted | $P_M + P_B$ | 18.24 | 42.90 |

Maximum Cumulative Fatigue Usage Factor: 0.70 at shroud cylinder core plate ledge.

The maximum cumulative fatigue usage factor was calculated to be 0.70 at the shroud cylinder near the core plate ledge, which is less than the 1.0 allowable.

2.3.2.5 Shroud Head Assembly

The stress analysis performed on the shroud head demonstrated that the calculated stresses were within the allowable limits when using both SRSS and ABS methods of summation (Table 2-17). The most highly stressed location was calculated to be at the shroud head bolts.

The maximum cumulative fatigue usage factor was calculated to be 0.273 at the shroud head bolt, which is less than the 1.0 allowable.

2.3.2.6 Core Support Plate

The stress analysis performed on the core support plate, to include the core support bolt, demonstrated that the calculated stresses were within the allowable limits as shown in Table 2-18. Additionally, a beam buckling analysis was performed which demonstrated that the core support plate met the required buckling criteria (Table 2-19).

The maximum cumulative fatigue usage factor was calculated to be 0.745 at the core plate stud which is less than the 1.0 allowable.

Table 2-17

SHROUD HEAD BOLT STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress SRSS | Calculated Stress ABS | Allowable Stress |
|---|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 9.601 | 10.89 | 23.3 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M$ | 5.29 | 6.07 | 34.95 |
| NL + (A-ΔP) + CHUG + $SRV_{(ADS)}$ + SSE | Faulted | $P_M$ | 17.28 | 19.71 | 55.92 |

Maximum Cumulative Fatigue Usage Factor: 0.273

Table 2-18

CORE SUPPORT PLATE LIGAMENT STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 18.22 | 25.35 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 11.61 | 38.03 |
| NL + (A-ΔP) + CHG + $SRV_{(ADS)}$ + SSE | Faulted | $P_M + P_B$ | 23.20 | 50.70 |

Maximum Cumulative Fatigue Usage Factor: 0.745 at core plate stud.

Table 2-19

CORE SUPPORT PLATE BEAM BUCKLING LOAD COMPARISON (lb/Bundle)

| Limiting Load Combination | Loading Condition | Calculated Load | Allowable Load |
|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | 359 | 366 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | 321 | 500 |
| NL + (A-ΔP) + CHG + $SRV_{(ADS)}$ SSE | Faulted | 620 | 683 |

### 2.3.2.7 Top Guide

The stress analysis performed on the top guide demonstrated that the calculated stresses were within the allowable limits. The most highly stressed beam results are provided in Table 2-20.

The maximum cumulative fatigue usage factor was calculated to be 0.23 at the beam slot, which is less than the 1.0 allowable.

Table 2-20

TOP GUIDE BEAM STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M$ | 1,566 | 16,900 |
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 25,272 | 25,350 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M$ | 57 | 25,350 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 14,152 | 38,025 |
| NL + (A-ΔP) + CHG + $SSE_{(ADS)}$ + SRV | Faulted | $P_M$ | 1,443 | 40,560 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ + SSE | Faulted | $P_M + P_B$ | 46,445 | 50,700 |

Maximum Cumulative Fatigue Usage Factor: 0.23 at beam slot.

### 2.3.2.8 Control Rod Drives

The analysis performed on the control rod drives demonstrated the design adequacy for all loading combinations using the SRSS and ABS methods of summation. A previously performed generic analysis for BWR/4 and 5 control rod drives was used to form the basis for the LaSalle 2 analysis.

The maximum combined loads calculated in the LaSalle 2 analysis were less than those calculated in the generic analysis for all components and all load cases. Therefore, all component stresses for the CRD were less than those calculated in the generic analysis.

As part of the basis for the generic CRD analysis, the CRD was statically and dynamically tested for seismic loads of various amplitudes. Static tests consisted of fuel channel deflections and core support displacements. The CRD housing lower flange was also oscillated up to a 2-inch peak to peak displacement with minimal effect on scram time. During a more recent test, the drive of similar configuration was subjected to a number of biaxial excitations. The dynamic test was followed by a hot functional test, with no apparent damage to the CRD. All drive functions remained normal.

Tables 2-21 through 2-25 summarize the points of highest stress of the CRD components. For all components, the emergency condition stresses were not as severe as the upset condition stresses. In all cases, the maximum cumulative fatigue usage factors were less than the 1.0 allowable.

2.3.2.9 Control Rod Drive Housings

The stress analysis performed on the CRD housings demonstrated that the calculated stresses were within the allowable limits when using the SRSS and ABS methods of summation (Table 2-26).

The maximum cumulative fatigue usage factor was calculated to be 0.27 at the lower housing, which is less than 1.0 allowable.

2.3.2.10 Control Rod Guide Tubes

The stress analysis performed on the control rod guide tubes demonstrated that the calculated stresses were within the allowable limits when using the ABS method of summation (Tables 2-27 through 2-28). The control rod guide tube stability criterion, which is the ratio of the applied vertical load over the collapse load, was also evaluated and the criteria satisfied (Table 2-29).

Table 2-21

CONTROL ROD DRIVE PISTON TUBE STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B$ | 17.4 | 43.0** |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B + Q$ | 80.2 | 87.7 |
| NL + (A-ΔP) + CHG + SRV + SSE + SCRAM | Faulted | $P_M + P_B$ | 18.5 | 70.2** |

Maximum Cumulative Fatigue Usage Factor: 0.253

*SRSS values are less than the ABS values for the corresponding load combination.
**Primary membrane criteria.

Table 2-22

CONTROL ROD DRIVE OUTER TUBE STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B$ | 32.9 | 37.3 |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M$ | 19.9 | 25.0 |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B$ | 24.7 | 26.1 |
| NL + (A-ΔP) + CHG + SRV + SSE + SCRAM | Faulted | $P_M$ | 20.7 | 54.0 |
| NL + (A-ΔP) + CHG+ SRV + SSE + SCRAM | Faulted | $P_M + P_B$ | 38.5 | 54.0 |

Maximum Cumulative Fatigue Usage Factor: 0.41

*SRSS values are less than the ABS values for the corresponding load combination.
**Primary membrane criteria.

Table 2-23

CONTROL ROD DRIVE CYLINDER STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B$ | 17.5 | 40.8 |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M$ | 15.3 | 27.4 |
| NL + (A-ΔP) + CHG + SRV + SSE + SCRAM | Faulted | $P_M + P_B$ | 19.2 | 58.4** |

Maximum Cumulative Fatigue Usage Factor: 0.08

*SRSS values are less than the ABS values for the corresponding load combination.
**Primary membrane criteria.

Table 2-24

CONTROL ROD DRIVE INDEX TUBE STRESS COMPARISON (KSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B$ | 32.7 | 42.5 |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M$ | 18.7 | 28.5 |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B + Q$ | 48.4 | 76.95 |
| NL + (A-ΔP) + CHG + SRV + SSE + SCRAM | Faulted | $P_M + P_B$ | 29.4 | 61.56 |
| NL + (A-ΔP) + CHG + SRV + SSE + SCRAM + JR | Faulted | $P_M + P_B$ | 29.4 | 56.5** |

Maximum Cumulative Fatigue Usage Factor: ~0

*SRSS values are less than the ABS values for the corresponding load combination.
**Primary membrane criteria.

Table 2-25

CONTROL ROD DRIVE INDICATOR TUBE STRESS COMPARISON (KSI)

| | | | | |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B + Q$ | 47.1 | 51.7 |
| NL + (U-ΔP) + OBE + SRV + SCRAM | Upset | $P_M + P_B$ | 24.7 | 25.9 |
| NL + (A-ΔP) + CHG + SRV + SSE + SCRAM | Faulted | $P_M$ | 37.6 | 40.0 |

Maximum Cumulative Fatigue Usage Factor: 0.093

*SRSS values are less than the ABS values for the corresponding load combination.

Table 2-26

CONTROL ROD DRIVE HOUSING STRESS COMPARISON (PSI)

| Loading Condition* | Stress Category | Calculated Stress (ABS)** | Allowable Stress |
|---|---|---|---|
| Upset | $P_M$ | 15,600 | 16,660 |
| Faulted | $P_M$ | 18,980 | 39,840 |

Maximum Cumulative Fatigue Usage Factor: 0.27

*Emergency stresses are less than or equal to upset stresses.

**SRSS values are less than the ABS values for the corresponding load combination.

Table 2-27

CONTROL ROD GUIDE TUBE FLANGE STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| N + (U-ΔP) + SRV | Upset | $P_M + P_B$ | 6,343 | 24,000 |
| N + (U-ΔP) + OBE + SRV | Emergency | $P_M + P_B$ | 7,206 | 36,000 |
| N + (A-ΔP) + SSE + JR + AP | Faulted | $P_M + P_B$ | 11,166 | 38,400 |

*SRSS values are less than the ABS values for the corresponding load combination.

Table 2-28

CONTROL ROD GUIDE TUBE BODY STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| N + (U-ΔP) + SRV | Upset | $P_M + P_B$ | 5,704 | 16,000 |
| N + (U-ΔP) + OBE + SRV | Emergency | $P_M + P_B$ | 5,795 | 16,000 |
| N + (A-ΔP) + SSE + JR + AP | Faulted | $P_M + P_B$ | 9,867 | 16,000 |

*SRSS values are less than the ABS values for the corresponding load combination.

**Conservatively compared to primary membrane stress limits for upset service Level B allowable.

Table 2-29

CONTROL ROD GUIDE TUBE STABILITY CRITERIA COMPARISON

| Limiting Load Combination | Loading Condition | Calculated Ratio | Allowable Ratio |
|---|---|---|---|
| N + (U-ΔP) + SRV | Upset | 0.41 | 0.45 |
| N + (U-ΔP) + OBE + SRV | Emergency | 0.42 | 0.67 |
| N + (A-ΔP) + SSE + JR + AP | Faulted | 0.65 | 0.90 |

The LaSalle 2 guide tubes are exempt from fatigue analysis per ASME B&PV Code, Section III, Para NG-3222.4d.

2.3.2.11 In-Core Housings and Guide Tubes

The new loads for LaSalle 2 were less than the new loads used to perform a generic stress analysis of the in-core housings and guide tubes. The generic calculated stresses were within the allowable limits and since LaSalle 2 loads were less and the geometry is the same, it is not necessary to perform a detailed analysis for LaSalle 2.

2.3.2.12 Jet Pumps and Jet Pump Riser Braces

The stress analysis performed on the jet pumps and jet pump riser braces demonstrated that the calculated stresses were within the allowable limits when using the ABS method of summation (Table 2-30 and 2-31).

The maximum cumulative fatigue usage factor was calculated to be $\leq$0.76, which is less than the 1.0 allowable.

Table 2-30

JET PUMP STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B + Q$ | 8,846 | 23,350 |
| NL + (A-ΔP) + OBE + SRV | Emergency | $P_M + P_B$ | 8,846 | 38.025 |
| NL + (A-ΔP) + JR + AP + SRV + SSE | Faulted | $P_M + P_B$ | 29,563 | 60.840 |

Maximum Cumulative Fature Usage Factor: $\leq 0.76$

*SRSS values is less than ABS value for the corresponding load combination.

Table 2-31

JET PUMP RISER BRACE STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B + Q$ | 18,641 | 50,700 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 11,508 | 38,025 |
| NL + (A-ΔP) + JR + AP + SSE | Faulted | $P_M + P_B$ | 42,501 | 60,840 |

Maximum Cumulative Fatigue Usage Factor: $\leq 0.76$

*SRSS values is less than ABS value for the corresponding load combination.

### 2.3.2.13 Core Differential Pressure and Liquid Control Line

The analysis was performed using a dynamic analysis program with the response spectrum input from the dynamic new loads. The limiting load cases for each code condition were selected for evaluation. Hardware was evaluated per ASME Code Section III, NB, piping analysis and fatigue evaluation per the ASME code. The ABS method was used as the limiting method for combining the loads for each load case (Table 2-32).

The maximum cumulative fatigue usage factor was calculated to be 0.02, which is less than the 1.0 allowable.

Table 2-32

CORE DIFFERENTIAL PRESSURE AND LIQUID CONTROL
STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + SRV | Upset | P + Q | 46,319 | 54,120 |
| NL + (U-ΔP) + OBE + SRV | Emergency | $P_M + P_B$ | 13,569 | 36.900 |
| NL + (A-ΔP) + JR + AP + SSE | Faulted | $P_M + P_B$ | 35,750 | 59,040 |

Maximum calculated fatigue usage factor: 0.02

*SRSS values are less than ABS values for the corresponding load combinations.

2.3.2.14 Fuel Assemblies

The LaSalle 2 fuel assemblies were evaluated for functional adequacy considering the seismic, SRV, and LOCA loadings to include annulus pressurization. Loading combination criteria were used to determine the maximum combined fuel acceleration profiles for normal, upset and faulted events. The fuel assembly fatigue analysis was performed for SRV and OBE+SRV load combinations. Both the SRSS and ABS methods of summation were used for the functional adequacy and fatigue evaluation.

The method used to demonstrate the adequacy of the LaSalle 2 fuel assemblies was to demonstrate that the LaSalle 2 fuel loadings were less than the verified capability of BWR/2-5 plants.

Normal/Upset Event Results

The limiting combination of horizontal accelerations for the normal and upset events was NL+OBE+SRV. The resulting SRSS and ABS combined horizontal acceleration profiles were compared to the BWR/2-5 upset design basis profile. The combined accelerations were shown to be less than the design basis accelerations over the full length of the fuel. The combination of horizontal and vertical fuel lift accelerations exceeded the design basis accelerations for concurrent horizontal and vertical loading, but were within the verified capability of BWR/2-5 fuel. Based on the above results, all design criteria were met for Normal and Upset events.

Emergency/Faulted Event Results

The limiting faulted load combination of horizontal accelerations was NL+SRV+LOCA+OBE. The LaSalle 2 combined horizontal accelerations exceeded the design basis acceleration profile locally at the bottom of the fuel assembly. Since resultant loadings are an integral effect of the acceleration distribution, it was acceptable to allow the resultant acceleration distribution to locally exceed the design basis profile. In this case, the actual component part loadings were compared to the design basis loads. The horizontal component loadings were shown to be less than the corresponding design basis loads.

The limiting faulted load combination of vertical accelerations was NL+SRV+LOCA+SSE. The combined horizontal and vertical accelerations exceeded the BWR/2-5 design basis accelerations; however, the combined vertical plus horizontal accelerations were shown to be within the verified capability of the fuel.

Based upon the above results, all design criteria were met for the faulted event.

Fatigue Analysis Results

The fuel fatigue analysis was performed for the limiting SRV case and the OBE+SRV load combination. Fuel assembly component loads were determined using an analytical model. The OBE and SRV component loads were combined by both the SRSS and ABS methods. Fatigue capability of the fuel components was determined by exchanging the previously evaluated capability of at least 10 to 150 cycles of peak SSE loading for a larger quantity of cycles of the lower OBE or SRV loads as allowed by the material fatigue curves.

The fuel component loadings determined from the LaSalle 2 horizontal and vertical OBE and SRV loads were small enough such that less than 20% cumulative damage fatigue is predicted to occur over the lifetime of the fuel assembly. Based upon the fatigue analysis, the fuel assembly has adequate fatigue capability to withstand the loadings resulting from multiple SRV actuations and the OBE+SRV event.

The LaSalle 2 fuel assembly horizontal loadings were shown to be less than the BWR/2-5 design basis loads for the limiting normal/upset and faulted events. Fuel lift vertical accelerations in combination with the appropriate horizontal accelerations were shown to be less than the verified capability of BWR/2-5 fuel for normal/upset and faulted events. Therefore, all normal, upset, emergency and faulted design criteria were met for the LaSalle 2 fuel assemblies (Table 2-33).

Each component of the LaSalle 2 fuel assembly was demonstrated to have adequate fatigue capability to withstand the loadings resulting from multiple SRV actuations over the lifetime of the fuel.

