The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

August 2, 1985
ST-HL-AE-1316
File No.: G4.2

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Meeting Notes from NRC MEB Audit
ASME Documentation Review Portion

Dear Mr. Knighton:

On June 26, 1985 representatives of the NRC Mechanical Engineering Branch (MEB) staff met with representatives of HL&P at the Houston office to discuss the mechanical design of the South Texas Project (STP). This meeting was conducted in two portions. Meeting notes covering the FSAR question responses were previously transmitted to you in our letter ST-HL-AE-1296 dated July 1, 1985 from M. R. Wisenburg to G. W. Knighton. Attached are the meeting notes from the portion of the meeting concerning review of STP ASME documentation and compliance for selected mechanical features.

This review covered five Nuclear Steam Supplier System (NSSS) scope items and four balance-of-plant items. Previous to the meeting the NRC had reviewed several documents that were transmitted to the NRC. The meeting on June 26, 1985 consisted of follow-up questions and corresponding requests for additional documents which addressed the follow-up questions. A summary of the results of each item is provided in Attachment A. Documents requested during the meeting (noted in the summary, Attachment A) are provided in Attachment B in the order that they are discussed in the summary.

Attachment C contains a list of attendees.

W2/NRC1/v

If you should have any questions on this matter, please contact Mr. M. E. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

CAA:yd

Attachments:
A. Summary of Results
B. Requested Documents
C. List of Attendees

W2/NRC1/v

cc:

*Hugh L. Thompson, Jr., Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Robert D. Martin
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

*N. Prasad Kadambi, Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20814

Claude E. Johnson
Senior Resident Inspector/STP
c/o U.S. Nuclear Regulatory Commission
P. O. Box 910
Bay City, TX 77414

M. D. Schwarz, Jr., Esquire
Baker & Botts
One Shell Plaza
Houston, TX 77002

J. R. Newman, Esquire
Newman & Holtzinger, P.C.
1615 L Street, N.W.
Washington, DC 20036

Director, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

E. R. Brooks/R. L. Range
Central Power & Light Company
P. O. Box 2121
Corpus Christi, TX 78403

H. L. Peterson/G. Pokorny
City of Austin
P. O. Box 1088
Austin, TX 78767

J. B. Poston/A. vonRosenberg
City Public Service Board
P.O. Box 1771
San Antonio, TX 78296

Brian E. Berwick, Esquire
Assistant Attorney General for
the State of Texas
P. O. Box 12548, Capitol Station
Austin, TX 78711

Lanny A. Sinkin
3022 Porter Street, N.W. #304
Washington, D. C. 20008

Oreste R. Pirfo, Esquire
Hearing Attorney
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Charles Bechhoefer, Esquire
Chairman, Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dr. James C. Lamb, III
313 Woodhaven Road
Chapel Hill, NC 27514

Judge Frederick J. Shon
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Ray Goldstein, Esquire
1001 Vaughn Building
807 Brazos
Austin, TX 78701

Citizens for Equitable Utilities, Inc.
c/o Ms. Peggy Buchorn
Route 1, Box 1684
Brazoria, TX 77422

*Docketing & Service Section
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555

NOTE: All copies w/o Attachment B except as noted above (*)

W2/NRC1/v

Revised 5/22/85

Attachment A

South Texas Project
Units 1 & 2
Summary of Results

Main Steam Piping

Comment:

1. Control of Minimum Wall Thickness

   Spec. 4L020PS0100 (Shop Fabrication), 4.3.3B., defines what is meant by "minimum wall thickness". In 4.3.9, wall thickness measurements are required to be made. Please provide copies of those documents which show compliance with 4.3.9 for:

   (a) one elbow and one pipe length used in main steam Dwg. 2C369PMS446.

   (b) counterbored end of 32 x 30 reducer, Dwg. 2C369PMS446.

Response:

1. A copy of the NPP-1 Data Report for Mark No. 2C369P-MS-1001-GA2-1-A was provided along with a copy of Question No. 564 from Southwest Fabricating and Welding Co.

Comment:

2. Steam Hammer Analysis

   Calc. NO. 2C159RC5038, page 32, indicates that PO = 5580 psi. This stress can be calculated by $PO = 1183x27.25^2/(30^2-27.25^2) = 5580$ psi. Page 11 of the calculation lists the maximum operating pressure as 1183 psi.

   (a) Does the 1183 psi operating pressure include the pressure wave due to the steam hammer?

   (b) Please describe the steam hammer analysis; e.g., source (turbine trip?), maximum moments and their locations, maximum pressures, support loads. (This may be given in Calculation No. 5N179RC9904; if so, please provide a copy of it.)

Response:

2. In response to Item (a), it was stated that the 1183 psi operating pressure does not include the pressure wave due to steam hammer.

   In response to Item (b), a copy of Calculation No. 5NN179RC9904 without appendices was provided. A hand calculation showing the maximum pressure caused by steam hammer was also provided.

Main Steam Supports

References

Calc. No. 2C159RC5038 (Pipe Calc.)
SWG. No. 2C369PMS446 (Dwg.)
Calc. No. JC-MS-9001-HL5016 (Support Calc.)

Comment:

1. The Pipe Calc., page 43, indicates a support MS-1001-HL5011 at Data Point 12B. The drawing identifies the support at Point 12B as HL-5016. Is the correct identification HL5011 or HL5016?

Response:

1. It was agreed that a data point versus mark numbers inconsistency existed. This will be corrected by revising the calculation.

Comment:

2. The Support Calc., page 3, shows forces which agree with those shown on pages 52 and 55 of the Pipe Calculation for Point 12B. The Support Calculation, page 8, shows forces for Data Point 12B which do not agree with those shown on pages 52 and 55 of the Pipe Calculation for either points 12B or 12A. Page 7 of the Support Calculation indicates page 8 is for Support HL5015, but the drawing indicates HL5015 is at Point 12A, not 12B. The Pipe Calculation, page 43, identifies the support at 12A as HL5010. Please explain.

Response:

2. A copy of the pages from the loop No. 2 piping calculation (RC5039) that gives loads corresponding to page 8 of Calculation No. JCMS9001HL5016 was provided.

Comment:

3. The Support Calculation., page 10, shows an allowable load for SMA-5501 of 50.6k for "upset", which agrees with CDRS No. SMY, page 4 of 9. However, we do not have that page of CDRS No. SMY which allows a load of 76.9k for faulted conditions. Please provide that page.

Response:

3. A copy of the pages from the CDRS number SMY which allows a load of 76.9 kips for the faulted condition was provided.

MS Safety Relief Valve

Reference Design Specification 4Z459ZS1006 and Dresser Stress Report, Dresser 3707R Main Steam Safety Valve, SR-370-15

Comment:

1. The specification identifies the valve as 3707RA while the Stress Report identifies it as 3707R. Is there a significant difference?

Response:

1. The extra "A" in the valve identification is only an indication that the valve will be used in saturated steam service. There is no significant difference.

Comment:

2. The specification identifies a back pressure of 157 psig; the Stress Report uses (for outlet design conditions) 140 psig at 400°F. Which should be used?

Response:

2. The vendor is in the process of preparing a new stress report. The new stress report will use a back pressure of 157 psig.

Comment:

3. The Stress Report states that "Allowable bolt stress at 600°F for SA193 Gr. B7 is 50000 psi (=2S)...". We believe the ASME Code allowable bolt stress, as a limit to the calculated (as indicated in App. B of the Stress Report) bolt stress, is S, not 2S. Please cite the Code portion which you think justifies using an allowable bolt stress of 2S.

Response:

3. It was agreed that the allowable bolt stress should be "S". Due to the conservative nature of the calculations for the MS Safety Relief Valve no problem was caused by the use of "2S" for these STP valves; however, STP must verify no other Dresser valves are used on STP, which use the incorrect stress allowable for bolts.

Comment:

4. Please provide a copy of those portions of the main steam piping analyses which show that the safety valve thrust of 27,000 lb has been evaluated.

Response:

4. A copy of sheet 20 of calculation RC6548 was provided. A copy of Drawing No. 5G369PMS646, sheet 3 was provided. A copy of the preliminary calculation for transient loads (RC9966) was provided.

Component Cooling Water Pumps

Comment:

1. Specification 3R209NS0011, 1.5.3, lists documents to be provided by the Seller.

   (a) Please briefly describe (or provide a copy of) the document; "a. ASME Code Calculations".

   (b) Please provide a copy of the document "f. Hydrostatic test results", including evidence that the tests were witnessed by an Authorized Nuclear Inspector.

Response:

1. In the response to Item (a), it was pointed out that the Vendor Seismic Analysis previously submitted contained the necessary ASME code calculations. Vendor Document 14926-4022-01018-BHT was provided which has the instructions for the pump seismic and ASME code analysis. In response to Item (b), a copy of the hydrostatic test certificate was provided (14926-4022-01055-AHT).

Comment:

2. Hayward Tyler Seismic Analysis Report, p. 10, cites loading criteria. Please indicate precisely where the cited "Maximum Nozzle Loads" are given in Specification 3R209NS0011 (e.g., page ____ of Appendix ____) and provide a copy of that page.

Response:

2. A copy of page B-1 from 3R209NS011-D was provided.

Comment:

3. Please provide a copy of those portions of the CCW piping system analysis which show that the maximum nozzle loads are not exceeded.

Response:

3. A copy of appropriate portions of calculations RC0034 and 35 were provided.

Reactor Coolant Pumps

Comment:

1. WEMD E. M. 5003, Table I, shows a calculated stress of 33,300 psi for "FAULTED". Table VII, for "Pipe Rupture (b)" indicates a moment resultant of

   $M_i = (87^2 + 103^2 + 63^2)^{1/2} \times 10^6$ in-lb $= 149 \times 10^6$ in-lb.

The data on page 15 indicates that the end of the pump suction nozzle has an inside diameter of 31", outside diameter of 38.2". The section modulus of that section is:

$$Z_i = (D_o^4 - D_i^4)/(32D_o) = 3099 \text{ in}^3$$

and the maximum stress intensity due to M_i - only is:

$$S = M_i/Z = 149 \times 10^6/3099 = 48080 \text{ psi}$$

Further, from the load combination for Faulted shown in Table V, it appears that the stress intensity for the suction nozzle end might be around 55 ksi, rather than 33.3 ksi shown in Table I. If so, then the stress would exceed your limit of 49.7 ksi and would exceed the stress of 48700 psi (for discharge nozzle) shown in Table 7.3 of WEMD E.M. 5351 - the South Texas Stress Report.

Your response is requested.

Response:

1. Westinghouse will add a footnote to EM5003. A copy of a revised Westinghouse internal memo was provided.

<u>Westinghouse Motor Operated Gate Valves</u>

Comment:

1. Specification G-952850

   (a) Please provide a copy of the documentation that shows compliance with hydrostatic tests, Paragraphs 6.3.1 and 6.3.2, for the valve identified by Drawing 8273D81 (8GM84).

