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March 12, 1993
Refer to: RC-93-0068

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. G. F. Wunder

Gentlemen:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
PIPING ANALYSES FOR THE DELTA 75 STEAM GENERATORS (REM 6000-6)

As part of the steam generator replacement effort, South Carolina Electric & Gas Company (SCE&G) is reanalyzing major piping connected to the steam generators. This includes Reactor Coolant Loop, Main Steam, Feedwater, Emergency Feedwater, and Steam Generator Blowdown piping. The attachment provides a description of the methodologies being used for the reanalyses. As a part of this effort, SCE&G is also pursuing snubber and pipe whip restraint reduction. SCE&G plans to use the provisions in 10CFR50.59 to implement these changes. This letter is provided for information. If you have any questions, please call Ms. April Rice at (803) 345-4232.

Very truly yours,

[signature]

John L. Skolds

ARR:smd
Attachment

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I. REACTOR COOLANT LOOP REANALYSIS

1.0 Introduction

South Carolina Electric and Gas Company (SCE&G), in conjunction with Westinghouse Electric Corporation, is performing the necessary Reactor Coolant System (RCS) loop reanalysis and component qualifications to accommodate the Delta 75 replacement Steam Generators (SGs). This analysis also includes a reduction in the number of SG hydraulic snubbers and piping whip restraints which serve as seismic restraints (PWR-SRs). This effort will provide the Virgil C. Summer Nuclear Station (VCSNS) with a reduction in the costs and man-rem exposures associated with maintenance, inspection, and testing of these components. Specifically, three of the five hydraulic snubbers will be removed from each of the three VCSNS SGs and both of the PWR-SRs will be removed or abandoned in place from each of the three reactor coolant pipe loops.

The RCS analysis will include the removal of SG hydraulic snubbers and PWR-SRs, the physical properties of the Delta 75 replacement steam generators, revised thermal/pressure transients (at an uprated power level), primary loop piping leak-before-break (LBB) results, and elimination of arbitrary intermediate breaks (EAIB) in branch piping to reduce the system design basis loadings and consequently reduce the number of required snubbers.

The benefits of this program are:

- Reduced man-rem exposure.
- Reduced inservice inspections and functional testing.
- Reduced maintenance and refurbishment costs.
- Reduced activity during plant outages.
- Increased plant availability.

2.0 Existing VCSNS Support Description

The VCSNS Nuclear Steam Supply System (NSSS) consists of three Reactor Coolant Loops (RCLs) attached to a common Reactor Pressure Vessel (RPV). Each RCL includes the loop piping, one SG, and one Reactor Coolant Pump (RCP). Figure 1.0 provides a layout of the three VCSNS reactor coolant loops. The support system for the RCL, RPV, SG, and RCP is designed to permit free radial thermal expansion of the components and also provide support in the operating position of the RCL for postulated dynamic loading conditions. Free thermal expansion is achieved through the use of pinned end columns, tie rods with slotted pin holes, single acting lateral bumper supports, gaps between pipe and whip restraints, and hydraulic snubbers. The VCSNS SG upper lateral support consists of a ring girder placed around the SG and hung from the SG lifting trunnions (see Figure 2.0). There is a bank of five, 1000 kip rated Paul-Munroe hydraulic snubbers attached to the ring girder and the primary shield wall concrete. The line of action of these snubbers is parallel to the hot leg piping, and the snubbers extend during loop thermal expansion (heatup) and contract during loop

thermal contraction (cooldown). The snubbers primarily restrain the SG for motions and loadings directed along the hot leg axis towards the RPV. Perpendicular to the hot leg axis and parallel to the hot leg directed away from the RPV, restraint is provided by a series of rigid steel bumpers.

The SG lower lateral support system consists of a structural frame attached to the primary and secondary shield wall concrete (see Figure 3.0). This support restrains SG lateral motion perpendicular to the hot leg and parallel to the hot leg away from the reactor pressure vessel. Vertical support for the SG is provided by four pinned end columns attached to the SG feet from the containment floor.