Table 2-33

FUEL ASSEMBLY PEAK ACCELERATION COMPARISON (g)

| Acceptance Criteria | Loading | Primary Load Type | Calculated Peak Acceleration | Evaluation Basis(1) Acceleration |
|---|---|---|---|---|
| Acceleration Envelope | Horizontal Direction:<br>1. Peak Pressure<br>2. Operational Basis Earthquake<br>3. Safety Relief Valve<br>4. Chugging | Horizontal Acceleration Profile | 1.3 G | 3.6 G |
| | Vertical Direction:<br>1. Peak Pressure<br>2. Safety Shutdown Earthquake<br>3. Safety Relief Valve<br>4. Condensation Oscillation | Vertical | 4.2 G | 12.0 G |

NOTES:

(1) Evaluation Basis Accelerations and Evaluations are contained in NEDE-21175-3-P. The evaluation basis acceleration envelope is defined by a coincident 8G vertical acceleration with the 3.6G horizontal acceleration. The 3.6G horizontal value is reduced linearly to zero as the corresponding vertical acceleration increased from 8 to 12 G's.

(2) The calculated maximum fuel assembly gap opening for the most limiting load combination is 0.12 inch. This is less than the gap (0.52 inch) required to start the disengagement of the lower tie plate from the fuel support casting.

(3) The fatigue analysis indicates that the fuel assembly has adequate fatigue capability to withstand the loadings resulting from multiple SRV actuations and the OBE+SRV event.

2.3.2.15 SRM and IRM Dry Tubes

The analyses performed on the Source Range Monitor (SRM) and Intermediate Range Monitor (IRM) dry tubes demonstrated that the combined loads were less than the load values contained in a previously performed BWR/4 and 5 generic analysis. The combined loads did not result in stresses which exceeded the ASMR Code allowables and therefore the design adequacy was demonstrated.

The maximum cumulative fatigue usage factor was calculated to be less than the 1.0 allowable.

2.3.2.16 LPRM Detectors

The analysis performed on the Low Power Range Monitor (LPRM) detector assemblies demonstrated that the combined loads were less than the load values calculated in a previously performed BWR/4 and 5 generic analysis. The generic BWR/4 and 5 analysis used a combination of test and analysis to qualify the LPRM detectors for loading conditions which exceeded the LaSalle 2 unique combined loads. Therefore, the design adequacy was demonstrated.

The maximum cumulative fatigue usage factor for the LPRM assembly was calculated to be less than the 1.0 allowable.

2.3.2.17 LPCI Couplings

The stress analysis performed on the LPCI couplings demonstrated that the calculated stresses were within the allowable limits using the ABS method of summation. The maximum stress location was at the LPCI ring (Table 2-34). The maximum cumulative fatigue usage factor was calculated to be less than 1.0.

Table 2-34

LPCI COUPLING STRESS COMPARISON (PSI)

| Limiting Load Combination | Loading Condition | Stress Category | Calculated Stress (ABS)* | Allowable Stress |
|---|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | $P_M + P_B$ | 8,112 | 25,350 |
| NL + (U-ΔP) + CHG + $SRV_{(ADS)}$ | Emergency | $P_M + P_B$ | 18,869 | 38,025 |
| NL + (A-ΔP) + JR + AP + SSE | Faulted | $P_M + P_B$ | 27,127 | 60,840 |

Maximum calculated fatigue usage factor: <1.0

2.3.2.18 Orificed Fuel Supports

The stress analysis performed on the orificed fuel supports demonstrated that the calculated stresses were within the allowable limits using the ABS method of summation (Table 2-35).

The maximum cumulative fatigue usage factor was calculated to be 0.25, which is less than the 1.0 allowable.

Table 2-35

ORIFICED FUEL SUPPORT COMPARISON

| Limiting Load Combination | Condition | Calculated (ABS)* | Allowable |
|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | 1,625** | 1,638*** |
| NL + (A-ΔP) + JR + AP + SSE | Faulted | 38,603 psi | 43,200 psi |

Maximum cumulative fatigue usage factor: 0.25

*SRSS values are less than ABS values for the corresponding load combinations.

**Horizontal load - lbs.

***Values are 44% of load capability as determined by test.

### 2.3.3 RPV Support Components

The RPV support components discussed in this section are:

Vessel Stabilizer
CRD Housing Restraint Beam
RPV Support

Design adequacy of these components was demonstrated by comparing the total dynamic and static loads to the loads for which the equipment was originally designed. By this comparison, it was determined that for the LaSalle 2 vessel stabilizer, CRD housing restraint beam and RPV support (girder assembly) the static and dynamic loads, when combined, were less than the design basis loads for all required load combinations listed in Table 2-1.

The results of the fatigue analyses conducted demonstrated all components adequate for cyclic fatigue loading.

#### 2.3.3.1 Vessel Stabilizer

The stress analysis performed on the vessel stabilizer demonstrated that the calculated stresses at the yoke were less than the allowable stresses using the SRSS method of summation (Table 2-36).

The fatigue analysis performed demonstrated the adequacy of the vessel stabilizer for cyclic fatigue loading per AISC criteria.

Table 2-36
VESSEL STABILIZER STRESS COMPARISON (PSI)

| Limiting Load Combination | Condition | Calculated Stress (SRSS) | Allowable Stress |
|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | 34,200 | 36,100 |
| NL + (A-ΔP) + JR + AP + SSE | Faulted | 50,300 | 54,100 |

2.3.3.2 CRD Housing Restraint Beam

The analysis performed on the CRD housing restraint beam demonstrated that the calculated static and dynamic loads were less than the design basis loads using the ABS method of summation (Table 2-37).

The fatigue analysis performed demonstrated the adequacy of the CRD housing restraint beam for cyclic fatigue loading per AISC criteria.

2.3.3.3 RPV Support

The RPV support ring girder loads for LaSalle 2 were less than the loads for LaSalle 1. It was demonstrated that the calculated static and dynamic loads were less than the design basis loads using both the SRSS and ABS methods for LaSalle 1. Therefore, the lower LaSalle 2 loads are adequate.

The fatigue analysis performed demonstrated the adequacy of the RPV support for cyclic fatigue loading per AISC criteria.

Table 2-37

CRD HOUSING RESTRAINT BEAM LOAD COMPARISON (KIP)

| Limiting Load Combination | Loading Condition** | Calculated Load (KIPS) (ABS)* | Allowable Load (kips) |
|---|---|---|---|
| NL + (U-ΔP) + OBE + SRV | Upset | 73.49 | 135 |
| NL + (A-ΔP) + JR + AP + SSE | Faulted | 96 | 182 |

*SRSS values are less than ABS values for the corresponding load combination.
**Emergency stress is equal to or less than the upset stress allowable.

# 3. NSSS PIPING SYSTEMS EVALUATION

## 3.1 OVERVIEW

A design adequacy evaluation for the LaSalle Unit 2 NSSS main steam and recirculation piping and pipe mounted equipment was performed. The Unit 2 "as-built" piping and suspension system configurations were verified by Sargent & Lundy engineers and subsequently submitted to GE as input for the stress and analyses performed. ASME Code Certified Piping Stress Reports were prepared and issued March 1983 (References 24 through 29, Appendix A).

### 3.1.1 Equipment Evaluated

The adequacy evaluation performed included the following NSSS main steam and recirculation piping and pipe mounted equipment.

- o Main Steam Piping System
  - Piping
  - Snubbers
  - Safety/Relief Valves (SRV)
  - Main Steam Isolation Valves (MSIV)

- o Recirculation Piping System
  - Piping
  - Snubbers
  - Suction Gate Valves
  - Discharge Gate Valves
  - Flow Control Valves
  - Recirculation Pumps and Motors

### 3.1.2 Load Combinations and Summation Methods

As a design basis, all dynamic loads were combined using the square root of the sume of squares (SRSS) method. In addition, the absolute sum (ABS) combination method was used. The evaluation was performed using the load combinations listed in Tables 3-1 through 3-8 for the main steam system and

Tables 3-42 through 3-51 for the recirculation system. These load combinations were derived from the more general load combinations listed in Table 1-2 in order to more adequately evaluate the induced loads from specific operating transients and postulated plant events.

### 3.1.3 Evaluation and Methodology

the NSSS piping stress analyses were conducted to consider the secondary dynamic responses from: (1) the original design-basis loads including seismic vibratory motions; (2) the structural system feedback loads from the suppression pool hydrodynamic events; and (3) the structural system loads from the LOCA induced annulus pressurization from postulated feedwater, recirculation and main steam pipe breaks.

The response spectra for piping attachment points on the reactor pressure vessel, shield wall and pedestal complex (above the pool area) were generated by General Electric, based upon the acceleration time-histories supplied by Sargent & Lundy Engineers. Containment response spectra were supplied directly by S&L. This combination of General Electric and S&L developed response spectra was used as input responses for all attachment points at each piping system.

Lumped mass models were developed by General Electric for the NSSS primary piping systems, main steam and recirculation. These lumped mass models include the snubbers, hangers, struts and pipe-mounted valves, and represent the major balance-of-plant branch piping connected to the main steam and recirculation systems. Amplied response spectra for all attachment points within the piping system were applied (i.e., distinct acceleration excitations were specified at each piping support and anchor point). The detailed models were analyzed independently to determine the piping system resulting loads (shears and moments). Additionally, the end reaction forces and/or accelerations for the pipe-mounted/connected equipment (valves and nozzles) were simultaneously calculated.

The piping stresses from the resulting loads (shears and moments) for each load event were determined and combined in accordance with the load combinations delineated in Table 1-2. These stresses were calculated at geometrical discontinuities and compared to ASME code allowable determined stresses (ASME Boiler and Pressure Vessel Code, Sec. III-NB-3650) for the appropriate loading condition in order to assure design adequacy.

The reaction forces and/or accelerations acting on the pipe-mounted/connected equipment, when combined using the appropriate load combinations, were compared to the equipment allowables to assure design adequacy.

## 3.2 MAIN STEAM PIPING SYSTEM EVALUATION RESULTS

### 3.2.1 Main Steam Piping

The stress analysis for main steam piping lines A, B, C and D was performed using the verified "as-built" configuration as submitted to GE. The load combinations listed in Tables 3-1 and 3-2 were used as the basis for the evaluation. Stresses were combined using both the SRSS and ABS methods of summation.

Tables 3-10, 3-11, 3-18, 3-19, 3-26, 3-27, 3-34 and 3-35 provide highest stress summaries for the Design Condition and Service Levels B, C and D loading conditions using both the SRSS and ABS methods of summation. The highest calculated stresses were below the ASME Code allowable limits. The stress analysis performed demonstrated that the main steam piping was designed and supported to withstand and applied loads as given in the applicable design specifications. ASME Code certified stress reports were prepared and issued reflecting the results of the analysis performed (References 24 through 27, Appendix A).

The main steam piping system, which is required to function for safe shutdown under the postulated events, was evaluated and proven adequate in meeting the functional capability requirements per NEDO-21985, Piping Functional Capability Criteria.

Node diagrams for Main Steam Lines A, B, C and D are provided for reference in Figures 3-1, 3-2, 3-3 and 3-4, respectively.

### 3.2.2 Main Steam Snubbers

The analysis performed demonstrated that the calculated loads on the main steam snubbers were below the allowable limits, verifying their capability to meet the design criteria. The load combinations listed in Tables 3-3 and 3-4 were used as the basis for the evaluation. Loads were combined using both SRSS and ABS methods of summation.

Tables 3-12, 3-13, 3-20, 3-21, 3-28, 3-29, 3-36 and 3-37 provide the highest loading summaries for Service Levels B, C and D loading conditions using both SRSS and ABS methods of summation. Initially, where snubber loads exceeded nominal ratings provided on the suspension purchase part drawings, subsequent snubber acceptability was demonstrated using actual manufacturer ratings based upon test results.

### 3.2.3 Main Steam Safety/Relief (SRV) and Isolation Valves (MSIV)

The analyses performed demonstrated that the calculated stresses, forces, moments and accelerations on the main steam safety relief and isolation valves were below the allowable limits. The load combinations listed in Tables 3-5 through 3-8 were used as the basis for the evaluation. Loads were combined using both SRSS and ABS methods of summation.

Tables 3-14 through 3-17, 3-22 through 3-25, 3-30 through 3-33 and 3-38 through 3-41 provide the highest loading summaries for the service level loading conditions evaluated using both SRSS and ABS methods of summation.

Table 3-1

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - SRSS

PIPING

| | | | | |
|---|---|---|---|---|
| DESIGN | 1 | PD + WT1 | + | OBEI |
| LEVEL B | 1 | PP + WT1 | + | SQRT((OBEI )**2 + ( TSV )**2 ) |
| LEVEL B | 2 | PP + WT1 | + | SQRT((OBEI )**2 + ( RV1 )**2 ) |
| LEVEL B | 3 | PP + WT1 | + | SQRT((OBEI )**2 + ( RV2I )**2 ) |
| LEVEL C | 1 | PP + WT1 | + | SQRT((CHUGI )**2 + ( RV1 )**2 ) |
| LEVEL C | 2 | PP + WT1 | + | SQRT((CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL C | 3 | PP + WT1 | + | RV1 |
| LEVEL C | 4 | PP + WT1 | + | RV2I |
| LEVEL D | 1 | PP + WT1 | + | SQRT((SSEI )**2 + ( RV2I )**2 ) |
| LEVEL D | 2 | PP + WT1 | + | SQRT((SSEI )**2 + ( TSV )**2 ) |
| LEVEL D | 3 | PP + WT1 | + | SQRT((SSEI )**2 + ( CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL D | 4 | PP + WT1 | + | COND I + SQRT((SSEI )**2 + ( RV2I )**2 ) |
| LEVEL D | 5 | PP + WT1 | + | COND I + SQRT((SSEI )**2 + ( RV1 )**2 ) |
| LEVEL D | 6 | PP + WT1 | + | SQRT((SSEI )**2 + ( CHUGI )**2 + ( RV1 )**2 ) |
| LEVEL D | 7 | PP + WT1 | + | SQRT((SSEI )**2 + ( API )**2 ) |

Table 3-2

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - ABS

PIPING

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1 | PD + WT1 | + | OBEI | | | | |
| LEVEL B | 1 | PP + WT1 | + | OBEI | + | TSV | | |
| LEVEL B | 2 | PP + WT1 | + | OBEI | + | RV1 | | |
| LEVEL B | 3 | PP + WT1 | + | OBEI | + | RV2I | | |
| LEVEL C | 1 | PP + WT1 | + | CHUGI | + | RV1 | | |
| LEVEL C | 2 | PP + WT1 | + | CHUGI | + | RV2I | | |
| LEVEL C | 3 | PP + WT1 | + | RV1 | | | | |
| LEVEL C | 4 | PP + WT1 | + | RV2I | | | | |
| LEVEL D | 1 | PP + WT1 | + | SSEI | + | RV2I | | |
| LEVEL D | 2 | PP + WT1 | + | SSEI | + | TSV | | |
| LEVEL D | 3 | PP + WT1 | + | SSEI | + | CHUGI | + | RV2I |
| LEVEL D | 4 | PP + WT1 | + | COND 1 | + | SSEI | + | RV2I |
| LEVEL D | 5 | PP + WT1 | + | COND 1 | + | SSEI | + | RV1 |
| LEVEL D | 6 | PP + WT1 | + | SSEI | + | CHUGI | + | RV1 |
| LEVEL D | 7 | PP + WT1 | + | SSEI | + | API | | |

Table 3-3

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - SRSS

SNUBBERS

| | | |
|---|---|---|
| LEVEL B | 1 | SQRT((OBEI + OBED )**2 + ( TSV )**2 ) |
| LEVEL B | 2 | SQRT((OBEI + OBED )**2 + ( RV1 )**2 ) |
| LEVEL B | 3 | SQRT((OBEI + OBED )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL C | 1 | SQRT((CHUGI + CHUGD )**2 + ( RV1 )**2 ) |
| LEVEL C | 2 | SQRT((CHUGI + CHUGD )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 1 | SQRT((SSEI + SSED )**2 + ( TSV )**2 |
| LEVEL D | 2 | SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 3 | COND I + COND D + SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 4 | SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + ( RV1 )**2 ) |
| LEVEL D | 5 | COND I + COND D + SQRT((SSEI + SSED )**2 + ( RV1 )**2 ) |
| LEVEL D | 6 | SQRT((SSEI + SSED )**2 + ( API + APD )**2 ) |
| LEVEL D | 7 | SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |

Table 3-4

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - ABS

SNUBBERS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL B | 1 | OBEI | + | OBED | + | TSV | | | | | | |
| LEVEL B | 2 | OBEI | + | OBED | + | RV1 | | | | | | |
| LEVEL B | 3 | OBEI | + | OBED | + | RV2I | + | RV2D | | | | |
| LEVEL C | 1 | CHUGI | + | CHUGD | + | RV1 | | | | | | |
| LEVEL C | 2 | CHUGI | + | CHUGD | + | RV2I | + | RV2D | | | | |
| LEVEL D | 1 | SSEI | + | SSED | + | TSV | | | | | | |
| LEVEL D | 2 | SSEI | + | SSED | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D |
| LEVEL D | 3 | COND I | + | COND D | + | SSEI | + | SSED | + | RV2I | + | RV2D |
| LEVEL D | 4 | SSEI | + | SSED | + | CHUGI | + | CHUGD | + | RV1 | | |
| LEVEL D | 5 | COND I | + | COND D | + | SSEI | + | SSED | + | RV1 | | |
| LEVEL D | 6 | SSEI | + | SSED | + | API | + | APD | | | | |
| LEVEL D | 7 | SSEI | + | SSED | + | RV2I | | | | | | |

Table 3-5

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - SRSS

SAFETY/RELIEF VALVES

| | | |
|---|---|---|
| LEVEL B | 1 | SQRT((OBEI )**2 + ( TSV )**2 ) |
| LEVEL B | 2 | SQRT((OBEI )**2 + ( RV1 )**2 ) |
| LEVEL B | 3 | SQRT((OBEI )**2 + ( RV2I )**2 ) |
| LEVEL C | 1 | SQRT((CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL C | 2 | SQRT((CHUGI )**2 + ( RV1 )**2 ) |
| LEVEL D | 1 | SQRT((SSEI )**2 + ( TSV )**2 ) |
| LEVEL D | 2 | SQRT((SSEI )**2 + ( CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL D | 3 | COND I + SQRT((SSEI )**2 + ( RV1 )**2 ) |
| LEVEL D | 4 | SQRT((SSEI )**2 + ( CHUGI )**2 + ( RV1 )**2 ) |
| LEVEL D | 5 | COND I + SQRT((SSEI )**2 + ( RV2I )**2 ) |
| LEVEL D | 6 | SQRT((SSEI )**2 + ( API )**2 ) |
| LEVEL D | 7 | SQRT((SSEI )**2 + ( RV2I )**2 ) |

Table 3-6

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - ABS

<u>SAFETY/RELIEF VALVES</u>

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LEVEL B | 1 | OBEI | + | TSV | | |
| LEVEL B | 2 | OBEI | + | RV1 | | |
| LEVEL B | 3 | OBEI | + | RV2I | | |
| LEVEL C | 1 | CHUGI | + | RV2I | | |
| LEVEL C | 2 | CHUGI | + | RV1 | | |
| LEVEL D | 1 | SSEI | + | TSV | | |
| LEVEL D | 2 | SSEI | + | CHUGI | + | RV2I |
| LEVEL D | 3 | COND I | + | SSEI | + | RV1 |
| LEVEL D | 4 | SSEI | + | CHUGI | + | RV1 |
| LEVEL D | 5 | COND I | + | SSEI | + | RV2I |
| LEVEL D | 6 | SSEI | + | API | | |
| LEVEL D | 7 | SSEI | + | RV2I | | |

Table 3-7

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - SRSS

SAFETY/RELIEF VALVE FLANGE MOMENTS

| | | |
|---|---|---|
| DESIGN | 1 | WT1 + TE |
| LEVEL B | 1 | WT1 + TE + SQRT((OBEI + OBED )**2 + ( TSV )**2 ) |
| LEVEL B | 2 | WT1 + TE + SQRT((OBEI + OBED )**2 + ( RV1 )**2 ) |
| LEVEL B | 3 | WT1 + TE + SQRT((OBEI + OBED )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL C | 1 | WT1 + TE + SQRT((CHUGI + CHUGD )**2 + ( RV1 )**2 ) |
| LEVEL C | 2 | WT1 + TE + SQRT((CHUGI + CHUGD )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 1 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( TSV )**2 ) |
| LEVEL D | 2 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + (RV2I + RV2D)**2) |
| LEVEL D | 3 | WT1 + TE + COND I + COND D + SQRT((SSEI + SSED ) **2 + (RV2I + RV2D)**2) |
| LEVEL D | 4 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + ( RV1 )**2) |
| LEVEL D | 5 | WT1 + TE + COND I + COND D + SQRT((SSEI + SSED ) **2 + ( RV1 )**2) |
| LEVEL D | 6 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( API + APD )**2 ) |
| LEVEL D | 7 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |

Table 3-8

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
MAIN STEAM - ABS

SAFETY/RELIEF VALVE FLANGE MOMENTS

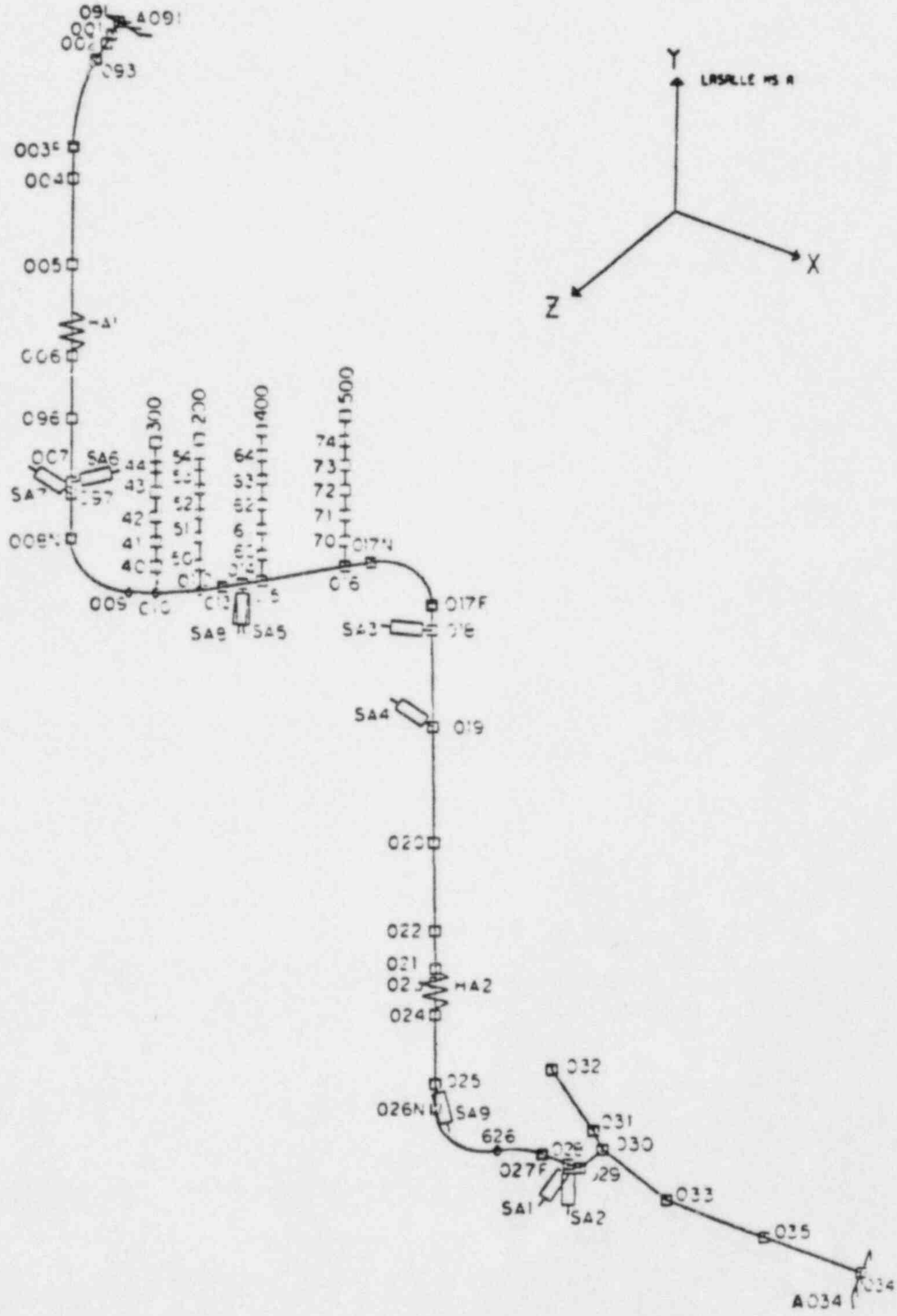
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN | 1 | WT1 | + | TE | | | | | | | | | | | | |
| LEVEL B | 1 | WT1 | + | TE | + | OBEI | + | OBED | + | TSV | | | | | | |
| LEVEL B | 2 | WT1 | + | TE | + | OBEI | + | OBED | + | RV1 | | | | | | |
| LEVEL B | 3 | WT1 | + | TE | + | OBEI | + | OBED | + | RV2I | + | RV2D | | | | |
| LEVEL C | 1 | WT1 | + | TE | + | CHUGI | + | CHUGD | + | RV1 | | | | | | |
| LEVEL C | 2 | WT1 | + | TE | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D | | | | |
| LEVEL D | 1 | WT1 | + | TE | + | SSEI | + | SSED | + | TSV | | | | | | |
| LEVEL D | 2 | WT1 | + | TE | + | SSEI | + | SSED | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D |
| LEVEL D | 3 | WT1 | + | TE | + | COND I | + | COND D | + | SSEI | + | SSED | + | RV2I | + | RV2D |
| LEVEL D | 4 | WT1 | + | TE | + | SSEI | + | SSED | + | CHUGI | + | CHUDG | + | RV1 | | |
| LEVEL D | 5 | WT1 | + | TE | + | COND I | + | COND D | + | SSEI | + | SSED | + | RV1 | | |
| LEVEL D | 6 | WT1 | + | TE | + | SSEI | + | SSED | + | API | + | APD | | | | |
| LEVEL D | 7 | WT1 | + | TE | + | SSEI | + | SSED | + | RV2I | + | RV2D | | | | |

Table 3-9

## LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR NSSS PIPING AND PIPE-MOUNTED EQUIPMENT

### NOMENCLATURE OF LOADS

| | | |
|---|---|---|
| API | = | Annulus Pressurization Loads (Inertial Effect) |
| APD | = | Annulus Pressurization Loads (Anchor Displacement Loads) |
| CHUGI | = | Chugging Load (Inertia Effect) |
| CHUGD | = | Chugging Load (Anchor Displacement Loads) |
| COND I | = | Condensation Oscillation (Inertia Effect) |
| COND D | = | Condensation Oscillation (Anchor Displacement Effects) |
| OBEI | = | Operating Basis Earthquake (Inertia Effect) |
| OBED | = | Operating Basis Earthquake (Anchor Displacement Load) |
| PO | = | Operating Pressure |
| PD | = | Design Pressure |
| PP | = | Peak pressure |
| PPATWS | = | Peak Pressure Due Automatic Transient Without Scram Event |
| RV1 | = | Safety Relief Valve Opening Loads (Acoustic Wave) |
| RV2I | = | Safety Relief Valve Basemat Acceleration Loads (Inertia Effect) |
| RV2D | = | Safety Relief Valve Basemat Accelerations Loads (Anchor Displacement Loads) |
| RV2ADI | = | Safety/Relief Valve Basemat Acceleration Due to Automatic Depressurization System Valves |
| RV2ADD | = | Safety/Relief Valve Basemat Acceleration Due to Automatic Depressurization System Valves (Anchor Displacement Loads) |
| SSEI | = | Safe Shutdown Earthquake (Inertia Effect) |
| SSED | = | Safe Shutdown Earthquake (Anchor Displacement Loads) |
| TE | = | Thermal Expansion |
| TSV | = | Turbine Stop Valve Closure Loads |
| VLCI | = | Vent Line Clearing Loads (Inertia Effect) |
| VLCD | = | Vent Line Clearing Loads (Anchor Displacement Loads) |
| WT1 | = | Dead Weight |
| RV2SVI | = | Safety/Relief Valve Basemat Acceleration Loads Due to a Single Valve Opening (Inertia Effect) |
| RV2SVD | = | Safety/Relief Valve Basemat Acceleration Loads Due to a Single Valve Opening (Anchor Displacement Loads) |



NODE DIAGRAM FOR LASALLE-2 MAIN STEAM LINE A

FIGURE 3-1

Table 3-10

HIGHEST STRESS SUMMARY - SRSS
MAIN STEAM LINE A

| Item Evaluated* | Highest Calculated Stress psi | Allowable Limits psi | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress Eq. 9 $\leq 1.5S_m$ Design Condition | 24,041 | 28,725 | 0.84 | Hanger Lug (024) |
| Primary Stress Eq. 9 = $1.8S_m$ & $1.5S_y$ Service Level B | 24,789 | 34,470 | 0.72 | Hanger Lug (024) |
| Primary Stress Eq. 9 $\leq 2.25S_m$ & $1.8S_y$ Service Level C | 24,758 | 43,088 | 0.57 | Hanger Lug (024) |
| Primary Stress Eq. 9 $\leq 3.0S_m$ Service Level D | 26,578 | 54,600 | 0.49 | Sweepolet (040) |
| Primary plus Secondary Eq. 10 $\leq 3.0S_m$ | 50,184 | 54,600 | 0.92 | Sweepolet (070) |
| Secondary Stresses Eq. 12 $\leq 3.0S_m$ | 18,772 | 53,100 | 0.35 | Elbow (626) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 38,468 | 54,600 | 0.70 | Sweepolet (040) |
| Cumulative Usage Factor U $\leq$ 1.0 | 0.15 | 1.0 | 0.15 | Sweepolet (070) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-11

HIGHEST STRESS SUMMARY - ABS
MAIN STEAM LINE A

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress<br>Eq. 9 $\leq 1.5S_m$<br>Design Condition | 24,041 | 28,725 | 0.84 | Hanger Lug (024) |
| Primary Stress<br>Eq. 9 = $1.8S_m$ & $1.5S_y$<br>Service Level B | 25,253 | 34,470 | 0.73 | Hanger Lug (024) |
| Primary Stress<br>Eq. 9 $\leq 2.25S_m$ & $1.8S_y$<br>Service Level C | 26,049 | 40,950 | 0.64 | Sweepolet (040) |
| Primary Stress<br>Eq. 9 $\leq 3.0S_m$<br>Service Level D | 30,760 | 54,600 | 0.56 | Sweepolet (040) |
| Primary plus Secondary<br>Eq. 10 $\leq 3.0S_m$ | 52,456 | 54,600 | 0.96 | Sweepolet (070) |
| Secondary Stresses<br>Eq. 12 $\leq 3.0S_m$ | 18,772 | 53,100 | 0.35 | Elbow (626) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 38,468 | 54,600 | 0.70 | Sweepolet (040) |
| Cumulative Usage Factor<br>U $\leq$ 1.0 | 0.16 | 1.0 | 0.16 | Sweepolet (070) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-12

SNUBBER LOADS - MAIN STEAM LINE A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 22,730 | 50,000 | 0.455 | SA9 |
| Level C | 16,995 | 66,500 | 0.256 | SA2 |
| Level D | 30,630 | 75,000 | 0.408 | SA1 |

Table 3-13

SNUBBER LOADS - MAIN STEAM LINE A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 32,145 | 50,000 | 0.643 | SA9 |
| Level C | 23,396 | 66,500 | 0.352 | SA2 |
| Level D | 37,982 | 75,000 | 0.506 | SA9 |

Table 3-14

SRV ACCELERATIONS - MAIN STEAM LINE A
HIGHEST ACCELERATIONS SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal Acceleration | | | | |
| Level B | 1.6917 g | 5.0 g | 0.338 | SRV Inlet (063) |
| Level C | 2.0776 g | 5.0 g | 0.416 | SRV Inlet (043) |
| Level D | 2.1779 g | 5.0 g | 0.436 | SRV Inlet (043) |
| Vertical Acceleration | | | | |
| Level B | 0.7456 g | 4.2 g | 0.178 | SRV Inlet (053) |
| Level C | 1.1556 g | 4.2 g | 0.275 | SRV Inlet (043) |
| Level D | 1.4151 g | 4.2 g | 0.337 | SRV Inlet (073) |