   (b) Paragraph 1.2.3 appears to be very restrictive for end moments that can be applied to the valves. For example, for a 304 stainless valve operating at 550F, 0.5Sy = 0.5x18.8 = 9.4 ksi. In contrast, Eq. (11) in ASME Code Subsection NC permits piping stresses due to moments to be up to 43.4 ksi. Please supply documentation which shows that the moment limits are being met; e.g., portion of a piping system calculation which shows both the calculated pipe moments at a valve covered by the specification and the allowable limit given in Paragraph 1.2.3D of the specification.

Response:

1. In response to Item (a), a copy of the hydrostatic test report was provided. In response to Item (b), a copy of Calculation RC0011, sheets 1 and 63, was provided.

Comment:

2. WEMD E.M. 5158 (Stress Report)

   The Stress Report refers to Specification G-952850 (General) but not to Specification 952874 (South Texas specific). Is there anything in Specification 952874 (such as Appendix C) that would invalidate the Stress Report?

Response:

2. There is nothing in Specification 952874 that would invalidate the Stress Report.

Westinghouse Class 1 Piping

Comment:

1. The intent of this audit item is to obtain and review the Code-required Stress Report for the primary coolant loop piping of the South Texas plant. WCP-9135 appears to be a part of that Stress Report. Volume 3 (also WCAP-9135?) may be another part of the Stress Report. Please provide for our review a complete copy of what you deem to be the Code-required Stress Report for primary coolant loop piping of the South Texas plant; including certification by the N-Certificate Holder (presumably, Westinghouse) and documentation of review by the Owner (Houston Lighting and Power). Upon receipt of the Stress Report, we will review it and the Design Specification and attempt to close this audit item.

   A copy of WCAP-9135, Vol. 1, was provided. Assuming that this is part of the Stress Report, we have the following comments.

   (a) We do not find any indication that the requirements of NB-3640, Pressure Design, have been considered or met. At the 5/17/85 Houston meeting, to expedite closing of this aspect, we agreed to review RPT-MED-PCE-577, "Reactor Coolant Loop Piping Pressure Design Calculations for Wolf Creek Unit No. 1", as representing what would be done for South Texas. However, Westinghouse (Rahe to Denton, May 30, 1985) did not provide the Wolf Creek report. When we receive the South Texas Stress Report, we will expect to find evidence that the requirements of NB-3640 have been met.

   (b) Design Specification 953385, Rev. 1, indicates that allowable nozzle loads for equipment (e.g., Steam Generator) must be established and the piping system analyses must show that these nozzle loads are not exceeded. We do not find any indication that allowable nozzle loads have been checked. Perhaps, this check is in Vol. 3. In any event, this is a check we will expect to find in the Stress Report.

(c) In general, we would like to have a Class 1 piping Stress Report that is at least as complete as calculation packages provided for Class 2 and 3 piping systems; e.g., Bechtel Calculation No. 2C159RC5038. Some of the information found in such calculation packages, but not in Vol. 1, are:

(1) Material identification

(2) Piping dimensions (e.g., diameters, wall thicknesses, axial lengths via Drawing NO. 2C369PMS446).

(3) Clear indication of what is included in the analysis (e.g., does Vol. 1 cover the pressurizer surge line? Does it cover the welds between austenitic pipe and ferritic components?)

(4) Nozzle loads and comparisons with allowable loads.

(5) Support Load summary.

(6) List of unusual stress intensification factors. For Vol. 1 and maybe Vol. 3, we would expect a list of stress indices which do not come directly from Code Table NB-3683.2.1; e.g., C_2 and K_2 indices for an elbow with instrument taps in the body thereof.

(7) Appendix C of the Code states:

"the Report should include copies of sufficient computer printouts to justify the governing stress values used in the Design Report and enable independent review."

If Vol. 1 is intended to be part of the Stress Report, we view its contents inadequate from the standpoint of an "independent review". Presumably, Westinghouse has on file the detailed calculations which provide the basis for the stress values shown in Table 5-1 of Vol. 1. We believe that the Stress Report should include a comprehensive and understandable (to an independent reviewer) road map to the files in which the detailed results are filed, and a commitment to maintain those files for as long as the Stress Report is required to be kept.

Response:

1. The items mentioned in this question will be addressed in the Class 1 Stress Report at the time of issuance (including as-built reconciliation). We agree with the issues raised by this question and will provide clear confirmation, specifically or by reference, in the Volume 1, 2, and 3 Class 1 Stress Reports, which will be provided in the third quarter of 1986.

Westinghouse Primary System Supports

Comment:

1. The intent of this audit item is to obtain and review the Code-required Stress Report for primary system supports of the South Texas plant. Volume 2 (of WCAP-9135?) may be a part of that Stress Report. At the 5/17/85 Houston meeting, to expedite closing of this item, we agreed to review WCAP-10197, which (apparently) covers the structural analysis of primary system supports for the Comanche Peak plant; as representing what would be done for South Texas. However, Westinghouse (Rahe to Denton, May 30, 1985) did not provide that report. Accordingly, please provide for our review a complete copy of what you deem to be the Code-required Stress Report for primary system supports of the South Texas plant; including certification by the N-Certificate Holder (presumably, Westinghouse) and documentation of review by the Owner (Houston Lighting and Power). Upon receipt of the Stress Report, we will review it and the Equipment Specification 953533 (which, we assume, is meant to be the Code-required Design Specification) and attempt to close this audit item.

Response:

1. The items mentioned in this question will be addressed in the Class 1 Stress Report at the time of issuance (including as-built reconcilation). We agree with the issues raised by this question and will provide clear confirmation, specifically or by reference, in the Volume 1, 2, and 3 Class 1 Stress Report, which will be provided in the third quarter of 1986.

Roto-Lok Head Closure System

Comment:

1. Design

   (a) CENC-1332 appears to evaluate stresses in the studs. Please provide that portion of the South Texas Stress Report (Analytical Report?) that evaluates the stresses in the stud inserts.

   (b) CENC-1332 identifies the stud material as SA-540-B24. This is incomplete. What is the Class? (WCAP-8447 identifies the stud material as Class 2, with S_m = 46.7 ksi at 100°F, 37.5 ksi at 650F.)

   (c) CENC-1332, page 3, indicates S_m = 42 ksi. What is the basis for S_m = 42 ksi?

   (d) CENC-1332, pages A138-A145: units shown in "tensile load" and "moment" columns appear to be incorrect.

(e) CENC-1332, page A143, shows a tensile stress for Case 1 of 47.6 ksi. Dividing this by 1.1 gives a tensile stress of 43.3 ksi for design pressure (2500 psi) loading only. ASME Code, NB-3231(a), appears to require that the tensile stress due to design pressure be less than S_m at design temperature; i.e., less than 37.5 ksi. Please provide a response.

(f) CENC-1332, page 3, states that 'All stresses meet the appropriate allowables stated in the ASME Boiler and Pressure Vessel Code, Section III . . .". However, we do not find any mention of bearing loads (NB-3227.1), pure shear (NB-3227.2) or, more generally, the stress intensity limits due to pressure loading only. Why are these seemingly applicable portions of the Code not considered and discussed in CENC-1332?

(g) The analysis described in CENC-1332 appears to involve the assumption of perfect axial matching between studs and stud inserts. Figure 7-10 of the Manual shows axial tolerances for the stud lugs of $\pm$0.001". Presumably, tolerances on the stud insert are similar. What effect does machining tolerances have on the load distribution between the 7 sets of lugs?

(h) CENC-1332, page 146, states that "Using a fatique strength reduction factor ...". The reader can deduce that the "fatigue strength reduction factor" used was 4, but the report should say that a factor of 4 was used. Our question concerning the validity of the fatigue elevation stems from footnote (4) to Code Table I-1.3:

"These stress values may result in relaxation of the bolting materials after prolonged service at these temperatures and the designer is to investigate the effect of this relaxation on the application."

During the 107 postulated boltup/unboltup cycles, the footnote suggests the possibility of ratcheting and the effect of this on fatigue is not apparent. Please provide a response.

(i) CENC-1332 appears to address normal operating conditions and hydrostatic testing. Are any evaluations needed for upset, emergency or faulted conditions and, if so, where in the South Texas Stress Report are they described?

Response:

1. Items (a), (b), (c), (e), (f), and (i) are answered by the base document, CENC-1302, Analytical Report for South Texas Project No. 1. Portions of Book 1 of this document have been provided in a separate transmittal by Westinghouse identified as NS-NRC-85--3044 dated July 3, 1985 from E.P. Rahe, Jr. to H.R. Denton of the NRC.. Item (d) correctly identifies incorrect units in the heading; however, this did not affect the final results. Item (g) is answered as follows: The worst case tolerances are used to check shear stresses of the lugs. The nominal dimensions are used

in the structural and fatigue analysis. The margins between calculated values and the code allowables cover the manufacturing tolerance effects. Item (h) is answered as follows: The maximum operating temperature of these studs is below the temperature range of concern in the ASME Code. The material in the bolts is Class 3.

Comment:

2. Installation

   (a) One of our initial concerns was assurance that all studs would be rotated into locked position before bolt-tightening and operation. The Installation Instructions, Section 3 of the Manual, has eliminated this concern.

   (b) The Manual, page 3-9, says: "Caution, Maximum hydraulic pump pressure shall not exceed 9100 psi". We question whether this is a prudent limit. We presume that 5500 psi corresponds to the stud load used for evaluating operating loads in CENC-1332; hence, 9100 psi pump pressure would presumably correspond to 9100/5500 =1.65 times the assumed design loads. If the 9100 psi pressure were reached one or more times during each boltup/unboltup cycle, the usage factor calculated in CENC-1332 might be too low. A maximum pump pressure slightly above the pressures needed for the tightening process, perhaps controlled by relief valve, would appear to be more prudent.

   In Section 6 of the Manual, which describes the unbolting procedure, we do not find any caution about maximum pump pressure.

   Your comments are requested.

Response:

2. It was agreed that Item (a) is a statement and no response is required. In response to Item (b), it is noted that the Combustion Engineering instruction manual provides guidelines. Specific instructions addressing these comments on installation will be in the plant operating procedures. The comment provided by the NRC consultant relative to the "caution" note in the procedure will be reviewed and discussed with HL&P operations personnel.

Attachment B

COPY

FORM NPP-1 DATA R)RT FOR FABRICATED NUCLEAR PIPI SUBASSEMBLIES*
(As Required by the Provisions of the ASME Code hu es)

1. Fabricated by SOUTHWEST FABRICATING & WELDING CO. INC. 7525 SHERMAN, HOU. TX 77011 Order No. S.O.#02657-MS P3.4
(Name and Address of Fabricator)

2. Fabricated for HOUSTON LIGHTING & POWER CO., HOUSTON, TX. Order No. P.O.#35-1197-6014
(Name and Address)

3. Owner HOUSTON LIGHTING & POWER CO.; SOUTH TEXAS NUCLEAR UNIT I 4. Location of Plant WADSWORTH, TX.

5. Piping System Identification Main Steam, Serial #39270
(Brief description of intended use, main coolant etc.)

(a) Drawing No. 02657-MS #1 Prepared by SOUTHWEST FAB. & WELDING CO., INC.

