GULF STATES UTILITIES COMPANY

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February 15, 1985
RBG- 20145
File Nos. G9.5 - G15.4.1

Mr. R. C. DeYoung, Director
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. DeYoung:

River Bend Station - Unit 1
Docket No. 50-458
Integrated Design Inspection
Inspection Report 84-18 Supplement 1

Gulf States Utilities (GSU) October 26, 1984 letter (RBG-19294) provided GSU's responses to Inspection Report 50-458/84-18. GSU's January 18, 1985 letter (RBG-19935) indicated GSU would provide certain supplemental information by February 15, 1985. This letter provides GSU's supplemental responses, and additional information in response to Supplement 1 to Inspection Report 50-458/84-18 (Enclosure 1). Enclosure 1 contains 14 supplementary revised responses which address 15 of the open items listed in Supplement 1 to the inspection report. It is GSU's understanding that the remaining open items are under internal NRC/NRR review and no additional response is required.

In response to the NRC recommendation that a limited design review be conducted by off-project SWEC or Gulf States Utilities personnel GSU directed SWEC (in GSU letter of September 27, 1984, RBS-19,042) to assume the responsibility for planning and conducting such a review in the form of a technical evaluation. This technical evaluation has been completed and a detailed presentation of the results was given to members of the Office of Inspection and Enforcement and their consultants in Washington D. C. on February 6, 1985.

A joint team of experienced GSU and SWEC engineers under the direction of SWEC Engineering Assurance Division (EA), Boston, was established to conduct the evaluation.

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The team selected the Reactor Core Isolation Cooling (ICS) system and the Fuel Building Ventilation (HVF) system as the basis of the evaluation. The ICS is a water and steam system, operates in various modes, contains various types of equipment, and involves SWEC/NSSS interface. The HVF is solely a SWEC supplied design, incorporating typical features of a ventilation system. It is considered that the two systems provided a good representation of engineering and design work.

The evaluation team established four (4) broad attributes or categories that would encompass the IDI identified deficiencies. The categories established are as follows:

- o Consistency between the FSAR and the design.
- o Adequacy of calculations supporting the design.
- o Compliance with Nuclear Steam System Supplier (NSSS) criteria/requirements.
- o Consistency between and completeness of drawings, diagrams, and specifications.

The review of the two systems has been completed with the following overall results and conclusions:

The review of the design of the ICS and HVF revealed that:

- o The designs are consistent with the FSAR, are technically adequate and will perform their intended safety functions.
- o Technically adequate calculations are available to support the designs.
- o The design of the ICS is in compliance with NSSS criteria/requirements.
- o Drawings, diagrams, and specifications associated with the systems are complete and consistent with each other.

Discrepancies were observed that are exceptions to the above overall results. In all cases discrepancies and concerns were investigated and action, has, or is being taken to "bound" the condition represented by the discrepancies: the extent evaluated; discrepancies corrected; and, where appropriate, preventive action implemented. In two areas where discrepancies were not totally bounded during the evaluation period, GSU directed SWEC to continue follow-on action that ensures the concerns are bounded. These actions include: 1) resolving differences between the

Structural and Geotechnical Design Criteria documents and the FSAR which is scheduled to be completed by March 1, 1985; and, 2) a review of all safety related ventilation systems to verify analyses or other technically suitable documentation are available to support FSAR commitments which is scheduled to be completed by March 15, 1985.

As a result of the review, two design modifications were initiated to eliminate potential nuclear safety concerns. These items were included in the February 6, 1985 presentation and were reviewed in detail with the NRC during the follow-up audit in Cherry Hill on February 7 & 8, 1985. One of the deficiencies was an instance of failure to meet single failure criteria. However, based on the evaluation results, and considering the circumstances surrounding this instance, there is no indication of a lack of understanding of the criteria or lack of overall implementation of the criteria. The specific discrepancy was that, during high drywell and containment pressure LOCA events, if valve 1-1CS*MOV-E010(ZR) fails to fully close (single failure) during changeover to suppression pool suction, a potential flow path is created that could allow suppression pool water to flow toward the Condensate Storage Tank (CST) and thus reduce the suppression pool water level. This potential path is created because the ICS/HPCS pump suction line changes from safety-related to nonsafety-related at approximately El.89'-3" (and must be assumed, for safety analysis, to terminate at this point) and the normal suppression pool level is approximately at El.89"-9".

This condition resulted when an earlier design change was made to correct a concern identified during a review of loop fill subsystem. Originally, a check valve was located upstream of the junction of the CST and suppression pool suction lines. At this location, the check valve would have precluded the concern raised by the team but would have isolated the ICS loop fill subsystem pump suction from the suppression pool whenever the ICS was lined up to take suction from the suppression pool.

No other discrepancies were observed that resulted from design changes. A further review revealed that no other lines terminated at or near the water level of the suppression pool. No other instances of failure to meet single failure criteria were observed. A BIP Support Plan Change Notice has been issued to correct this concern.

The other discrepancy involves an air transfer floor opening located at El.95' in the fuel building. This opening is used to pass air to the lower building floors during the accident mode. There is an exhaust duct to a unit cooler in the vicinity above this opening. The exhaust duct is not seismically supported, and no other provision had been made, to preclude potential obstruction of the floor opening due to a seismic event. A change has been initiated to address this concern.

No similar instances (non-seismic equipment over air openings or over safety-related systems, structure, or components) were observed during the site inspection. Additional field walkdowns had been previously planned in accordance with Project Management Memorandum PMM-106, to re-verify that all safety-related equipment is still

protected from seismically induced failure of non-seismically designed equipment. PMM-106 has been revised to specifically address air flow openings.

The conclusion reached as a result of this evaluation considered: the number of documents reviewed; the depth and detail of the review; results of additional investigation done by both the team members and project personnel to evaluate significance of, extent of, and action for resolving concerns/discrepancies identified during the evaluation. In addition, positive results as well as all discrepancies were considered.

After studying discrepancies identified during this evaluation, both individually and collectively, none could be associated with any overall programmatic or systematic weakness. Instances were observed that required procedure improvement but, in general, procedures were available and provided the necessary controls including interface controls. In most areas reviewed, implementation of the procedural program was adequate. Most of the discrepancies observed were limited and random instances of incomplete compliance to program requirments and, although not acceptable, are what might be expected from a complex design process. In each instance, individual discrepancies were corrected (or are in the process of correction) and, where appropriate, action to prevent recurrence was implemented.

GSU has evaluated the results and actions taken from both the IDI and the Off-Project review and concludes that there are no overall programatic or systematic weaknesses in the design process including the design verification process and therefore the overall design process has been effective and adequate. In most cases, deficiencies observed were limited or random instances of non-compliance to procedures. In all cases, concerns were thoroughly investigated and appropriate corrective and preventive actions were taken. We believe that none of the deficiencies collectively or individually represent generic or systematic concerns and therefore we conclude that the design process used on River Bend Station is adequate.

Should you have any questions regarding this information, please do not hesitate to contact us.

Sincerely,

J. E. Booker

J. E. Booker
Manager-Engineering,
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/LAE/lp

ENCLOSURE 1

REVISED AND SUPPLEMENTARY RESPONSES
TO THE INTEGRATED DESIGN INSPECTION REPORT
FOR THE RIVER BEND STATION OF
GULF STATES UTILITIES COMPANY

SUPPLEMENTAL RESPONSE - IDI DEFICIENCY NO. D2.3-1

Calculation No. PN-268 has been revised. The low-pressure coolant injection (LPCI) runout mode portion has been deleted. The remaining portions of this calculation were reviewed to ensure that they reflect conservative data and assumptions and to correct minor discrepancies in internal page referencing.

A new calculation, Calculation No. PN-331, was issued to address the LPCI runout mode. This calculation included the system resistance curve, as well as data and assumptions that are conservative with respect to calculating the maximum probable runout flow. In addition, GE was contacted to clarify the maximum allowable runout flow for the residual heat removal (RHR) pumps. This value is 6060 gpm, as stated in GE Letter No. GSS-4382.

The results of Calculation No. PN-331 indicate runout flows of 6000 gpm (pump A), 5940 gpm (pump B), and 6000 gpm (pump C). Since none of these calculated values exceeds the maximum allowed value, Calculation No. 331 has been issued with the conclusion that flow restriction orifices are not required in any of the three LPCI injection lines. This completes the corrective action required in response to the deficiency.

Calculation No. 331 has been issued, with confirmation required upon completion of field testing in the LPCI injection mode, to ensure that actual flow conditions will not exceed the maximum allowable flow. Followup to ensure that this confirmation is made will be performed in accordance with EAP 5.3 and Project Procedure RBP 6.4 requirements for scheduling, monitoring, and completing calculation confirmations.

Pump calculations for the high-pressure core spray (HPCS), the low-pressure core spray (LPCS), and the fuel pool cooling pumps were also reviewed to ensure that conditions similar to those which existed in Calculation No. PN-268 did not exist in these calculations. The results of this review indicated that similar discrepancies did not exist and that these calculations are adequate to support the existing design. Therefore, no additional calculation reviews are required in response to this deficiency.

The Lead Power Engineer has issued a memorandum to all River Bend Project power engineers emphasizing the need to pay close attention to the types of items identified in this deficiency during preparation and checking of calculations and to require the inclusion of system resistance in future pump calculations.

SUPPLEMENTAL RESPONSE - IDI DEFICIENCY NOS. D2.3-2 and D2.3-3

The design of the floor drainage system in the crescent area of the auxiliary building has been modified to add a safety-related level transmitter to each of the two sumps located in this area in order to provide flood detection capability for all postulated plant scenarios.

Additional design changes have been made to add piping and valves and to upgrade the sump pumps to allow the control room operator to isolate the normal pump discharge path to the radwaste system and to direct the discharge from the pumps in the two crescent area sumps back to the suppression pool, if necessary, in order to ensure that suppression pool inventory is not unacceptably depleted and that ECCS suction isolation valves are not flooded.

The above design changes are reflected in E&DCR Nos. P-13,043A and P-13,062.

Power Division Technical Procedure PTP 0.3.1 was revised on December 21, 1984, by the issuance of Power Division Memorandum PDM(BOS)-T84-4. This change eliminates the requirement for assuming pipe cracks as post-LOCA passive failures and allows the postulation of pump and valve seal failures as post-LOCA passive failures instead. This change is consistent with NUREG-0800 and NUREG-0138 and SRP 3.6.1 and SECY 77-439 which do not require postulating pipe cracks in these lines. The River Bend Project is assuming a maximum flow rate of 50 gpm from such postulated pump and valve seal failures. This is considered to be a conservative assumption well in excess of the realistic leakage that would occur, especially since only low system pressure will exist in the post-LOCA environment.

Calculation No. PN-334 is being issued to document the review of flooding potential for both the ECCS pump cubicles and the crescent area of the auxiliary building under both normal and post-LOCA plant conditions. With the addition of the design changes and the limitation of the maximum post-LOCA leakage rate identified above, the design of both the ECCS pump cubicles and the crescent area of the auxiliary building is adequate to prevent flooding of equipment in excess of what is necessary to meet single failure criteria and to preclude unacceptable loss of suppression pool water inventory.

GSU is reviewing SWEC Letter No. RBS-10,041 dated January 31, 1985, which recommends that post-LOCA operating procedures include a requirement for placing the control room switches for the ECCS pump cubicles and auxiliary building crescent area sump pumps in the off position in order to preclude any inadvertent pumping of radioactive water to other plant areas. This letter also recommends that the procedure require that if a post-LOCA high sump level alarm is received for the auxiliary building crescent area, the sump pumps should be started with their discharge directed to the suppression pool and the sump pump run times should be logged. Finally, if the frequency of repeated high level alarms warrants it, the letter recommends the procedure to include directions for isolating systems one at a time in order to identify the source of leakage.

In the event of a post-LOCA sump high level alarm in one of the ECCS pump cubicles, the associated ECCS should be isolated, and if necessary, one of the redundant ECCSs placed in service. GSU will issue appropriate abnormal operating procedures reflecting these recommendations.

Project Management Memorandum PMM-163, Revision 3, has been issued to provide additional details regarding the evaluation of post-LOCA passive failures. In addition, the Lead Power Engineer has issued a memorandum to all River Bend Project power engineers emphasizing the need for careful attention to the key items identified in these deficiencies during the preparation and checking of calculations.

DEFICIENCY NO. D2.3-6 (Revised)

RESPONSE

Cause

A discrepancy was found in the RHR preoperational test procedure concerning the verification of maximum flow rate of the RHR pumps in the LPCI mode. GE Test Specification No. 22A5296AB required that any restricting orifice in the injection line be sized correctly to limit the maximum flow rate, and this requirement was included in the procedure without verifying the presence of the orifice.

Extent of Condition

This discrepancy is limited to the RHR test procedure, since LPCI and HPCS do have orifices installed in the injection line. Although the test procedure calls for sizing an orifice which is not installed, the test would have adequately verified that the maximum flow limits had not been exceeded. This discrepancy is an isolated incident, and the reference to the nonexistent orifice has no effect on the verification of the maximum flow limit.

Action to Correct Existing Condition

The RHR preoperational test procedure has been revised to delete the reference to the orifice.

Action to Prevent Recurrence

This error is an isolated incident and is not indicative of a program problem. The method of drafting a test procedure is to obtain and review the appropriate GE/SWEC design documents and incorporate this design information into the draft procedure in the format set up by the Joint Test Group (JTG). The design documents used are added to the procedure as part of Section 2.0. After the draft is complete, the procedure goes through a number of reviews. The first review is by the Pre-Operational Test Supervisor, then two rounds by the JTG, and a final review when the JTG approves the procedure. Prior to the performance of the test, the test engineer again reviews the design document identified in Section 2.0 of the procedure. During this extensive review process, any design discrepancies between GE and SWEC documents should be identified and the appropriate information incorporated into the procedure. In the case of the RHR procedure, the one isolated incident which was identified is not considered indicative of an overall test program problem.

DEFICIENCY NO. D2.3-7

RESPONSE

Cause

An incorrect assumption was made as to using barometric pressure reading recorded at the time of flow testing, then subtracting vapor pressure at 212°F in order to correct the NPSH to 212°F. The assumption was incorrect because the barometric pressure at the time of testing may be different than standard conditions, which would then cause some effect on the NPSH value when the 212°F vapor pressure is subtracted.

Extent of Condition

The same incorrect assumption was used in the HPCS and RHR preoperational test procedures. The result of the incorrect assumptions is that NPSH readings could be affected (either positively or negatively) due to barometric pressure being different than the standard. The effect on NPSH probably would have been slight in either case, since the average barometric pressure is 14.68 psi for the past 9 years.

Action to Correct Existing Condition

The LPCS and HPCS test procedures have been revised to change the NPSH calculation. The RHR test procedure has been revised to change the NPSH calculation in the same manner.

There is no action necessary to reference the NPSH to the pump suction nozzle. The requirement to verify NPSH greater than 5 feet at a reference location 2 feet above the pump mounting flange has been met by the procedure. Correcting to an equivalent NPSH at the pump suction nozzle would be of no added benefit, since the design criteria is specified at the reference location. This same reference location is used in both the GE test specification and the GE design specification. The GE lead system engineer has confirmed that there is no conflict between the preoperational test specification (22A5296A6, Rev. 1, B5.5.9) and the RHR process flow diagram (762E425AA, Rev. 4, Note 8). The reference location is specified because the flow diagram is prepared before the nozzle center line is known. Standard engineering practice is used to determine the equivalent NPSH at any other location.