Table 3-15

SRV ACCELERATIONS - MAIN STEAM LINE A
HIGHEST ACCELERATIONS SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal Acceleration | | | | |
| Level B | 2.2264 g | 5.0 g | 0.445 | SRV Inlet (063) |
| Level C | 2.8659 g | 5.0 g | 0.573 | SRV Inlet (043) |
| Level D | 3.4738 g | 5.0 g | 0.695 | SRV Inlet (043) |
| Vertical Acceleration | | | | |
| Level B | 0.9518 g | 4.2 g | 0.227 | SRV Inlet (053) |
| Level C | 1.5761 g | 4.2 g | 0.375 | SRV Inlet (043) |
| Level D | 1.8272 g | 4.2 g | 0.435 | SRV Inlet (043) |

Table 3-16A

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE A - MSIV INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,684 | 15,375 | 0.500 | MSIV Inlet (029) |
| Level B | 7,849 | 41,000 | 0.191 | MSIV Outlet (033) |
| Level C | 7,830 | 41,000 | 0.191 | MSIV Outlet (033) |
| Level D | 7,936 | 41,000 | 0.194 | MSIV Outlet (033) |
| Stress Due to Torsional Moment | | | | |
| Level A | 635 | 15,375 | 0.041 | MSIV Outlet (029) |
| Level B | 981 | 41,000 | 0.024 | MSIV Inlet (029) |
| Level C | 959 | 41,000 | 0.023 | MSIV Inlet (029) |
| Level D | 1,190 | 41,000 | 0.029 | MSIV Inlet (029) |
| Stress Due to Bending Moment | | | | |
| Level A | 3,101 | 15,375 | 0.202 | MSIV Inlet (029) |
| Level B | 3,936 | 41,000 | 0.096 | MSIV Inlet (029) |
| Level C | 4,264 | 41,000 | 0.104 | MSIV Inlet (029) |
| Level D | 4,854 | 41,000 | 0.118 | MSIV Inlet (029) |

Table 3-16B

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE A - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,503 | 38,713 | 0.039 | MSIV Bonnet (031) |
| Level B | 2,377 | 38,713 | 0.061 | MSIV Bonnet (031) |
| Level C | 3,162 | 38,713 | 0.082 | MSIV Bonnet (031) |
| Level D | 3,713 | 38,713 | 0.096 | MSIV Bonnet (031) |
| Bending Moment (in-lbs) | | | | |
| Level A | 67,985 | 2,021,373 | 0.034 | MSIV Bonnet (031) |
| Level B | 362,413 | 2,021,373 | 0.179 | MSIV Bonnet (031) |
| Level C | 599,584 | 2,021,373 | 0.297 | MSIV Bonnet (031) |
| Level D | 787,737 | 2,021,373 | 0.390 | MSIV Bonnet (031) |

Table 3-17A

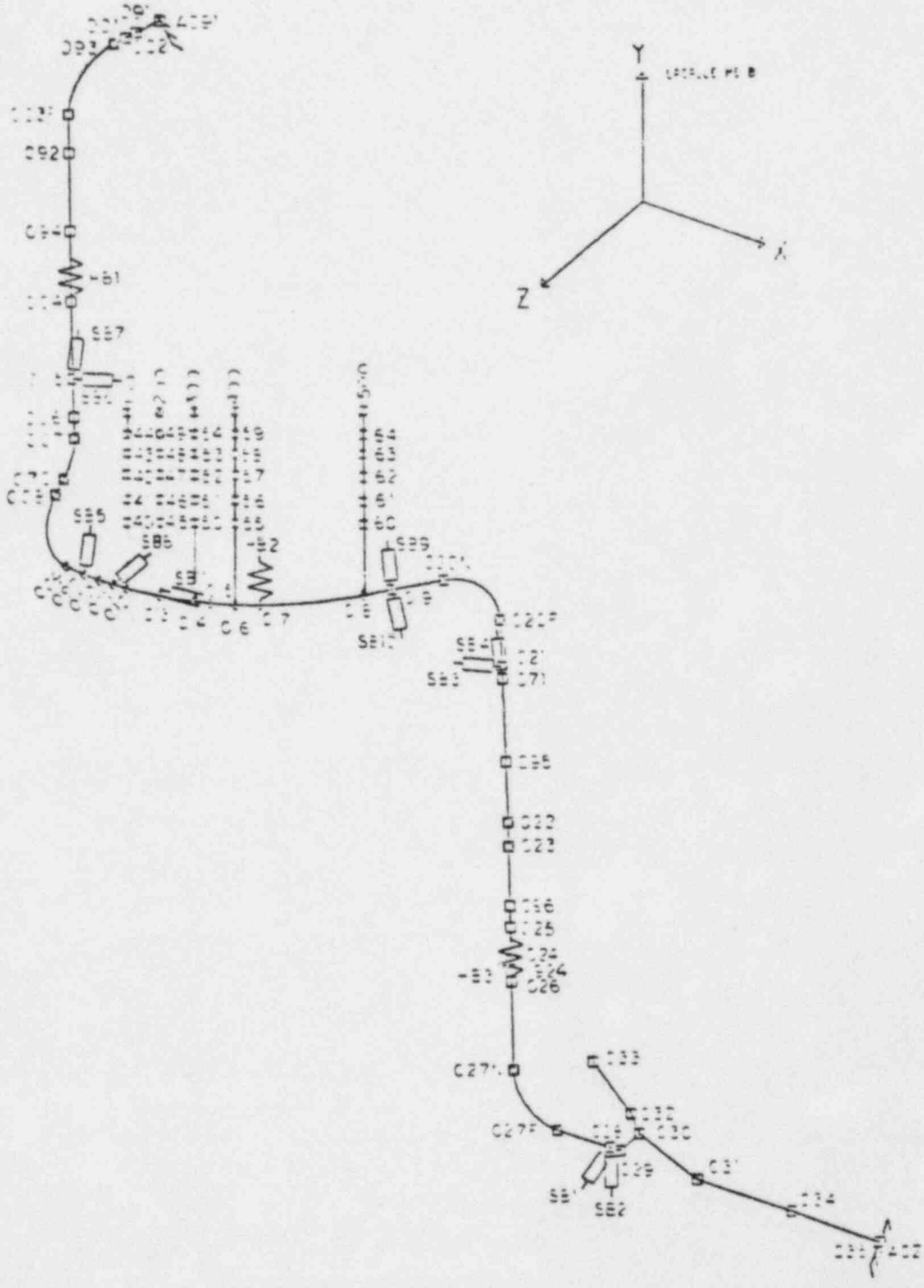
HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE A - MSIV INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,684 | 15,375 | 0.500 | MSIV Inlet (029) |
| Level B | 7,917 | 41,000 | 0.193 | MSIV Outlet (033) |
| Level C | 7,885 | 41,000 | 0.192 | MSIV Outlet (033) |
| Level D | 8,015 | 41,000 | 0.195 | MSIV Outlet (033) |
| Stress Due to Torsional Moment | | | | |
| Level A | 635 | 15,375 | 0.041 | MSIV Inlet (029) |
| Level B | 1,106 | 41,000 | 0.027 | MSIV Inlet (029) |
| Level C | 1,081 | 41,000 | 0.026 | MSIV Inlet (029) |
| Level D | 1,382 | 41,000 | 0.034 | MSIV Inlet (029) |
| Stress Due to Bending Moment | | | | |
| Level A | 3,101 | 15,375 | 0.202 | MSIV Inlet (029) |
| Level B | 4,295 | 41,000 | 0.105 | MSIV Inlet (029) |
| Level C | 4,699 | 41,000 | 0.115 | MSIV Inlet (029) |
| Level D | 5,388 | 41,000 | 0.131 | MSIV Inlet (029) |

Table 3-17B

HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE A - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,503 | 38,713 | 0.039 | MSIV Bonnet (031) |
| Level B | 2,638 | 38,713 | 0.068 | MSIV Bonnet (031) |
| Level C | 3,762 | 38,713 | 0.097 | MSIV Bonnet (031) |
| Level D | 4,085 | 38,713 | 0.106 | MSIV Bonnet (031) |
| Bending Moment (in-lbs) | | | | |
| Level A | 67,985 | 2,021,373 | 0.034 | MSIV Bonnet (031) |
| Level B | 469,798 | 2,021,373 | 0.232 | MSIV Bonnet (031) |
| Level C | 793,442 | 2,021,373 | 0.393 | MSIV Bonnet (031) |
| Level D | 944,195 | 2,021,373 | 0.467 | MSIV Bonnet (031) |




NODE DIAGRAM FOR LASALLE-2 MAIN STEAM LINE B

FIGURE 3-2

Table 3-18

HIGHEST STRESS SUMMARY - SRSS
MAIN STEAM LINE B

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress<br>Eq. 9 $\leq 1.5S_m$<br>Design Condition | 20,810 | 28,725 | 0.72 | Hanger Lug (026) |
| Primary Stress<br>Eq. 9 = $1.8S_m$ & $1.5S_y$<br>Service Level B | 21,546 | 34,470 | 0.63 | Hanger Lug (026) |
| Primary Stress<br>Eq. 9 $\leq 2.25S_m$ & $1.8S_y$<br>Service Level C | 22,079 | 40,950 | 0.54 | Sweepolet (060) |
| Primary Stress<br>Eq. 9 $\leq 3.0S_m$<br>Service Level D | 28,324 | 54,600 | 0.52 | Sweepolet (060) |
| Primary plus Secondary<br>Eq. 10 $\leq 3.0S_m$ | 45,342 | 54,600 | 0.83 | Sweepolet (060) |
| Secondary Stresses<br>Eq. 12 $\leq 3.0S_m$ | 20,745 | 53,100 | 0.39 | Elbow (020N) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 42,546 | 54,600 | 0.78 | Sweepolet (060) |
| Cumulative Usage Factor<br>U $\leq$ 1.0 | 0.08 | 1.0 | 0.08 | Sweepolet (055) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-19

HIGHEST STRESS SUMMARY - ABS
MAIN STEAM LINE B

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress Eq. 9 $\leq 1.5S_m$ Design Condition | 20,810 | 28,725 | 0.72 | Hanger Lug (026) |
| Primary Stress Eq. 9 $= 1.8S_m$ & $1.5S_y$ Service Level B | 21,839 | 32,760 | 0.67 | Sweepolet (060) |
| Primary Stress Eq. 9 $\leq 1.85S_m$ & $1.5S_y$ Service Level C | 26,672 | 40,950 | 0.65 | Sweepolet (060) |
| Primary Stress Eq. 9 $\leq 3.0S_m$ Service Level D | 33,100 | 54,600 | 0.61 | Sweepolet (060) |
| Primary plus Secondary Eq. 10 $\leq 3.0S_m$ | 52,453 | 54,600 | 0.96 | Sweepolet (060) |
| Secondary Stresses Eq. 12 $\leq 3.0S_m$ | 20,745 | 53,100 | 0.39 | Elbow, lower riser (020N) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 42,546 | 54,600 | 0.78 | Sweepolet (060) |
| Cumulative Usage Factor $U \leq 1.0$ | 0.08 | 1.0 | 0.08 | Sweepolet (055) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-20

SNUBBER LOADS - MAIN STEAM LINE B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 16,830 lb | 50,000 lb | 0.337 | SB11 |
| Level C | 19,809 lb | 66,500 lb | 0.298 | SB9 |
| Level D | 33,831 lb | 75,000 lb | 0.451 | SB11 |

Table 3-21

SNUBBER LOADS - MAIN STEAM LINE B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 23,514 lb | 50,000 lb | 0.470 | SB11 |
| Level C | 26,797 lb | 66,500 lb | 0.403 | SB9 |
| Level D | 44,575 lb | 75,000 lb | 0.594 | SB11 |

Table 3-22

SRV ACCELERATIONS - MAIN STEAM LINE B
HIGHEST ACCELERATIONS SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal | | | | |
| Level B | 2.5585 g | 5.0 g | 0.512 | SRV Inlet (063) |
| Level C | 2.9271 g | 5.0 g | 0.585 | SRV Inlet (063) |
| Level D | 3.0938 g | 5.0 g | 0.619 | SRV Inlet (063) |
| Vertical | | | | |
| Level B | 1.4531 g | 4.2 g | 0.346 | SRV Inlet (058) |
| Level C | 1.9789 g | 4.2 g | 0.471 | SRV Inlet (058) |
| Level D | 2.3215 g | 4.2 g | 0.553 | SRV Inlet (058) |

Table 3-23

SRV ACCELERATIONS - MAIN STEAM LINE B
HIGHEST ACCELERATIONS SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal | | | | |
| Level B | 3.2439 g | 5.0 g | 0.649 | SRV Inlet (063) |
| Level C | 3.9538 g | 5.0 g | 0.791 | SRV Inlet (063) |
| Level D | 4.8391 g | 5.0 g | 0.968 | SRV Inlet (063) |
| Vertical | | | | |
| Level B | 2.0405 g | 4.2 g | 0.486 | SRV Inlet (058) |
| Level C | 2.6616 g | 4.2 g | 0.634 | SRV Inlet (058) |
| Level D | 3.8038 g | 4.2 g | 0.906 | SRV Inlet (058) |

Table 3-24A

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE B - MSIV INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,688 | 15,375 | 0.500 | MSIV Outlet (031) |
| Level B | 7,794 | 41,000 | 0.190 | MSIV Outlet (031) |
| Level C | 7,806 | 41,000 | 0.190 | MSIV Outlet (031) |
| Level D | 7,872 | 41,000 | 0.192 | MSIV Outlet (031) |
| Stress Due to Torsional Moment | | | | |
| Level A | 149 | 15,375 | 0.010 | MSIV Inlet (029) |
| Level B | 375 | 41,000 | 0.009 | MSIV Inlet (029) |
| Level C | 414 | 41,000 | 0.010 | MSIV Inlet (029) |
| Level D | 573 | 41,000 | 0.014 | MSIV Inlet (029) |
| Stress Due to Bending Moment | | | | |
| Level A | 4,306 | 15,375 | 0.280 | MSIV Inlet (029) |
| Level B | 5,383 | 41,000 | 0.131 | MSIV Inlet (029) |
| Level C | 5,557 | 41,000 | 0.136 | MSIV Inlet (029) |
| Level D | 6,376 | 41,000 | 0.156 | MSIV Inlet (029) |

Table 3-24B

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE B - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,435 | 38,713 | 0.037 | MSIV Bonnet (032) |
| Level B | 2,619 | 38,713 | 0.068 | MSIV Bonnet (032) |
| Level C | 3,506 | 38,713 | 0.091 | MSIV Bonnet (032) |
| Level D | 4,300 | 38,713 | 0.111 | MSIV Bonnet (032) |
| Bending Moment (in-lbs) | | | | |
| Level A | 68,086 | 2,021,373 | 0.034 | MSIV Bonnet (032) |
| Level B | 312,267 | 2,021,373 | 0.154 | MSIV Bonnet (032) |
| Level C | 506,541 | 2,021,373 | 0.251 | MSIV Bonnet (032) |
| Level D | 683,164 | 2,021,373 | 0.338 | MSIV Bonnet (032) |