(b) National Board No. N/A

6. The material, design, construction, and workmanship complies with ASME Code Section III, Class 2

Edition 1974, Addenda Date WINTER 1975, Case No. ---

Remarks: Manufacturers' Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report PIPE - (P1) Ladish Co. S/N 40U;
(Name of Part – item number, Manufacturer's name, and Identifying stamp)
ELL - Item (A) Southwest Fabricating & Welding Co. Inc. S/N LR-9087;
RED. - Item (B) Southwest Fabricating & Welding Co. Inc. S/N CC-4008

7. Shop Hydrostatic Test N/A psi.

8. Description of piping inspected MK: 2C369P-MS-1001-GA2-1-A; SA-155 KCF-70 Wld'd CL. I,
(include – mark no. – material spec. – nom. pipe size – schedule or thickness – length – fittings – flanges, etc.)
30" O.D. (1.375" W) 22 7/16" long; SA-420 WPL6 Wld'd, 30" O.D. (1.375" MW) 90° LR Ell; SA-420 WPL6 Wld'd, 32" O.D. X 30" O.D. (1.375" MW) Conc. Cone Red.

Material machined to a minimum wall of 1.250".

RIP # 4457

We certify that the statements made in this report are correct and that the fabrication of the described piping conforms with the requirements of SECTION III of the ASME BOILER AND PRESSURE VESSEL CODE.

Date 8-31-84 Signed SF&WCO (Fabricator) By (ih) [signature]

Certificate of Authorization Expires JULY 23, 1985 Certificate of Authorization No. N-1459

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of TEXAS and employed by H.S.B.I.&I.Co., HARTFORD, CT have inspected the piping described in this Data Report on 8-31 19 84, and state that to the best of my knowledge and belief, the Manufacturer has constructed this piping in accordance with the applicable Subsections of ASME Code, Section III.

By signing this certificate, neither the Inspector nor his employer make any warranty, expressed or implied, concerning the piping in this Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 8-31, 19 84

[signature] (Inspector) Commissions Tex 370
National Board, State, Province and No.

*Supplemental sheets in form of lists, sketches or drawings may be used provided (1) size is 8½" x 11", (2) information in items 1, 2 and 5 on this data report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded in item 7, "Remarks".

COPY

S.O. No. Q2657MS

Sheet No. 1

Southwest Fabricating & Welding Co., Inc.

LIQUID PENETRANT INSPECTION REPORT

Date 8-25-84

Page ____ of ____

Procedure No. P.T-5, R/4

CLIENT	MATERIAL DESCRIPTION	MATERIAL TYPE
Houston Lighting & Power	30" Pipe Spool	S.S. To C.S.

PENETRANT SYSTEM	BRAND NAME	PENETRANT	BATCH NO	REMOVER	BATCH NO	DEVELOPER	BATCH NO	SURFACE CONDITION
Solvent Removable ☑ Water Washable ☐	Spot Check	SKL-S ☑ SKL-W ☐	794039	SKC-S ☑ Water ☐	80E042	SKD-S ☑	83A051	As Welded ~~and~~/or As Ground

TEMPERATURE	PRECLEANER TYPE & BATCH NO	CLEANER DRYING TIME	DWELL TIME	PENETRANT REMOVAL METHOD
80 °F	SKC-S, 80E042	5 Minutes	10 Minutes	Solvent Wiped ☑ Water Spray ☐

REMOVER DRYING TIME	DEVELOPMENT TIME	POST CLEANER		EVALUATED BY	ASNT LEV
5 Minutes	10 Minutes	Solvent ☑ Water ☐		W. J. Malek	II

PIECE OR WELD NO.	ACCEPT	REJECT	LINEAR	ROUNDED	DESCRIPTION OF INDICATIONS
W-1	✓			✓	Within Spec

RIP # 4457

BECHTEL 743

4

COPY

S.O. No: Q2657 MS
Sheet No. 1

Southwest Fabricating & Welding Co. Inc.

MAGNETIC PARTICLE INSPECTION REPORT

Date 8-27-84

Procedure No. MT-3, R/5

CLIENT: HOUSTON LIGHTING & POWER

MATERIAL DESCRIPTION: 30" PIPE SPOOL

Material Type: CARBON STEEL

TYPE MAGNETIZATION: A.C. CONTINUOUS

AMPS: N/A

TYPE PARTICLE: MAGNAFLUX #1/8A

COLOR: GRAY, RED

SURFACE PREPARATION: AS WELDED AND/OR AS GROUND

EQUIPMENT: Y-6 YOKE (MAGNAFLUX) SN MX 11

TECHNICIAN: W.I. Malek

ASNT Level: II

PIECE OR WELD NO.	ACCEPT	REJECT	LINEAR	ROUNDED	DESCRIPTION OF INDICATIONS
W-7	✓				N.A.D
W-8	✓				N.A.D
W-9	✓				N.A.D
W-10	✓				N.A.D

RIP # 4457

BECHTEL 743

COPY

RADIOGRAPHIC INSPECTION REPORT

SOUTHWEST FABRICATING & WELDING CO. INC.

S.O. No Q 2657 MS

SHEET No 1

MK. No 2C369P-MS-1001 GM-1-A

PROCEDURE No RT 10 9/1

CUSTOMER H.L.&P

DESCRIPTION 30" PIPE SPOOL

ASME III CL 2

VIEWED SINGL. ☐ DOUBL. ☐

DENSITOMETER S/N 80118

WELD OR SEAM	FILM LOCATION	ACCEPT	REJECT	POROSITY	SLAG	INC PENET	INC FUSION	CRACK	SURFACE	EXCESSIVE PENETRATION		REMARKS	WELD OR SEAM	FILM LOCATION	ACCEPT	REJECT	POROSITY	SLAG	INC. PENET	INC. FUSION	CRACK	SURFACE	EXCESSIVE PENETRATION
W2	1.2	✓																					
	2.3	✓																					
	2.4	✓		✓																			
	4.5	✓																					
	5.6	✓																					
	6.7	✓		✓																			
	7.1	✓																					
W3	1.2	✓																					
	2.3	✓																					
	2.4	✓		✓																			
	4.5	✓																					
	5.6	✓																					
	6.7	✓																					
	7.1	✓																					

RIP # 4457

CUSTOMER REVIEW BECHTEL 743 DATE:

INTERPRETED & CERTIFIED BY: J Martin ASNT LEVEL: II DATE: 8.29.84

W-TUNGSTEN
RT-RETAKE
R-REPAIR

U/C-UNDERCUT
EOW-EDGE OF WELD
WV-WELD VALLEY

CONC-CONCAVE ROOT
FM-FOREIGN MATERIAL
CR-CASSETTE CREASE

HAF-HANDLING ARTIFACT
PAF-PROCESSING ARTIFACT
LS-LONGITUDINAL SEAM

CS-CIRCUMFERENTIAL SEAM
CLS-CENTERLINE SHRINKAGE
IRR-IRREGULARITY IN WELD PROFILE

FORM 473-4-2

SOUTHWEST FABRICATING & WELDING CO., INC.

RADIOGRAPHIC TECHNIQUE DATA

PROCEDURE NO: RT 10 R/7

S. O. NO: [illegible] 2657-MS-1

DATE: 8-28-84

MATERIAL TYPE: CARBON PIPE SIZE: 30" THICKNESS: 1.375"

WELD THICK: 1.500" TYPE SEAM: GIRTH COVERAGE PER FILM: 13.5

WELDING PROCEDURE USED: S.M.A.W. ☐ S.A.W. ☒ G.T.A.W. ☐ G.M.A.W. ☒

K.V. USED: N/A M.A. USED: N/A

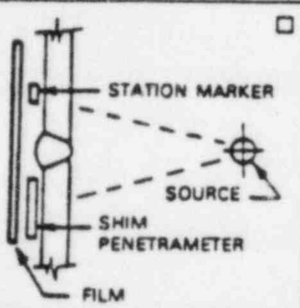
ISOTOPE TYPE: IR-192 CURIES: 100 EFFECTIVE FOCAL SIZE: .100"

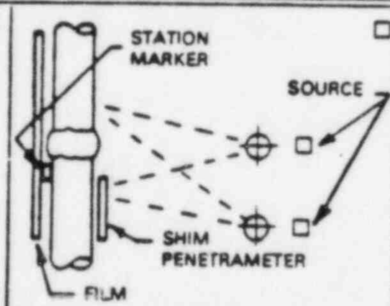
S.F. DISTANCE: 15" O.F. DISTANCE: CONTACT SCREENS USED: .010"/.010"

FILM TYPE: KODAK-M PEN. MAT'L. & NO. SS/30 PEN. FILM SIDE: ☐ PEN. SOURCE SIDE ☒

FILM SIZE: 4.5" X 17" No. EXPOSURES: 2 EXPOSURE TIME: 3:45

FILM PROCESSING: MAN. ☐ AUTO. ☒ WELD No. 2 & 3 RADIOGRAPHER: J. A. STEINOCHER ASNT Lev. II

☐


☐


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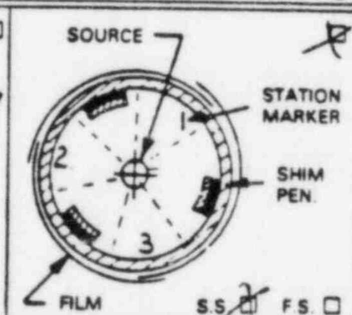
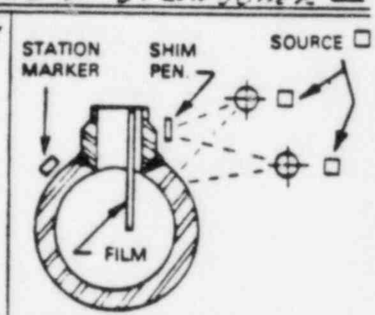
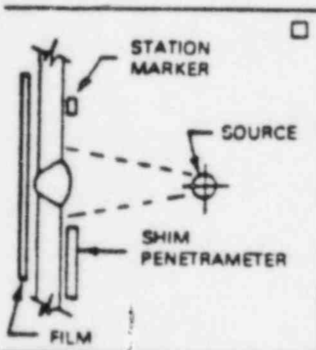
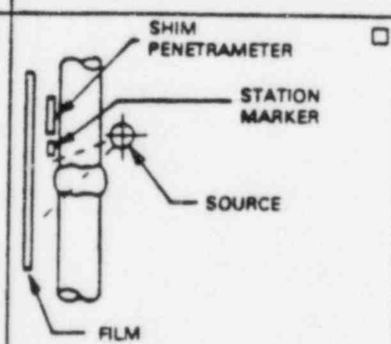




☐


☐


OTHER ☐

RIP # 4457

REMARKS:

BECHTEL 743

COPY

COPY

ASME SECTION III, 1974 EDITION AND ADDENDA THRU WINTER 1975. CLASS 2.