Field test data has been finalized for the LPCS and HPCS pumps and shows that NPSH available, extrapolated to 212°F, and assuming minimum static head, is approximately 7.7 ft for the LPCS pump and 8.9 ft for the HPCS pump. We believe that test data for the RHR pumps will have approximately the same margin.

Action to Prevent Recurrence

There is no further action required to prevent recurrence, since the problem is confined to the previously mentioned systems.

DEFICIENCY NO. D2.7-1 (Revised)

RESPONSE 1

Cause

Timely review of the interim problem report (IPR) was not performed because the IPR was inadvertently routed to the wrong lead engineer by the on-project IPR coordinator. This IPR was located, routed to the correct lead engineer, and responded to during the course of the inspection.

Extent of Condition

This is an isolated case. The on-project IPR distribution system was reviewed, and it was determined that all IPRs are being forwarded to the correct lead engineers, including distribution to multiple lead engineers when appropriate.

Action to Correct Existing Condition

No additional corrective action is needed relative to the IPR distribution system.

Action to Prevent Recurrence

No specific action to prevent recurrence is required. The on-project IPR coordinator is aware of the need to distribute all IPRs to the correct lead engineers.

RESPONSE 2

We do not concur with the portions of Deficiency No. D2.7-1 which in essence state that the evaluations performed in response to NRC IE Information Notice 83-26 were inadequate.

The information in IE Information Notice 83-26 and INPO Significant Event Report No. 16-83 (both of which were included in SWEC Interim Problem Report No. 50978) contained several significant items.

1. For all the events reported, none indicated that the ability to maintain the reactor in a safe condition was ever compromised.

2. Two of the plants were able to initiate a normal cooldown, indicating that steam leakage was not severe.

3. None of the plants indicated damage to other equipment as a result of the steam leakage.

4. All the problems were associated with failure to achieve tight shutoff; thus there was no indication that the vacuum breaking function was ever jeopardized.

5. Where specific information was provided, it pointed to problems associated with hinge pin size and materials and bearing materials.

Had any of the reported events indicated a more severe failure (e.g., other equipment damaged, vacuum breaking capability compromised, safe shutdown capability compromised), a more indepth evaluation would have been performed. However, since this was not the case, SWEC and GSU proceeded to evaluate the applicability of the defined hinge pin and bearing problems.

Both General Precision Engineering (GPE) and Anderson Greenwood valves, which had experienced problems, were evaluated.

The 10-in., 300-psi GPE valves were modified to increase the hinge pin diameter from 5/16 in. to 1/2 in., and both the hinge pin and bearing materials were changed to a harder material (e.g., 416 stainless steel bearing material).

Both 6-in. and 8-in., 300-psi Anderson Greenwood valves with 7/16-in. diameter hinge pins were modified to replace the hinge pins and bearings with A654 (630 stainless steel) pins and bearings.

For the three modifications identified above, the respective utilities which implemented the modifications reported that no subsequent failures were experienced.

Although no operating experience yet exists for such application of the 10-in., 300-psi Anderson Greenwood valve, this valve uses a 9/16-in. diameter hinge pin and A654 hinge pin and bearing material.

Since the 10-in., 600-psi Velan valves used at River Bend contain 3/4-in. diameter hinge pins, use A654 as the hinge pin material, and have stellite bearings, we believe that these valves are equal to, if not better than, the modified Anderson Greenwood and GPE valves, which have operated successfully.

We believe that the actions taken to arrive at this conclusion constituted an adequate response to IE Information Notice 83-26.

NOTE: The Velan vacuum breakers are designed, analyzed, fabricated, and installed to the requirements of ASME III and will be subjected to the inservice inspection (ISI) requirements of ASME XI. Specifically, GSU's pump and valve ISI program which was submitted to the NRC in November 1984, indicated an ISI requirement for these check valves on pages 110 to 114. These 32 valves are required to be exercised whenever the plant is in cold shutdown. In addition, a requirement is included to test the setpoints of four valves during each refueling outage.

SUPPLEMENTAL RESPONSE - D3.3-1

CAUSE

Engineering was aware at the time it incorporated the ball joint rotational installation tolerance into the piping erection specification, that other piping installation tolerances were reflected in a Field Quality Control (FQC) inspection plan. Engineering mistakenly assumed that an additional piping installation tolerance (i.e., the ball joint rotational tolerance) would be automatically incorporated by FQC into its inspection plan and therefore did not formally instruct FQC to do so.

EXTENT

Suitable piping installation tolerances were already incorporated into the piping erection specification (Specification No. 228.160) and the associated FQC inspection plan. Both general and unique installation tolerances for equipment were already identified in the mechanical equipment erection specifications (Specification Nos. 229.150 and 229.160) and, where appropriate, into the applicable FQC inspection plans. The extent is therefore limited to the ball joint rotational tolerance.

CORRECTIVE ACTION

E&DCR No. P-13,050 was issued on November 20, 1984, to add a requirement to the Inspection section of the piping erection specification to verify that the ball joint rotational installation tolerance was satisfied. This constitutes formal direction by Engineering to FQC. Change C to FQC Inspection Plan No. R12283I2F0507 was then issued to incorporate this inspection requirement.

PREVENTIVE ACTION

Since this event is limited to a single case, no specific action to prevent recurrence is necessary.

SUPPLEMENTAL RESPONSE TO NRC IDI FINDING D3.4-4

A study on the effect of including supplemental structural steel in SWEC's pipe support stiffness model pertaining to snubbers has been completed. The flexibility of the supplemental steel was not considered in previous analyses because its impact was considered to be negligible. The present study supports this view.

The study was a two-phase investigation. In the first phase, the stiffness of the pipe support, including supplemental steel, was calculated for all the PSA-35, PSA-10, and PSA-3 snubbers. The resulting stiffnesses were then compared to the values used in the pipe stress analysis. These results are tabulated in Attachment 1. A review of Attachment 1 indicated that most of the new stiffness values were close to the original values used in the pipe stress analysis. However, in one case, the combined stiffness was 53 percent of the original stiffness. To further investigate the significance of this reduction in stiffness, the frequency analysis of the piping model (AX-108Y) was rerun, incorporating the reduced stiffness value, for the second phase of the investigation. The changes in modal frequencies are tabulated in Attachment 2 for the first ten modes.

The study shows that including the supplemental steel in the pipe support model had a minor impact on the pipe stress analysis. The largest change in the modal frequency is 5.3 percent, which is more than accounted for by the ±15-percent peak spreading of the amplified response spectra. Furthermore, this magnitude of frequency change occurs for only one of the first ten modes which would tend to further dilute the impact.

Additionally, Pacific Scientific Co., the supplier of snubbers on the RBS project, confirmed that the snubber functioning will not be impaired unless there is a significant deflection of the supporting structure before the frictional force (1 to 2 percent of rated snubber capacity) is overcome to engage the snubber. In the example support analyzed in the second phase, the deflection of the support system subjected to 2 percent of the snubber capacity, is 0.0036 in. This is negligible compared to the inherent tolerances in the snubber hardware. Thus, there is no effect on proper functioning of the snubbers.

We therefore conclude that the methods used by SWEC to account for pipe support stiffness in pipe stress analyses are adequate.

ATTACHMENT 1

Support BZ No.	Original Calculated Stiffness (lb/in.) A	Stiffness Including Supplemental Steel (lb/in.) B	Stiffness Used in Stress Analysis (lb/in.) C	Ratio B/C
3AA	4.6E5	4.65E5	5.25E5	0.89
3AX	6.54E4	6.4E4	5.63E4	1.14
3BE	6.3E4	6.26E4	5.63E4	1.11
3BR	6.8E4	6.8E4	5.63E4	1.21
3BU	5.75E4	5.37E4	5.63E4	0.95
3CA	2.09E5	1.95E5	1.8E5	1.08
17GK	6.46E5	6.35E5	5.25E5	1.21
17GM	5.45E5	4.72E5	5.25E5	0.90
17JW	4.82E5	3.51E5	5.25E5	0.67
27F	2.15E5	6.3E4	5.63E4	1.12
27PK	6.55E4	6.51E4	5.63E4	1.16
71AD		7.4E4	5.63E4	1.31
71AP		7.4E4	5.63E4	1.31
71DD		1.84E5	1.8E5	1.02
71GX	1.7E5	1.67E5	1.8E5	0.93
71TK	4.13E5	6.05E4	5.63E4	1.07
71UB	2.1E5	1.94E5	1.8E5	1.08
71VY	2.09E5	1.89E5	1.8E5	1.05
74BG	6.33E4	6.08E4	5.63E4	1.08
74CK	6.49E4	6.1E4	5.63E4	1.08
76BF	5.93E4	5.56E4	5.63E4	0.99
78AP	4.7E4	1.36E5	1.8E5	0.76
83CB		6.61E4	5.63E4	1.17
108UV	4.24E5	2.76E5	5.25E5	0.53
770DW	6.95E4	7.11E4	5.63E4	1.26

ATTACHMENT 2

EFFECT OF SNUBBER STIFFNESS REDUCTION (AX-108Y-NP272SX)

Mode No.	Old Frequency	New Frequency	Percent Change
1	7.550	7.147	5.34
2	8.714	8.714	0.00
3	9.106	8.953	1.68
4	9.739	9.709	0.30
5	9.935	9.935	0.00
6	10.310	10.295	0.15
7	10.528	10.527	0.01
8	11.437	11.437	0.00
9	11.665	11.654	0.09
10	12.160	12.125	0.29

SUPPLEMENTAL RESPONSE - IDI DEFICIENCY NO. D3.6-2

Twenty additional vendor documents were reviewed for conformance to their associated specification requirements. In all cases, the documents satisfactorily agreed with their respective specifications. Therefore, no further review of vendor documents is required. The list of documents reviewed is included as Attachment 1.

The vendor documents associated with the ball joints have been rereviewed and appropriately reconciled with Specification No. 228.150. An additional explanation is provided in Attachment 2.

The Lead Power Engineer has issued a memorandum to all River Bend Project power engineers emphasizing the need to provide suitable backup documentation whenever a specification requirement deviation is allowed and to promptly issue an appropriate change to the specification to ensure compatibility between the specification and other associated documents.

We believe that the ball joints are suitable for their intended use and that no further action is required at this time to demonstrate such suitability. This conclusion was reached after reevaluation of the submitted vendor data, additional discussions with the vendor, and after discussions with other knowledgeable industry personnel, including GE personnel.

We have completed evaluating the three methods identified in our original response to this deficiency for possibly providing additional assurance that higher breakaway figures either would not occur or could be tolerated and have concluded that:

a. Since breakaway torque tests were already performed by the vendor, nothing significant would be gained by repeating these tests. Also, such tests would not reveal the effects, if any, of aging on breakaway torque.

b. Redoing the stress analysis using higher breakway torques would not be definitive. Even though some margin does in fact exist in the present design, without an accepted regulatory or industry standard to define the acceptability of the demonstrated margin, acceptability of pipe stress analysis alone would remain a matter of individual judgment. In addition, we have been advised that the vendor's tests revealed breakaway torques of approximately one-half the 6500 ft-lb value, which introduces an additional safety factor of 2 into the design, in addition to other existing margin.

c. Performance of a periodic test of selected ball joints was rejected because:

   1. An in-situ test cannot be performed with a high steam pressure applied, and performance of a test without applied steam pressure eliminates one of the variables affecting breakway torque.

2. Removal of joints for testing would not likely be conclusive, since the physical effects of removing and transporting the joint to a remote test location would tend to exercise the joint. This could relieve the conditions which could have accumulated in a manner that might have otherwise caused the breakaway torque to increase.

Despite the fact that at present no regulatory requirements or industry standards exist which specifically address ball joint performance, we believe that the actions taken to date throughout the industry do demonstrate that the ball joints are suitable for their intended application in the main steam safety relief valve discharge lines.

In addition, we believe that the probability of aging causing significant increases in breakaway torque is extremely low. Breakaway torque is affected by the normal force and the coefficient of friction between the ball and gasket.

The normal force is affected by the steam pressure inside the ball, and by the bolt torque on the gasket retaining flange. The peak pressure is fixed over the plant life. The bolt torque is also fixed. The only variable is the gasket itself. Due to the low frequency of ball joint exposure to flow and the inherent design of the ball joint, it is unlikely that any appreciable deposition of corrosion products would occur between the ball and the gasket. The gasket has been shown to be suitable for approximately 34 years. Gasket aging is not considered to be a source of increased friction.

ATTACHMENT 1

LIST OF VENDOR DOCUMENTS REVIEWED IN RESPONSE TO
IDI DEFICIENCY NO. D3.6-2

Specification No. 216.210 - Control Building Centrifugal Liquid Chillers

6216.210-085-001A	-	Nuclear Environmental Qualification Program
6216.210-085-003A 6216.210-085-003B 6216.210-085-003C 6216.210-085-003D 6216.210-085-003E	-	Nuclear Environmental Qualification Report - Carrier Air Conditioning Corporation

Specification No. 223.311 - Fuel Pool Cooling Pumps

4223.311-021-001C	-	Nuclear Power Motor - System Type Test Report
6223.311-021-008A	-	Pump Motor Routine Test Report
6223.311-021-009B 6223.311-021-010A	-	Pump Motor Performance Test Report
7223.311-021-004A	-	Performance Test Curve - Pump 1A
7223.311-021-005A	-	Performance Test Curve - Pump 1B

Specification No. 228.212 - Motor-Operated Carbon Steel Valves 2 1/2 Inch and Larger

6228.212-047-068A 6228.212-047-068B 6228.212-047-068C 6228.212-047-068D	-	Actuator Qualification Report for IEEE 382, 323, and 344

Specification No. 232.920 - Standby Service Water Pumps

6232.920-257-005A	-	Qualification for Class 1E Motors
6232.920-257-008A	-	Pump 2A Performance Test Data
6232.920-257-009A	-	Pump 2C Performance Test Data

Specification No. 237.150 - Diesel Generator Fuel Oil Transfer Pumps

6237.150-168-001A 6237.150-168-001B 6237.150-168-001C	-	Qualification of Class 1E Motors
7237.150-168-001A	-	Pump Performance Data

Specification No. 237.160 - Miscellaneous Horizontal Centrifugal Pumps

6237.160-108-001A 6237.160-108-001B 6237.160-108-001C 6237.160-108-001D 6237.160-108-001E 6237.160-108-001F 6237.160-108-001G	-	IEEE Qualification of Class IE Motors
6237.160-108-010A	-	Chilled Water Pump P1A Performance Test Curve
6237.160-108-039A	-	Circulating Water Pump 1SWP*P3D Performance Test Curve

ATTACHMENT 2

DETAILS OF REREVIEW OF BALL JOINT VENDOR DOCUMENTS
IN RESPONSE TO IDI DEFICIENCY NO. D3.6-2

Low-Pressure Leakage Test Report

Aeroquip Report No. 40764-2 has been reentered into the SWEC vendor document system under SWEC File No. 6228.150-084-006B with an explanation that this document is acceptable because it exceeds the specification requirements. No change to the specification is required.