Two pipe whip restraints which act as thrust blocks are located on the RCL crossover leg pipe (one at each end of the horizontal run). The thrust blocks are restrained by steel frames fastened to the containment floor and the secondary shield wall. These restraints are considered as linear springs in the seismic analysis of the RCL. Free thermal expansion is achieved through the use of shims between the support and pipe which provide a gap for normal thermal movement. Figure 4.0 provides a sectional view of the existing VCSNS cross-over leg restraints.

3.0 Methodology

The number of required SG snubbers and pipe whip restraints is decreased by reducing the design basis loadings on the pipe through the elimination of pipe rupture effects (LBB, EAIB), using component support reserve design margin, taking advantage of changes in licensing requirements, and using improved analytical techniques. Some of the specific changes and improvements which will be utilized are:

- General Design Criterion 4 Rule Change: This change permits the application of LBB technology to eliminate large postulated primary loop pipe ruptures. LBB technology was approved by NRC for use on VCSNS on January 11, 1993.

- Generic Letter 87-11: This letter permits the elimination of arbitrary intermediate breaks (EAIBs) in RCL auxiliary lines, the Main Steam lines, and the Feedwater lines.

- ASME Code Case N-411: This code case provides more realistic damping values.

These options provide the analysis, qualification, and licensing bases necessary to eliminate the majority of the 15 SG snubbers and 6 PWR-SRs. Figure 5.0 illustrates a plan view of the SG upper lateral support system with the proposed snubbers removed.

The results of the RCL analysis will be incorporated in a snubber reduction program on the ASME Class 1 auxiliary piping lines (including their ASME Class 2 and 3 extensions up to the first anchor) connected to the RCL piping. This program will utilize ASME Code Case N-411 response spectra and reduced LOCA loading due to the application of LBB technology to eliminate as many snubbers as possible. Code Case N-411 damping values are applied to the coupled models of the RCL piping and the connected auxiliary line piping. The envelope response spectra method will be used. Energy dissipation supports will not be used. Requalification of the piping, supports, and other plant components affected by this snubber reduction program will be performed, including reissuing the Class 1 stress reports.

The activities required to implement this program are summarized below and discussed in further detail in the following sections.

1. RCL System Analysis - Perform RCL response spectra seismic and LOCA analyses, including the effects of:

   (1) The revised SG upper support configuration with snubber reduction.

   (2) The elimination of pipe whip restraints which serve as seismic restraints.

   (3) Physical properties of the Delta 75 replacement SGs.

   (4) Revised thermal/pressure transients at uprated power conditions.

2. Component Requalification - Perform requalification of the RCL piping, nozzles, equipment, and equipment supports for the new design basis loadings.

3. Reconciliation of RCL LBB - Review the loop LBB analysis to confirm that the effects of the revised support configuration have no impact on the previous conclusions.

3.1 RCL System Analysis

As part of the RCL System Analysis, the SG upper support stiffness values will be revised to include the effects of the reduction in the number of SG snubbers. The existing design basis RCL analysis model will be updated to reflect the new SG, SG upper support configuration, and the removal of existing pipe whip restraints serving as seismic restraints. A response spectra seismic analysis and a static analysis for deadweight and thermal loadings will be performed to develop new design basis loadings.

The following pipe breaks remain as a result of the LBB and EAIB programs and will be evaluated:

- Surge Line Nozzle at the RCL
- RHR Line Nozzles at the RCL

- Accumulator Line Nozzles at the RCL
- Feedwater Line Nozzle at the SG
- Main Steam Line Nozzle at the SG

The magnitudes of the loads for these breaks are relatively small and will be included in the faulted condition evaluation to demonstrate that sufficient design margins in the equipment supports are maintained.

3.2 Component Requalification

An evaluation of the new RCL piping stresses and fatigue factors will be performed for the required load combinations of pressure, thermal, dead weight, seismic, and remaining pipe ruptures. The analysis will be performed in accordance with the ASME code and the VCSNS FSAR.