(4)

SOUTHWEST FABRICATING & WELDING CO INC

30" 1.375" MW 90° Ell

HOUSTON, TEXAS July 29, 1980

Low Temp WPL-6 W

DETAILED ANALYSIS REPORT

ORDER NO MWO-06183-1

CUSTOMERS' ORDER NO S.O. 06183

(80)

DESCRIPTION	HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 8"	PERCENT REDUCTION IN AREA	C	MN	P	S	SI	CR	NI	MO	CB	HEAT OR LOT NO.	SPECIFICATION OF MATERIAL FROM WHICH MADE
Made From: Phoenix Steel		50700	79000	25.0		.25	1.02	.015	.009	.24						
Corp., SA-516 Gr.70,	Charpy V-Notch at +40°F.														8889626	
(Normalized).	Impact Tested = 108-82-73														Slab: 58051	
	% Shear = 60-50-50															
	Lateral Exp. = .085-.073-.065															
(1) SA-420 WPL-6 (W),	Physicals and Chemicals same as shown above.															
30" (1.375"MW) LR 90° Ell.	100% X-Ray Long Seam Weld per UW-51 and SF&WCO Procedure: RT-4,R/2.															
	Results: Satisfactory.															
Mark No. LR-9087	Normalized at 1600°F., ± 50°F.															
	(Weld) Charpy V-Notch at +40°F.					(Base) Charpy V-Notch at +40°F.										
	Impact Tested = 92-75-81					Impact Tested = 68-60-65										
	% Shear = 70-60-70					% Shear = 40-40-40										
	Lateral Exp. = 78-72-76					Lateral Exp. = 57-53-58										

RIF # 4457

BECHTEL 743

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

Judy K. Sanders

COPY

ASME SECTION III, 1974 EDITION AND
ADDENDA THRU WINTER 1975. CLASS 2.

SOUTHWEST FABRICATING & WELDING CO INC

HO 5

HOUSTON, TEXAS July 29,1980

ORDER NO MWO-Q6183-1

CUSTOMERS' ORDER NO S.O. Q6183

DETAILED ANALYSIS REPORT

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE					CHEMICAL ANALYSIS									HEAT OR LOT NO	SPECIFICATION OF MATERIAL FROM WHICH MADE
	[illegible]	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 2	PERCENT REDUCTION IN AREA	C	MN	P	S	SI	CR	NI	MO	CB		
3/32" & 1/8" Page AS-25 Spec. SFA-5.18 Cl. E70S-3	Chemical Analysis Reported for Information Only.					.079	1.22	.015	.032	.46	.02	.08	.01	Cu .10	909105	
3/32" & 1/8" Page AS-25 Spec. SFA-5.18 Cl. E70S-3						.073	1.21	017	.035	.47	.06	.07	.02	Cu .10	90963	
1/8" Chemetron Atom Arc Spec. SFA-5.1 Cl. E-7018						.04	1.02	.012	.017	.44	.03	.02	.01	Va .02	432C3491	
3/32" Linclon L-61 W. Wire Spec. SFA-5.17 Cl. F72-EM12K	Linclon 860 Flux Ht#. 85R					.10	1.10	.012	.020	.31	.10	.09	.02	Cu .19	77F	

RIP # 4457

BECHTEL 743

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

Judy K. Sanders

FORM NM-1 DATA REPORT FOR TUBULAR PRODUCTS AND FITTINGS WELDED WITH FILLER METAL
As required by the Provisions of the ASME Code Rules, Section III, Division 1

1. Manufactured by SOUTHWEST FABRICATING &WELDING CO., INC. HOUSTON, TEXAS
(Name and address of NPT Certificate Holder of tubular products)
2. Manufactured for SOUTHWEST FABRICATING & WELDING CO., INC. HOUSTON, TEXAS
(Name and address of purchaser)
3. Identification-NPT Certificate Holder's Serial No. LR-9087
(Lot, etc.) (CRN & Drawing No.)
N/A 1980
(Nat'l Board No.) (yr. mfg.)
4. (a) Manufactured according to Mat'l Spec. SA-420 WPL-6 (W) (SA or SB) Purchase Order No. MWO-06183-1
(b) Description of Product Inspected (1) 30" (1.375"MW) LR 90° Ell.
(c) Applicable ASME Code: Section III, Edition 1974 Addenda date W/1975 Case No. — Class 2
5. Remarks: None.
(Brief Description of Fabrication)

CERTIFICATE OF COMPLIANCE

We certify the statements made in this report are correct and the products defined in this report conform to the requirements of the ASME Material Specification listed above on line 4 (a). The radiographic film and a radiographic report showing film locations are attached to the Certified Material Test Reports provided for the material covered by this report.

Date July 29, 1980 Signed SF&WCO (NPT Certificate Holder) By Judy K. Sanders

ASME Certificate of Authorization No. N-1459 to use the NPT (NPT) Symbol expires July 23,1982 (Date)

CERTIFICATE OF INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Texas and employed by HSBI&ICo. of Hartford, Conn. have inspected the products described in this Partial Data Report on 7/29/ 1980, and state that to the best of my knowledge and belief, the NPT Certificate Holder has produced this product in accordance with the ASME Code Section III.

By signing this certificate, neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the product described in this Partial Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 7-31 1980

RIP # 4457

(Inspector's Signature) Commissions Texas 966
National Board, State, Province and No.

*Supplemental sheets in form of lists, sketches or drawings may be used provided (1) size is 8½ in. x 11 in., (2) information on items 1-4 on this Data Report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded at the top of this form.

QA 6

BECHTEL
743

(10/77)

This form (E00080) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

COPY

Supplier Deviation Disposition Request

NOTE:
1. COMPLETE INSTRUCTIONS ON BACK OF THIS SHEET
2. Items 1-18 below to be completed by supplier
3. * Items. Bechtel entries only
4. Attach additional information whenever necessary
5. Bechtel must be notified within 5 days after detection of deviation
6. A copy of the completed SDDR form shall be included by the supplier in the quality verification data package for each item to which this SDDR applies

SUPPLIER COMPLETED

FOR SUPPLIER USE — Supplier SDDR No.: 17 — Date Submitted: 1/9/84

PROJECT: SOUTH TEXAS — JOB NO. 14926-001

FOR BECHTEL USE — Bechtel SDDR No.: 0591 — Date Received: 1-9-84

1. Supplier Name: SOUTHWEST FABRICATING & WELDING CO INC — Address: 7525 SHERMAN — City & State: HOUSTON TX — Zip: 77012
2. Supplier's Order No.: 2657-2659
3. Supplier's Part No.: Q2657MS-1,-8,-15,-23; Q2659MS-1,5,13,22
4. Supplier's Part Name: FABRICATED PIPE SPOOL
5. Deviation Detected: 1/4/84 (Date) — PROCUREMENT REVIEW (Method)
6. All Previous SDDR (No. & Date's): 4/0431 5/1/83
7. Bechtel P.O. & Rev. No.: 35-1197-6014 c/o 24
8. Bechtel Part No.: SEE #12
9. Bechtel Part Name: FABRICATED PIPE SPOOL
10. Bechtel SQR Notified: N/A (Date) — ** (Method)
11. Bechtel Engrg Notified: 1/4/84 (Date) — VERBAL (Method)

12. Deviation Description (Attach extra sheets, photographs, sketches, etc. as necessary and identify quantity and serial No.'s as applicable)

BEC ISOMETRICS 2C365P-MS-1001 THRU 1004, SH 75 1, PC MKS A REQUIRE A TOTAL OF (8) 32" OD X 30" OD 1.375 MW CONC REDUCERS - 24" LONG AT THE STEAM GENERATOR NOZZLES. VENDORS OFFER STRAIGHT TAPER CONE REDUCERS

13. Suppliers Proposed Disposition: [X] Use-As-Is [ ] Repair [ ] Modify Bechtel Requirement

14. Cost Impact: APPROX 500^{00} EA. COST INCREASE
15. Schedule Impact: 4-8 WK DELAY

16. Proposed Disposition and Technical (plus Cost/Schedule if applicable) Justification: Attach extra sheets, sketches, etc. as necessary

ACCEPT STRAIGHT TAPER CONE REDUCERS. USE IS NOT PROHIBITED BY THE SPECIFICATION - COST SAVINGS AND IMPROVED DELIVERY SCHEDULE WILL RESULT.

17. Associated Supplier Document Change(s): SHOP DETAIL SHEETS

RIP # 4457

18. Suppliers Authorized Representative
Name: R C GREEN Jr — Signature: [signature] — Title: PROJECT MANAGER — Date: 1-4-84

BECHTEL

*19. Bechtel Engrg. Action: [X] Accepted [ ] Rejected
Engrg. Follow-up: [X] Dwg Change ([X] Bechtel [X] Supplier) [ ] Spec/Req. Change ([ ] Bechtel [ ] Supplier) [ ] Other Suppliers Affected [ ] Licensing Doc. Change [ ] Price Adjustment [ ] Other

*20. Bechtel Disposition Statement Including Justification (Attach extra sheets, sketches, etc. as necessary)

THE SUBSTITUTION OF A 32" OD x 30" OD STRAIGHT TAPER CONE REDUCER FOR THE SPECIFIED CONCENTRIC REDUCER IS ACCEPTABLE TO BECHTEL. THE STRAIGHT TAPER CONE REDUCER IS SIMILAR IN CONFIGURATION AND DESIGN WITH THE SAME STRESS INTENSIFICATION FACTOR. ADDITIONAL THE STRAIGHT TAPER CONE REDUCER WILL NOT AFFECT THE FLOW. THIS IS A ONE TIME DEVIATION AND DOES NOT REQUIRE A SPECIFICATION REVISION. THIS WILL BE INCORPORATE INTO BECHTEL DRAWINGS 2C369P-MS-1001 THRU 1004, SHEET 1

** BECHTEL SQR, K. BELTER, NOTIFIED PER TELECON 1-30-84 [initials]

Construction Action Required: [ ] YES [X] NO

*21. Bechtel Acceptance/Signature
GS [signature] — Date 1/24/84
PE [signature] — 2/1/84
QA [signature] QE

22. Supplier: Herbert W. Kantz [signature] — Date 2-9-84
*23. Bechtel Supplier Quality Representative: K Belter [signature] — Date 2/9/84

COPY

ASME Section III, 1974 edition
& addenda thru Winter 1975.
Class 2.

(81)

SOUTHWEST FABRICATING
& WELDING CO INC

(44)

NO 5

HOUSTON, TEXAS June 6, 1984

ORDER NO MWO 2657N-245

CUSTOMERS ORDER NO 2657N-245

DETAILED ANALYSIS REPORT

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE: HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 2" 8"	PERCENT REDUCTION IN AREA	CHEMICAL ANALYSIS: C	MN	P	S	SI	CR	NI	MO	CB	HEAT OR LOT NO	SPECIFICATION OF MATERIAL FROM WHICH MADE
Steel from Luken Steel Co.		52,200	80,200	28		.22	1.20	.018	.006	.23					D-6817 SL #3H	SA-516 GR-70
Conforms to SA-516 GR-70																
(8) 32" x 30" (1.375" MW)	Physicals and chemicals same as shown above.															
Concentric Cone Reducers	Heat treat per procedure 10-120 R/1 @ 1620° F. for 1 hr 30 min.															
SA-420 WPL-6 (W)	Charpy V-Notch tested @ +40°F.							Ft.Lbs.		Lat.Exp.		%Shear			Lot # 3179	
	(Size: 10mm x 10mm)					Weld		48.0		42		40				
								44.0		41		40				
								44.0		42		40				
Mfg. S/N CC-4003 thru						HAZ		50.5		47		40				
								63.0		55		50				
CC-4010								66.0		56		50				
						Base		99.0		75		85				
								97.0		70		80				
								96.0		70		80				
	X-Ray long seam per procedure RT-11 R/4															
	Results - Satisfactory															

RIP # 4457

BECHTEL 743

S.F.& W.CO. QA 2

This material was manufactured and supplied in accordance with the SF&W Co. Quality Assurance Manual Rev. #4, meeting the requirements of NCA-3800.