Radiation Life Test

Aeroquip Report No. 40764-2 has been reentered into the SWEC vendor document system under SWEC File No. 6228.150-084-006B with an explanation that radiation life test data are superseded by Aeroquip Report No. 122021.

Aeroquip Report No. 122021 has been reentered into the SWEC vendor document system under SWEC File No. 6228.150-084-005B with an explanation that the gasket material has been qualified by SWEC, based on available industry data, for an approximate 34 year life. This is considered to be an acceptable replacement frequency. The results of all such evaluations performed by SWEC on materials such as the ball joint gaskets are reported to GSU for input into GSU's program for replacing components which are approaching the end of their qualified life.

In addition, due to their physical location, it is unlikely that the ball joints would undergo significant neutron irradiation, and a good potential exists for extending the qualified life of the gaskets based on actual operational radiation exposure.

The vendor has confirmed by telephone that the lubricant is used only to facilitate gasket installation. SWEC has evaluated this lubricant and has found that its use in the application is acceptable for the radiological environment that the ball joints will experience.

A one-time-only deviation to the specification to accept the existing ball joints radiological qualification has been documented by issuance of E&DCR No. P-13,070.

Endurance Life Cycle

Aeroquip Report No. 40764-2 has been reentered into the SWEC vendor document system under SWEC File No. 6228.150-084-006B with an explanation that the endurance life cycle test information does not satisfy the stated specification requirements, although it does demonstrate that the ball joints can undergo some cyclic movements without any apparent adverse effects.

The vendor has advised by telephone that any additional torque required to overcome gasket adhesion on a 10-inch ball joint would be insignificant, but that no test data exist to verify this.

A one-time-only deviation to the specification to accept the existing ball joints without the specified endurance life cycle qualification has been documented by issuance of E&DCR No. P-13,070. This is considered acceptable, since even if the specification requirements had been completely satisfied, the effects, if any, of aging on breakaway torque would not have been revealed.

Vibration Test

A review of the system stress analysis indicates that the ball joints will not be subjected to vibratory motion due to either fluid flow or hydrodynamic loads. The requirement for vibration testing has been deleted from the specification by the issuance of E&DCR No. P-13,070.

Shock Test

Aeroquip Report No. 40764-2 has been reentered into the SWEC vendor document system under SWEC File No. 6228.150-064-006B with an explanation that the impulse cycling test, Aeroquip Report Nos. 101 and 116C (SWEC File No. 6228.150-084-010A), shall apply for the shock test required by the specification. Although Aeroquip Report Nos. 101 and 116C do not fully comply with the specification, they are considered to be a reasonably close substitute. Again, even if the specification requirements had been complied with completely, this test would not have identified the effects, if any, of aging on the breakaway torque. A one-time-only deviation of the specification to accept this report has been documented by issuance of E&DCR No. P-13,070.

Temperature Cycling Tests

Aeroquip Report Nos. 101 and 116E have been entered into the SWEC vendor document system under SWEC File No. 6228.150-084-006C with an explanation that the tests do not fully satisfy the specification requirements.

However, the tests which were conducted are very close to the specified requirements, and a one-time deviation to the specification has been documented by the issuance of E&DCR No. P-13,070.

Other

The apparent confusion created by References 8, 9, and 10, as listed in Deficiency No. D3.6-2, was resolved when E&DCR No. P-12,830 was issued.

DEFICIENCY NO. D6.4-1

RESPONSE

As explained below, we do not concur that the cited condition constitutes a deficiency. However, a modification which will further improve the system is being made to the standby service water system supply to provide HPCS independence as described under the Summary Section below.

We concur that in order for the high-pressure core spray (HPCS) system to be operable, either the Division I or Division II standby service water (SSW) system supply and return to the HPCS diesel generator and HPCS pumproom unit cooler must also be available. However, as noted in Observation D6.4-1, "...the present River Bend design satisfies existing industry standards and NRC regulatory requirements with regard to the single failure criterion and a minimum redundancy of two independent core cooling systems."

Keeping in mind the current requirements for single failure, the River Bend Station design is considered more reliable overall in that there are now fewer total Division III (i.e., HPCS) components which can potentially fail and render the HPCS inoperable.

FSAR

The FSAR statement that "...the high pressure core spray diesel generator is operable as an isolated system independent of electrical connection to any other system" is correct. It simply means that Division III electrical power is not provided to any Division I or II loads, and conversely, no Division I or II electrical power is supplied to any Division III loads. Since the FSAR sections that define the mechanical portions of HPCS and SSW clearly identify the interface between these two systems, the FSAR is considered adequate as is.

MOVs

The MOVs associated with the SSW supply and return are intended to be left open at all times to ensure availability of cooling water from either SSW division in the event of an accident, while minimizing the number of devices which must change state in response to such an event. Use of the LOCA signal to automatically open these valves was not included in the design because:

1. The LOCA signal locks in, and depending upon actual plant conditions, considerable time may elapse before the control room operator can safely reset the LOCA signal.

2. During this period, if a pipe crack were to occur, the control room operator would be unable to close the MOVs to isolate the cracked pipe.

Therefore, not providing a LOCA-based automatic opening signal is in compliance with General Design Criterion 20. Plant accessibility may be

severely restricted following a LOCA due to radiation levels; therefore, racking out of breakers and local locks at the MOVs was not employed. Overriding these devices in the event of pipe crack might not be reasonably achievable.

Inadvertent closure of one or all four MOVs would constitute a single failure induced by operator error; under such a condition, it is not required under single failure criteria that either the Division I or II electrical systems be postulated to fail concurrently.

Thus, upon careful comparison with the existing industry standard and NRC requirements, the River Bend Station design in this regard is equally, if not more, reliable.

Summary

GSU Letter Nos. RBS-19,576 dated November 29, 1984, and RBG-20,086 dated February 6, 1985, transmitted to the NRC draft FSAR changes committing to the following features. One 50-percent standby service water pump (1SWP*P2C), its discharge valve (1SWP*MOV40C), and pumproom cooling fan (1HVY*FN1C) are being switched over from the Division I power supply to the Division III (HPCS) diesel generator power supply. In addition, the HPCS cooling system bypass inoperative alarm logic is being modified to include standby service water supply return valves (to HPCS) "not fully open" positions and/or standby service water pump (1SWP*P2C) inoperative status. As noted in these letters, these changes will be incorporated in a future FSAR amendment.

Since the mechanical system integrity of Divisions I and II remains intact with the above modification, the requirement for independence of the HPCS cooling system is satisfied while retaining the higher reliability of the existing design as described under RESPONSE above.

DEFICIENCY NO. D6.6-1

RESPONSE

Inconsistencies noted in this finding do not constitute deficiencies in the design process. The policy implemented for the establishment of instrument setpoints is a controlled, technically acceptable process.

The policy for dissemination of safety-related instrument setpoints is clearly stated in SWEC Control Systems Division Memorandum CSDM 81/3-0, as follows:

> The issued setpoint calculation sheets will serve as the official source document for authorized instrument settings.

Similar rules for nonsafety-related setpoints are established by SWEC CSDM 82/11-0. In addition, this policy has been reinforced in other internal memoranda or Controls Group guidelines indicating that setpoints given on documents other than the setpoint calculation are for information only and are not to be considered official setpoint values. The actual calibration of instruments is based on the information contained in loop calibration reports issued to the testing organization and to the Client, and the only official source for preparation of these documents is the issued setpoint calculation.

Many of the related documents which include approximate setpoint information were prepared early in the life of the project, prior to the completion of formal setpoint calculations. In those cases, it was necessary to establish a target setpoint so that design and procurement could proceed. The actual setpoint could not be accurately calculated at that time, since the instrument had not been selected and the design process had not been completed. Generally, the desired process limit was developed by the responsible engineer and used as the interim setpoint.

Completion of formal setpoint calculations was scheduled to occur within 6 months of release of the equipment to the testing organization, followed by completion of loop calibration reports. This allowed the orderly scheduling of instrument procurement and the completion of the design process necessary to support completion of the calculations and resulted in minimal duplication of effort over the life of the project.

We do not believe that any problems exist in the above-described policy. This policy was deliberate and was implemented to ensure the issuance of technically correct documents. Affected project groups were notified and are aware of the policy. In addition, instrument calibrations are based only on loop calibration reports, which use issued setpoint calculations as the source.

However, in order to provide additional assurance, PMM 188 has been issued to the project, and SWEC Letter No. RBS-9838 dated November 19, 1984, has been received by Gulf States Utilities Company advising that the only official source for setpoints is the setpoint calculation. Other documents (e.g., logic diagrams, loops, etc) containing setpoint

information, when reissued for other reasons, may include either the latest available setpoint obtained from the setpoint calculations or a note stating that the setpoint information shown thereon is for information only and the setpoint calculation is the only source of actual setpoints. GSU is using setpoint values as indicated in this SWEC letter.

DEFICIENCY NO. D6.9-1

RESPONSE

This finding includes four basic concerns as follows:

1. FSAR Table 7.5-2 does not include battery current indication.

2. Normal service water system accident monitoring instrumentation for engineered safety features (ESF) cooling flow and temperature is implemented with QA Category II components.

3. The loop diagram indicated that the flow measurement is used for capacity checks, not for accident monitoring.

4. FSAR Table 7.5-2 has not been updated to include specific instrument identification numbers.

In addition, this finding also challenges the control of the design process.

With the exception of Items 1 and 2 above, we do not agree that deficiencies exist, or that there are systematic design control problems.

River Bend Station (RBS) uses shared service water systems: the QA Category II normal service water system (NWS) and the QA Category I standby service water system (SWP). The quality of instrumentation for the NWS is commensurate with the quality of the NWS components to which the instruments are attached, that is, QA Category II. This exception to Regulatory Guide 1.97 is justified in FSAR Table 7.5-2, Note 17, and is therefore not a deficiency. However, we concur that the higher reliability instrument indication provided by an upgraded instrument would provide greater assurance of availability and proper operation when required. The existing NWS flow instruments will be replaced with instruments procured to the same requirements as QA Category I as soon as practicable, but before returning to power after the first refueling outage. However, the meters will be installed and maintained as QA Category II.

Loop diagrams indicate instrument identification numbers, function, and location. In the aforementioned Note 17, the system function is described. QA Category I instrumentation in the SWP initiates starting of the SWP and isolation from the NWS, should the NWS pressure decrease and render the NWS unavailable. This QA Category I instrumentation is consistent with the requirements of Regulatory Guide 1.97 for monitoring performance of cooling water flow and temperature to ESF system components.

Whereas GSU suggested (IDI Reference 2) that SWEC include specific instrument identification numbers in FSAR Table 7.5-2, SWEC responded in SWEC Letter No. RBS-8188 dated December 20, 1982, that it would be inappropriate to do so, since inclusion of all the instrument identification numbers in Table 7.5-2 would make it unnecessarily unwieldy. FSAR

Table 7.5-2 furnishes information consistent with the requirements of NUREG-0800, the standard review plan for Section 7.5, and is therefore not considered to be a deficiency. The NRC was subsequently provided with a list of instrument identification numbers, which included those used to meet Regulatory Guide 1.97 requirements, by means of GSU Letter No. RBG-17,668 dated April 24, 1984.

The information given above demonstrates that the RBS design is controlled and that no systematic design control deficiencies exist. To verify that the RBS design process has been adequately controlled, a review of all instruments designated to meet Regulatory Guide 1.97 requirements has been conducted. Results indicate that Regulatory Guide 1.97 commitments have been satisfied.

With regard to Item 1 concerning battery current indication, the following applies:

Cause

The cause of the battery current being left off the list of Regulatory Guide 1.97 variables in FSAR Table 7.5-2 could not be determined.

Extent of Condition

This condition is confined to the specific device furnished to meet the requirements of Regulatory Guide 1.97 for measurement of dc battery current.

Action to Correct Existing Condition

FSAR Table 7.5-2 is being revised to include the dc ammeters for battery current.

NWS flow instruments will be upgraded as indicated above.

Action to Prevent Recurrence

The results of the instrument review against Regulatory Guide 1.97 requirements showed that no further action is required.

SUPPLEMENTAL RESPONSE TO DEFICIENCY NO. D.A.1-2

The review of additional mechanical calculations for arithmetic discrepancies and internal page referencing discrepancies, which was committed in the initial response to Deficiency No. D.A.1-2, has been completed.

Calculation Nos. PN-048 and PN-268 have been revised in response to Deficiency Nos. D2.3-4 and D2.3-1, respectively.

Calculation Nos. PN-263 and PN-307, as well as 18 other calculations covering a diversity of topics and a broad range of calculation completion dates, have been reviewed. A complete listing of calculation numbers, issue dates, and topics is attached.

Although additional instances of minor arithmetic and internal page referencing discrepancies were detected during this review, none of these discrepancies is significant enough to have created a situation where the affected system/equipment would not have been able to perform all of its intended functions. No hardware modifications are required as a result of this review.

Eight of the 20 calculations contained neither arithmetic nor page referencing discrepancies. Although seven calculations had page referencing discrepancies, in some calculations this was limited to a single instance, and in no case did any page referencing discrepancy result in the introduction of a significant technical discrepancy. Nine calculations contained minor arithmetic discrepancies. However, in four of these, this condition was limited to a single instance. In several cases, the discrepancy was entirely typographical (e.g., the correct number was actually used in the computations, but digits were transposed when the number was recorded in the calculation). In all cases where arithmetic discrepancies existed, the discrepancies were minor and will not preclude the affected systems/equipment from performing all of their intended functions.

Since no adverse impacts on the ability of the affected systems/equipment to perform their intended functions were discovered, no additional review of mechanical calculations is necessary.

In order to ensure the quality of mechanical calculations in the future, additional guidance and instructions for the preparation and checking of calculations have been prepared by the Lead Power Engineer and reviewed by all River Bend Power Division engineers. A copy of the memorandum containing this guidance and instruction is attached.