Revised RCL equipment nozzle and support pad loads will be compared to the equipment specification umbrella allowable loads. A stress evaluation of the equipment supports will be performed to demonstrate conformance with VCSNS specific FSAR design criteria. The revised design basis loads will be compared to existing design basis loads and the differences will be reconciled. New equipment support concrete loads will be compared to existing concrete loads and the differences will be reconciled.

3.3 Reconciliation of RCL LBB

The new design basis RCL piping loads will be compared to the loads used in the existing LBB analysis and an assessment will be performed and documented to demonstrate that the LBB conclusions are still valid.

3.4 Criteria, Codes, and Standards

Analyses will be performed in accordance with the existing plant design basis criteria outlined in the VCSNS FSAR. The design basis piping code for VCSNS is ASME Code Section III, 1971 Edition through Summer 1973 Addenda. An exception will be taken for the fatigue requalification of Class 1 piping components and the 1977 Edition and all Addenda through Summer 1979 will be used.

II. Reanalysis of Piping Connected to the SG

1.0 Introduction

SCE&G, in conjunction with Bechtel Corporation and ABB/Impell Corporation, is performing piping reanalysis of the Main Steam (MS), Feedwater (FW), Emergency Feedwater (EFW), and Blowdown (BD) Systems to accommodate the Delta 75 replacement steam generators.

These analyses will take into account snubber reduction, elimination of arbitrary intermediate line breaks and associated pipe whip restraints/jet shields, the physical properties of the replacement steam generators, changes in licensing requirements,

and improved computer modeling techniques (i.e., a mathematical stick model for the SG).

2.0 Existing VCSNS Description

The VCSNS has four primary piping systems servicing the SGs: the MS, FW, EFW, and BD systems. The Delta 75 replacement SG piping nozzle locations have no effect on the existing pipe routes of the MS and BD piping. However, the new FW and EFW nozzle locations require piping reroutes. The new FW nozzles will be approximately thirty-three (33) feet above the existing nozzles. The new EFW nozzles are on the same elevation, but are rotated counterclockwise from the existing nozzles.

3.0 Methodology

The number of pipe snubbers and pipe whip restraints can be reduced by using component support reserve design margins, taking advantage of changes in licensing requirements (i.e., Generic Letter 87-11, which permits the elimination of arbitrary intermediate line breaks), efficiently rerouting piping, and increasing the emphasis placed on snubber removal by the stress analyst.

The existing design basis analysis for the MS, FW, EFW, and BD piping will be updated to reflect the new SG mass, center of gravity, and upper support configuration. Also, the new pipe reroutes will be included in the analysis of the FW and EFW piping. A static analysis will be performed for deadweight and thermal loadings. In addition, a response spectra analysis will be performed to evaluate seismic loadings. A "mathematical stick model" of the Delta-75 SG that includes the SG and its support stiffness has been developed. Using this mathematical model, the pipe stress analysis will extend from the containment penetrations through the SGs to the containment basemat. The existing containment building response spectra, based on Regulatory Guide 1.61 damping values, will be used as input at the containment penetration and the basemat.

Due to the reroute of the FW piping, it will be necessary to recalculate the loads imposed on the piping by postulated hydraulic transients. These hydraulic loads will be recalculated using the RELAP5/MOD3 computer code. Two dynamic hydraulic transients will be considered in the FW pipe analysis: (1) a condition caused by excess flow from improper operation of the FW regulation valve or a MS line break, and (2) a condition caused by FW containment isolation check valve slam due to reverse flow caused by a FW line break.

All containment penetrations will be qualified to the existing design basis allowable loads or code of record requirements. Pipe loads imposed on the SG nozzles will be qualified to the allowable loads specified in the Delta 75 SG equipment specification. Also, the pipe stresses will conform to the design basis piping code, ASME Section III, 1971 Edition through Summer 1973 Addenda, as

specified in the FSAR. All pipe supports will be requalified to the new loads calculated in the piping reanalyses. This requalification will conform to ASME Section III, 1971 Edition through Winter 1973 Addenda, Subsection NF, as specified in the FSAR. Also, piping reanalyses will demonstrate that arbitrary intermediate line pipe breaks can be eliminated as permitted by Generic Letter 87-11.