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

M. Fiore

COPY

HO-3

SOUTHWEST FABRICATING & WELDING CO INC

HOUSTON, TEXAS June 6, 1984

ORDER NO MWO 2657N-245

DETAILED ANALYSIS REPORT

CUSTOMERS ORDER NO 2657N-245

CONTINUED

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE					CHEMICAL ANALYSIS									HEAT OR LOT NO	SPECIFICATION OF MATERIAL FROM WHICH MADE
	HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 2"	PERCENT REDUCTION IN AREA	C	MN	P	S	SI	CR	NI	MO	CU		
1/8" Page AS-25 Carbon Steel Weld Wire Spec: SFA-5.18 Class ER70S-3/E70S-3		Reported for information only				.095 VA <.01	1.07	.016	.017	.47	.07	.06	.02	.29	20941	
.035" Airco Carbon Steel Weld Wire SFA-5.18 Type E-70 S-6		Reported for information only				.095 VA .007	1.43	.015	.011	.96	.031	.061	.010	.20	45458	
3/32" Page AS-25 Carbon Steel Weld Wire Spec: SFA-5.17 EM13K with Lincoln 860 Flux Lot #110F Class F7P25-EM13K		Reported for information only				.070 VA <.01	1.20	.022	.015	.72	.06	.08	.04	.18	30945	
Mfg S/N CC-4003 thru CC-4010																

RIP # 4457

S.F.& W CO. QA 2

BECHTEL 743

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

M. Fiore

13

FORM NM-1 DATA REPORT FOR TUBULAR PRODUCTS AND FITTINGS WELDED WITH FILLER METAL
As required by the Provisions of the ASME Code Rules, Section III, Division 1

1. Manufactured by Southwest Fabricating & Welding Co.Inc.,7525 Sherman, Houston, TX
(Name and address of NPT Certificate Holder of tubular products)
2. Manufactured for Southwest Fabricating & Welding Co.Inc.,7525 Sherman, Houston, TX
(Name and address of purchaser)
3. Identification-NPT Certificate Holder's Serial No. CC-4003 thru CC-4010
(Lot, etc.) (CRN & Drawing No.)
N/A (Nat'l Board No.) 1984 (yr. mfg.)
4. (a) Manufactured according to Mat'l Spec SA-420 WPL-6 (W) (SA or SB) Purchase Order No. 2657N-245
(b) Description of Product Inspected 32" x 30" (1.375" MW) Conc Cone Red. (24" lg)
(c) Applicable ASME Code: Section III, Edition 1974 Addenda date W/75 Case No. -- Class 2
5. Remarks: N/A
(Brief Description of Fabrication)

CERTIFICATE OF COMPLIANCE

We certify the statements made in this report are correct and the products defined in this report conform to the requirements of the ASME Material Specification listed above on line 4 (a). The radiographic film and a radiographic report showing film locations are attached to the Certified Material Test Reports provided for the material covered by this report.

Date June 6, 19 84 Signed S F & W Co. (NPT Certificate Holder) By M. Fiore

ASME Certificate of Authorization No. N-1459 to use the NPT (NPT) Symbol expires 7-23-85 (Date)

RIP # 4457

CERTIFICATE OF INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Texas and employed by H S B I & I Co. of Hartford, Conn. have inspected the products described in this Partial Data Report on 6-12 19 84, and state that to the best of my knowledge and belief, the NPT Certificate Holder has produced this product in accordance with the ASME Code Section III.

By signing this certificate, neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the product described in this Partial Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 6-12 19 84

W. E. Freeman (Inspector's Signature) Commissions Texas 370 (National Board, State, Province and No.)

*Supplemental sheets in form of lists, sketches or drawings may be used provided (1) size is 8½ in. x 11 in., (2) information on items 1-4 on this Data Report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded at the top of this form.

S.F.& W.CO. QA 2

BECH 743

(10/77)

This form (E00080) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

COPY

14

COPY (JY) (A)

LADISH CO.
Material Analysis Report
METALLURGICAL DEPARTMENT (1)

30" (...) Pipe

PURCHASER Southwest Fab & Weld Co. SA-155

PURCHASER'S ORDER NO. 6181 N-6 KCF-70 CL-1

ADDRESS P.O. Box 9449 - Houston, Texas 77011 C.S.

CUDAHY, WIS., October 24, 1978

LSO NO. B21172

INVOICE NO.

NO. PCS.	DESCRIPTION AND SPECIFICATION	HEAT NO. AND CODE	C	MN	P	S	SI	NI	CR	MO	YIELD STRENGTH KSI	ULTIMATE STRENGTH KSI	ELONG. %	RED. OF AREA
	Item #1	C9726		HEAT ANALYSIS							MILL TENSILE			
	30" O.D. x 1.375 N/W Pipe Sq. Cut Ends	JY4UH	.23	.98	.011	.003	.26				53.2	77.6	26	
				PRODUCT ANALYSIS							(L) CENTER WELD TENSILE			
			.23	.95	.008	.010	.25				62.8	81.6	22	70
											60.4	80.3	23	70
											64.8	80.5	23	69

ASME SA 155 KCF 70 Class 1 per ASME Section III Class 2 1974 Edition, through Winter 1975 Addenda Notes 1, 3 & 4 only of Purchasing Notes QA-20 dtd. 10-11-74 apply.

Weld No. 40U

ASME NPT Certificate No. N1600 expires 1-10-80.

VEE notch Charpy impacts at +40°F. - Full Size

	Ft. Lbs.	% Shear	Lateral Expansion
C.W.	90.0 - 83.0 - 83.5	90 - 67 - 65	.077 - .073 - .074
P.M.	33.5 - 35.0 - 36.5	29 - 29 - 35	.030 - .028 - .030
H.A.Z.	60.0 - 47.0 - 43.0	55 - 52 - 47	.052 - .048 - .036

Manufactured from ASME SA 516 Grade 70 plate.

Guided weld bend test - satisfactory.

RIP # 445

BECHTEL 743

QA 6

SUBSCRIBED AND SWORN TO BEFORE ME THIS 24th DAY OF October 1978

Lorraine Zajac
NOTARY PUBLIC

MY COMMISSION EXPIRES August 17, 1980

I HEREBY CERTIFY THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF THE ABOVE REPORT IS TRUE AND CORRECT.

[signature]

COPY

Material Analysis Report

METALLURGICAL DEPARTMENT

PURCHASER Southwest Fab & Weld Co. CUDAHY, WIS., October 24, 19 78

PURCHASER'S ORDER NO. 6181 N-6 LSO NO. B21172

ADDRESS P.O. Box 9449 - Houston, Texas 77011 INVOICE NO.

Center weld impacts were taken with their longitudinel axis transverse to the longitudinal axis of the pipe, 1/2" from the outer surface. The axis of the notch is centered on the welded joint and perpendicular to the surface.

Parent metal impacts were taken with their longitudinal axis transverse to the longitudinal axis of the pipe, 1/2" from outer surface. The axis of the VEE is perpendicular to the surface.

Heat Affected Zone impacts were taken with their longitudinal axis transverse to the longitudinal axis of the pipe, 1/2" from the outer surface. The axis of the notch is centered on the fusion line and perpendicular to the surface.

Pipe was welded per 16-F-115 Rev. 9 dtd. 12-8-77 using Page AS-15, Heat No. 60403 weld wire and Lincoln 860 Lot 47E flux.

Procedure qualification record no. YR 489 dtd. 11-16-77.

Pipe was heat treated per (L) Procedure 13-N-628 dtd. 5-3-77. Stress relieved at 1125^{o}F. Air cooled.

Welds were radiographically inspected and accepted per (L) Procedure 9-Q-216 Rev. 5 dtd. 12-8-77.

Pipe was hydrostatically tested and approved per (L) Procedure 19-Q-010 dtd. 1-17-77 at 2612 psi.

PIPE IS IDENTIFIED AS FOLLOWS:

Ladish ASME SA 155 KCF 70
Class 1 SA 516 Gr. 70 - L - JY4UH
Weld No. 40U 2612 psi
Identification includes NPT Stamp Cl. 2 1978.
Partial Data Reports attached.

BECHTEL 743

RIP # 4457

S.F.&W.CO. QA 6

SUBSCRIBED AND SWORN TO BEFORE ME THIS

24th DAY OF October 19 78

Lorraine Zajac
NOTARY PUBLIC

MY COMMISSION EXPIRES August 17, 1980

I HEREBY CERTIFY THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF THE ABOVE REPORT IS TRUE AND CORRECT.

COPY

LADISH CO.
Material Analysis Report
METALLURGICAL DEPARTMENT

PURCHASER Southwest Fab & Weld Co.

CUDAHY, WIS., February 27, 19 79

PURCHASER'S ORDER NO. 6181 N-6

LSO NO. B21172

ADDRESS P.O. Box 9449 - Houston, Texas 77011

INVOICE NO.

SUPPLEMENT TO ORIGINAL REPORT DTD. 10-24-78

Weld was repaired per Procedure 16-F-020 Rev. 7 dtd. 6-22-78 using Chemetron E7018 heat no. 421W9081 electrodes.

Procedure qualification record no. YR 490 dtd. 12-29-77.

Pipe was heat treated per (L) Procedure 13-N-628 dtd. 5-3-77. Stress relieved at 1125°F. Air cooled.

Weld was radiographically inspected and accepted per (L) Procedure 9-Q-216 Rev. 5 dtd. 12-8-77.

Pipe was hydrostatically tested and approved per (L) Procedure 19-Q-010 dtd. 1-17-77 at 2612 psi.

RIP # 457

BECHTEL 743

S.F.&W.CO. QA 6

SUBSCRIBED AND SWORN TO BEFORE ME THIS

27th DAY OF February 19 79

Lorraine Zajac
NOTARY PUBLIC

I HEREBY CERTIFY THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF THE ABOVE REPORT IS TRUE AND CORRECT.

R.M.P.

FORM NM-1 DATA REPORT FOR TUBULAR PRODUCTS AND FITTINGS WELDED WITH FILLER METAL
As required by the Provisions of th ASME Code Rules

1. Manufactured by Ladish Co., 5481 S. Packard Ave., Cudahy, Wis. 53110
(Name and address of Manufacturer of tubular products)

2. Manufactured for Southwest Fab & Weld Co., PO Box 9449, Houston, Texas 7701
(Name and address of purchaser)

3. Identification-Manufacturer's Serial No. 40U 62-38809
(Lot, etc.) (CRN & Drawing No.)

-- 1978
(Nat'l Board No.) (yr. mfg.)

4. (a) Manufactured according to Mat'l Spec SA155 KCF70 Cl.1 Purchase Order No. 6181 N-6
(SA or SB)

(b) Description of Product Inspected 30" O.D. x 1.375 N/W Pipe

(c) Applicable ASME Code: Section III, Edition 1974 Addenda date W75 Case No. - Class 2

5. Remarks: ***
(Brief Description of Fabrication)

Welded with filler metal and produced in accordance with ASME Sec. III Class 2 to SA155 KCF 70 specifications.