Table 3-25A

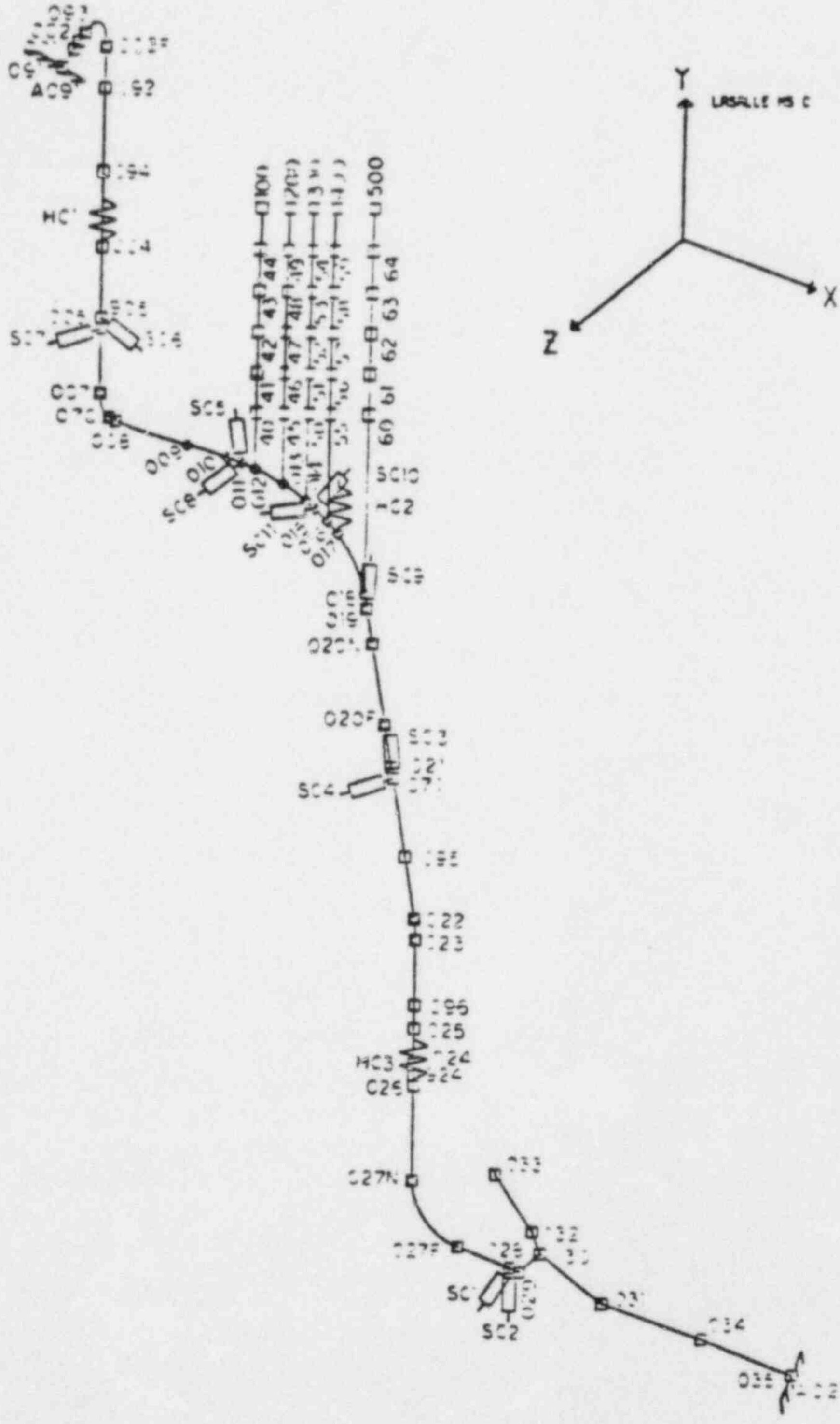
HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE B - MSIV INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,688 | 15,375 | 0.500 | MSIV Outlet (031) |
| Level B | 7,838 | 41,000 | 0.191 | MSIV Outlet (031) |
| Level C | 7,849 | 41,000 | 0.191 | MSIV Outlet (031) |
| Level D | 7,920 | 41,000 | 0.193 | MSIV Outlet (031) |
| Stress Due to Torsional Moment | | | | |
| Level A | 149 | 15,375 | 0.010 | MSIV Inlet (029) |
| Level B | 465 | 41,000 | 0.011 | MSIV Inlet (029) |
| Level C | 512 | 41,000 | 0.012 | MSIV Inlet (029) |
| Level D | 694 | 41,000 | 0.017 | MSIV Inlet (029) |
| Stress Due to Bending Moment | | | | |
| Level A | 4,306 | 15,375 | 0.280 | MSIV Inlet (029) |
| Level B | 5,802 | 41,000 | 0.141 | MSIV Inlet (029) |
| Level C | 6,054 | 41,000 | 0.148 | MSIV Inlet (029) |
| Level D | 6,848 | 41,000 | 0.167 | MSIV Inlet (029) |

Table 3-25B

HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE B - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,435 | 38,713 | 0.037 | MSIV Bonnet (032) |
| Level B | 2,883 | 38,713 | 0.074 | MSIV Bonnet (032) |
| Level C | 4,305 | 38,713 | 0.111 | MSIV Bonnet (032) |
| Level D | 4,608 | 38,713 | 0.119 | MSIV Bonnet (032) |
| Bending Moment (in-lbs) | | | | |
| Level A | 68,086 | 2,021,373 | 0.034 | MSIV Bonnet (032) |
| Level B | 410,617 | 2,021,373 | 0.203 | MSIV Bonnet (032) |
| Level C | 667,874 | 2,021,373 | 0.330 | MSIV Bonnet (032) |
| Level D | 807,969 | 2,021,373 | 0.400 | MSIV Bonnet (032) |




NODE DIAGRAM FOR LASALLE-2 MAIN STEAM LINE C

FIGURE 3-3

Table 3-26

HIGHEST STRESS SUMMARY - SRSS
MAIN STEAM LINE C

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress Eq. 9 $\leq 1.5S_m$ Design Condition | 20,772 | 28,725 | 0.72 | Hanger Lug (026) |
| Primary Stress Eq. 9 = $1.8S_m$ & $1.5S_y$ Service Level B | 21,536 | 34,470 | 0.62 | Hanger Lug (026) |
| Primary Stress Eq. 9 $\leq 2.25S_m$ & $1.8S_y$ Service Level C | 22,336 | 40,950 | 0.55 | Sweepolet (040) |
| Primary Stress Eq. 9 $\leq 3.0S_m$ Service Level D | 26,835 | 54,600 | 0.49 | Sweepolet (040) |
| Primary plus Secondary Eq. 10 $\leq 3.0S_m$ | 54,842 | 54,600 | 1.004** | Sweepolet (040) |
| Secondary Stresses Eq. 12 $\leq 3.0S_m$ | 22,769 | 54,600 | 0.42 | Sweepolet (040) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 38,584 | 54,600 | 0.71 | Sweepolet (040) |
| Cumulative Usage Factor U $\leq$ 1.0 | 0.17 | 1.0 | 0.17 | Sweepolet (040) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.
**Per NB-3653.6 Eq. 10 need not be satisfied for all load sets.

Table 3-27

HIGHEST STRESS SUMMARY - ABS
MAIN STEAM LINE C

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress<br>Eq. 9 $\leq 1.5S_m$<br>Design Condition | 20,772 | 28,725 | 0.72 | Hanger Lug (026) |
| Primary Stress<br>Eq. 9 = $1.8S_m$ & $1.5S_y$<br>Service Level B | 22,017 | 34,470 | 0.64 | Hanger Lug (026) |
| Primary Stress<br>Eq. 9 $\leq 2.25S_m$ & $1.8S_y$<br>Service Level C | 26,937 | 40,950 | 0.66 | Sweepolet (040) |
| Primary Stress<br>Eq. 9 $\leq 3.0S_m$<br>Service Level D | 31,808 | 54,600 | 0.58 | Sweepolet (040) |
| Primary plus Secondary<br>Eq. 10 $\leq 3.0S_m$ | 54,842 | 54,600 | 1.004** | Sweepolet (040) |
| Secondary Stresses<br>Eq. 12 $\leq 3.0S_m$ | 22,769 | 54,600 | 0.42 | Sweepolet (040) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 38,584 | 54,600 | 0.71 | Sweepolet (040) |
| Cumulative Usage Factor<br>U $\leq$ 1.0 | 0.17 | 1.0 | 0.17 | Sweepolet (040) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.
**Per NB-3653.6 Eq. 10 need not be satisfied for all load sets.

Table 3-28

SNUBBER LOADS - MAIN STEAM LINE C
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 20,212 | 50,000 | 0.404 | SC11 |
| Level C | 15,427 | 66,500 | 0.232 | SC9 |
| Level D | 34,027 | 75,000 | 0.454 | SC11 |

## Table 3-29

SNUBBER LOADS - MAIN STEAM LINE C
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 28,401 | 50,000 | 0.568 | SC11 |
| Level C | 21,059 | 66,500 | 0.317 | SC9 |
| Level D | 44,199 | 75,000 | 0.589 | SC11 |

Table 3-30

SRV ACCELERATIONS - MAIN STEAM LINE C
HIGHEST ACCELERATIONS SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal Acceleration | | | | |
| Level B | 1.6791 g | 5.0 g | 0.336 | SRV Inlet (048) |
| Level C | 1.9057 g | 5.0 g | 0.381 | SRV Inlet (048) |
| Level D | 2.0392 g | 5.0 g | 0.408 | SRV Inlet (048) |
| Vertical Acceleration | | | | |
| Level B | 0.7089 g | 4.2 g | 0.169 | SRV Inlet (058) |
| Level C | 1.4549 g | 4.2 g | 0.346 | SRV Inlet (058) |
| Level D | 1.4792 g | 4.2 g | 0.352 | SRV Inlet (058) |

Table 3-31

SRV ACCELERATIONS - MAIN STEAM LINE C
HIGHEST ACCELERATIONS SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal Acceleration | | | | |
| Level B | 2.1325 g | 5.0 g | 0.427 | SRV Inlet (048) |
| Level C | 2.6536 g | 5.0 g | 0.531 | SRV Inlet (063) |
| Level D | 3.1933 g | 5.0 g | 0.639 | SRV Inlet (063) |
| Vertical Acceleration | | | | |
| Level B | 0.9239 g | 4.2 g | 0.220 | SRV Inlet (058) |
| Level C | 1.9548 g | 4.2 g | 0.465 | SRV Inlet (058) |
| Level D | 2.2222 g | 4.2 g | 0.529 | SRV Inlet (058) |

Table 3-32A

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE C - MSIV INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,679 | 15,375 | 0.499 | MSIV Outlet (031) |
| Level B | 7,769 | 41,000 | 0.189 | MSIV Outlet (031) |
| Level C | 7,782 | 41,000 | 0.190 | MSIV Outlet (031) |
| Level D | 7,867 | 41,000 | 0.192 | MSIV Outlet (031) |
| Stress Due to Torsional Moment | | | | |
| Level A | 191 | 15,375 | 0.012 | MSIV Outlet (031) |
| Level B | 442 | 41,000 | 0.011 | MSIV Inlet (029) |
| Level C | 503 | 41,000 | 0.012 | MSIV Inlet (029) |
| Level D | 655 | 41,000 | 0.016 | MSIV Inlet (029) |
| Stress Due to Bending Moment | | | | |
| Level A | 3,984 | 15,375 | 0.259 | MSIV Inlet (029) |
| Level B | 5,318 | 41,000 | 0.130 | MSIV Inlet (029) |
| Level C | 5,205 | 41,000 | 0.127 | MSIV Inlet (029) |
| Level D | 6,229 | 41,000 | 0.152 | MSIV Inlet (029) |

Table 3-32B

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE C - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,435 | 38,713 | 0.037 | MSIV Bonnet (032) |
| Level B | 2,272 | 38,713 | 0.059 | MSIV Bonnet (032) |
| Level C | 2,895 | 38,713 | 0.075 | MSIV Bonnet (032) |
| Level D | 3,470 | 38,713 | 0.090 | MSIV Bonnet (032) |
| Bending Moment (in-lbs) | | | | |
| Level A | 68,086 | 2,021,373 | 0.034 | MSIV Bonnet (032) |
| Level B | 303,498 | 2,021,373 | 0.150 | MSIV Bonnet (032) |
| Level C | 449,418 | 2,021,373 | 0.222 | MSIV Bonnet (032) |
| Level D | 613,945 | 2,021,373 | 0.304 | MSIV Bonnet (032) |

Table 3-33A

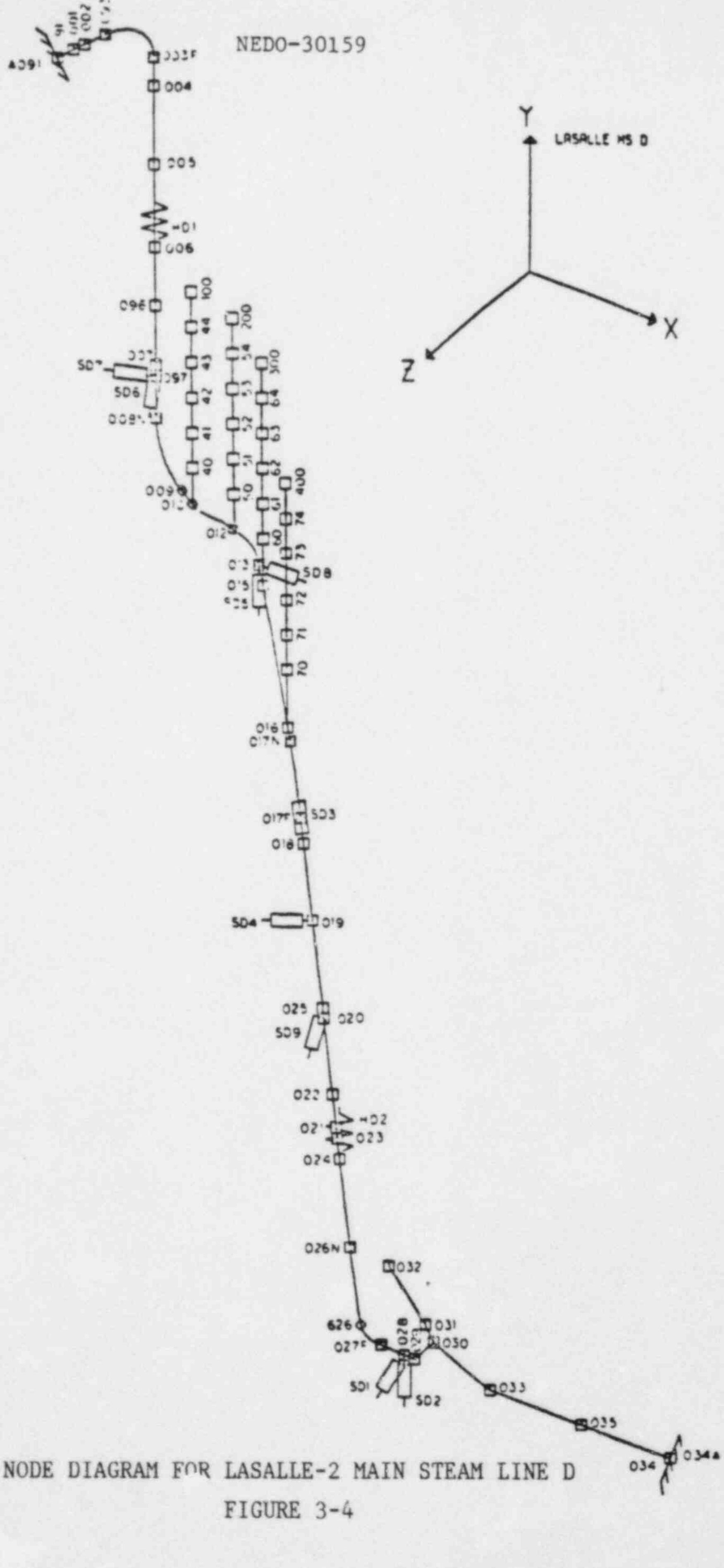
HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE C - MSIV INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,679 | 15,375 | 0.499 | MSIV Outlet (031) |
| Level B | 7,805 | 41,000 | 0.190 | MSIV Outlet (031) |
| Level C | 7,820 | 41,000 | 0.191 | MSIV Outlet (031) |
| Level D | 7,925 | 41,000 | 0.193 | MSIV Outlet (031) |
| Stress Due to Torsional Moment | | | | |
| Level A | 191 | 15,375 | 0.012 | MSIV Outlet (031) |
| Level B | 542 | 41,000 | 0.013 | MSIV Inlet (029) |
| Level C | 613 | 41,000 | 0.015 | MSIV Inlet (029) |
| Level D | 822 | 41,000 | 0.020 | MSIV Inlet (029) |
| Stress Due to Bending Moment | | | | |
| Level A | 3,984 | 15,375 | 0.259 | MSIV Inlet (029) |
| Level B | 5,849 | 41,000 | 0.143 | MSIV Inlet (029) |
| Level C | 5,691 | 41,000 | 0.139 | MSIV Inlet (029) |
| Level D | 6,961 | 41,000 | 0.170 | MSIV Inlet (029) |