LISTING OF CALCULATIONS REVIEWED IN ACCORDANCE
WITH SUPPLEMENTAL RESPONSE TO DEFICIENCY NO. D.A.1-2

Item No.	Calc. No.	Rev. No.	Issue Date	Calculation Topic
1	PN-213	0	12/07/79	Calculate suppression pool volume and surface area (input to LOCA analysis)
2*	PN-232	0	11/12/80	Calculate pump discharge head and orifice pressure drops for LPCS
3	PN-239	0	06/26/81	Verify 125,000-gallon reserve capacity in condensate storage tank
4	PN-246	0	10/27/80	Calculate required flow rate for RHR heat exchanger steam relief valves
5	PN-247	0	10/27/80	Calculate normal and maximum temperatures for containment fuel storage pool
6*	PN-257	0	12/24/80	Calculate NPSH and discharge head for fuel pool cooling pumps
7	PN-259	0	12/19/80	Calculate flow rate due to recirculation system sample line break (input to FSAR Section 9.3.2)
8	PN-261	1	03/10/81	Calculate required flow rate for RHR heat exchanger condensate relief valve
9	PN-263	0	02/05/81	Calculate orifice pressure drops for ECCS subsystem pump discharge lines
10	PN-272	0	04/01/81	Calculate time required to drain containment and fuel building refueling pools
11	PN-280	2	06/01/83	Verify piping minimum wall thickness for penetration valve leakage control system
12	PN-285	1	07/05/83	Verify size of reactor water cleanup system backwash receiving tank vent line
13*	PN-289	0	11/10/82	Calculate pump discharge head and orifice pressure drops for HPCS
14	PN-292	0	06/08/83	Calculate flow rates required for turbulent flow in sample systems
15	PN-295	0	11/09/82	Verify adequate volume in control rod drive system scram discharge volume

Item No.	Calc. No.	Rev. No.	Issue Date	Calculation Topic
16	PN-301	1	01/12/83	Calculate steam flow rate through RHR heat exchanger vent line steam condensing mode
17	PN-304	0	06/29/83	Calculate volume required for condensing pots for E51*PDTN083A, B; N084A, B
18	PN-306	0	08/04/83	Calculate pressure drop across RCIC restriction orifice (E51-ROD005)
19	PN-307	0	08/24/83	Verify piping minimum wall thickness for RHR system
20	PN-312	1	09/18/84	Calculate heatup rate of spent fuel storage pool without cooling supply to fuel pool cooling heat exchangers

SUPPLEMENTAL RESPONSE - IDI UNRESOLVED ITEM U4.16-1

The additional information requested by the IDI Team to complete the resolution of this item was provided to one of the team members during the followup inspection conducted in November 1984. The information is contained in an RCI calculation entitled Decoupling Study Task File dated September 26, 1984. This document describes the method of analysis used, both with and without inclusion of the pipe mass, and a comparison of the two results. For a ready reference, a copy of this study is attached.

Reacto- Controls, Inc.

Serial Letter No. RCI-S&W-280

October 3, 1984

Stone & Webster Engineering Corporation
3 Executive Campus
Post Office Box 5200
Cherry Hill, New Jersey 08034

Attention: Project Engineer
J. O. No. 12210
Lead Power Engineer

Subject: Contract No. RBS-288.180-C285
Fabrication, Erection and Testing of Control Rod Drive System - Piping
River Bend Station - Unit 1
(J. O. No. 12210)
Gulf States Utilities

Attachment: Decoupling Study Task File
Rev. 0, Dated 9/26/84

Gentlemen:

The purpose of this letter is to transmit a copy of our Decoupling Study Task File, Attachment 1, as requested.

This information is submitted for your information and use. If you have any questions, please let me know.

Very truly yours,

REACTOR CONTROLS, INC.

R. C. Weitenstein
Project Manager

Attachment

cc: See Page Two

cc: B. MacKellar - RCI
G. Secchi - RCI

Contracts Admin. - SWEC
Manager, Procurement Q. C. Div. - SWEC
Manager, River Bend Project - GSU
Sr. Contracts Manager - SWEC
S. Malhotra - SWEC

RCW:er

Reactor Controls, Inc. ATTACHMENT #1
SAN JOSE, CALIFORNIA

Client: Stone and Webster
Project: Piver Bend

Document:
Date Originated: 9/26/84
Current Revision: 0
Page: 1 Continued 2

Decoupling study
task file.

NOTED OCT 1 0 1984 S.M. MALHOTRA

Rev.	Date	Change	Prepared by	Checked by	Approved by
0	9/26/84	Initial issue	S. Schulz	[illegible]	[illegible]

ORIGINATED: S. Solomon	DATE: 9/26/84
CHECKED: [illegible]	DATE: 9/26-84

Decoupling Study
Task file content.

I. Background / Purpose

II Selection of Study Case

III Method of Analysis

1. Without pipe masses
2. With pipe masses
3. Comparison of the results.
4. Static equivalent

IV Conclusion.

V Appendices

A. Frequency table, mass participation factors and max. stress ratio summaries for run w/o pipe masses

B. The same for run with pipe masses.

C. stress ratio summary for static equivalent method.

D. Pipe masses summary table from piping group.

I

BACKGROUND

The River Bend CRDHS Insert/Withdraw piping configuration consists of bundles of 1.0 and 1-1/4" NPS piping supported by large rigid frame structures. A single support in this configuration will support approximately 74 individual pipes. The piping configuration, although similar, is unique enough that at various support locations the individual response from pipe to pipe will vary significantly.

PURPOSE

The purpose of this evaluation is to demonstrate:

1. The effects of pipe mass are adequately accounted for in the support structure analysis.
2. The frequency response for the three supports analyzed dynamically would not be significantly affected by the addition of pipe mass.
3. The conservatism built in to the current analysis methods are more than adequate to qualify the supports for their intended function.
4. The intent of SRP 3.7.2 & FSAR Section 3.7.2.1.1.2A is satisfied.

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II Selection of study case

Selection of structure to study was done based on the highest pipe mass to support mass ratio.

For I/W support 4 trough 7 this ratio is :

Translational masses of the structure itself (Ref Run ANFGGRR 9/29/83)

≈ 11,250 lbs

Translational masses of the structure with the pipe masses (Ref. Run. ANFGJGR 9/11/84)

≈ 16,700 lbs

Pipe masses alone 16,700 - 11,250 = 5,450 lbs

$$Ratio = \frac{5,450}{11,250} = .48$$

The other two supports, analyzed dynamically, are: Multifunction platform and control station.

Mass of multifunction support structure is 48,000 lbs (Ref. Run ANFGBRS from 4/24/83)

and mass of control station support is 17,400 lbs (Ref Run ANFGQFU from 3/15/84).

Both these structures appears to be more massive than I/W support 4 through 7 and pipe masses to be applied are less [illegible], so mass ratios would be much smaller.

It is reasonable to assume, that I/W support 4 through 7 will be good selection for the study.

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C
III Method

P.5 Cont. 6

1 Support is analyzed dynamically without tributary pipe masses and response is combined by absolute sum with other statically applied loads.
Response spectra curves, used for dynamic analysis, were enveloped from all applicable elevations.
Piping dynamic response loads were applied assuming the peak response from all individual pipe occurs in-phase.
This is very conservative because in actuality the piping frequency response will vary causing cancellat of reactions within the pipe bundle.
Frequency table, mass modal participation factor and stress ratio summaries are attached in Appendix A of this folder.

2 Support is analyzed dynamically with the tributory pipe masses and response is combined the same way as before.
Pipe masses are obtained by applying acceleration of gravity to the individual piping systems and reactions at the restrained direction are applied back to the support as masses for every pipe in the bundle.
Note, that including the mass of the piping in the frequen analysis of the support adds conservatism to the analys which already accounts for piping response by applying statically reactions due to pipe excitation.
Frequency table, mass modal participation factors and

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stress ratio summaries are presented in Appendix B.

3. Comparison of the results.

Even though, including tributary pipe masses, affected support natural frequencies to be shifted to the down side, max. stress ratios of different support members did not change significantley.

For example, max. direct stress ratio for the most critical section TS 6×6×½" is:

Without piping masses — .721 (Ref. Run ANFGEMJ, 10/1...

With piping masses — .722 (Ref. Run ANFGCEF, 9/12/84

TS 16×8×½ :

Without piping masses — .364 } (Same ref.)

With piping masses — .366 }

These results lead to the reasonable conclusion that initial conservatism, used in dynamic analysis without piping masses, covers all significant modes and response spectra peaks.

It also leads to the assumption that static equivalent method can be used instead of modal dynamic analysis and it will not significantly change the results.

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4. Finally, to conform, that results from initial dynamic analysis of the structure without tribute pipe masses, was adequatly conservative, static equivalent method is used with dynamic load factor of 1.5, times peak acceleration from each spectrum, according to SRP 3.7.2.
Stress ratio summary is presented in Appendix C.
Results show insignificant changes in max. stress ratios for different sections.
For example (Ref. Run ANFGCVI)

TS 6×6×½'	.736	(Versus .721)
TS 16×8×½'	.397	(Versus .364)

IV
Conclusion:

The decoupling of piping masses from the structure did not affect significantly results due to conservatism used for response spectra curves.

V Appendices

Appendix A.

I G E N V A L U E   T A B L E

V8,SA-0900,SP-4, ,7,QUAD 1,2,3
. K. LIE 9-26-83

ROOT NUMBER	E I G E N V A L U E S (RADIANS/UNIT TIME)**2	CIRCULAR FREQUENCY (RADIANS/UNIT TIME)	FREQUENCY (CYCLES/UNIT TIME)	PERIOD (TIME/ONE CYCLE)
1	.103320236720312E+06	.321435E+03	51.1579	.019547
2	.214234784895591E+06	.462855E+03	73.6657	.013575
3	.248205856958849E+06	.498203E+03	79.2914	.012612
4	.479223374107770E+06	.692260E+03	110.1765	.009076
5	.566465405573331E+06	.752634E+03	119.7862	.008348
6	.600833465711163E+06	.775134E+03	123.3665	.008106
7	.642906507705244E+06	.801816E+03	127.6129	.007836
8	.662834556352599E+06	.814147E+03	129.5754	.007718
9	.690144545710677E+06	.830749E+03	132.2179	.007563
10	.752482471959910E+06	.867457E+03	138.0601	.007243
11	.809697442871000E+06	.899832E+03	143.2127	.006983
12	.836468214250040E+06	.914586E+03	145.5609	.006870

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MASS MODAL PARTICIPATION FACTORS

RVR.SA-0900.SP-4,5,6,7,QUAD 1,2,3
G. K. LIE 9-26-83

GLOBAL AXIS	CENTROIDAL COORDINATE	TOTAL MASS	MASS MOMENT OF INERTIA
X	34.2261	2.903885E+01	1.364726E+05
Y	103.3406	2.903885E+01	4.979542E+04
Z	45.0133	2.903885E+01	1.378366E+05

MODE NUMBER	PARTICIPATION FACTORS GLOBAL X DIRECTION	PARTICIPATION FACTORS GLOBAL Y DIRECTION	PARTICIPATION FACTORS GLOBAL Z DIRECTION	PERCENT OF TOTAL MASS GLOBAL X DIRECTION	PERCENT OF TOTAL MASS GLOBAL Y DIRECTION	PERCENT OF TOTAL MASS GLOBAL Z DIRECTION
1	-3.957017E+00	3.061189E-02	4.500157E-01	53.921 ← 1	.005	.697
2	1.243782E-01	-4.495574E+00	2.353542E-01	.053	69.597 ← 2	.191
3	1.596227E+00	3.055195E-01	-2.194760E-01	8.796 ← 3	.321	.166
4	-4.216602E-01	-1.022050E+00	-2.007631E+00	.612	3.597 [illegible]	13.880 ← 4
5	-2.317814E-02	3.346654E-02	-2.151517E-01	.002	.004	.159
6	-1.081888E-01	5.811006E-01	-3.794960E-01	.040	1.163	.496
7	-6.367843E-01	9.729299E-02	1.154644E+00	1.396	.033	4.591 ← #7
8	-1.074145E-01	-8.096174E-02	-5.518080E-02	.040	.023	.010
9	-6.195568E-01	-1.623298E-02	-3.919569E-01	1.322	.001	.529
10	1.167122E-01	4.456353E-01	-9.254329E-02	.047	.684	.029
11	-3.360430E-02	-1.599380E-01	1.432705E+00	.004	.087	7.069 — 11
12	1.255327E+00	-5.264025E-02	2.805741E-01	5.427 ← 12	.010	.271
				71.660	75.524	28.089
				28.3%	24.48%	71.91%

Running [illegible]

XVII-2000 STEEL DESIGN EVALUATION   RUN DATE (83/10/14.) PAGE (475)

RIVERHEND,SA-0900,SUPPORT 4,5,6,7$ JOB NAME (ANFGEMJ) VERSION (13.4-B)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	ALLOWABLE STRESSES AXIAL	ALLOWABLE STRESSES STRONG BENDING	ALLOWABLE STRESSES WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
TS6X6X.5	1	1.000	.236	68	2215.1(21)	23.88	26.50	24.09	.110	67	16.06
	2	1.000	.006	103	2215.1(21)	23.89	26.50	24.09	.002	175	16.06
	3	1.000	.334	68	2215.1(21)	23.88	26.50	24.09	.184	67	16.06
	4	1.000	.484	68	2215.1(21)	23.88	26.50	24.09	.284	67	16.06
	5	1.000	.056	102	2215.1(21)	23.88	26.50	24.09	.017	175	16.06
	6	1.090	.025	761	2215.1(21)	23.18	26.50	24.09	.002	175	16.06
	7	1.000	.235	103	2215.1(21)	23.89	26.50	24.09	.076	67	16.06
	8	1.000	.170	102	2215.1(21)	23.88	26.50	24.09	.053	167	16.06
	9	1.000	.430	159	2215.1(21)	23.67	26.50	24.09	.050	175	16.06
	10	1.000	.252	68	2215.1(21)	23.88	26.50	24.09	.117	67	16.06
	11	1.000	.721	68	2215.1(21)	23.88	26.50	24.09	.395	67	16.06
	12	2.000	.368	68	2215.1(21)	23.88	53.00	48.18	.198	67	32.12
	13	1.000	.593	68	2215.1(21)	23.88	26.50	24.09	.292	67	16.06
	14	2.000	.324	159	2215.1(21)	23.67	53.00	48.18	.146	67	32.12
	15	1.330	.998	68	2215.1(21)	23.88	35.24	32.04	.227	67	21.36
	16	1.690	.438	68	2215.1(21)	23.88	44.78	40.71	.234	67	27.14
	17	1.690	.471	68	2215.1(21)	23.88	44.78	40.71	.186	67	27.14
	18	1.690	.398	68	2215.1(21)	23.88	44.78	40.71	.180	67	27.14
TS6X4X.5	1	1.000	.061	771	2215.1(21)	23.56	26.50	24.09	.012	771	16.06
	2	1.000	.006	757	2215.1(21)	22.14	26.50	24.09	.001	776	16.06
	3	1.000	.078	771	2215.1(21)	23.56	26.50	24.09	.015	771	16.06
	4	1.000	.084	771	2215.1(21)	23.56	26.50	24.09	.017	771	16.06
	5	1.000	.059	757	2215.1(21)	22.14	26.50	24.09	.007	125	16.06
	6	1.000	.022	771	2215.1(21)	23.56	26.50	24.09	.006	771	16.06
	7	1.000	.157	1010	2215.1(21)	22.43	26.50	24.09	.035	776	16.06
	8	1.000	.185	757	2215.1(21)	22.14	26.50	24.09	.032	776	16.06
	9	1.000	.201	771	2215.1(21)	23.56	26.50	24.09	.052	771	16.06
	10	1.000	.136	776	2215.1(21)	23.70	26.50	24.09	.033	776	16.06
	11	1.000	.146	771	2215.1(21)	23.56	26.50	24.09	.028	771	16.06
	12	2.000	.193	771	2215.1(21)	23.56	53.00	48.18	.033	771	32.12
	13	1.000	.181	1010	2215.1(21)	22.43	26.50	24.09	.030	776	16.06
	14	2.000	.196	771	2215.1(21)	23.56	53.00	48.18	.033	771	32.12
	15	1.330	.201	1010	2215.1(21)	22.43	35.24	32.04	.029	776	21.36
	16	1.690	.113	771	2215.1(21)	23.56	44.78	40.71	.018	771	27.14
	17	1.690	.330	1010	2215.1(19)	22.43	44.40	40.05	.046	776	27.14
	18	1.690	.182	1010	2215.1(21)	22.43	44.78	40.71	.024	776	27.14
TS4X4X.5	1	1.000	.106	606	2215.1(21)	22.94	26.50	24.09	.013	608	16.06
	2	1.000	.003	608	2215.1(21)	23.49	26.50	24.09	.001	609	16.06
	3	1.000	.148	606	2215.1(21)	22.94	26.50	24.09	.015	609	16.06
	4	1.000	.081	606	2215.1(21)	22.94	26.50	24.09	.013	608	16.06
	5	1.000	.026	608	2215.1(21)	23.49	26.50	24.09	.006	609	16.06
	6	1.000	.002	609	2215.1(21)	23.50	26.50	24.09	.000	609	16.06
	7	1.000	.187	608	2215.1(21)	23.49	26.50	24.09	.042	609	16.06
	8	1.000	.081	608	2215.1(21)	23.49	26.50	24.09	.019	609	16.06
	9	1.000	.033	609	2215.1(21)	23.50	26.50	24.09	.010	609	16.06
	10	1.000	.147	608	2215.1(21)	23.49	26.50	24.09	.021	608	16.06