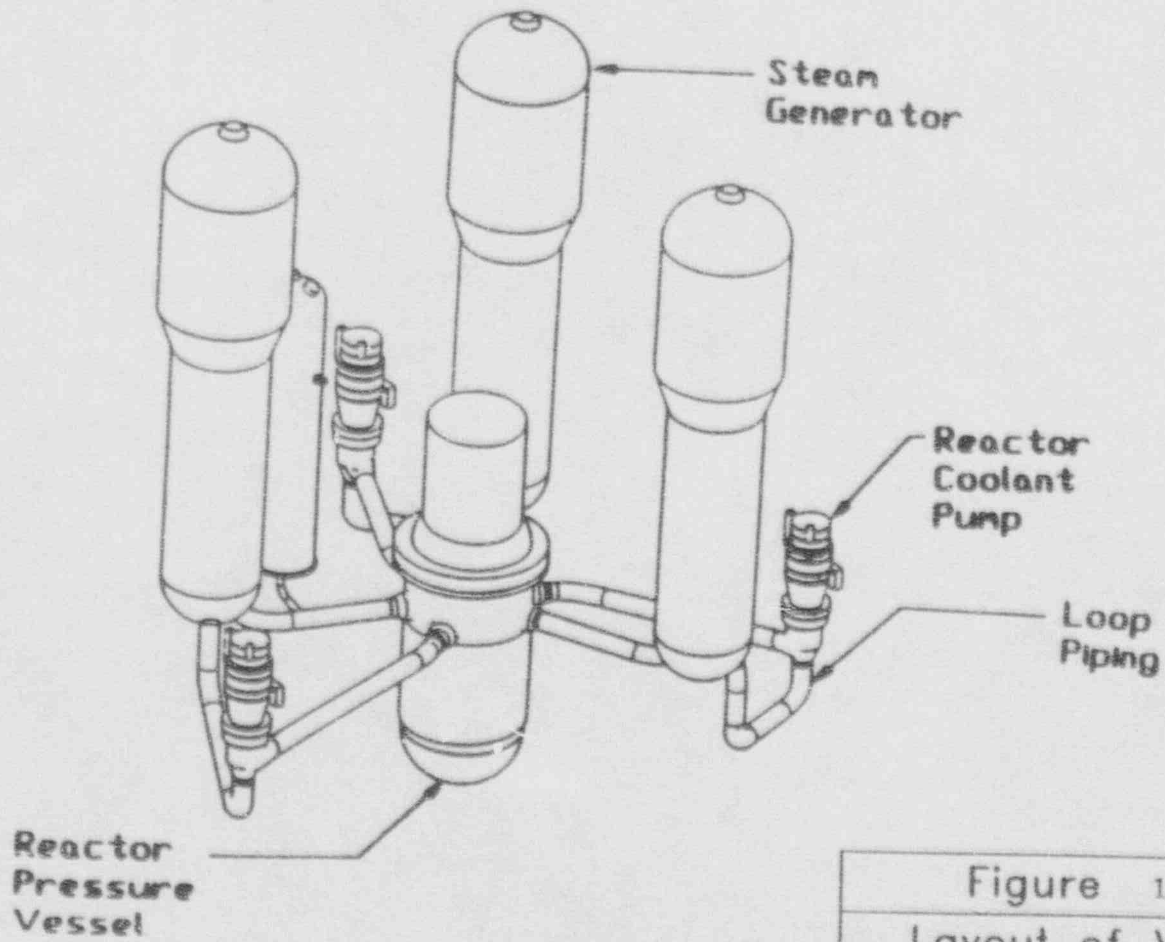


Figure 1.0