Table 3-33B

HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE C - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,435 | 38,713 | 0.037 | MSIV Bonnet (032) |
| Level B | 2,554 | 38,713 | 0.066 | MSIV Bonnet (032) |
| Level C | 3,439 | 38,713 | 0.080 | MSIV Bonnet (032) |
| Level D | 3,806 | 38,713 | 0.098 | MSIV Bonnet (032) |
| Bending Moment (in-lbs) | | | | |
| Level A | 68,086 | 2,021,373 | 0.034 | MSIV Bonnet (032) |
| Level B | 404,895 | 2,021,373 | 0.200 | MSIV Bonnet (032) |
| Level C | 588,271 | 2,021,373 | 0.291 | MSIV Bonnet (032) |
| Level D | 752,252 | 2,021,373 | 0.372 | MSIV Bonnet (032) |




NODE DIAGRAM FOR LASALLE-2 MAIN STEAM LINE D

FIGURE 3-4

Table 3-34

HIGHEST STRESS SUMMARY - SRSS
MAIN STEAM LINE D

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress Eq. 9 $\leq 1.5S_m$ Design Condition | 24,060 | 28,725 | 0.84 | Hanger Lug (024) |
| Primary Stress Eq. 9 = $1.8S_m$ & $1.5S_y$ Service Level B | 25,501 | 34,470 | 0.74 | Hanger Lug (024) |
| Primary Stress Eq. 9 $\leq 2.25S_m$ & $1.8S_y$ Service Level C | 24,906 | 43,088 | 0.58 | Hanger Lug (024) |
| Primary Stress Eq. 9 $\leq 3.0S_m$ Service Level D | 26,768 | 57,450 | 0.47 | Hanger Lug (024) |
| Primary plus Secondary Eq. 10 $\leq 3.0S_m$ | 46,306 | 54,600 | 0.85 | Sweepolet (060) |
| Secondary Stresses Eq. 12 $\leq 3.0S_m$ | 18,947 | 53,100 | 0.36 | Elbow (093) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 34,678 | 54,600 | 0.64 | Sweepolet (050) |
| Cumulative Usage Factor U $\leq 1.0$ | 0.04 | 1.0 | 0.04 | Sweepolet (040) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-35

HIGHEST STRESS SUMMARY - ABS
MAIN STEAM LINE D

| Item Evaluated* | Highest Calculated Stress (psi)/ Usage Factor | Allowable Limits (psi) | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress Eq. 9 $\leq 1.5S_m$ Design Condition | 24,060 | 28,725 | 0.84 | Hanger Lug (024) |
| Primary Stress Eq. 9 = $1.8S_m$ & $1.5S_y$ Service Level B | 26,205 | 34,470 | 0.76 | Hanger Lug (024) |
| Primary Stress Eq. 9 $\leq 2.25S_m$ & $1.8S_y$ Service Level C | 25,444 | 43,088 | 0.59 | Hanger Lug (024) |
| Primary Stress Eq. 9 $\leq 3.0S_m$ Service Level D | 27,338 | 57,450 | 0.48 | Hanger Lug (024) |
| Primary plus Secondary Eq. 10 $\leq 3.0S_m$ | 46,306 | 54,600 | 0.85 | Sweepolet (060) |
| Secondary Stresses Eq. 12 $\leq 3.0S_m$ | 18,947 | 53,100 | 0.36 | Elbow (093) |
| Primary plus Secondary Stress without Thermal Expansion, Eq. 13 $\leq 3.0S_m$ | 34,678 | 54,600 | 0.64 | Sweepolet (050) |
| Cumulative Usage Factor U $\leq$ 1.0 | 0.04 | 1.0 | 0.04 | Sweepolet (040) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-36

SNUBBER LOADS - MAIN STEAM LINE D
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 25,371 | 50,000 | 0.507 | SD1 |
| Level C | 20,047 | 66,500 | 0.301 | SD1 |
| Level D | 48,568 | 75,000 | 0.648 | SD1 |

Table 3-37

SNUBBER LOADS - MAIN STEAM LINE D
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load (lb) | Allowable Limits (lb) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 35,575 | 50,000 | 0.711 | SD1 |
| Level C | 28,313 | 66,500 | 0.426 | SD1 |
| Level D | 57,720 | 75,000 | 0.770 | SD1 |

Table 3-38

SRV ACCELERATIONS - MAIN STEAM LINE D
HIGHEST ACCELERATIONS SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal | | | | |
| Level B | 1.9088 g | 5.0 g | 0.382 | SRV Inlet (073) |
| Level C | 2.0477 g | 5.0 g | 0.410 | SRV Inlet (073) |
| Level D | 2.2683 g | 5.0 g | 0.454 | SRV Inlet (073) |
| Vertical | | | | |
| Level B | 0.6110 g | 4.2 g | 0.145 | SRV Inlet (073) |
| Level C | 1.0403 g | 4.2 g | 0.248 | SRV Inlet (043) |
| Level D | 1.1554 g | 4.2 g | 0.275 | SRV Inlet (043) |

Table 3-39

SRV ACCELERATIONS - MAIN STEAM LINE D
HIGHEST ACCELERATIONS SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Horizontal Acceleration | | | | |
| Level B | 2.5803 g | 5.0 g | 0.516 | SRV Inlet (073) |
| Level C | 2.8595 g | 5.0 g | 0.572 | SRV Inlet (073) |
| Level D | 3.7962 g | 5.0 g | 0.759 | SRV Inlet (073) |
| Vertical Acceleration | | | | |
| Level B | 0.8429 g | 4.2 g | 0.201 | SRV Inlet (073) |
| Level C | 1.4195 g | 4.2 g | 0.338 | SRV Inlet (043) |
| Level D | 1.7160 g | 4.2 g | 0.409 | SRV Inlet (073) |

Table 3-40A

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE D - INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,686 | 15,375 | 0.500 | MSIV Inlet (029) |
| Level B | 7,954 | 41,000 | 0.194 | MSIV Outlet (033) |
| Level C | 7,824 | 41,000 | 0.191 | MSIV Outlet (033) |
| Level D | 7,953 | 41,000 | 0.194 | MSIV Outlet (033) |
| Stress Due to Torsional Moment | | | | |
| Level A | 607 | 15,375 | 0.039 | MSIV Inlet (029) |
| Level B | 1,080 | 41,000 | 0.026 | MSIV Outlet (033) |
| Level C | 882 | 41,000 | 0.022 | MSIV Outlet (033) |
| Level D | 1,359 | 41,000 | 0.033 | MSIV Outlet (033) |
| Stress Due to Bending Movement | | | | |
| Level A | 3,118 | 15,375 | 0.203 | |
| Level B | 4,188 | 41,000 | 0.102 | MSIV Inlet (029) |
| Level C | 4,087 | 41,000 | 0.100 | MSIV Inlet (029) |
| Level D | 4,981 | 41,000 | 0.121 | MSIV Inlet (029) |

Table 3-40B

HIGHEST LOADING SUMMARY - SRSS
MAIN STEAM LINE D - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,503 | 38,713 | 0.039 | MSIV Bonnet (031) |
| Level B | 2,507 | 38,713 | 0.065 | MSIV Bonnet (031) |
| Level C | 3,407 | 38,713 | 0.088 | MSIV Bonnet (031) |
| Level D | 4,009 | 38,713 | 0.104 | MSIV Bonnet (031) |
| Bending Moment (in-lbs) | | | | |
| Level A | 67,985 | 2,021,373 | 0.034 | MSIV Bonnet (031) |
| Level B | 338,065 | 2,021,373 | 0.167 | MSIV Bonnet (031) |
| Level C | 524,764 | 2,021,373 | 0.260 | MSIV Bonnet (031) |
| Level D | 715,004 | 2,021,373 | 0.354 | MSIV Bonnet (031) |

Table 3-41A

HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE D - INLET/OUTLET

| Item Evaluated | Highest Calculated Load (psi) | Allowable Limits (psi) | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Stress Due to Axial Force | | | | |
| Level A | 7,686 | 15,375 | 0.500 | MSIV Inlet (029) |
| Level B | 8,009 | 41,000 | 0.195 | MSIV Outlet (033) |
| Level C | 7,875 | 41,000 | 0.192 | MSIV Outlet (033) |
| Level D | 8,005 | 41,000 | 0.195 | MSIV Outlet (033) |
| Stress Due to Torsional Moment | | | | |
| Level A | 607 | 15,375 | 0.039 | MSIV Inlet (029) |
| Level B | 1,255 | 41,000 | 0.031 | MSIV Outlet (033) |
| Level C | 996 | 41,000 | 0.024 | MSIV Outlet (033) |
| Level D | 1,495 | 41,000 | 0.036 | MSIV Outlet (033) |
| Stress Due to Bending Moment | | | | |
| Level A | 3,118 | 15,375 | 0.203 | MSIV Inlet (029) |
| Level B | 4,627 | 41,000 | 0.113 | MSIV Inlet (029) |
| Level C | 4,490 | 41,000 | 0.110 | MSIV Inlet (029) |
| Level D | 5,376 | 41,000 | 0.131 | MSIV Inlet (029) |

Table 3-41B

HIGHEST LOADING SUMMARY - ABS
MAIN STEAM LINE D - MSIV BONNET

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Axial Force (lb) | | | | |
| Level A | 1,503 | 38,713 | 0.039 | MSIV Bonnet (031) |
| Level B | 2,813 | 38,713 | 0.073 | MSIV Bonnet (031) |
| Level C | 4,094 | 38,713 | 0.106 | MSIV Bonnet (031) |
| Level D | 4,474 | 38,713 | 0.116 | MSIV Bonnet (031) |
| Bending Moment (in-lbs) | | | | |
| Level A | 67,985 | 2,021,373 | 0.034 | MSIV Bonnet (031) |
| Level B | 448,797 | 2,021,373 | 0.222 | MSIV Bonnet (031) |
| Level C | 694,967 | 2,021,373 | 0.343 | MSIV Bonnet (031) |
| Level D | 857,850 | 2,021,373 | 0.424 | MSIV Bonnet (031) |

## 3.3 RECIRCULATION PIPING SYSTEM EVALUATION RESULTS

### 3.3.1 Recirculation Piping

The stress analysis for recirculation piping loops A and B was performed using the verified "as-built" configuration as submitted to GE. The load combinations listed in Tables 3-42 and 3-43 were used as the basis for the evaluation. Stresses were combined using both the SRSS and ABS methods of summation.

Tables 3-53, 3-54, 3-67 and 3-68 provide highest stress summaries for the Design Condition and Service Levels B, C and D loading conditions using both SRSS and ABS methods of summation. The highest calculated stresses were below the ASME Code allowable limits. The stress analysis performed demonstrated that the recirculation piping was designed and supported to withstand the applied loads as given in the applicable design specifications. ASME Code certified stress reports were prepared and issued reflecting the results of the analysis performed (References 28 and 29, Appendix A).

The recirculation piping system, which is required to function for safe shutdown under the postulated events, has been evaluated and proven adequate in meeting the functional capability requirements per NEDO-21985, Piping Functional Capability Criteria.

Node diagrams for Recirculation Loops A and B are provided for reference in Figures 3-5 and 3-6, respectively.

### 3.3.2 Recirculation Snubbers

The analysis performed demonstrated that the calculated loads on the recirculation snubbers were below the allowable limits, verifying their capability to meet the design criteria. The load combinations listed in Tables 3-44 and 3-45 were used as the basis for the evaluation. Loads were combining using both SRSS and ABS methods of summation.

Tables 3-55, 3-56, 3-69 and 3-70 provide the highest loading summaries for Service Levels B, C and D loading conditions using both SRSS and ABS methods of summation. Initially, where snubber loads exceeded nominal ratings provided on the suspension purchase part drawings, subsequent snubber acceptability was demonstrated using actual manufacturer ratings based upon test results.

### 3.3.3 Recirculation Suction Gate Valves, Discharge Gate Valves and Flow Control Valves

The analyses performed demonstrated that the calculated accelerations on the suction gate valves, discharge gate valves and flow control valves were in all cases below the allowable SRSS limits. The load combinations listed in Tables 3-48 through 3-51 were used as the basis for the evaluation. Accelerations were combined using both SRSS and ABS methods of summation.

Tables 3-57 through 3-62 and 3-71 through 3-76 provide the highest acceleration loading summaries for the loading conditions evaluated using both SRSS and ABS methods of summation.

### 3.3.4 Recirculation Pumps and Motors

The analysis performed demonstrated that the calculated accelerations, attachment loads and cyclic loads on the recirculation pumps and motors were below the allowable limits. The load combinations listed in Tables 3-48 and 3-49 were used as the basis for the evaluation. Loads were combined using both SRSS and ABS methods of summation.

Tables 3-63 through 3-66 and 3-77 through 3-80 provide the highest acceleration loading summaries for the service level loading conditions evaluated using both SRSS and ABS methods of summation.

As a result of the recirculation pump and motor analysis performed, one pump motor hardware modification was required. The analysis identified the need to upgrade the load carrying capability of the outer motor lugs on both Loops A and B pump motors by the addition of gussets. A Field Disposition Instruction

(FDI) was issued to implement the design modification. The recirculation pump and motor analysis incorporated the pump motor lug modification. The analysis verified the pump and motor's capability to withstand the applied loads for the loading combinations evaluated.

### 3.3.5 Recirculation Pipe Break Analysis

A pipe break analysis was performed on the recirculation loop pipe whip restraints. As a result of the analysis pipe whip restraints, R3, R4 and R5 were classified as inactive. A summary of the analysis is contained in the issued Pipe Whip Restraint Design Report and the interface control drawing (MPL B33-G003).