ORIGINATED: S. Solomon DATE: 9/26/84
CHECKED: [illegible] DATE: 9/26-84

P. 11 Cont. 12

ORIGINATED : S. Chaney DATE : 9/26/84
CHECKED : [initials] DATE : 9/26/84

P. 12 Cont. 13

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	ALLOWABLE STRESSES AXIAL	STRONG BENDING	WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	11	1.000	.190	606	2215.1(21)	22.94	26.50	24.09	.026	608	16.06
	12	2.000	.109	607	2215.1(21)	22.95	53.00	48.18	.014	608	32.12
	13	1.000	.269	606	2215.1(21)	22.94	26.50	24.09	.034	609	16.06
	14	2.000	.150	607	2215.1(21)	22.95	53.00	48.18	.019	609	32.12
	15	1.330	.238	606	2215.1(21)	22.94	35.24	32.04	.032	609	21.36
	16	1.690	.138	606	2215.1(21)	22.94	44.78	40.71	.018	608	27.14
	17	1.690	.231	606	2215.1(21)	22.94	44.78	40.71	.045	609	27.14
	18	1.690	.195	606	2215.1(21)	22.94	44.78	40.71	.026	609	27.14
TS8X8X.6	1	1.000	.092	33	2215.1(21)	24.01	26.50	24.09	.067	75	16.06
	2	1.000	.006	71	2215.1(21)	24.01	26.50	24.09	.004	71	16.06
	3	1.000	.146	33	2215.1(21)	24.01	26.50	24.09	.103	35	16.06
	4	1.000	.189	33	2215.1(21)	24.01	26.50	24.09	.154	35	16.06
	5	1.000	.065	107	2215.1(21)	24.01	26.50	24.09	.044	71	16.06
	6	1.000	.068	39	2215.1(21)	24.01	26.50	24.09	.036	37	16.06
	7	1.000	.204	71	2215.1(21)	24.01	26.50	24.09	.145	71	16.06
	8	1.000	.206	107	2215.1(21)	24.01	26.50	24.09	.144	71	16.06
	9	1.000	.348	1	2215.1(21)	23.89	26.50	24.09	.111	160	16.06
	10	1.000	.127	1	2215.1(21)	23.89	26.50	24.09	.074	75	16.06
	11	1.000	.283	33	2215.1(21)	24.01	26.50	24.09	.211	35	16.06
	12	2.000	.314	1	2215.1(21)	23.89	53.00	48.18	.110	35	32.12
	13	1.000	.289	33	2215.1(21)	24.01	26.50	24.09	.161	35	16.06
	14	2.000	.314	1	2215.1(21)	23.89	53.00	48.18	.088	35	32.12
	15	1.330	.263	33	2215.1(21)	24.01	35.24	32.04	.134	75	21.36
	16	1.690	.188	33	2215.1(21)	24.01	44.78	40.71	.126	35	27.14
	17	1.690	.347	71	2215.1(21)	24.01	44.78	40.71	.197	71	27.14
	18	1.690	.219	33	2215.1(21)	24.01	44.78	40.71	.106	75	27.14
TS35X35X.3	1	1.000	.112	602	2215.1(21)	20.04	26.50	24.09	.010	44	16.06
	2	1.000	.005	604	2215.1(21)	16.29	26.50	24.09	.000	604	16.06
	3	1.000	.151	602	2215.1(21)	20.04	26.50	24.09	.015	44	16.06
	4	1.000	.190	602	2215.1(21)	20.04	26.50	24.09	.022	44	16.06
	5	1.000	.044	604	2215.1(21)	16.29	26.50	24.09	.003	604	16.06
	6	1.000	.015	42	2215.1(21)	22.30	26.50	24.09	.002	42	16.06
	7	1.000	.170	605	2215.1(21)	15.81	26.50	24.09	.006	44	16.06
	8	1.000	.145	604	2215.1(21)	16.29	26.50	24.09	.007	602	16.06
	9	1.000	.104	604	2215.1(21)	16.29	26.50	24.09	.011	44	16.06
	10	1.000	.136	602	2215.1(21)	20.04	26.50	24.09	.011	44	16.06
	11	1.000	.303	602	2215.1(21)	20.04	26.50	24.09	.033	44	16.06
	12	2.000	.232	602	2215.1(21)	20.04	53.00	48.18	.017	44	32.12
	13	1.000	.265	602	2215.1(21)	20.04	26.50	24.09	.025	44	16.06
	14	2.000	.210	602	2215.1(21)	20.04	53.00	48.18	.014	44	32.12
	15	1.330	.255	602	2215.1(21)	20.04	35.24	32.04	.020	44	21.36
	16	1.690	.233	602	2215.1(21)	20.04	44.78	40.71	.019	44	27.14
	17	1.690	.334	605	2215.1(19)	15.81	39.02	35.47	.017	44	27.14
	18	1.690	.229	602	2215.1(21)	20.04	44.78	40.71	.016	44	27.14
TS25X25X.2	1	1.000	.094	610	2215.1(21)	20.85	26.50	24.09	.006	611	16.06

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	LC	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	ALLOWABLE STRESSES AXIAL	ALLOWABLE STRESSES STRONG BENDING	ALLOWABLE STRESSES WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	2	1.000	.004	612	2215.1(21)	20.77	26.50	24.09	.000	610	16.06
	3	1.000	.129	610	2215.1(21)	20.85	26.50	24.09	.008	611	16.06
	4	1.000	.068	610	2215.1(21)	20.85	26.50	24.09	.005	611	16.06
	5	1.000	.031	612	2215.1(21)	20.77	26.50	24.09	.003	610	16.06
	6	1.000	.002	611	2215.1(21)	20.86	26.50	24.09	.000	612	16.06
	7	1.000	.133	611	2215.1(21)	20.86	26.50	24.09	.007	611	16.06
	8	1.000	.087	612	2215.1(21)	20.77	26.50	24.09	.008	610	16.06
	9	1.000	.031	610	2215.1(21)	20.85	26.50	24.09	.002	610	16.06
	10	1.000	.134	610	2215.1(21)	20.85	26.50	24.09	.007	611	16.06
	11	1.000	.163	610	2215.1(21)	20.85	26.50	24.09	.012	611	16.06
	12	2.000	.132	610	2215.1(21)	20.85	53.00	48.18	.006	611	32.12
	13	1.000	.235	610	2215.1(21)	20.85	26.50	24.09	.016	611	16.06
	14	2.000	.186	610	2215.1(21)	20.85	53.00	48.18	.008	611	32.12
	15	1.330	.237	610	2215.1(21)	20.85	35.24	32.04	.015	611	21.36
	16	1.690	.154	610	2215.1(21)	20.85	44.78	40.71	.008	611	27.14
	17	1.690	.273	610	2215.1(19)	20.85	42.98	39.07	.015	610	27.14
	18	1.690	.222	610	2215.1(19)	20.85	43.39	39.44	.012	611	27.14
TS4X2X.3	1	1.000	.150	330	2215.1(21)	23.80	26.50	24.09	.042	393	16.06
	2	1.000	.005	480	2215.1(21)	23.76	26.50	24.09	.001	480	16.06
	3	1.000	.242	353	2215.1(21)	23.82	26.50	24.09	.076	393	16.06
	4	1.000	.363	334	2215.1(21)	23.80	26.50	24.09	.080	393	16.06
	5	1.000	.056	480	2215.1(21)	23.76	26.50	24.09	.037	480	16.06
	6	1.000	.007	383	2215.1(21)	23.42	26.50	24.09	.001	395	16.06
	7	1.000	.331	480	2215.1(21)	23.76	26.50	24.09	.064	592	16.06
	8	1.000	.170	480	2215.1(21)	23.76	26.50	24.09	.021	480	16.06
	9	1.000	.068	272	2215.1(21)	23.42	26.50	24.09	.006	286	16.06
	10	1.000	.158	330	2215.1(21)	23.80	26.50	24.09	.044	393	16.06
	11	1.000	.499	334	2215.1(21)	23.80	26.50	24.09	.122	393	16.06
	12	2.000	.251	334	2215.1(21)	23.80	53.00	48.18	.061	393	32.12
	13	1.000	.394	353	2215.1(21)	23.82	26.50	24.09	.091	393	16.06
	14	2.000	.204	353	2215.1(21)	23.82	53.00	48.18	.046	393	32.12
	15	1.330	.332	353	2215.1(21)	23.82	35.24	32.04	.090	393	21.36
	16	1.690	.400	334	2215.1(21)	23.80	44.78	40.71	.072	393	27.14
	17	1.690	.431	480	2215.1(21)	23.76	44.78	40.71	.072	393	27.14
	18	1.690	.272	480	2215.1(21)	23.76	44.78	40.71	.071	393	27.14
TS16X8X.5	1	1.000	.088	763	2215.1(21)	23.54	26.50	24.09	.035	762	16.06
	2	1.000	.004	763	2215.1(21)	23.54	26.50	24.09	.002	762	16.06
	3	1.000	.116	763	2215.1(21)	23.54	26.50	24.09	.046	762	16.06
	4	1.000	.123	763	2215.1(21)	23.54	26.50	24.09	.053	762	16.06
	5	1.000	.031	763	2215.1(21)	23.54	26.50	24.09	.012	762	16.06
	6	1.000	.018	766	2215.1(21)	23.47	26.50	24.09	.006	765	16.06
	7	1.000	.080	763	2215.1(21)	23.54	26.50	24.09	.031	762	16.06
	8	1.000	.091	763	2215.1(21)	23.54	26.50	24.09	.033	762	16.06
	9	1.000	.489	763	2215.1(21)	23.54	26.50	24.09	.098	763	16.06
	10	1.000	.118	763	2215.1(21)	23.54	26.50	24.09	.046	762	16.06
	11	1.000	.212	763	2215.1(21)	23.54	26.50	24.09	.088	762	16.06

ORIGINATED : S. Ehmus DATE : 9/26/84
CHECKED : fa DATE : 9/26-84

P. 13 Cont. 14

XVII-2000 STEEL DESIGN EVALUATION — RUN DATE (83/10/14.) PAGE (478)

RIVERBEND,SA-0900,SUPPORT 4,5,6,7$ — JOB NAME (ANFGEMJ) VERSION (13.4-B)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	LC	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	ALLOWABLE STRESSES AXIAL	ALLOWABLE STRESSES STRONG BENDING	ALLOWABLE STRESSES WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	12	2.000	.364	763	2215.1(21)	23.54	53.00	48.18	.067	762	32.12
	13	1.000	.214	763	2215.1(21)	23.54	26.50	24.09	.087	762	16.06
	14	2.000	.363	763	2215.1(21)	23.54	53.00	48.18	.066	762	32.12
	15	1.330	.201	763	2215.1(21)	23.54	35.24	32.04	.072	762	21.36
	16	1.690	.168	763	2215.1(21)	23.54	44.78	40.71	.054	762	27.14
	17	1.690	.225	763	2215.1(21)	23.54	44.78	40.71	.071	762	27.14
	18	1.690	.180	763	2215.1(21)	23.54	44.78	40.71	.057	762	27.14
RIGIDBEAM	1	1.000	.019	764	2215.1(21)	24.09	26.50	24.09	.024	764	16.06
	2	1.000	.001	764	2215.1(21)	24.09	26.50	24.09	.001	764	16.06
	3	1.000	.023	764	2215.1(21)	24.09	26.50	24.09	.029	764	16.06
	4	1.000	.026	764	2215.1(21)	24.09	26.50	24.09	.033	764	16.06
	5	1.000	.006	764	2215.1(21)	24.09	26.50	24.09	.007	767	16.06
	6	1.000	.003	767	2215.1(21)	24.09	26.50	24.09	.006	767	16.06
	7	1.000	.016	764	2215.1(21)	24.09	26.50	24.09	.016	767	16.06
	8	1.000	.016	764	2215.1(21)	24.09	26.50	24.09	.018	767	16.06
	9	1.000	.100	764	2215.1(21)	24.09	26.50	24.09	.026	764	16.06
	10	1.000	.025	764	2215.1(21)	24.09	26.50	24.09	.032	764	16.06
	11	1.000	.045	764	2215.1(21)	24.09	26.50	24.09	.056	764	16.06
	12	2.000	.079	764	2215.1(21)	24.09	53.00	48.18	.035	764	32.12
	13	1.000	.045	764	2215.1(21)	24.09	26.50	24.09	.055	764	16.06
	14	2.000	.079	764	2215.1(21)	24.09	53.00	48.18	.035	764	32.12
	15	1.330	.042	764	2215.1(21)	24.09	35.24	32.04	.044	767	21.36
	16	1.690	.035	764	2215.1(21)	24.09	44.78	40.71	.035	764	27.14
	17	1.690	.046	764	2215.1(21)	24.09	44.78	40.71	.041	767	27.14
	18	1.690	.037	764	2215.1(21)	24.09	44.78	40.71	.035	764	27.14

ORIGINATED : S. Ehmy DATE : 9/26/84
CHECKED : [initials] DATE : 9/26-84

P.14 Comb. 15

Appendix B

ORIGINATED : S. Schumm DATE : 9/26/84
CHECKED : [illegible] DATE : 9/26-84

P. 16 Cont. 17

E I G E N V A L U E   T A B L E

[illegible] HAD 1,2,3

ROOT NUMBER	E I G E N V A L U E S (RADIANS/UNIT TIME)**2	CIRCULAR FREQUENCY (RADIANS/UNIT TIME)	FREQUENCY (CYCLES/UNIT TIME)	PERIOD (TIME/ONE CYCLE)
1	[illegible]	.263906E+03	42.0020	.023808
2	[illegible]	.277613E+03	44.1834	.022633
3	[illegible]	.334020E+03	53.1623	.018810
4	[illegible]	.381640E+03	60.7408	.016463
5	[illegible]	.494191E+03	78.6529	.012714
6	[illegible]	.527627E+03	83.9744	.011908
7	[illegible]	.547390E+03	87.1965	.011480
8	[illegible]	.570840E+03	90.8529	.011007
9	[illegible]	.581686E+03	92.5786	.010802
10	[illegible]	.608387E+03	96.8278	.010328
11	[illegible]	.624196E+03	99.3296	.010067
12	[illegible]	.637042E+03	101.3884	.009863