Layout of VCSNS
Reactor Coolant Loops

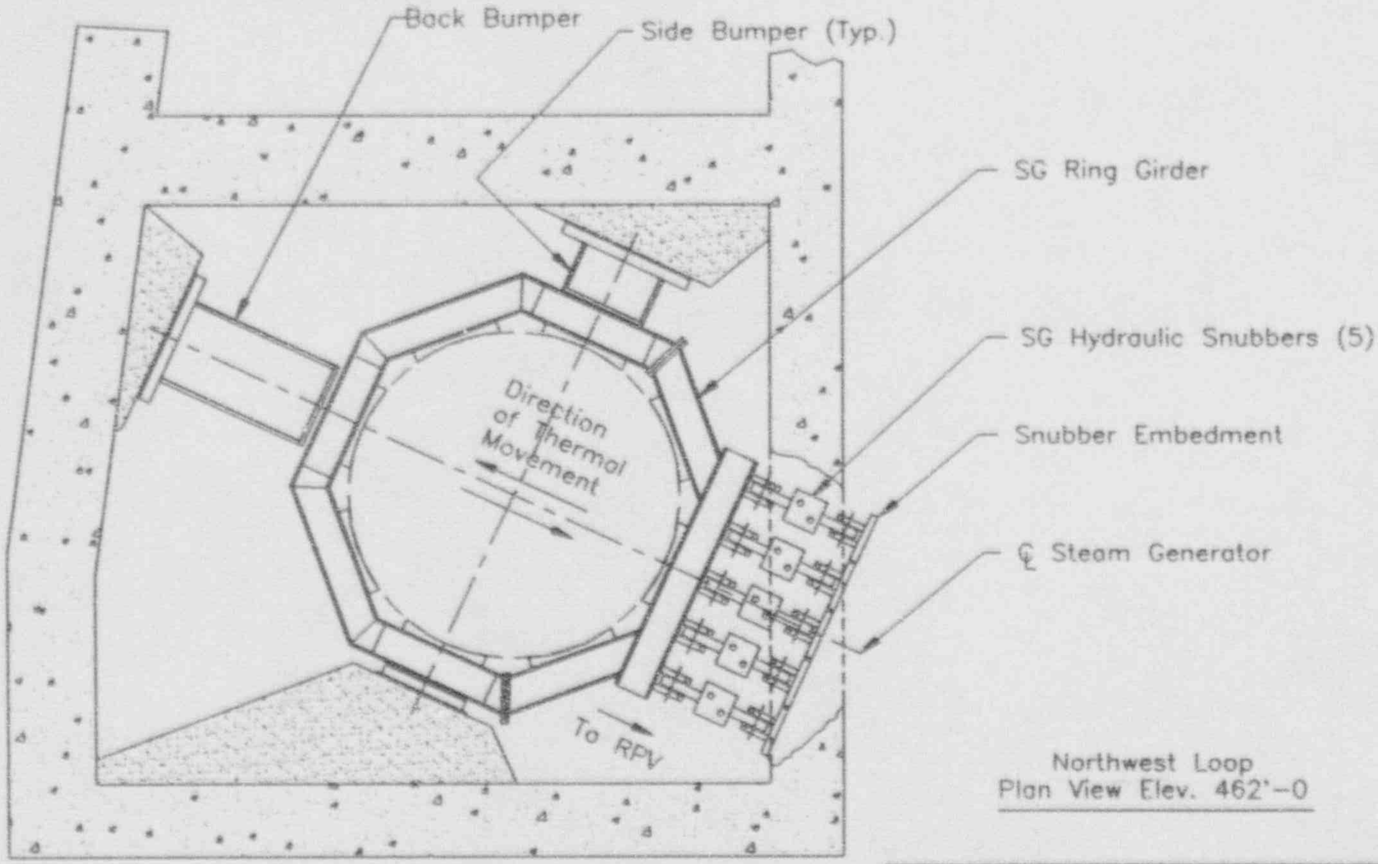