Table 3-42

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - SRSS

PIPING

| | | | | |
|---|---|---|---|---|
| DESIGN | 1 | PD + WT1 | + | OBEI |
| LEVEL B | 1 | PP + WT1 | + | SQRT((OBEI )**2 + ( RV2I )**2 ) |
| LEVEL B | 2 | PP + WT1 | + | SQRT((OBEI )**2 + ( RV2I )**2 ) |
| LEVEL C | 1 | PP + WT1 | + | SQRT((CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL C | 2 | PP + WT1 | + | RV2I |
| LEVEL D | 1 | PP + WT1 | + | SQRT((SSEI )**2 + ( RV2I )**2 ) |
| LEVEL D | 2 | PP + WT1 | + | SQRT((SSEI )**2 + ( CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL D | 3 | PP + WT1 | + | COND I + SQRT((SSEI )**2 + ( RV2I )**2 ) |
| LEVEL D | 4 | PP + WT1 | + | SQRT((SSEI )**2 + ( API )**2 ) |

Table 3-43

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - ABS

PIPING

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DESIGN | 1 | PD + WT1 | + | OBEI | | | | | |
| LEVEL B | 1 | PP + WT1 | + | OBEI | + | RV2I | | | |
| LEVEL B | 2 | PP + WT1 | + | OBEI | + | RV2I | | | |
| LEVEL C | 1 | PP + WT1 | + | CHUGI | + | RV2I | | | |
| LEVEL C | 2 | PP + WT1 | + | RV2I | | | | | |
| LEVEL D | 1 | PP + WT1 | + | SSEI | + | RV2I | | | |
| LEVEL D | 2 | PP + WT1 | + | SSEI | + | CHUGI | + | RV2I | |
| LEVEL D | 3 | PP + WT1 | + | COND I | + | SSEI | + | RV2I | |
| LEVEL D | 4 | PP + WT1 | + | SSEI | + | API | | | |

Table 3-44

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - SRSS

SNUBBERS

| | | |
|---|---|---|
| LEVEL B | 1 | SQRT((OBEI + OBED )**2 + ( RV2I RV2D )**2 ) |
| LEVEL C | 1 | SQRT((CHUGI + CHUGD )**2 + ( RV2I RV2D )**2 ) |
| LEVEL D | 1 | SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + ( RV2I + RV2D )**2) |
| LEVEL D | 2 | COND I + COND D + SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 3 | SQRT((SSEI + SSED )**2 + ( API + APD )**2 ) |
| LEVEL D | 4 | SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |

Table 3-45

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - ABS

SNUBBERS

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL B | 1 | OBEI | + | OBED | + | RV2I | + | RV2D | | | | | |
| LEVEL C | 1 | CHUGI | + | CHUGD | + | RV2I | + | RV2D | | | | | |
| LEVEL D | 1 | SSEI | + | SSED | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D |
| LEVEL D | 2 | COND I | + | COND D | + | SSEI | + | SSED | + | RV2I | + | RV2D |
| LEVEL D | 3 | SSEI | + | SSED | + | API | + | APD | | | | | |
| LEVEL D | 4 | SSEI | + | SSED | + | RV2I | + | RV2D | | | | | |

Table 3-46

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - SRSS

STRUTS

| | | |
|---|---|---|
| LEVEL B | 1 | WT1 + TE + SQRT((OBEI + OBED )**2 + ( RC2I + RV2D )**2 ) + WT2 |
| LEVEL C | 1 | WT1 + TE + SQRT((CHUGI + CHUGD )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 1 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + (RV2I + RV2D)**2) |
| LEVEL D | 2 | WT1 + TE + COND I + COND D + SQRT((SSEI + SSED ) **2 + (RV2I + RV2D)**2) |
| LEVEL D | 3 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( API + APD )**2 ) |
| LEVEL D | 4 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |

Table 3-47

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - ABS

STRUTS

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL B | 1 | WT1 | + | TE | + | OBEI | + | OBED | + | RV2I | + | RV2D | + | WT2 | | |
| LEVEL C | 1 | WT1 | + | TE | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D | + | TSV | | |
| LEVEL D | 1 | WT1 | + | TE | + | SSEI | + | SSED | + | CHUGI | + | CHUGD | | RV2I | + | RV2D |
| LEVEL D | 2 | WT1 | + | TE | + | COND I | + | COND D | + | SSEI | + | SSED | + | RV2I | + | RV2D |
| LEVEL D | 3 | WT1 | + | TE | + | SSEI | + | SSED | + | API | + | APD | + | | | |
| LEVEL D | 4 | WT1 | + | TE | + | SSEI | + | SSED | + | RV2I | + | RV2D | | | | |

Table 3-48

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - SRSS

VALVES, PUMPS AND MOTORS

| | | |
|---|---|---|
| LEVEL B | 1 | SQRT((OBEI )**2 + ( RV2I )**2 ) |
| LEVEL C | 1 | SQRT((CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL D | 1 | SQRT((SSEI )**2 + ( CHUGI )**2 + ( RV2I )**2 ) |
| LEVEL D | 2 | COND I + SQRT((SSEI )**2 + ( RV2I )**2 ) |
| LEVEL D | 3 | SQRT((SSEI )**2 + ( API )**2 ) |
| LEVEL D | 4 | SQRT((SSEI )**2 + ( RV2I )**2 ) |

Table 3-49

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - ABS

VALVES, PUMPS AND MOTORS

| | | | | | | |
|---|---|---|---|---|---|---|
| LEVEL B | 1 | OBEI | + | RV2I | | |
| LEVEL C | 1 | CHUGI | + | RV2I | | |
| LEVEL D | 1 | SSEI | + | CHUGI | + | RV2I |
| LEVEL D | 2 | COND I | + | SSEI | + | RV2I |
| LEVEL D | 3 | SSEI | + | API | | |
| LEVEL D | 4 | SSEI | + | RV2I | | |

Table 3-50

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - SRSS

FLANGE MOMENTS

| | | |
|---|---|---|
| DESIGN | 1 | WT1 + TE + |
| LEVEL B | 1 | WT1 + TE + SQRT((OBEI + OBED )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL C | 1 | WT1 + TE + SQRT((CHUGI + CHUGD )**2 + ( RV2I + RV2D )**2 ) |
| LEVEL D | 1 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( CHUGI + CHUGD )**2 + (RV2I + RV2D)**2) |
| LEVEL D | 2 | WT1 + TE + COND I + COND D + SQRT((SSEI + SSED ) **2 + (RV2I + RV2D)**2) |
| LEVEL D | 3 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( API + APD )**2 ) |
| LEVEL D | 4 | WT1 + TE + SQRT((SSEI + SSED )**2 + ( RV2I + RV2D )**2 ) |

Table 3-51

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT
RECIRCULATION - ABS

FLANGE MOMENTS

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN | 1 | WT1 | + | TE | | | | | | | | | | | | |
| LEVEL B | 1 | WT1 | + | TE | + | OBEI | + | OBED | + | RV2I | + | RV2D | | | | |
| LEVEL C | 1 | WT1 | + | TE | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D | | | | |
| LEVEL D | 1 | WT1 | + | TE | + | SSEI | + | SSED | + | CHUGI | + | CHUGD | + | RV2I | + | RV2D |
| LEVEL D | 2 | WT1 | + | TE | + | COND I | + | COND D | + | SSEI | + | SSED | + | RV2I | + | RV2D |
| LEVEL D | 3 | WT1 | + | TE | + | SSEI | + | SSED | + | API | + | APD | | | | |
| LEVEL D | 4 | WT1 | + | TE | + | SSEI | + | SSED | + | RV2I | + | RV2D | | | | |

Table 3-52

LOAD COMBINATION AND ACCEPTANCE CRITERIA FOR
NSSS PIPING AND PIPE-MOUNTED EQUIPMENT

NOMENCLATURE OF LOADS

| | | |
|---|---|---|
| API | = | Annulus Pressurization Loads (Inertial Effect) |
| APD | = | Annulus Pressurization Loads (Anchor Displacement Loads) |
| CHUGI | = | Chugging Load (Inertia Effect) |
| CHUGD | = | Chugging Load (Anchor Displacement Loads) |
| COND I | = | Condensation Oscillation (Inertia Effect) |
| COND D | = | Condensation Oscillation (Anchor Displacement Effects) |
| OBEI | = | Operating Basis Earthquake (Inertia Effect) |
| OBED | = | Operating Basis Earthquake (Anchor Displacement Load) |
| PO | = | Operating Pressure |
| PD | = | Design Pressure |
| PP | = | Peak pressure |
| PPATWS | = | Peak Pressure Due Automatic Transient Without Scram Event |
| RV1 | = | Safety Relief Valve Opening Loads (Acoustic Wave) |
| RV2I | = | Safety Relief Valve Basemat Acceleration Loads (Inertia Effect) |
| RV2D | = | Safety Relief Valve Basemat Accelerations Loads (Anchor Displacement Loads) |
| RV2ADI | = | Safety/Relief Valve Basemat Acceleration Due to Automatic Depressurization System Valves |
| RV2ADD | = | Safety/Relief Valve Basemat Acceleration Due to Automatic Depressurization System Valves (Anchor Displacement Loads) |
| SSEI | = | Safe Shutdown Earthquake (Inertia Effect) |
| SSED | = | Safe Shutdown Earthquake (Anchor Displacement Loads) |
| TE | = | Thermal Expansion |
| TSV | = | Turbine Stop Valve Closure Loads |
| VLCI | = | Vent Line Clearing Loads (Inertia Effect) |
| VLCD | = | Vent Line Clearing Loads (Anchor Displacement Loads) |
| WT1 | = | Dead Weight |
| RV2SVI | = | Safety/Relief Valve Basemat Acceleration Loads Due to a Single Valve Opening (Inertia Effect) |
| RV2SVD | = | Safety/Relief Valve Basemat Acceleration Loads Due to a Single Valve Opening (Anchor Displacement Loads) |

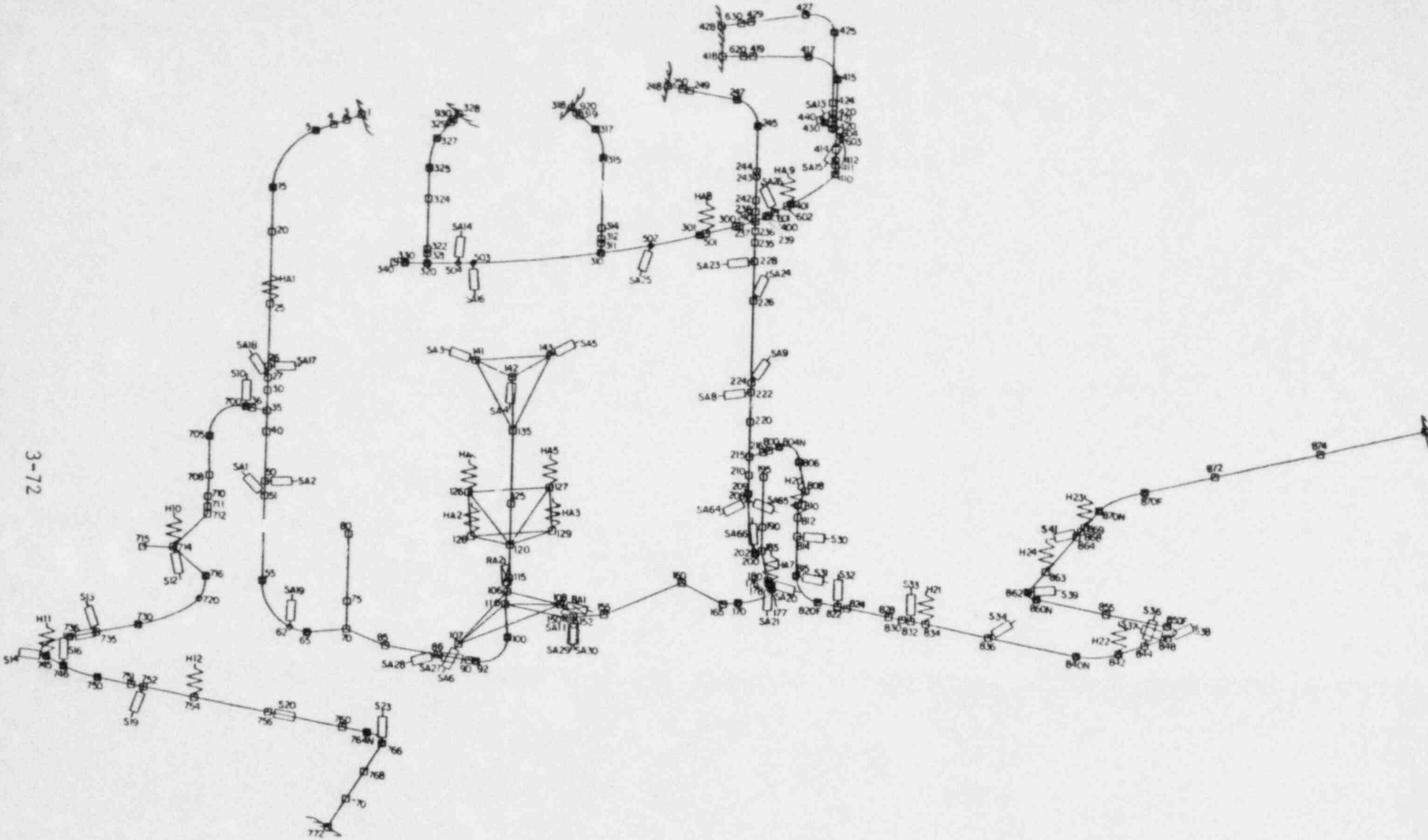



Figure 3-5. LaSalle Recirculation Loop A Node Diagram

Table 3-53

HIGHEST STRESS SUMMARY - SRSS
RECIRCULATION LOOP A

| Item Evaluated* | Highest Calculated Stress/ Usage Factor | Allowable Limits | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress<br>Eq. 9 $\leq 1.5S_m$<br>Design Condition | 16,813 psi | 25,005 psi | 0.65 | Reducer (242) |
| Primary Stress<br>Eq. 9 = $1.8S_m$ & $1.5S_y$<br>Service Level B | 19,055 psi | 28,596 psi | 0.67 | Snubber Lug (090) |
| Primary Stress<br>Eq. 9 $\leq 2.25S_m$ & $1.8S_y$<br>Service Level C | 20,367 psi | 34,315 psi | 0.59 | Snubber Lug (090) |
| Primary Stress<br>Eq. 9 $\leq 3.0S_m$<br>Service Level D | 26,415 psi | 50,010 psi | 0.53 | Snubber Lug (090) |
| Secondary Stresses<br>Eq. 12 $\leq 3.0S_m$ | 30,743 psi | 50,010 psi | 0.61 | Sweepolet (410) |
| Primary plus Secondary Stress without Thermal Expansion<br>Eq. 13 $\leq 3.0S_m$ | 42,025 psi | 50,010 psi | 0.84 | Sweepolet (310) |
| Cumulative Usage Factor<br>U $\leq$ 1.0 | 0.28 | 1.0 | 0.28 | Sweepolet (410) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-54

HIGHEST STRESS SUMMARY - ABS
RECIRCULATION LOOP A

| Item Evaluated* | Highest Calculated Stress/ Usage Factor | Allowable Limits | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress Eq. 9 $\leq 1.5S_m$ Design Condition | 16,831 psi | 25,005 psi | 0.67 | Reducer (242) |
| Primary Stress Eq. 9 = $1.8S_m$ & $1.5S_y$ Service Level B | 23,341 psi | 28,596 psi | 0.82 | Snubber Lug (090) |
| Primary Stress Eq. 9 $\leq 2.25S_m$ & $1.8S_y$ Service Level C | 24,952 psi | 34,315 psi | 0.73 | Snubber Lug (090) |
| Primary Stress Eq. 9 $\leq 3.0S_m$ Service Level D | 33,393 psi | 50,010 psi | 0.67 | Snubber Lug (090) |
| Secondary Stresses Eq. 12 $\leq 3.0S_m$ | 30,743 psi | 50,010 psi | 0.61 | Sweepolet (410) |
| Primary plus Secondary Stress without Thermal Expansion Eq. 13 $\leq 3.0S_m$ | 42,025 psi | 50,010 psi | 0.84 | Sweepolet (310) |
| Cumulative Usage Factor U $\leq$ 1.0 | 0.30 | 1.0 | 0.30 | Sweepolet (410) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-55

SNUBBER LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 31,772 lb | 50,000 lb | 0.635 | SA65 |
| Level C | 41,026 lb | 66,500 lb | 0.617 | SA65 |
| Level D | 54,003 lb | 75,000 lb | 0.72 | SA65 |

Table 3-56

SNUBBER LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 44,687 lb | 50,000 lb | 0.894 | SA65 |
| Level C | 55,171 lb | 66,500 lb | 0.830 | SA65 |
| Level D | 75,929 lb | 75,000 lb Nom | | SA65 |
| | | 91,000 lb Test | 0.834 | |

Table 3-57

SUCTION GATE VALVE LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 5.45 g | 10.6 g | 0.514 | Operator |
| Vertical | 1.11 g | 4.0 g | 0.277 | Operator |

Table 3-58

SUCTION GATE VALVE LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 6.80 g | 10.6 g | 0.642 | Operator |
| Vertical | 1.36 g | 4.0 g | 0.340 | Operator |

Table 3-59

DISCHARGE GATE VALVE LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 5.77 g | 7.7 g | 0.749 | Operator |
| Vertical | 0.77 g | 4.0 g | 0.192 | Operator |

Table 3-60

DISCHARGE GATE VALVE LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 9.46 g | 7.7 g | 1.23* | Operator |
| Vertical | 1.25 g | 4.0 g | 0.311 | Operator |

*This is a passive valve and is not required to meet ABS limits (see Table 3-59).