MASS MODAL PARTICIPATION FACTORS

RVH,SA-[illegible]-SP-[illegible]LOAD 1,2,3
G. K, LTF 9-33-13

GLOBAL AXIS	CENTROIDAL COORDINATE	TOTAL MASS	MASS MOMENT OF INERTIA
X	15.7588	[illegible]E+01	1.6322[illegible]E+05
Y	[illegible]	[illegible]	6.1714[illegible]E+04
Z	[illegible]	[illegible]	1.7587[illegible]E+05

MODE NUMBER	PARTICIPATION FACTORS GLOBAL X DIRECTION	GLOBAL Y DIRECTION	GLOBAL Z DIRECTION	PERCENT OF TOTAL MASS GLOBAL X DIRECTION	GLOBAL Y DIRECTION	GLOBAL Z DIRECTION
1	-5.32555[illegible]	[illegible]	4.6872[illegible]E-01	58.773	.425	.511
2	[illegible]E-01	[illegible]	-1.5416[illegible]E-01	.308	61.677	.063
3	2.007645E-02	-1.747391E+00	1.4236[illegible]E-01	.001	6.830	.047
4	2.34[illegible]E+00	[illegible]E-02	-1.9333[illegible]E-01	12.835	.011	.087
5	-5.1[illegible]E-01	5.6653[illegible]E-01	-2.1847[illegible]E+00	.607	.390	11.109
6	[illegible]	[illegible]	6.1[illegible]E-01	.629	.152	1.538
7	-2.1[illegible]	[illegible]E-01	1.766[illegible]E+00	.106	.527	7.429
8	[illegible]	[illegible]E-01	1.5362[illegible]E+00	.341	1.970	5.493
9	1.7993[illegible]E-01	1.646623E+00	1.153446E+00	.075	6.052	3.096
10	-4.46[illegible]E-01	[illegible]E-01	-2.15172[illegible]E+00	.559	1.033	10.775
11	[illegible]	[illegible]E-01	1.32753[illegible]E-01	.009	.994	.041
12	[illegible]	[illegible]E-01	5.5376[illegible]E-01	.078	.061	.714
				74.503	80.031	40.903

ORIGINATED : S. Schmuck DATE : 9/25/84
CHECKED : [illegible] DATE : 9/26/84

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X V I I - 2 0 0 0   S T E E L   D E S I G N   E V A L U A T I O N   RUN DATE (84/09/12.) PAGE (892)

RIVER BEND SA-0900 SUPPORTS 4 - 7 QUADRANTS 1,2,3   JOB NAME (ANFGCEF) VERSION (13.4-B)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE STRESSES---/ AXIAL	STRONG BENDING	WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
TS6X8X.5	1	1.000	.236	64	2215.1(21)	23.88	26.50	24.09	.110	67	16.06
	2	1.000	.014	68	2215.1(21)	23.88	26.50	24.09	.095	67	16.06
	3	1.000	.334	64	2215.1(21)	23.88	26.50	24.09	.184	67	16.06
	4	1.000	.484	68	2215.1(21)	23.88	26.50	24.09	.234	67	16.06
	5	1.000	.090	103	2215.1(21)	23.89	26.50	24.09	.031	167	16.06
	6	1.000	.025	761	2215.1(21)	23.18	26.50	24.09	.092	175	16.06
	7	1.000	.235	103	2215.1(21)	23.89	26.50	24.09	.076	67	16.06
	8	1.000	.204	103	2215.1(21)	23.89	26.50	24.09	.073	167	16.06
	9	1.000	.430	159	2215.1(21)	23.67	26.50	24.09	.050	175	16.06
	10	1.000	.252	63	2215.1(21)	23.88	26.50	24.09	.117	67	16.06
	11	1.000	.722	68	2215.1(21)	23.88	26.50	24.09	.395	67	16.06
	12	2.000	.369	68	2215.1(21)	23.88	53.00	48.18	.198	67	32.12
	13	1.000	.618	68	2215.1(21)	23.88	26.50	24.09	.277	67	16.06
	14	2.000	.325	159	2215.1(21)	23.67	53.00	48.18	.149	67	32.12
	15	1.330	.525	68	2215.1(21)	23.88	35.24	32.04	.234	67	21.36
	16	1.690	.441	68	2215.1(21)	23.88	44.78	40.71	.235	67	27.14
	17	1.690	.503	64	2215.1(21)	23.88	44.78	40.71	.198	67	27.14
	18	1.690	.421	68	2215.1(21)	23.88	44.78	40.71	.180	67	27.14
TS6X4X.5	1	1.000	.061	771	2215.1(21)	23.56	26.50	24.09	.012	771	16.06
	2	1.000	.008	757	2215.1(21)	22.14	26.50	24.09	.001	776	16.06
	3	1.000	.078	771	2215.1(21)	23.56	26.50	24.09	.015	771	16.06
	4	1.000	.084	771	2215.1(21)	23.56	26.50	24.09	.017	771	16.06
	5	1.000	.086	757	2215.1(21)	22.14	26.50	24.09	.013	776	16.06
	6	1.000	.022	771	2215.1(21)	23.56	26.50	24.09	.006	771	16.06
	7	1.000	.157	1010	2215.1(21)	22.43	26.50	24.09	.035	776	16.06
	8	1.000	.297	757	2215.1(21)	22.14	26.50	24.09	.043	776	16.06
	9	1.000	.201	771	2215.1(21)	23.56	26.50	24.09	.052	771	16.06
	10	1.000	.136	776	2215.1(21)	23.70	26.50	24.09	.033	776	16.06
	11	1.000	.146	771	2215.1(21)	23.56	26.50	24.09	.028	771	16.06
	12	2.000	.194	771	2215.1(21)	23.56	53.00	48.18	.034	771	32.12
	13	1.000	.200	1019	2215.1(21)	22.43	26.50	24.09	.035	776	16.06
	14	2.000	.200	771	2215.1(21)	23.56	53.00	48.18	.033	771	32.12
	15	1.330	.216	1019	2215.1(21)	22.43	35.24	32.04	.036	776	21.36
	16	1.690	.114	771	2215.1(21)	23.56	44.78	40.71	.018	771	27.14
	17	1.690	.335	1019	2215.1(19)	22.43	44.38	40.90	.050	776	27.14
	18	1.690	.197	1019	2215.1(21)	22.43	44.78	40.71	.029	776	27.14
TS4X4X.5	1	1.000	.106	606	2215.1(21)	22.94	26.50	24.09	.013	608	16.06
	2	1.000	.097	609	2215.1(21)	23.49	26.50	24.09	.031	609	16.06
	3	1.000	.148	606	2215.1(21)	22.94	26.50	24.09	.015	609	16.06
	4	1.000	.081	606	2215.1(21)	22.94	26.50	24.09	.013	608	16.06
	5	1.000	.060	608	2215.1(21)	23.49	26.50	24.09	.013	609	16.06
	6	1.000	.002	609	2215.1(21)	23.50	26.50	24.09	.000	609	16.06
	7	1.000	.187	608	2215.1(21)	23.49	26.50	24.09	.042	609	16.06
	8	1.000	.139	603	2215.1(21)	23.49	26.50	24.09	.031	609	16.06
	9	1.000	.033	609	2215.1(21)	23.50	26.50	24.09	.010	609	16.06
	10	1.000	.147	608	2215.1(21)	23.49	26.50	24.09	.021	608	16.06

ORIGINATED: S. Schmung DATE: 9/26/84
CHECKED: [initials] DATE: 9/26-84

P. 18 Cont. 19

ORIGINATED : S. Schumm DATE : 9/26/84
CHECKED : [initials] DATE : 9/26/84

p. 19 Cont. 20

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE STRESSES---/ AXIAL	STRONG BENDING	WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	11	1.000	.191	606	2215.1(21)	22.94	26.50	24.09	.026	608	16.06
	12	2.000	.110	607	2215.1(21)	22.95	53.00	48.18	.015	608	32.12
	13	1.000	.281	606	2215.1(21)	22.94	26.50	24.09	.040	609	16.06
	14	2.000	.156	607	2215.1(21)	22.95	53.00	48.18	.021	609	32.12
	15	1.330	.255	606	2215.1(21)	22.94	35.24	32.04	.039	609	21.36
	16	1.690	.141	606	2215.1(21)	22.94	44.78	40.71	.018	608	27.14
	17	1.690	.260	608	2215.1(21)	23.47	44.78	40.71	.052	609	27.14
	18	1.690	.210	606	2215.1(21)	22.94	44.78	40.71	.031	609	27.14
TS8X8X.6	1	1.000	.092	33	2215.1(21)	24.01	26.50	24.09	.067	75	16.06
	2	1.000	.010	71	2215.1(21)	24.01	26.50	24.09	.007	71	16.06
	3	1.000	.146	33	2215.1(21)	24.01	26.50	24.09	.193	35	16.06
	4	1.000	.189	33	2215.1(21)	24.01	26.50	24.09	.154	35	16.06
	5	1.000	.095	107	2215.1(21)	24.01	26.50	24.09	.064	71	16.06
	6	1.000	.068	37	2215.1(21)	24.01	26.50	24.09	.030	37	16.06
	7	1.000	.204	71	2215.1(21)	24.01	26.50	24.09	.145	71	16.06
	8	1.000	.230	107	2215.1(21)	24.01	26.50	24.09	.157	71	16.06
	9	1.000	.348	1	2215.1(21)	23.89	26.50	24.09	.111	100	16.06
	10	1.000	.127	1	2215.1(21)	23.89	26.50	24.09	.074	75	16.06
	11	1.000	.283	33	2215.1(21)	24.01	26.50	24.09	.211	35	16.06
	12	2.000	.315	1	2215.1(21)	23.89	53.00	48.18	.111	35	32.12
	13	1.000	.398	33	2215.1(21)	24.01	26.50	24.09	.163	35	16.06
	14	2.000	.317	1	2215.1(21)	23.89	53.00	48.18	.089	35	32.12
	15	1.330	.242	33	2215.1(21)	24.01	35.24	32.04	.147	71	21.36
	16	1.690	.191	33	2215.1(21)	24.01	44.78	40.71	.120	35	27.14
	17	1.690	.359	71	2215.1(21)	24.01	44.78	40.71	.205	71	27.14
	18	1.690	.236	33	2215.1(21)	24.01	44.78	40.71	.117	71	27.14
TS35X35X.3	1	1.000	.112	602	2215.1(21)	20.04	26.50	24.09	.010	44	16.06
	2	1.000	.007	604	2215.1(21)	16.29	26.50	24.09	.001	44	16.06
	3	1.000	.151	602	2215.1(21)	20.04	26.50	24.09	.015	44	16.06
	4	1.000	.190	602	2215.1(21)	20.04	26.50	24.09	.022	44	16.06
	5	1.000	.063	604	2215.1(21)	16.29	26.50	24.09	.003	604	16.06
	6	1.000	.015	42	2215.1(21)	22.30	26.50	24.09	.002	42	16.06
	7	1.000	.170	605	2215.1(21)	15.81	26.50	24.09	.006	44	16.06
	8	1.000	.157	42	2215.1(21)	22.30	26.50	24.09	.007	602	16.06
	9	1.000	.104	604	2215.1(21)	16.29	26.50	24.09	.011	44	16.06
	10	1.000	.136	602	2215.1(21)	20.04	26.50	24.09	.011	44	16.06
	11	1.000	.303	602	2215.1(21)	20.04	26.50	24.09	.033	44	16.06
	12	2.000	.234	602	2215.1(21)	20.04	53.00	48.18	.017	44	32.12
	13	1.000	.272	602	2215.1(21)	20.04	26.50	24.09	.026	44	16.06
	14	2.000	.215	602	2215.1(21)	20.04	53.00	48.18	.014	44	32.12
	15	1.330	.265	602	2215.1(21)	20.04	35.24	32.04	.020	44	21.36
	16	1.690	.234	602	2215.1(21)	20.04	44.78	40.71	.019	44	27.14
	17	1.690	.358	605	2215.1(19)	15.41	36.42	34.92	.017	44	27.14
	18	1.690	.239	602	2215.1(21)	20.04	44.78	40.71	.010	44	27.14
TS25X25X.2	1	1.000	.094	610	2215.1(21)	20.85	26.50	24.09	.006	611	16.06

RIVER BEND SA-0900 SUPPORTS 4 - 7 QUADRANTS 1,2,3   JOB NAME (ANFGCEF) VERSION (13.4-8)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE AXIAL	STRONG BENDING	WEAK BENDING STRESSES---/	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	2	1.000	.006	612	2215.1(21)	20.77	20.59	24.09	.001	610	16.06
	3	1.000	.129	613	2215.1(21)	20.85	20.59	24.09	.008	611	16.06
	4	1.000	.068	612	2215.1(21)	20.85	20.59	24.09	.005	611	16.06
	5	1.000	.042	612	2215.1(21)	20.77	20.59	24.09	.004	610	16.06
	6	1.000	.092	611	2215.1(21)	20.86	20.59	24.09	.009	612	16.06
	7	1.000	.133	611	2215.1(21)	20.86	20.59	24.09	.007	611	16.06
	8	1.000	.099	612	2215.1(21)	20.77	20.59	24.09	.007	610	16.06
	9	1.000	.031	610	2215.1(21)	20.85	20.59	24.09	.002	610	16.06
	10	1.000	.134	610	2215.1(21)	20.85	20.59	24.09	.007	611	16.06
	11	1.000	.164	610	2215.1(21)	20.85	20.59	24.09	.012	611	16.06
	12	2.000	.133	610	2215.1(21)	20.85	53.09	44.18	.026	611	32.12
	13	1.000	.241	610	2215.1(21)	20.85	20.59	24.09	.017	611	16.06
	14	2.000	.190	610	2215.1(21)	20.85	53.09	44.18	.009	611	32.12
	15	1.330	.249	610	2215.1(19)	20.85	34.12	31.92	.015	611	21.36
	16	1.690	.156	610	2215.1(21)	20.85	44.73	40.71	.015	611	27.14
	17	1.690	.284	610	2215.1(19)	20.85	42.72	39.92	.015	610	27.14
	18	1.690	.232	610	2215.1(19)	20.85	43.34	39.40	.012	611	27.14
TS4X2X.3	1	1.000	.150	330	2215.1(21)	23.80	20.59	24.09	.042	393	16.06
	2	1.000	.013	372	2215.1(21)	23.42	20.59	24.09	.002	372	16.06
	3	1.000	.242	351	2215.1(21)	23.42	20.59	24.09	.076	393	16.06
	4	1.000	.363	334	2215.1(21)	23.80	20.59	24.09	.080	393	16.06
	5	1.000	.111	372	2215.1(21)	23.42	20.59	24.09	.017	372	16.06
	6	1.000	.007	383	2215.1(21)	23.42	20.59	24.09	.001	395	16.06
	7	1.000	.331	480	2215.1(21)	23.70	20.59	24.09	.064	392	16.06
	8	1.000	.266	383	2215.1(21)	23.42	20.59	24.09	.042	372	16.06
	9	1.000	.068	272	2215.1(21)	23.42	20.59	24.09	.006	286	16.06
	10	1.000	.158	339	2215.1(21)	23.80	20.59	24.09	.044	393	16.06
	11	1.000	.500	334	2215.1(21)	23.80	20.59	24.09	.122	393	16.06
	12	2.000	.254	334	2215.1(21)	23.80	53.09	48.18	.061	393	32.12
	13	1.000	.437	372	2215.1(21)	23.42	20.59	24.09	.074	393	16.06
	14	2.000	.277	372	2215.1(21)	23.42	53.09	44.18	.047	393	32.12
	15	1.330	.401	372	2215.1(21)	23.42	35.24	32.04	.072	393	21.36
	16	1.690	.394	334	2215.1(21)	23.40	44.78	40.71	.073	393	27.14
	17	1.690	.473	480	2215.1(21)	23.76	44.78	40.71	.076	393	27.14
	18	1.690	.324	372	2215.1(21)	23.42	44.78	40.71	.073	393	27.14
TS16X8X.5	1	1.000	.088	763	2215.1(21)	23.54	20.59	24.09	.035	762	16.06
	2	1.000	.006	763	2215.1(21)	23.54	20.59	24.09	.002	762	16.06
	3	1.000	.110	763	2215.1(21)	23.54	20.59	24.09	.040	762	16.06
	4	1.000	.123	763	2215.1(21)	23.54	20.59	24.09	.053	762	16.06
	5	1.000	.034	766	2215.1(21)	23.47	20.59	24.09	.015	762	16.06
	6	1.000	.318	765	2215.1(21)	23.47	20.59	24.09	.006	765	16.06
	7	1.000	.040	763	2215.1(21)	23.54	20.59	24.09	.031	762	16.06
	8	1.000	.398	766	2215.1(21)	23.47	20.59	24.09	.037	762	16.06
	9	1.000	.480	763	2215.1(21)	23.54	20.59	24.09	.090	763	16.06
	10	1.000	.118	763	2215.1(21)	23.54	20.59	24.09	.040	762	16.06
	11	1.000	.212	763	2215.1(21)	23.54	20.59	24.09	.038	762	16.06