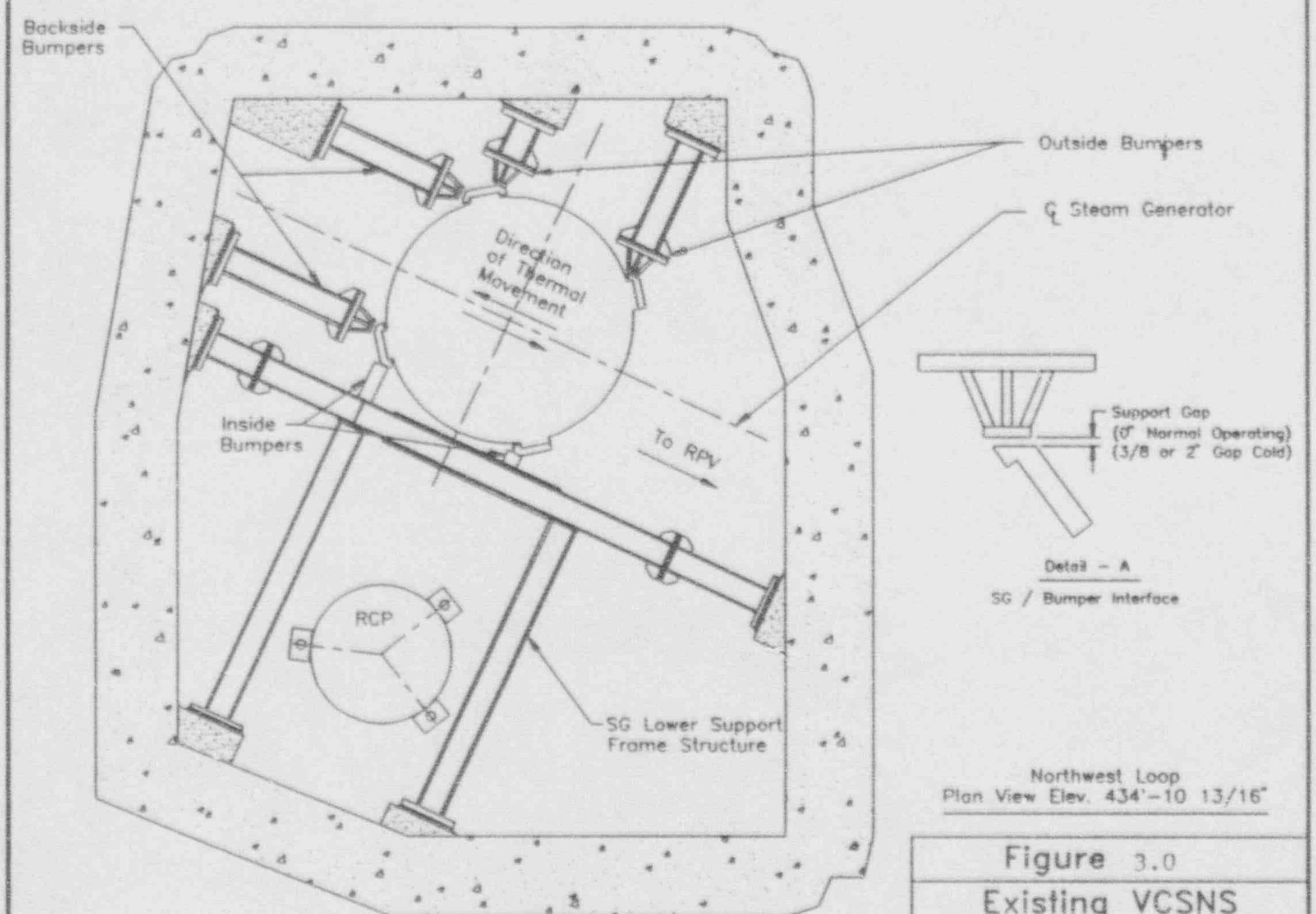