Table 3-61

FLOW CONTROL VALVE LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 2.16 g | 9.0 g | 0.240 | Body |
| Vertical | 1.91 g | 6.0 g | 0.319 | Body |

Table 3-62

FLOW CONTROL VALVE LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 3.62 g | 9.0 g | 0.402 | Body |
| Vertical | 3.26 g | 6.0 g | 0.544 | Body |

Table 3-63

RECIRCULATION PUMP LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 0.65 g | 4.5 g | 0.144 | Pump CG |
| Vertical | 1.18 g | 3.5 g | 0.338 | Pump CG |

Table 3-64

RECIRCULATION PUMP LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 1.08 g | 4.5 g | 0.240 | Pump CG |
| Vertical | 2.02 g | 3.5 g | 0.578 | Pump CG |

Table 3-65

RECIRCULATION PUMP MOTOR LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 1.31 g | 4.5 g | 0.291 | Motor CG |
| Vertical | 1.21 g | 3.5 g | 0.346 | Motor CG |

Table 3-66

RECIRCULATION PUMP MOTOR LOADS - RECIRCULATION LOOP A
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 2.21 g | 4.5 g | 0.492 | Motor CG |
| Vertical | 2.07 g | 3.5 g | 0.591 | Motor CG |

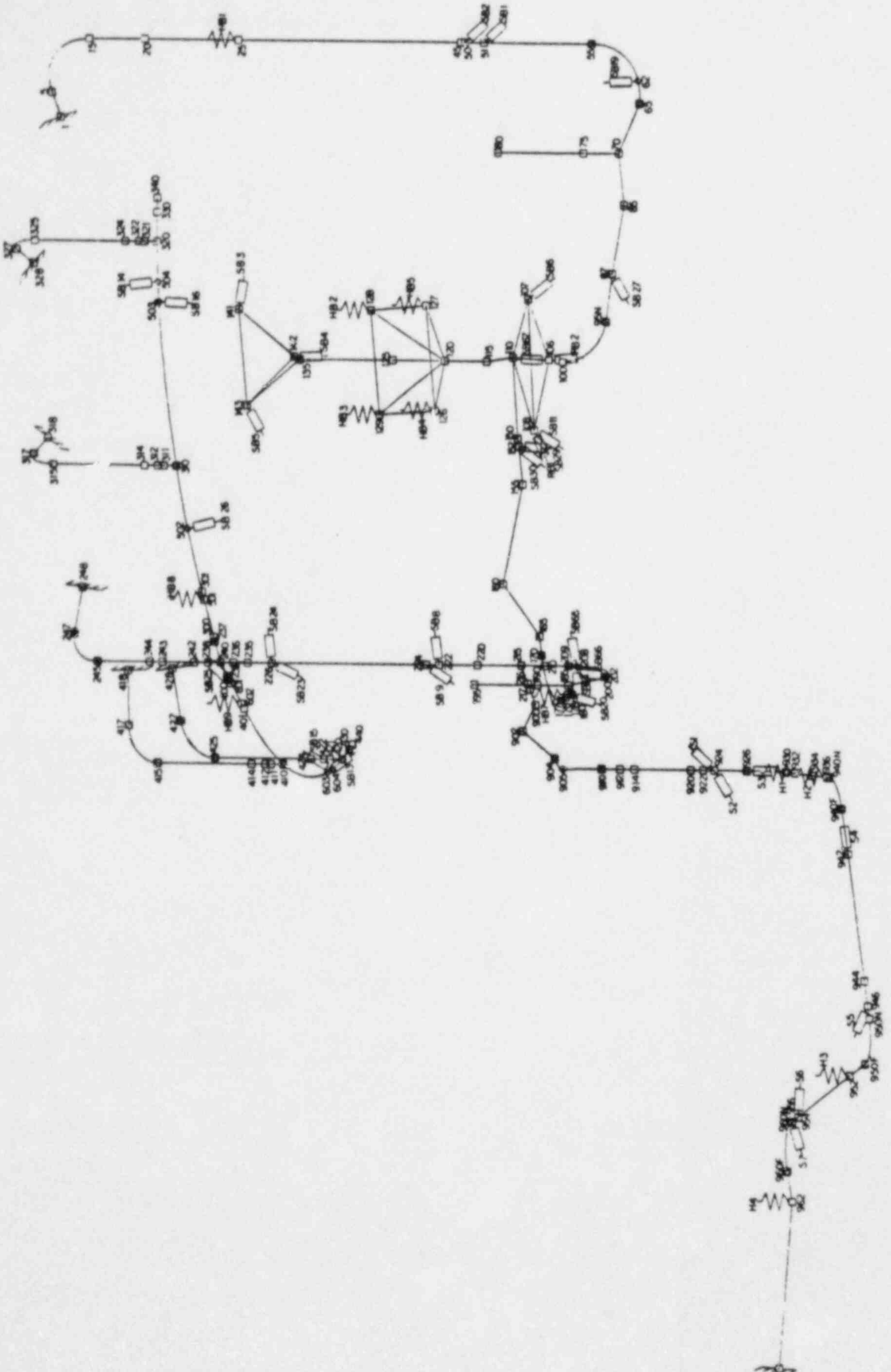


Figure 3-6. LaSalle Recirculation Loop B Node Diagram

Table 3-67

HIGHEST STRESS SUMMARY - SRSS
RECIRCULATION LOOP B

| Item Evaluated* | Highest Calculated Stress/ Usage Factor | Allowable Limits | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress<br>Eq. 9 $\leq 1.5S_m$<br>Design Condition | 17,616 psi | 25,005 psi | 0.70 | Snubber Lug (87) |
| Primary Stress<br>Eq. 9 $= 1.8S_m$ & $1.5S_y$<br>Service Level B | 19,722 psi | 28,596 psi | 0.69 | Snubber Lug (87) |
| Primary Stress<br>Eq. 9 $\leq 2.25S_m$ & $1.8S_y$<br>Service Level C | 19,257 psi | 34,315 psi | 0.56 | Reducer (242) |
| Primary Stress<br>Eq. 9 $\leq 3.0S_m$<br>Service Level D | 29,637 psi | 50,010 psi | 0.59 | Snubber Lug (87) |
| Secondary Stresses<br>Eq. 12 $\leq 3.0S_m$ | 31,310 psi | 50,010 psi | 0.63 | Sweepolet (410) |
| Primary plus Secondary Stress without Thermal Expansion<br>Eq. 13 $\leq 3.0S_m$ | 41,845 psi | 50,010 psi | 0.84 | Sweepolet (310) |
| Cumulative Usage Factor<br>$U \leq 1.0$ | 0.30 | 1.0 | 0.30 | Sweepolet (410) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-68

HIGHEST STRESS SUMMARY - ABS
RECIRCULATION LOOP B

| Item Evaluated* | Highest Calculated Stress/ Usage Factor | Allowable Limits | Ratio Actual/ Allowed | Identification of Location of Highest Stress Points |
|---|---|---|---|---|
| Primary Stress<br>Eq. 9 $\leq 1.5S_m$<br>Design Condition | 17,616 psi | 25,005 psi | 0.70 | Snubber Lug (87) |
| Primary Stress<br>Eq. 9 = $1.8S_m$ & $1.5S_y$<br>Service Level B | 23,833 psi | 28,596 psi | 0.83 | Snubber Lug (87) |
| Primary Stress<br>Eq. 9 $\leq 2.25S_m$ & $1.8S_y$<br>Service Level C | 20,250 psi | 34,315 psi | 0.59 | Reducer (242) |
| Primary Stress<br>Eq. 9 $\leq 3.0S_m$<br>Service Level D | 33,747 psi | 50,010 psi | 0.67 | Snubber Lug (87) |
| Secondary Stresses<br>Eq. 12 $\leq 3.0S_m$ | 31,310 psi | 50,010 psi | 0.63 | Sweepolet (410) |
| Primary plus Secondary Stress without Thermal Expansion<br>Eq. 13 $\leq 3.0S_m$ | 41,845 psi | 50,010 psi | 0.84 | Sweepolet (310) |
| Cumulative Usage Factor<br>$U \leq 1.0$ | 0.32 | 1.0 | 0.32 | Sweepolet (410) |

*All equations used are from ASME B&PV Code, Sec. III - NB-3650.

Table 3-69

SNUBBER LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 27,647 lb | 50,000 lb | 0.553 | SB29 |
| Level C | 30,740 lb | 66,500 lb | 0.463 | SB29 |
| Level D | 44,584 lb | 75,000 lb | 0.594 | SB29 |

Table 3-70

SNUBBER LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Equipment with Highest Loads |
|---|---|---|---|---|
| Level B | 38,254 lb | 50,000 lb | 0.765 | SB29 |
| Level C | 41,364 lb | 66,500 lb | 0.622 | SB29 |
| Level D | 61,516 lb | 75,000 lb | 0.820 | SB29 |

Table 3-71

SUCTION GATE VALVE LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 6.01 g | 10.6 g | 0.567 | Operator |
| Vertical | 1.06 g | 4.0 g | 0.266 | Operator |

Table 3-72

SUCTION GATE VALVE LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 9.50 g | 10.6 g | 0.896 | Operator |
| Vertical | 1.70 g | 4.0 g | 0.425 | Body |

Table 3-73

DISCHARGE GATE VALVE LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 5.31 g | 7.7 g | 0.690 | Operator |
| Vertical | 1.03 g | 4.0 g | 0.259 | Operator |

Table 3-74

DISCHARGE GATE VALVE LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 8.51 g | 7.7 g | 1.11* | Operator |
| Vertical | 1.75 g | 4.0 g | 0.438 | Operator |

*This is a passive valve and is not required to meet ABS limits.

Table 3-75

FLOW CONTROL VALVE LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 1.20 g | 9.0 g | 0.133 | Body |
| Vertical | 2.09 g | 6.0 g | 0.349 | Body |

Table 3-76

FLOW CONTROL VALVE LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 1.98 g | 9.0 g | 0.220 | Body |
| Vertical | 3.55 g | 6.0 g | 0.592 | Body |

Table 3-77

RECIRCULATION PUMP LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 0.82 g | 4.5 g | 0.182 | Pump CG |
| Vertical | 1.05 g | 3.5 g | 0.300 | Pump CG |

Table 3-78

RECIRCULATION PUMP LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 1.36 g | 4.5 g | 0.302 | Pump CG |
| Vertical | 1.79 g | 3.5 g | 0.511 | Pump CG |

Table 3-79

RECIRCULATION PUMP MOTOR LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - SRSS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 1.63 g | 4.5 g | 0.362 | Motor CG |
| Vertical | 1.07 g | 3.5 g | 0.306 | Motor CG |

Table 3-80

RECIRCULATION PUMP MOTOR LOADS - RECIRCULATION LOOP B
HIGHEST LOADING SUMMARY - ABS

| Item Evaluated | Highest Calculated Load | Allowable Limits | Ratio | Identification of Location of Highest Loads |
|---|---|---|---|---|
| Acceleration | | | | |
| Horizontal | 2.71 g | 4.5 g | 0.602 | Motor CG |
| Vertical | 1.83 g | 3.5 g | 0.523 | Motor CG |

# APPENDIX A
# REFERENCES

This appendix contains the major Sargent & Lundy Engineers transmitted structural response inputs which constitute the data base for the LaSalle 2 NSSS New Loads Design Adequacy Evaluation. In addition, S&L transmitted interface loads used in the performance of specific analyses are referenced. The major General Electric references provided in this appendix consist of the dynamic loads reports used as inputs to perform the NSSS piping and equipment adequacy evaluations, in addition to the NSSS Piping and Pipe Mounted Equipment design reports resulting from the analyses of the Main Steam and Recirculation Piping Systems. References to specific input data, reference documents, test reports, detailed calculations, methods and results of the analyses and evaluations performed are contained in the Design Record Files maintained by the General Electric Company.

## A.1 SARGENT & LUNDY SEISMIC DATA

| | | |
|---|---|---|
| 1. | OBE and SEE Building Response Spectra, Horizontal (N-S, E-W). Including Soil Structure Interactions (SSI). | 3/11/82 |
| 2. | OBE and SSE Building Response Spectra, Vertical. Including Soil Structure Interaction. | 8/8/73 |
| 3. | OBE and SSE Horizontal Seismic Analysis. Reactor, Auxiliary and Turbine Building Model. SSI Time-History at Base Slab. (Ref. Only) | 11/17/75 |
| 4. | OBE and SSE Vertical Seismic Analysis. Pedestal - Sacrificial Shield Model, SSI Time-History at Base Slab. | 11/25/75 |
| 5. | Seismic Analysis for Unit 2 (Horizontal Excitation). Response Spectra and Vessel/Vessel Internal Forces. | 3/11/82 |

6. Horizontal Seismic Analysis. Acceleration Time-History. Peak Accelerations. Response Spectra Assessment Results. Horizontal. 3/19/82

7. Horizontal Seismic Analysis. Response to GE 2/25/82 request. 3/31/82

## A.2 SARGENT & LUNDY POOL HYDRODYNAMIC DATA

8. Transmittal of Revised Calculated Pressures on the RPV and Sacrificial Shield Due to Postulated Pipe Break Within the S.S. Annulus. 5/9/77

9. Chugging Response Spectra +20/-4 psi, 20-30 Hz. Retransmitted on 4/29/80. 4/20/78

10. SRV/Chugging Time-Histories. KWU SRV Asymmetric, Single and Symmetric/ADS and Symmetric Chugging Acceleration Time-Histories. Tapes retransmitted on 3/4/80. 2/26/80

11. CO Vertical Unwidened Response Spectra. 2/28/80

12. Chugging Horizontal Acceleration Time-Histories. 4/11/80

13. KWU SRV Asymmetric and Single Valve Horizontal Acceleration Time-History. 4/18/80

14. Clarifications to SRV/LOCA Hydrodynamic Input (reply to GE 5/1/80 letter). 5/20/80

15. 4TCO Symmetric Chugging Acceleration Time-History. 2/27/81

16. 4TCO Symmetric Chugging Response Spectra on Containment Wall (6 locations). 6/11/81

A.3 SARGENT & LUNDY TRANSMITTED INTERFACE LOADS

| | | |
|---|---|---|
| 17. | (Deleted) | |
| 18. | Loads on CRD Piping. | 2/26/82 |

A.4 GE DYNAMIC LOADS EVALUATION REPORTS

| | | |
|---|---|---|
| 19. | Dynamic Loads Report - Seismic | 23A1312, REV. 0 |
| 20. | Dynamic Loads Report, Safety Relief Valve | 23A1313, REV. 0 |
| 21. | Dynamic Loads Report - Loss-of-Coolant Accident | 23A1314, REV. 0 |
| 22. | Dynamic Loads Report - Annulus Pressurization | 23A1315, REV. 0 |
| 23. | Dynamic Loads Report - Fuel Support Vertical Load | 23A1316, REV. 0 |

A.5 GE NSSS PIPING SYSTEM DESIGN REPORTS

| | | |
|---|---|---|
| 24. | Main Steam Piping and Equipment Loads Design Report - Line A | 23A1451, REV. 0 |
| 25. | Main Steam Piping and Equipment Loads Design Report - Line B | 23A1452, REV. 0 |
| 26. | Main Steam Piping and Equipment Loads Design Report - Line C | 23A1453, REV. 0 |
| 27. | Main Steam Piping and Equipment Loads Design Report - Line D | 23A1454, REV. 0 |
| 28. | Piping, Recirculation Piping and Equipment Loads Design Report | 23A1449, REV. 0 |

29. Piping, Recirculation Piping and Equipment Loads Design Report 23A1450, REV. 0

# APPENDIX B

## GENERIC ANALYSES EVALUATED EQUIPMENT AND COMPONENTS

The following active and passive safety-related equipment and components were generically analyzed to demonstrate design adequacy:

| | |
|---|---|
| B13-D009 | Control Rod |
| B13-D020 | Head Cooling Spray Nozzle |
| B13-D040 | Access Hole Cover |
| B13-D055 | Cap Screw |
| B13-D056 | Cap Screw |
| B13-D058 | Consumable Insert |
| B13-D060 | Consumable Insert |
| B13-D061 | Shroud Backing Ring |
| B13-D065 | Keeper |
| B13-D066 | Bolt |
| B13-D067 | Top Guide Wedge |
| B13-D069 | CRD Housing Lateral Restraint |
| B13-D085 | Consumable Insert |
| B13-D091 | Peripheral Fuel Support |
| B13-D093 | Access Hole Cover |
| B13-D094 | Adapter Ring |
| B13-D096 | Jet Pump Instrumentation Penetration Seal |
| B13-D098 | Consumable Insert |
| B13-D182 | Plug |
| B13-U004 | CRD Housing Support |