ORIGINATED : S. [signature] DATE : 9/26/89
CHECKED : [signature] DATE : 9/26/89

P. 20 Cont. 21

ORIGINATED : S. Schumm DATE: 9/26/84
CHECKED : [initials] DATE: 9/26 84

P. 21 Cont. 22

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE STRESSES---/ AXIAL	STRONG BENDING	WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	12	2.000	.366	763	2215.1(21)	23.54	53.09	48.16	.067	762	32.12
	13	1.000	.219	763	2215.1(21)	23.54	26.59	24.09	.089	762	16.06
	14	2.000	.365	763	2215.1(21)	23.54	53.09	48.16	.067	762	32.12
	15	1.330	.209	763	2215.1(21)	23.54	35.24	32.04	.075	762	21.36
	16	1.690	.169	763	2215.1(21)	23.54	44.78	40.71	.055	762	27.14
	17	1.690	.230	763	2215.1(21)	23.54	44.78	40.71	.074	762	27.14
	18	1.690	.187	763	2215.1(21)	23.54	44.78	40.71	.060	762	27.14
RIGIDBEAM	1	1.000	.019	764	2215.1(21)	24.09	26.59	24.09	.024	764	16.06
	2	1.000	.001	764	2215.1(21)	24.09	26.59	24.09	.031	767	16.06
	3	1.000	.023	764	2215.1(21)	24.09	26.59	24.09	.029	764	16.06
	4	1.000	.026	764	2215.1(21)	24.09	26.59	24.09	.033	764	16.06
	5	1.000	.007	764	2215.1(21)	24.09	26.59	24.09	.009	767	16.06
	6	1.000	.003	767	2215.1(21)	24.09	26.59	24.09	.036	767	16.06
	7	1.000	.016	764	2215.1(21)	24.09	26.59	24.09	.016	767	16.06
	8	1.000	.019	764	2215.1(21)	24.09	26.59	24.09	.022	767	16.06
	9	1.000	.100	764	2215.1(21)	24.09	26.50	24.09	.026	764	16.06
	10	1.000	.025	764	2215.1(21)	24.09	26.59	24.09	.032	764	16.06
	11	1.000	.045	764	2215.1(21)	24.09	26.59	24.09	.057	764	16.06
	12	2.000	.079	764	2215.1(21)	24.09	53.09	48.16	.030	764	32.12
	13	1.000	.046	764	2215.1(21)	24.09	26.59	24.09	.055	764	16.06
	14	2.000	.079	764	2215.1(21)	24.09	53.09	48.16	.035	764	32.12
	15	1.330	.043	764	2215.1(21)	24.09	35.24	32.04	.040	767	21.36
	16	1.690	.035	764	2215.1(21)	24.09	44.78	40.71	.035	764	27.14
	17	1.690	.047	764	2215.1(21)	24.09	44.78	40.71	.043	767	27.14
	18	1.690	.038	764	2215.1(21)	24.09	44.78	40.71	.037	767	27.14

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Appendix C.

RIVER BEND SA-0900 SUPPORTS 4 - 7 QUADRANTS 1,2,3   JOB NAME (ANFGCVI) VERSION (13.4-8)

ORIGINATED : S. Schumm DATE: 9/20/84
CHECKED : [initials] DATE: 9/26-84

P.23 Cont. 24

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE AXIAL	STRONG BENDING	STRESSES---/ WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
TS6X6X.5	1	1.000	.236	68	2215.1(21)	23.88	26.50	24.09	.110	67	16.06
	2	1.000	.065	103	2215.1(21)	23.89	26.50	24.09	.020	175	16.06
	3	1.000	.334	68	2215.1(21)	23.88	26.50	24.09	.184	67	16.06
	4	1.000	.484	68	2215.1(21)	23.88	26.50	24.09	.284	67	16.06
	5	1.000	.085	103	2215.1(21)	23.89	26.50	24.09	.028	175	16.06
	6	1.000	.025	761	2215.1(21)	23.18	26.50	24.09	.002	175	16.06
	7	1.000	.235	103	2215.1(21)	23.89	26.50	24.09	.075	67	16.06
	8	1.000	.282	30	2215.1(21)	23.88	26.50	24.09	.095	167	16.06
	9	1.000	.430	159	2215.1(21)	23.67	26.50	24.09	.053	175	16.06
	10	1.000	.252	68	2215.1(21)	23.88	26.50	24.09	.117	67	16.06
	11	1.000	.736	68	2215.1(21)	23.88	26.50	24.09	.395	67	16.06
	12	2.000	.378	68	2215.1(21)	23.88	53.00	48.18	.198	67	32.12
	13	1.000	.619	68	2215.1(21)	23.88	26.50	24.09	.233	67	16.06
	14	2.000	.361	159	2215.1(19)	23.67	52.93	48.12	.147	67	32.12
	15	1.330	.521	68	2215.1(21)	23.88	35.24	32.04	.228	67	21.36
	16	1.690	.467	68	2215.1(21)	23.88	44.78	40.71	.235	67	27.14
	17	1.690	.546	103	2215.1(21)	23.89	44.78	40.71	.188	67	27.14
	18	1.690	.429	68	2215.1(21)	23.88	44.78	40.71	.181	67	27.14
TS6X4X.5	1	1.000	.061	771	2215.1(21)	23.56	26.50	24.09	.012	771	16.06
	2	1.000	.070	757	2215.1(21)	22.14	26.50	24.09	.015	776	16.06
	3	1.000	.078	771	2215.1(21)	23.56	26.50	24.09	.015	771	16.06
	4	1.000	.084	771	2215.1(21)	23.56	26.50	24.09	.017	771	16.06
	5	1.000	.091	757	2215.1(21)	22.14	26.50	24.09	.019	776	16.06
	6	1.000	.022	771	2215.1(21)	23.56	26.50	24.09	.005	771	16.06
	7	1.000	.157	1010	2215.1(21)	22.43	26.50	24.39	.035	775	16.06
	8	1.000	.334	757	2215.1(19)	22.14	26.15	23.48	.073	776	16.06
	9	1.000	.201	771	2215.1(21)	23.56	26.50	24.09	.052	771	15.06
	10	1.000	.136	776	2215.1(21)	23.70	26.50	24.09	.033	776	16.06
	11	1.000	.159	771	2215.1(21)	23.56	26.50	24.09	.033	771	16.06
	12	2.000	.219	771	2215.1(21)	23.56	53.00	48.18	.035	771	32.12
	13	1.000	.232	1010	2215.1(21)	22.43	26.50	24.39	.044	775	16.06
	14	2.000	.227	771	2215.1(21)	23.56	53.00	48.18	.037	776	32.12
	15	1.330	.252	1010	2215.1(21)	22.43	35.24	32.04	.043	775	21.36
	16	1.690	.171	1010	2215.1(21)	22.43	44.78	40.71	.027	776	27.14
	17	1.690	.479	1010	2215.1(19)	22.43	44.18	39.56	.072	776	27.14
	18	1.690	.259	1010	2215.1(19)	22.43	44.50	40.21	.039	775	27.14
TS4X4X.5	1	1.000	.106	506	2215.1(21)	22.94	26.50	24.09	.013	608	16.06
	2	1.000	.023	508	2215.1(21)	23.49	26.50	24.39	.005	607	16.06
	3	1.000	.148	606	2215.1(21)	22.94	26.50	24.09	.015	607	16.06
	4	1.000	.081	606	2215.1(21)	22.94	26.50	24.09	.013	605	16.06
	5	1.000	.026	508	2215.1(21)	23.49	26.50	24.09	.007	607	16.06
	6	1.000	.002	609	2215.1(21)	23.50	26.50	24.39	.003	607	16.06
	7	1.000	.187	608	2215.1(21)	23.49	26.50	24.09	.042	607	16.06
	8	1.000	.087	508	2215.1(21)	23.49	26.50	24.09	.025	607	16.06
	9	1.000	.033	509	2215.1(21)	23.50	26.50	24.09	.013	607	16.06
	10	1.000	.147	608	2215.1(21)	23.49	26.50	24.09	.021	605	16.06

RIVER BEND SA-0900 SUPPORTS 4 - 7 QUADRANTS 1,2,3   JOB NAME (ANFGCVI) VERSION (13.4-8)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE AXIAL	STRONG BENDING	STRESSES---/ WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	11	1.000	.194	506	2215.1(21)	22.94	26.50	24.09	.028	603	15.06
	12	2.000	.113	507	2215.1(21)	22.95	53.00	48.18	.015	608	32.12
	13	1.000	.271	506	2215.1(21)	22.94	26.50	24.09	.035	603	16.06
	14	2.000	.153	507	2215.1(21)	22.95	53.00	48.18	.023	603	32.12
	15	1.330	.237	606	2215.1(21)	22.94	35.24	32.04	.032	603	21.36
	16	1.690	.148	606	2215.1(21)	22.94	44.78	40.71	.021	605	27.14
	17	1.690	.232	608	2215.1(21)	23.49	44.78	40.71	.045	603	27.14
	18	1.690	.199	606	2215.1(21)	22.94	44.78	40.71	.027	603	27.14
TS8X8X.6	1	1.000	.092	33	2215.1(21)	24.01	26.50	24.09	.067	75	16.06
	2	1.000	.097	71	2215.1(21)	24.01	26.50	24.09	.061	71	16.06
	3	1.000	.146	33	2215.1(21)	24.01	26.50	24.09	.103	35	16.06
	4	1.000	.189	33	2215.1(21)	24.01	26.50	24.09	.154	35	16.06
	5	1.000	.120	107	2215.1(21)	24.01	26.50	24.09	.084	71	16.06
	6	1.000	.058	39	2215.1(21)	24.01	26.50	24.09	.035	37	16.06
	7	1.000	.204	71	2215.1(21)	24.01	26.50	24.09	.145	71	16.06
	8	1.000	.434	107	2215.1(21)	24.01	26.50	24.09	.311	71	16.06
	9	1.000	.348	1	2215.1(21)	23.89	26.50	24.09	.111	163	16.06
	10	1.000	.127	1	2215.1(21)	23.89	26.50	24.09	.074	75	16.06
	11	1.000	.317	33	2215.1(21)	24.01	26.50	24.09	.211	35	16.06
	12	2.000	.347	1	2215.1(19)	23.89	52.98	48.16	.111	35	32.12
	13	1.000	.352	33	2215.1(21)	24.01	26.50	24.09	.185	71	16.06
	14	2.000	.352	1	2215.1(19)	23.89	52.98	48.15	.097	71	32.12
	15	1.330	.323	33	2215.1(21)	24.01	35.24	32.04	.177	71	21.36
	16	1.690	.255	33	2215.1(21)	24.01	44.78	40.71	.125	35	27.14
	17	1.690	.516	71	2215.1(21)	24.01	44.78	40.71	.308	71	27.14
	18	1.690	.308	71	2215.1(21)	24.01	44.78	40.71	.162	71	27.14
TS35X35X.3	1	1.000	.112	602	2215.1(21)	20.04	26.50	24.09	.013	44	16.06
	2	1.000	.083	604	2215.1(21)	16.29	26.50	24.09	.005	604	16.06
	3	1.000	.151	602	2215.1(21)	20.04	26.50	24.09	.015	44	16.06
	4	1.000	.190	602	2215.1(21)	20.04	26.50	24.09	.022	44	16.06
	5	1.000	.110	604	2215.1(21)	16.29	26.50	24.09	.007	604	16.06
	6	1.000	.015	42	2215.1(21)	22.30	26.50	24.09	.002	42	16.06
	7	1.000	.170	605	2215.1(21)	15.81	26.50	24.09	.035	44	16.06
	8	1.000	.358	604	2215.1(19)	16.29	23.54	21.40	.018	603	16.06
	9	1.000	.104	504	2215.1(21)	16.29	26.50	24.09	.011	44	16.06
	10	1.000	.136	502	2215.1(21)	20.04	26.50	24.09	.011	44	16.06
	11	1.000	.315	502	2215.1(21)	20.34	26.50	24.09	.033	44	16.06
	12	2.000	.250	502	2215.1(21)	20.04	53.00	48.18	.019	44	32.12
	13	1.000	.281	602	2215.1(21)	20.04	26.50	24.09	.027	44	15.06
	14	2.000	.245	604	2215.1(19)	16.29	48.32	43.93	.015	44	32.12
	15	1.330	.274	504	2215.1(21)	16.29	35.24	32.04	.021	44	21.36
	16	1.690	.260	602	2215.1(21)	20.34	44.78	40.71	.021	44	27.14
	17	1.690	.476	504	2215.1(19)	16.29	37.98	34.53	.023	44	27.14
	18	1.690	.273	604	2215.1(21)	16.29	44.78	40.71	.018	44	27.14
TS25X25X.2	1	1.000	.094	610	2215.1(21)	20.85	26.50	24.09	.035	611	16.06

ORIGINATED: S. Schaumy DATE: 9/26/84
CHECKED: [initials] DATE: 9/26-84

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X V I I - 2 0 0 0   S T E E L   D E S I G N   E V A L U A T I O N   RUN DATE (84/09/12.) PAGE (892)