CERTIFICATE OF COMPLIANCE

We certify the statements made in this report are correct and the products defined in this report conform to the requirements of the ASME Material Specification listed above on line 4 (a). The radiographic film and a radiographic report showing film locations are attached to the Certified Material Test Reports provided for the material covered by this report.

Date October 31 1978 Signed Ladish Co. By [signature]
(Manufacturer)

ASME Certificate of Authorization No. N1600 to use the NPT Symbol expires 1-10-80
(Date)

[signature] 3/27/79

RIP # 4457

CERTIFICATE OF INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Wisconsin and employed by **
of Waltham, Mass. have inspected the products described in this Manufacturer's Partial Data Report on Nov 3, 1978 and state that to the best of my knowledge and belief, the Manufacturer has produced this product in accordance with the ASME Code Section III.

By signing this certificate, neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the product described in this Manufacturer's Partial Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Nov 3, 1978

D. S. Oakley Commissions NB 7452
(Inspector's Signature) National Board, State, Province and No.

D. S. Oakley 3/27/79

7/76 This form (E00080) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

** Arkwright Boston Manufacturers Mutual Insurance Co.
Mutual Boiler Division, Factory Mutual System

*** Weld was repaired per Procedure 16-F-020 Rev. 7 dtd. 6-22-78 using Chemetron E7018 Heat No. 421W9081 electrodes. Procedure Qualification record no. YR 490 dtd. 12-29-77. Pipe was heat treated per (L) Procedure 13-N-623 dtd. 5-3-77. Stress relieved at 1125°F. Air cooled. Weld was radiographically inspected and accepted per (L) Procedure 9-Q-216 Rev. 5 dtd. 12-8-77. Pipe was hydrostatically tested and approved on 2-27-79 per (L) Procedure 19-Q-010 dtd. 1-17-77 at 2612 psi.

BECHTEL
743

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Ring was normalized at 1650°
weld' '; stress relieved @112
2-1/ hrs. @ temp.

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb.	Ultimate Unit Stress KSI *	Character of Failure & Location
QW462.1(d)	CW 1T	.5045"Ø		15,975	79.9	#1Part. Cup&Cone/
QW462.1(d)	CW 1B	.505"Ø		15,450	77.1	#2Part. Cup&Cone/
QW462.1(d)	CW 2T	.5045"Ø		15,700	78.5	#3Part. Cup&Cone/
QW462.1(d)	CW 2B	.5045"Ø		15,500	77.5	#4Part. Cup&Cone/
QW462.1(d)	PM(Long.)	.504"Ø		15,250	76.4	#5Cup&Cone/Cente
QW462.1(d)	PM(Circum)	.504"Ø		15,250	76.4	#6Part. Cup&Cone/

Toughness Tests (QW-170)

Specimen No.	Notch Location	Notch Type	Test Temp	Impact Values	Lateral Exp. % Shear	Lateral Exp. Mils	Drop Weight Break	Drop Weight No Break
SA370				Ft-Lbs.				
Fig. 11a								
	CW	Vee	+30°F	86.0	72	69		
	CW	Vee	+30°F	86.0	62	73		
	CW	Vee	+30°F	83.0	55	74		
	HAZ	Vee	+30°F	39.0	55	38		
	HAZ	Vee	+30°F	52.0	69	46		
	HAZ	Vee	+30°F	46.0	62	46		
	PM(Long.)	Vee	+30°F	57.0	57	52		
	PM(")	Vee	+30°F	49.0	45	44		
	PM(")	Vee	+30°F	57.0	50	54		

RIP # 4457

Other Tests

CHARGE NO. 51-12089
MO 64-02365

Type of Test Radiographic Satisfactory to ASME Sec. VIII Para. UW51 Z50

Deposit Analysis

	C	Mn	P	S	Si	Ni	Cu
+ Other (L)Weld	.10	1.86	.024	.016	.27	.02	.13

+Deposit chemistry as-welded per 16 F 115 R9 (2-3/16" thick A516 plate) from SFA 5.17 EH14 (Page AS15, Ht. 60403) wire, 5/32"Ø, & Lincoln-860 flux, Lot 47E.

Welder's Name R. Kateley

Tests conducted by: R. Wells Clock No. 12888 Stamp No. L88

Laboratory Test No. YR489

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date 11/8/77 Manufacturer LADISH CO. By [signature]

*	YLD. STR. KSI .2% OFFSET	% EL.	% RA	
#1-CW	60.5	14	52	Fract. outside gage mark.
#2-CW	49.9	24	56	
#3-CW	53.7	16	52	Fract. in gage mark.
#4-CW	49.9	33	57	
#5-PM (Long.)	49.6	33	66	
#6-PM (Circum.)	49.9	31	59	

L.P.&W.CO. QA 6

BECHTEL 743

Z50
Ht. Y54538
Code JJ4Z

COPY

(See QW-2(.. Sd on IX, 1974 ASME Boiler and Pressure Vess(.ode)

Company Name: Ladish Co.

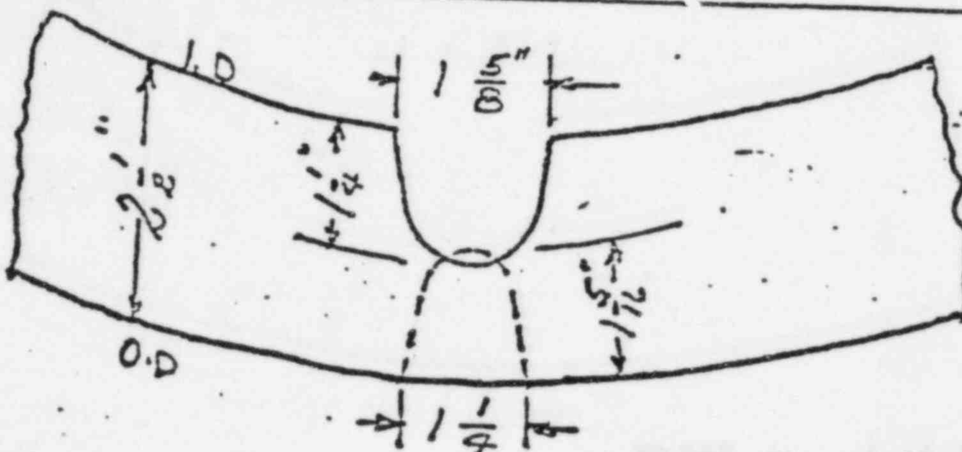
Procedure Qualification Record No.: YR490

WPS No.: 16 F 020 LR and 16F008 Rev. 8 — Date: 12/28/77

Welding Process(es): SMAW

Types (Manual, Automatic, Semi-Auto.): Manual — (L) Unit AC394582

JOINTS (QW-402)



S.F.& W.CO. QA 2

Groove Design Used

RIP # 4457

BASE METALS (QW-403)

Material Spec.: A516

Type or Grade: 70

P No.: 1 to P No.: 1

Thickness: 2-1/2"

Diameter:

Other: Range 3/16" to 5"

Ht. No. Y54532, Code JJLZ (250)

POSTWELD HEAT TREATMENT (QW-407)

Temperature: See Individual TEst Resul

Time:

Other:

GAS (QW-408)

Type of Gas or Gases: —

Composition of Gas Mixture: —

Other:

FILLER METALS (QW-404)

Weld Metal Analysis A No.: 1

Size of Electrode: 3/16"

Filler Metal F No.: 4

SFA Specification: 5.1

AWS Classification: E7018

Other: Chemetron E7018, Ht. #421W908-1

ELECTRICAL CHARACTERISTICS (QW-409)

Current: DC

Polarity: - Reverse

Amps.: * Volts: *

Other: *See Attached Welding Record

POSITION (QW-405)

Position of Groove: Flat

Weld Progression (Uphill, Downhill): Horizontal

Other:

TECHNIQUE (QW-410)

Travel Speed: *

String or Weave Bead: String

Oscillation: —

Multipass or Single Pass (per side): Multipass

Single or Multiple Electrodes: Single

Other:

PREHEAT (QW-406)

Preheat Temp.: 60-250°F

Interpass Temp.: 60-600°F

Other:

BECHTEL 743

(1/76)

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QW-483 (Back) Test section(ormalized prior welding, welded, stress relie @ 112; +0 -25, 2-1/2 hrs. @

Tensile Test (QW-150)

Specimen No	[illegible]	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress KSI	*	Character of Failure & Location
QW462.1(d)	CW 1B	.505"Ø		15,000	74.9	#1	Cup&Cone/Wel
QW462.1(d)	CW 1B	.504"Ø		14,550	72.9	#2	Cup&Cone/Wel
QW462.1(d)	CW 2B	.5045"Ø		15,050	75.3	#3	Cup&Cone/Wel
QW462.1(d)	CW 2B	.504"Ø		14,650	73.4	#4	Cup&Cone/Wel
QW462.1(d)	PM(Long)	.505"Ø		16,125	80.5	#5	Cup&Cone/Cen
QW462.1(d)	PM(Circum)	.505"Ø		15,800	78.9	#6	Cup&Cone/Cen

Toughness Tests (QW-170)

Specimen No	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp. % Shear	Lateral Exp. Mils	Drop Weight Break	Drop Weight No Break
SA370				Ft-Lbs.				
Fig. 11a	CW	Vee	+30°F	184.5	100	92		
	CW	Vee	+30°F	190.0	100	89		
	CW	Vee	+30°F	194.0	100	77		
	HAZ	Vee	+30°F	56.0	95	49		
	HAZ	Vee	+30°F	52.0	89	47		
	HAZ	Vee	+30°F	48.0	80	43		
	PM(Long.	Vee	+30°F	101.0	75	65		
	PM("	Vee	+30°F	129.0	100	82		
	PM("	Vee	+30°F	106.0	82	76		

S.F.& W.CO. QA 2

RIP # 4457

Other Tests CHARGE NO. 51-12090
MO 64-02371

Type of Test Radiographic Satisfactory to ASME Sec. VIII Para. UW51, UW174

	C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al	V
Deposit Analysis Other (L)Weld	.05	1.20	.015	.016	.38	.02	.05	.01	.06	.01	<.01	.01
Mill - PM	.26	1.05	.011	.017	.24	—	—	—	—	—	—	

Welder's Name S. Thompson Clock No. 12660 Stamp No. L50

Tests conducted by: R. Wells Laboratory Test No. YR490 ✓

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date 12/30/73

Manufacturer W.O. LARISH CO.