Figure 2.0

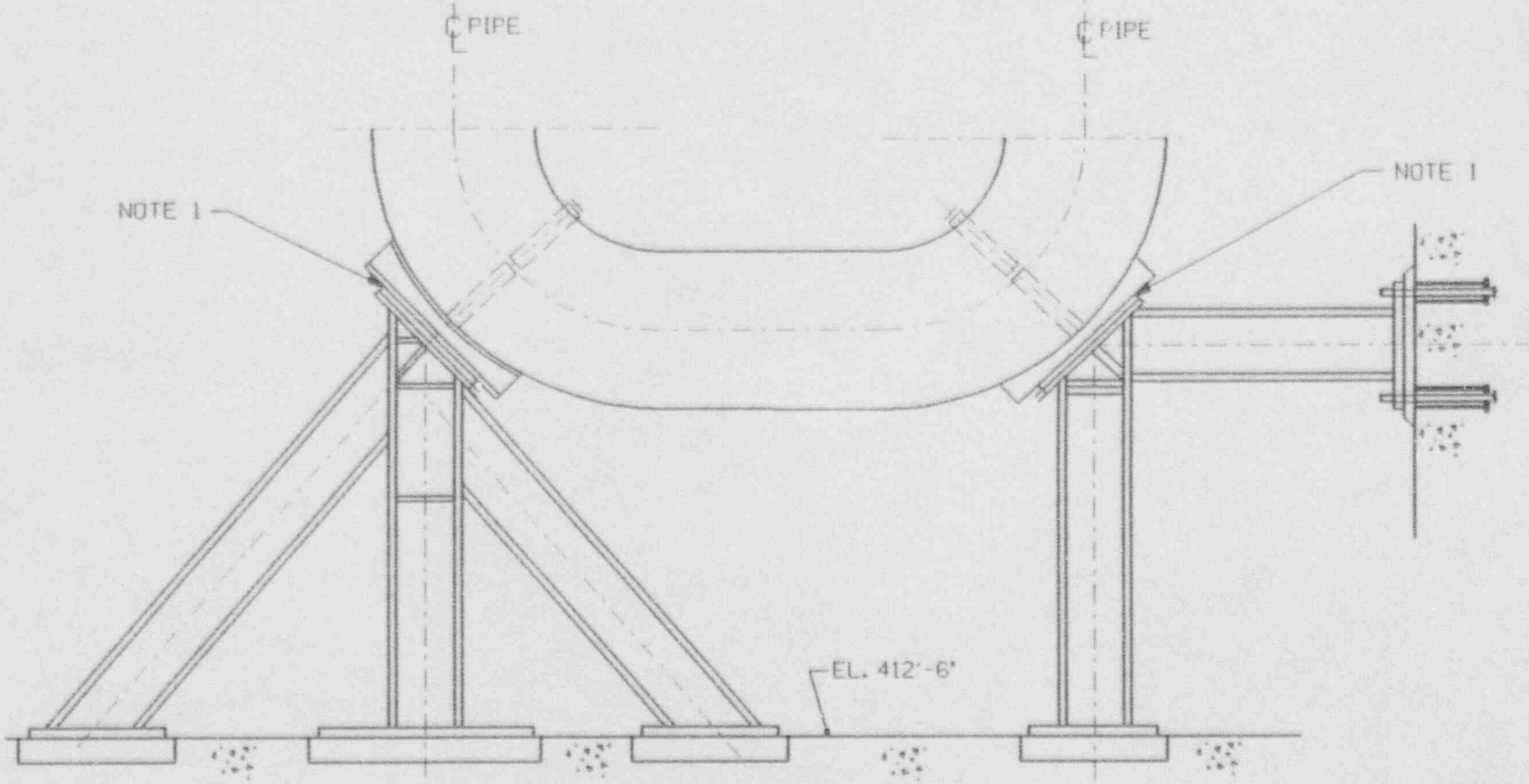
Existing VCSNS SG Upper Support



Northwest Loop
Plan View Elev. 434'-10 13/16"

Figure 3.0

Existing VCSNS SG Lower Support



SECTION B-B

SEE DWG. 1MS-07-055-8

NOTE:

1. MACHINE SHIM TO 0" CLEARANCE IN HOT POSITION

Figure 4.0

Existing VCSNS
RCL CROSS OVER LEG
PIPE WHIP/SEISMIC RESTRAINT

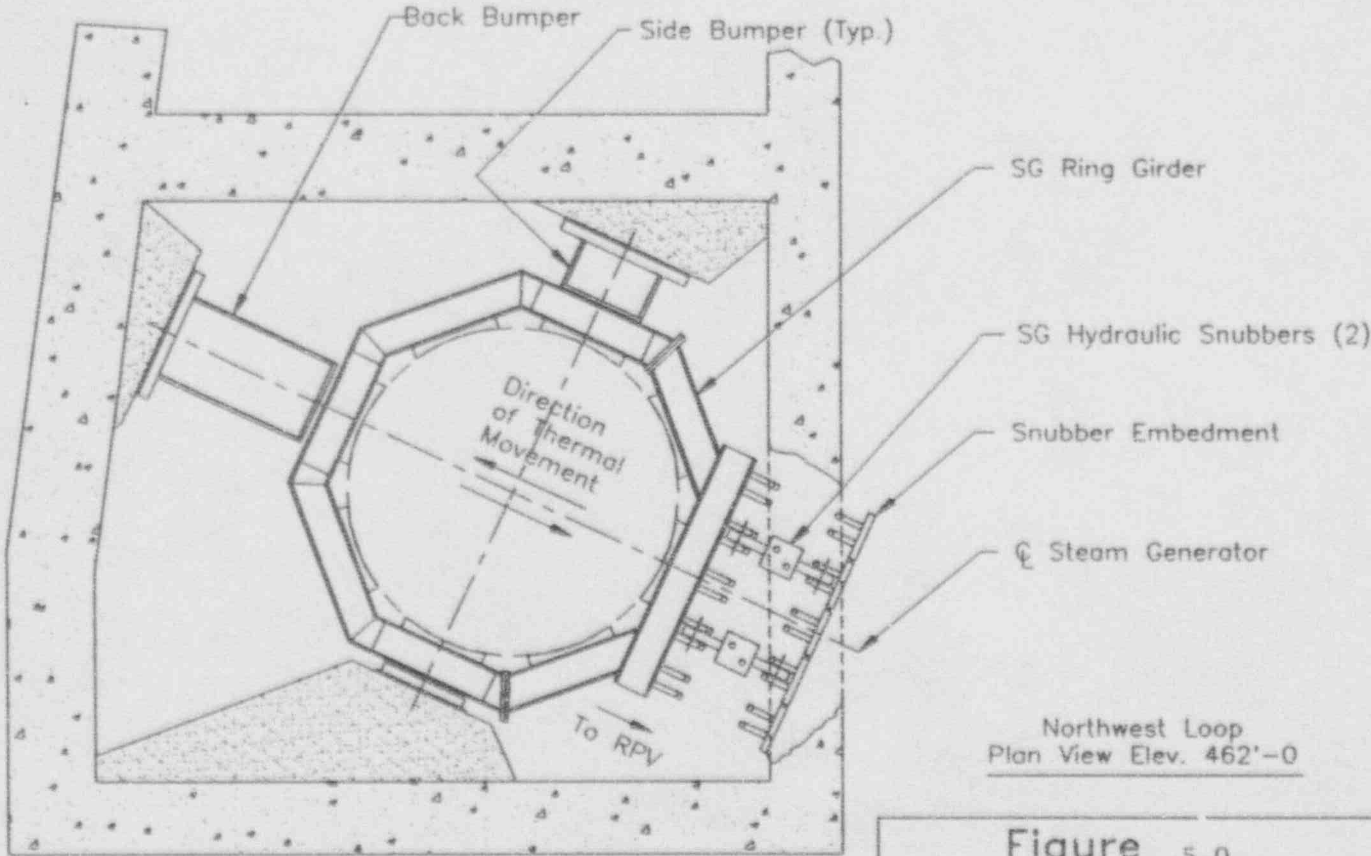


Figure 5.0
Modified VCSNS
SG Upper Support