RIVER BEND SA-0900 SUPPORTS 4 - 7 QUADRANTS 1,2,3   JOB NAME (ANFGCVII) VERSION (13.4-B)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE AXIAL	STRONG BENDING	STRESSES---/ WEAK BENDING	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	2	1.000	.041	512	2215.1(21)	20.77	26.50	24.09	.004	613	16.06
	3	1.000	.129	610	2215.1(21)	20.85	26.50	24.09	.008	611	16.06
	4	1.000	.068	610	2215.1(21)	20.85	26.50	24.09	.005	611	16.06
	5	1.000	.041	512	2215.1(21)	20.77	26.50	24.09	.005	613	15.06
	6	1.000	.002	611	2215.1(21)	20.86	26.50	24.09	.003	612	16.06
	7	1.000	.133	511	2215.1(21)	20.86	26.50	24.09	.007	611	16.06
	8	1.000	.107	610	2215.1(21)	20.85	26.50	24.09	.015	610	16.06
	9	1.000	.031	510	2215.1(21)	20.85	26.50	24.09	.002	613	16.06
	10	1.000	.134	610	2215.1(21)	20.85	26.50	24.09	.007	611	16.06
	11	1.000	.171	510	2215.1(21)	20.95	26.50	24.09	.013	611	16.06
	12	2.000	.143	510	2215.1(21)	20.85	53.00	48.18	.007	610	32.12
	13	1.000	.240	610	2215.1(21)	20.85	26.50	24.09	.019	61[illegible]	16.06
	14	2.000	.192	610	2215.1(21)	20.85	53.00	48.18	.013	610	32.12
	15	1.330	.239	610	2215.1(21)	20.85	35.24	32.04	.017	611	21.36
	16	1.690	.177	510	2215.1(21)	20.85	44.78	40.71	.013	611	27.14
	17	1.690	.284	510	2215.1(19)	20.95	43.02	39.11	.023	613	27.14
	18	1.690	.234	610	2215.1(19)	20.85	43.32	39.38	.014	610	27.14
TS4X2X.3	1	1.000	.150	330	2215.1(21)	23.80	26.50	24.09	.042	393	16.06
	2	1.000	.054	480	2215.1(21)	23.76	26.50	24.09	.007	483	16.06
	3	1.000	.242	353	2215.1(21)	23.82	26.50	24.09	.076	393	16.06
	4	1.000	.363	334	2215.1(21)	23.80	26.50	24.09	.083	393	16.06
	5	1.000	.077	480	2215.1(21)	23.76	26.50	24.09	.011	483	16.06
	6	1.000	.007	383	2215.1(21)	23.42	26.50	24.09	.001	395	16.06
	7	1.000	.331	480	2215.1(21)	23.76	26.50	24.09	.064	592	16.06
	8	1.000	.288	480	2215.1(21)	23.76	26.50	24.09	.039	480	16.06
	9	1.000	.069	272	2215.1(21)	23.42	26.50	24.09	.005	285	16.06
	10	1.000	.158	330	2215.1(21)	23.80	26.50	24.09	.044	393	16.06
	11	1.000	.501	334	2215.1(21)	23.80	26.50	24.09	.122	393	16.06
	12	2.000	.257	353	2215.1(21)	23.82	53.00	48.18	.061	393	32.12
	13	1.000	.402	353	2215.1(21)	23.82	26.50	24.09	.091	393	16.06
	14	2.000	.211	480	2215.1(21)	23.76	53.00	48.18	.045	393	32.12
	15	1.330	.358	480	2215.1(21)	23.76	35.24	32.04	.090	393	21.36
	16	1.690	.310	353	2215.1(21)	23.82	44.78	40.71	.072	393	27.14
	17	1.690	.523	480	2215.1(21)	23.76	44.78	40.71	.072	393	27.14
	18	1.690	.315	480	2215.1(21)	23.76	44.78	40.71	.071	393	27.14
TS16X8X.5	1	1.000	.088	763	2215.1(21)	23.54	26.50	24.09	.035	762	16.06
	2	1.000	.056	763	2215.1(21)	23.54	26.50	24.09	.017	762	16.06
	3	1.000	.110	763	2215.1(21)	23.54	26.50	24.09	.046	762	15.06
	4	1.000	.123	763	2215.1(21)	23.54	26.50	24.09	.053	762	16.06
	5	1.000	.050	763	2215.1(21)	23.54	26.50	24.09	.017	765	15.06
	6	1.000	.018	766	2215.1(21)	23.47	26.50	24.09	.005	765	16.06
	7	1.000	.080	763	2215.1(21)	23.54	26.50	24.09	.031	762	16.06
	8	1.000	.149	766	2215.1(21)	23.47	26.50	24.09	.064	763	16.06
	9	1.000	.480	763	2215.1(21)	23.54	26.50	24.09	.093	763	16.06
	10	1.000	.118	763	2215.1(21)	23.54	26.50	24.09	.046	752	16.06
	11	1.000	.230	763	2215.1(21)	23.54	26.50	24.09	.093	762	16.06

ORIGINATED : S. Schmus   DATE : 9/26/84
CHECKED : JO   DATE : 9/26/84

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RIVER BEND SA-0900 SUPPORTS 4 - 7 QUADRANTS 1,2,3 JOB NAME (ANFGCVI) VERSION (13.4-B)

SUMMARY OF CRITICAL MEMBERS FOR EACH SECTION PROPERTY

SECTION LABEL	L C	STRESS INCREASE FACTOR	DIRECT STRESS RATIO	BEAM ELEMENT NUMBER	GOVERNING CODE PROVISION	/---ALLOWABLE AXIAL	STRONG BENDING	WEAK BENDING STRESSES---/	SHEAR STRESS RATIO	BEAM ELEMENT NUMBER	ALLOWABLE SHEAR STRESS
	12	2.000	.396	763	2215.1(21)	23.54	53.00	48.18	.075	762	32.12
	13	1.000	.242	763	2215.1(21)	23.54	26.50	24.09	.095	762	16.06
	14	2.000	.377	763	2215.1(21)	23.54	53.00	48.18	.075	762	32.12
	15	1.330	.226	763	2215.1(21)	23.54	35.24	32.04	.074	762	21.36
	16	1.690	.210	763	2215.1(21)	23.54	44.78	40.71	.065	762	27.14
	17	1.690	.278	763	2215.1(21)	23.54	44.78	40.71	.085	762	27.14
	18	1.690	.224	763	2215.1(21)	23.54	44.79	40.71	.059	762	27.14
RIGIDBEAM	1	1.000	.019	764	2215.1(21)	24.09	26.50	24.09	.024	764	16.06
	2	1.000	.011	764	2215.1(21)	24.09	26.50	24.09	.012	767	16.06
	3	1.000	.023	764	2215.1(21)	24.09	26.50	24.09	.027	764	16.06
	4	1.000	.026	764	2215.1(21)	24.09	26.50	24.09	.033	764	16.06
	5	1.000	.010	764	2215.1(21)	24.09	26.50	24.09	.003	767	16.06
	6	1.000	.003	767	2215.1(21)	24.09	26.50	24.09	.005	767	16.06
	7	1.000	.016	764	2215.1(21)	24.09	26.50	24.09	.016	767	16.06
	8	1.000	.026	767	2215.1(21)	24.09	26.50	24.09	.023	772	16.06
	9	1.000	.100	764	2215.1(21)	24.09	26.50	24.09	.025	764	16.06
	10	1.000	.325	764	2215.1(21)	24.09	26.50	24.09	.032	764	16.06
	11	1.000	.048	764	2215.1(21)	24.09	26.50	24.09	.059	764	16.06
	12	2.000	.085	764	2215.1(21)	24.09	53.00	48.18	.039	764	32.12
	13	1.000	.050	764	2215.1(21)	24.09	26.50	24.09	.058	764	16.06
	14	2.000	.086	764	2215.1(21)	24.09	53.00	48.18	.033	754	32.12
	15	1.330	.046	764	2215.1(21)	24.09	35.24	32.04	.047	764	21.36
	16	1.690	.043	764	2215.1(21)	24.09	44.78	40.71	.041	764	27.14
	17	1.690	.055	764	2215.1(21)	24.09	44.78	40.71	.047	767	27.14
	18	1.690	.045	764	2215.1(21)	24.09	44.78	40.71	.042	764	27.14

ORIGINATED : S. Schmus DATE : 9/26/84
CHECKED : [illegible] DATE : 9/26-84

p. 26 Cont. 27

Appendix D

p. 27 Cont. 28

Reactor Controls, Inc.

SAN JOSE, CALIFORNIA

SA-4976 ART-17
PAGE 1 / CONT 2

CLIENT: STONE & WEBSTER ENG'ING CORP	DOCUMENT: SA-4912 -ART-14	REVISION: N/A
PROJECT: RIVERBEND NUCLEAR STATION	ORIGINATED: 9/10/87	PAGE 28 CONT. 29

ANALYSIS RESULTS / ANALYSIS INPUT TRANSMITTAL
(INTERNAL) ART

FOR :

COMPONENT	S.A. NO.
AVG. MASS AT THE SUPPORT 4, 5. 6. 7 & 11 FOR THE INSIDE I/W LINE	SA-5374 SA-4827 SA-5375 SA-4826 SA-4820 SA-4831

To : SIMON SCHMUKLER

From : BHARAT TRIPATHI

The following analysis result(s) are to be used for analysis input of the above component or for transmittal to :

I. ANALYSIS RESULTS PER ATTACHED SUMMARIES :

INSERT LINE : Sheet 1 through 2

WITHDRAW : Sheet 2 through F

: Sheet ____ through ____

II. COMMENTS :

Attached are the avg. masses (weights) at the support 4, 5. 6. 7 & 11 per each Insert and with draw line.

APPROVAL :

[signature] 9/10/87 — Chairman/Project Engr.

[signature] 9/10/87 — Lead Engr. Analyst

[signature] 9/10/87 — Engr./Analyst

TITLE: SUMMERY OF THE MASS (AVG WEIGHT) AT THE SUPPORTS OF INSIDE I/W PIPING

CLIENT: STONE & WEBSTER

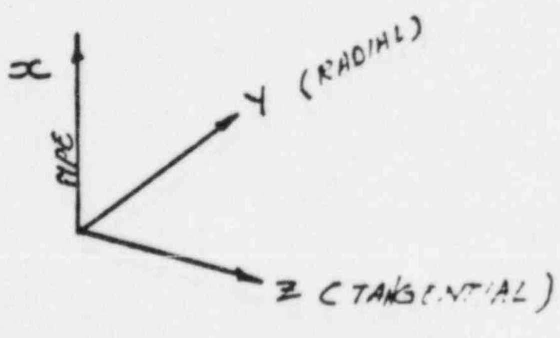
PROJECT: RIVER BEND

DOCUMENT:

PREPARER	DATE	CHECKED	DATE	REV.	PAGE
[illegible]	9/10/84	TDH	9/10/84	Ø	29 Cont. 30

INSERT

SUPPORT I.D.	RESTRAINT DIRECTION (LOCAL)	MASS (WEIGHT)		
		X (lb)	Y (lb)	Z (lb)
SP4	YZ	–	18.55	23.70
SP5	XYZ	88.25	28.91	29.15
SP6	YZ	–	14.56	14.21
SP7	YZ	–	14.75	18.88
SP11	XZ	44.97	-	26.15



RESTRAINT DIRECTION.

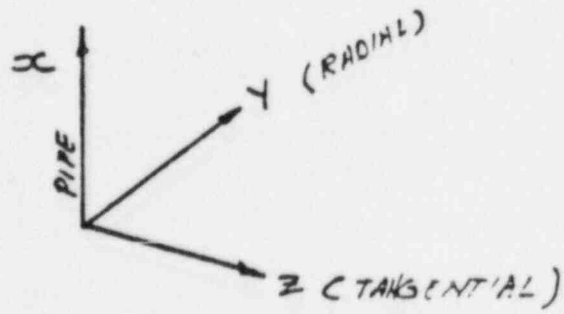
Reactor Controls, Inc.
SAN JOSE, CALIFORNIA

SA-4978ART-14
PAGE 3 CONT F

TITLE: SUMMERY OF THE MASS (AND WEIGHT) AT THE SUPPORTS OF INSIDE I/W PIPING	DOCUMENT:					
CLIENT: STONE & WEBSTER	PREPARER	DATE	CHECKED	DATE	REV	PAGE
PROJECT: RIVER BEND	[signature]	9/10/??	TDN	9/10/84	0	30 Cont F

WITHDRAW

SUPPORT I.D.	RESTRAINT DIRECTION (LOCAL)	MASS (WEIGHT)		
		X (lb)	Y (lb)	Z (lb)
SP4	YZ	–	27.66	14.90
SP5	YZ	–	11.11	14.66
SP6	XYZ	76.31	18.85	17.66
SP7	YZ	–	10.81	13.40
SP11	YZ	–	10.9	14.70



RESTRAINT DIRECTION.

UNRESOLVED ITEM NO. U5.12-1

RESPONSE

We believe that this item should be considered as resolved and that no additional action is necessary.

The IDI team classified this issue as unresolved because they believed that the lube oil (keep warm) system for the Transamerica DeLaval, Inc. (TDI), diesel generators should be powered by a Class 1E power source, similar to that furnished by GE for the HPCS diesel generator. This opinion was based, in part, on the apparent inconsistency of having an unqualified non-Class 1E motor driving a seismic Category I, ASME III pump.

The Electrical Engineering Group at SWEC reviewed TDI assignments of ASME, non-ASME, and DEMA components of the standby diesel generators in early 1981. At that time motor qualification of the jacket water and lube oil keep warm systems (IDI Reference 5) was questioned. At a meeting held at TDI's Oakland, California, facility on May 10, 1983, motor qualification for lube oil and jacket water keep warm systems was again questioned.

TDI responded (IDI Reference 4) by stating that these pumps are designed to enhance starting capability and to flatten out the thermal gradient of the diesel generator upon starting, at which time the engine-driven pumps would take over.

One reason for having ASME III pumps and piping is to maintain pressure boundaries for fuel, lube oil, and water regardless of the qualification of the motor drivers.

The TDI response was accepted for two reasons. While SWEC is responsible for establishing the performance requirements, TDI is obligated to furnish equipment capable of meeting performance requirements as incorporated into the Category I purchase specification, which include the requirement for starting and accepting load in 10 seconds. Secondly, TDI is responsible for establishing the design basis for their diesel generator to meet SWEC's performance criteria.

The IDI report refers to NUREG-CR0660 in terms of its recommendations for starting the prelube pump with the same signal that starts the diesel generator. TDI's design includes a continuous prelube system which, rather than starting <u>with</u> the diesel generator start signal, operates continuously during the standby mode to provide greater assurance that the diesel generator is properly lubricated for easier starting when required.

Also referenced in the IDI report is NUREG-0800, the standard review plan, which is the guidance provided to the NRR reviewers recommending that the lube oil temperature be properly maintained to improve first start capability. TDI's design also includes a non-Class 1E lube oil heater to accomplish this. Alarms in the main control room indicate the proper operation of the prelube keep warm system (by monitoring the

header inlet and outlet temperature and alarming low temperature), providing further assurance of the diesel generator's ability to start when required.

In the response to these concerns, TDI defended the non-Class 1E classification of the prelube motor by stating that it does not perform a Category I function. TDI stated that it enhances the diesel generator's ability to perform its Category I function. The prelube keep warm system is intended to provide greater assurance that the diesel generator will start on command and to improve the longevity of engine parts, thus reducing downtime and related expenses. Because of the benefits expected from continuous operation while in the standby mode, GSU has revised the operators' daily log to require verification during each shift that the keep-warm pump is running.