By W.R. Waltering

	YLD. STR. KSI .2% OFFSET	% EL.	% RA
-CW	52.4	26	73
-CW	52.4	24	75
-CW	51.0	27	74
-CW	55.6	25	74
-PM (Long.)	53.7	32	66
-PM (Circum)	52.7	30	58

BECHTEL 743

COPY

COPY 2

309/309L SS

SOUTHWEST FABRICATING & WELDING CO. INC

(5)

HO-5

HOUSTON, TEXAS January 18, 1977

AN-TECH CORP. REPORT NO. 3965

TEST ~~ORDER~~ NO. 01335

DETAILED ANALYSIS REPORT

CUSTOMERS' ORDER NO

CORRECTED 5-6-82

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE					CHEMICAL ANALYSIS									HEAT OR LOT NO.	SPECIFICATION OF MATERIAL FROM WHICH MADE
	HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 2"	PERCENT REDUCTION IN AREA	C	MN	P	S	SI	CR	NI	MO	CO		
.035",3/32",1/8" Combustion			REPORTED			.02	1.51	.018	.005	.25	24.05	12.80	.10		74649	
Engr. T-309/309L Stainless						CU.05, N .05										
Steel Wire. Specification																
SFA-5.9; Class ER-309/ER-309L		Check Analysis For				CHECK ANALYSIS										
		Information Purposes				.023	1.58	.015	.007	.38	24.48	12.34	.21	.09		
		Only.				V.038, CU .19, Ti .01, Cb + Ta .017, N .011										
						FERRITE 12%-13% CALCULATED FROM CHEMICAL ANALYSIS OF CHECK ANALYSIS USING SCHAEFFLER DIAGRAM.										

RIP # 4457

QA 6

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

David F. Hartmann

BECHTEL 743

POWER SYSTEMS
Combustion Engineering, Inc.
C-E Wire
4224 Shackleford Road
Norcross, Georgia 30093

MANUFACTURERS OF HIGH QUALITY NICKEL ALLOY STAINLESS STEEL AND LOW ALLOY WIRE FOR WELDING, FORMING AND OTHER APPLICATIONS CERTIFIED TO ASTM, ASME, AWS, SECTION I AND SECTION III NUCLEAR SPECIFICATIONS

SHIP TO: Southwest Fa[illegible]icating & Welding
7525 Sherman
Houston, Texas 77011

DATE SHIPPED: 12-23-76
Corrective Copy 5-4-82
MARKED:

CERTIFICATE OF QUALITY CONFORMANCE TESTS

CUSTOMER PURCHASE ORDER NO.
SHOP ORDER NO.: 2076

SPECIFICATIONS SFA 5.9 This material was manufactured and supplied in accordance with Quality Assurance manual revision Dated: 11/1/76 accepted by Southwest Fabricating.

ITEM	HEAT NUMBER	SIZE	TYPE	POUNDS SHIPPED	
1	74649	.035"Dia.	ER309/ER309L		
2		.094"Dia.			
3		.125"Dia.			RIP # 4457
4					

CHEMICAL ANALYSIS

ITEM	C	Mn	Si	S	P	Cr	Ni	Cu	Al	Mo	N_2				
1	.02	1.51	.25	.005	.018	24.05	12.80	.05		.10	.05				
2															
3															
4															

S.F.&W.CO. QA 6

ITEM	TENSILE STRENGTH	YIELD STRENGTH	ELONGATION	ADDITIONAL TESTS
1	Welding Temper			
2				
3				BECHTEL 743
4				

WE HEREBY CERTIFY THAT MATERIAL REFERRED TO ABOVE CONFORMS TO THE PHYSICAL AND CHEMICAL TESTS AND IS IN ACCORDANCE WITH SPECIFICATIONS

Notary Public, Georgia, State at Large
My Commission Expires Aug. 15, 1982

Sue Kelley
NOTARY

COPY

Combustion Engineering, Inc.
Lucy Cox
AUTHORIZED OFFICIAL

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COPY

(04)

SOUTHWEST FABRICATING & WELDING CO INC

HO-5

HOUSTON, TEXAS 5/3/84

AN-TECH LAB REPORT NO. 84-1618-1 & 2

TEST ORDER NO. 02183

DETAILED ANALYSIS REPORT

CUSTOMERS' ORDER NO

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE: HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 2"	PERCENT REDUCTION IN AREA	CHEMICAL ANALYSIS: C	MN	P	S	SI	CR	NI	MO	CU CB	HEAT OR LOT NO.	SPECIFICATION OF MATERIAL FROM WHICH MADE
3/32" & 1/8" PAGE AS-25		REPORTED				.095	1.29	.012	.007	.52	.10	.10	.023	.184	40911	
CARBON STEEL WELD WIRE						Va = .002										
SPECIFICATION SFA-5.18						AS WELDED										
CLASS ER70S-3/E70S-3		72,500	90,500	28.0	73.0	.078	1.20	.012	.010	.46	.07	.10	.01	.27		
						Va = .01										
						"V" NOTCH CHARPY IMPACT AT -20°F										
						FT.LBS. 64.0 - 70.0 - 97.0										
						LAT. EXP. 46 - 55 - 69										
						% SHEAR 50 - 60 - 70										
						STRESS RELIEVED AT 1150 °F FOR 8 HOURS										
		63,700	106,100	27.0	75.0	CHEMISTRY SAME AS ABOVE.										
						"V" NOTCH CHARPY IMPACT AT -20°F										
WELDED PER 01.01.037 R/5						FT.LBS. 150.0 - 151.0 - 155.5										
HEAT TREATED PER HT-P1-2 R/4						LAT. EXP. 80 - 82 - 83										
X-RAY SATISFACTORY						% SHEAR 100 - 100 - 100										

RIP # 4457

BECHTEL 743

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

W.D. Russell

PAGE-WILSON CORPORATION

PAGE WELDING DIVISION

CHEMICAL ANALYSIS REPORT

RECEIVED MAY 18 1984 Southwest Fabricating & Welding Co.

Date: 4/11/84

Customer's Order: 2442

Shipped To: CHAMPION INDUSTRIAL SALES., HOUSTON, TX

S.W. Fab P.O. #84-0194

FOR: SOUTHWEST FABRICATING & WELDING HOUSTON, TX

Our Register: 1300-122-133
1300-138-095

Via: UNIBRAZE-PAGE

Pallets: 2 Gross: 3114 Net: 3000

Material: 3/32 AS-25 #2 COIL *
1/8 AS-25 #2 COIL **
ASME Boiler & Pressure Vessel Code
Section II, Part C
Specification SFA 5.17, Classification EM-13K
and Specification SFA 5.18, Classification ER70S-3/E70S3

ACTUAL CHEMISTRY

Heat No.	C	Mn	P	S	Si	Mo	Cu	Al	Ni	Cr	V	
40911	.095	1.29	.012	.007	.52	.023	.184* TOTAL* .176 ** TOTAL **		.10	.10	<.002	

RIP # 4457

We certify that these chemical test results are correct as contained in the records of the company.

A. Stamps, Q.C. Dept.

This material was manfactured in accordance with the Quality Assurance Manual, revision dated March 31, 1983, accepted by Southwest Fabricating and Welding Co., as meeting the requirements of NCA-3800.

A. Stamps /[illegible]
A. STAMPS

BECHTEL 743

COPY

CHAMPION INDUSTRIAL SALES CO. • 6420 Navigation • P. O. Box 9130 • Houston, Texas 77011 • Phone 713-921-7183

JUNE 1, 1984

SOUTHWEST FABRICATING & WELDING CO., INC.
P.O. BOX 9449
HOUSTON, TEXAS 77011

RE: P.O.#84-0194 (Ht. #40911)

1/8 AND 3/32 PAGE AS-25 MATERIAL WAS MANUFACTURED AND SUPPLIED IN ACCORDANCE WITH THE QUALITY ASSURANCE MANUAL, REVISION III, DATED 1/02/83, ACCEPTED AND APPROVED BY SOUTHWEST FABRICATING & WELDING CO., INC., MEETING THE REQUIREMENTS OF NCA 3800.

CHAMPION INDUSTRIAL SALES CO.

AMOS STIBORIK

AS/jt

RIP # 4457

BECHTEL
743

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ALLOY RODS, INC.

CERTIFICATE OF ANALYSIS

P.O. BOX 517 HANOVER, PA 17331 717/637-8911

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CERTIFIED MATERIALS TEST REPORT

IWECO, INC.
P.O. BOX 12668
8350 MOSLEY
HOUSTON, TX 77017
ATTN: QA MANAGER

Customer Order No. N84363

Order No. 228759-1

This Material Conforms to Specificatio ASME SFA 5.1 Sec. II Part C & ASME Sec III, NB-2400 1983 Ed. thru Summer 1983 Add. 10 CFR Part 21 applies.

Trade Name or Trademark: Atom Arc 7018

Diameter Size: 3/32"

Weight: 2,500 lbs.

Lot Number: 2J311AA02

Heat Number: 411X0991

Type: E7018

Test No. 2-2945-00
Control No. JJ043
X-Rays Satisfactory

Moisture @ 1800° F. 0.08%
Concentricity 3%
Type Steel A-285

Carbon	.05
Manganese	1.07
Chromium	.03
Nickel	.03
Silicon	.40
Columbium+ Tantalum	
Molybdenum	.01
Tungsten	
Copper	.02
Titanium	
Phosphorus	.016
Sulphur	.013
Vanadium	.01
Cobalt	

Test No. Tensiles & Impacts	Full	Split	Volts	Amps
	1	3	22	100 D

Test Results:	As Welded	Stress Relieved 8 hrs. @ 1150° F.
Yield	70,500	62,600
Tensile	84,000	77,000
Elongation	34.0%	34.0%
Red. of Area	75.6%	76.0%
Charpy V-Notch Impacts Tested @ -20° F.		
Ft. Lbs.	90-92-96	140-120-134
Lat. Exp.	64-66-71	82-82-83
% Shear	30-30-30	60-40-40

Ferrite:

Fillets: OK Vertical/Overhead

Tensile Specimen .252"
Impact Specimen .394" x .394"

Location & Orientation of Charpy-V-Notch/Tensile Specimens is I/A/W ASME NX-2322 and/or AWS/SFA specifications as applicable.

RIP # 4457

Quality Systems Certificate No. QSC-22
Expiration Date: September 8, 1984

State of Pennsylvania
County of York } SS

Subscribed and sworn to before me this 5th day of December, 1983

SEAL Kay Hildavan
Notary Public

My Commission expires: 11/22/86

The undersigned certifies that the contents of this report are correct and accurate and that all operations performed by the undersigned or sub contractors are in compliance with requirements of the material specification and ASME Boiler and Pressure Vessel Code Section III Division I Subsection NCA-3800

ALLOY RODS, INC.

BY D. E. Lebo
D. E. Lebo
Quality Assurance Specialist

Q A

BECHTEL
743

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IWECO

P.O. Box 12668
Houston, Texas 77017

8350 Mosley
Houston, Texas 77075

IWECO, INC.

713-943-2000
Distributors For
Union Carbide · Linde, Chemetron · Atom Arc, Stoody, Aronson, Reid · Avery, Pandjiris, Westinghouse, Arcos, All-State, Arcair, Tweco

CERTIFICATE OF COMPLIANCE

Southwest Fabricating & Weld. P. O. NO. 83-1282

Material Specification E-7018, SFA 5.1, Sec II "C"

Heat No. 411X0991

Lot No. 2J311AA02

Control JJ043

RIP # 4457

This material was manufactured and supplied in accordance with the Quality Assurance Manual Revision NO. 2, 11-3-80

Accepted by Southwest Fabricating, meeting the requirements of NCA-3800. ✓

Q A 6

Joe Morgan
Joe Morgan
Q.A. Mgr.

BECHTEL
743

COPY

2.

COPY (84) (4)

HO-5

SOUTHWEST FABRICATING & WELDING CO. INC.

HOUSTON, TEXAS 3/22/84

Test NO. 02161

CUSTOMERS' ORDER NO. ____________

An-Tech Lab. Report No. 84-1080-1 & 2

DETAILED ANALYSIS REPORT

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE: HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION IN 2"	PERCENT REDUCTION IN AREA	CHEMICAL ANALYSIS: C	MN	P	S	SI	CR	NI	MO	CU	HEAT OR LOT NO.	SPECIFICATION OF MATERIAL FROM WHICH MADE
.035 Alloy Rod			Reported			.09	1.46	.006	.013	.85	.04	.04	.01	.05	12132	
Spoolarc 88 Carbon Steel						Va =	.01									
Weld Wire								As Welded								
Specification: SFA-5.18		66,400	86,100	23	61.3	.11	1.47	.005	.012	.80	.05	.05	.01	.25		
Class E70S-6/ER70S-6						Va =	<.01									
						"V" Notch Charpy Impact at 0°F.										
						Ft.Lbs.		33.0	-	35.0	- 53.0					
						Lat. Exp.		25	-	28	- 42					
						% Shear		30	- 30	- 40						
						Stress Relieved at 1150°F for 8 Hrs.										
		58,600	74,800	28.0	70.9	Chemistry same as above.										
						"V" Notch Charpy Impact at 0°F.										
Welded per 01.01.038 R/7						Ft.Lbs.		71.5	-	74.0	- 76.5					
Heat Teated per HT-P1-2 R/4						Lat. Exp.		56 -	57	- 63						
X-Ray Satisfactory						% Shear		70 -	70	- 70						

RIP # 4457

S.F. & W.CO. QA 2

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

David F. Hartmann

BECHTEL 743

ALLOY RODS, INC.

P.O. BOX 517 HANOVER, PA 17331 71 ,7-8911

CERTIFICATE OF ANALYSIS

CERTIFIED MATERIALS TEST REPORT

SOUTHERN ALLOY & EQUIP.
6620 FULTON
REF. P.O. 0739
HOUSTON, TX 77022

Customer Order No. 1461

Order No. 232119-1

Shipped:

This Material Conforms to Specification ASME SFA 5.18 Sec. II Part C & ASME B&P Sec. III NB-2400 1983 Ed. thru Summer 1983 Add. 10 CFR Part 21 applies.

Type: ER 70S-6

Test No. 2-3380-00

Trade Name or Trademark: Spoolarc 88

Diameter Size: .035"

Weight: 1,020 lbs.

Lot Number:

Heat Number: 12132

Carbon	.09
Manganese	1.46
Chromium	.04
Nickel	.04
Silicon	.85
Columbium+ Tantalum	
Molybdenum	.01
Tungsten	
Copper	.05
Titanium	
Phosphorus	.006
Sulphur	.013
Vanadium	.01
Cobalt	
FERRITE	

RIP # 4457

State of Pennsylvania
County of York } SS

Subscribed and sworn to before me this 22nd day of March, 1984

SEAL.......................
Notary Public

My Commission expires: 03/16/87

Quality Systems Certificate No. QSC-221
Expiration Date: September 8, 1984

The undersigned certifies that the contents of this report are correct and accurate and that all operations performed by the undersigned or sub contractors are in compliance with requirements of the material specification and ASME Boiler and Pressure Vessel Code Section III Division I Subsection NCA-3800

ALLOY RODS, INC.

BY.......................
J. L. Starner
Q.A. Supervisor

S.F.A.W.CO. QA 2

APPROVED
BY Q. A. ________ DATE 3-26-84
SOUTHERN ALLOY & EQUIPMENT, INC.

BECHTEL 743

COPY

SOUTHERN ALLOY & EQUIPMENT, INC.

382 GARDEN OAKS BLVD. • P. O. BOX 10208
HOUSTON, TEXAS 77206
(713) 691-5513

March 20, 1984

Re: SF&WCO P.O. Number 84-0163 dated 2-8-84

1020# Chemtron .035" Dia. "Spoolarc 88" Mild Steel Mig Wire
AWS-SFA 5.18 Class ER-70S-6 Heat #12132

THIS MATERIAL WAS MANUFACTURED AND SUPPLIED IN ACCORDANCE WITH THE QUALITY ASSURANCE MANUAL REV.3 DATED 3-24-80 ACCEPTED BY SF & WCO, MEETING THE REQUIREMENTS OF NCA-3800.

Southern Alloy & Equipment, Inc.

C.A. Hardin

C.A. Hardin
Mgr. Q.A.

RIR # 4457

S.F.& W.CO. QA 2

BECHTEL 743

COPY

21

COPY

(84)

(13)

HO 5

SOUTHWEST FABRICATING & WELDING CO. INC.

HOUSTON, TEXAS 8-10-84

AN-TECH LAB. REPORT NO. 84-3057-1 & 2

TEST NO 02212

DETAILED ANALYSIS REPORT

CUSTOMERS' ORDER NO

DESCRIPTION	PHYSICALS OF MATERIALS FROM WHICH MADE					CHEMICAL ANALYSIS									HEAT OR LOT NO	SPECIFICATION OF MATERIAL FROM WHICH MADE
	HEAT TREATMENT	YIELD POINT PER SQUARE INCH	TENSILE STRENGTH PER SQUARE INCH	PERCENT ELONGATION	PERCENT REDUCTION IN AREA	C	MN	P	S	SI	CR	NI	MO	CU		
3/32" PAGE AS-25 CARBON		REPORTED				.13	1.18	.013	.009	.58	.046	.041	.007	.16	40925	
STEEL WELD WIRE						V=	.002									
SPECIFICATION: SFA 5.17		72,900	85,800	26.0	64.9		-	AS WELDED -								
CLASS EM13K WITH						.13	1.15	.024	.010	.60	.06	.07	.02	.22		
LINCOLN 860 FLUX LOT#						V= < .01										
137S CLASS F70-						"V" NOTCH CHARPY IMPACT @ 0° F.										
EM13K F7A0-EM13K						FT.	LBS.	39.0	36.0	38.0						
OR F7P0-EM13K						LAT.	EXP	38	31	35						
						% SHEAR		40	40	40						
						STRESS RELIEVED @ 1150° F. FOR 8 HOURS										
		64,400	81,400	27.0	66.1	CHEMISTRY SAME AS ABOVE										
						"V" NOTCH CHARPY IMPACT @ 0° F.										
WELDED PER 01.01.040 R/7						FT.	LBS.	45.0	44.0	45.0						
HEAT TREATED PER HT-P1-2 R/4						LAT.	EXP	43	42	43						
X-RAY SATISFACTORY						% SHEAR		40	40	40						

RIP # 4457

S.F.&W.CO. QA 2

BECHTEL 743

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS CORPORATION

W. C. Russell

UNIBRAZE-PAGE CORPORATI
205 CLAY STREET, BOX 1839
BOWLING GREEN, KENTUCKY 42102-1839 (502) 781-5560 TELEX 55-4353

CHEMICAL ANALYSIS REPORT

Date: 8-9-84

Shipped To: CHAMPION INDUSTRIAL SALES
HOUSTON, TX

Customer's Order: 2637

FOR: SOUTHWEST FABRICATION & WELDING
HOUSTON, TX.

S.W. Fab. P.O. 84-0597

Via: CUSTOMER PICK UP

Our Register: 1300-208-128

Pallets: 2 Gross: 2928# Net: 2816#

Material: 3/32" AS-25 #2 Coils

ASME Boiler & Pressure Vessel Code
Section II, Part C
Specification SFA 5.17, Classification EM-13K
and Specification SFA 5.18, Classification ER70S-3/E70S-3

Heat No.	C	Mn	P	S	Si	Mo	Cu	Al	Ni	CR	V	
40925	.13	1.18	.013	.009	.58	.007	.16 TOTAL		.041	.046	.002	

RIP # 4457

We certify that these chemical test results are correct as contained in the records of the company.

A. Stamps, Q.C. Dept.

This material was manufactured in accordance with the Quality Assurance Manual, revision dated march 31, 1983, accepted by Southwest Fabrication and Welding Co as meeting the requirements of NCA-3800.

S.F.&W.CO. QA 2

A. Stamps, Q.C. Department

BECHTEL
743

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CHAMPION INDUSTRIAL SALES CO. • 6420 Navigation • P. O. Box 9130 • Houston, Texas 77011 • Phone 713-921-7183

August 10, 1984

Southwest Fabricating & Welding Co.
P. O. box 9449
Houston, Texas 77011

Re: PO#84-0697 Chg. 1 (40925)

3/32 Page AS-25 material was manufactured and supplied in accordance with the Quality Assurance Manual, revision III/ dated 01/02/83, accepted and approved by Southwest Fabricating and Welding Co., Ind, meeting the requirements of NCA 3800.

Amos Stiborik

RIP # 4457

S.F.& W.CO. QA 2

BECHTEL
743

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CUSTOM BLAST SERVICES, INC.
P.O. Box 1565 LaPorte, Texas 77571
713/487-6066

This is to certify that the following items have been processed with Accordance With Approved Procedure #1002-NUC-83 Rev.1.

Lot A Dated 9.11.84

Sales Order	Sheet No.	Piece Mark
Q2657	CC-120	3C369P-CC-1504-WA3-03-PA
Q2657	MS-1	2C369P-MS-1001-GA2-1-A
Q2657	MS-8	2C369P-MS-1002-GA2-1-A
Q2657	MS-15	2C369P-MS-1003-GA2-1-A
Q2657	MS-23	2C369P-MS-1004-GA2-1-A
Q2659	CC-189	3C369P CC-2504-WA3-03-PA
		RIP # 4457

BECHTEL
743

COPY

PRODU IDENTITY RECORD FOR COATING MA--RIALS

(By Seller / Subcontractor)

PROJECT NAME : SOUTH TEXAS NUCLEAR PROJECT
PROJECT NUMBER: P.O./SUBCONTRACT NO: 3-5749
SELLER : CUSTOM BLAST, 255C Genoa Red Bluff, Houston, Texas 77571
FOR ITEM/AREA :

(By Coating Material Supplier)

MANUFACTURER : AMERON PROTECTIVE COATINGS DIVISION
LOCATION : 201 NORTH BERRY STREET
BREA, CALIFORNIA 92621

PRODUCT NAME : DIMETCOTE 6 PRIMER
GENERIC TYPE : SOLVENT BASED INORGANIC ZINC PRIMER

ORDER NO. : 7004483 CUST. PO # : 3-5749 GALS SHIPPED: SEE COMPONENTS

COMPONENTS	BATCH NO.	DATE OF MFG.	SHELF LIFE EXPIRES
A. Powder (27 x 5 gals)	108126	3/29/84	3/29/86
B. Liquid (80 x 5 gals)	108382	4/16/84	4/16/86

Provide batch and standard test data for all components.

TEST	METHOD	A - COMPONENT		B - COMPONENT	
COMPONENTS	ASTM or OTHER	BATCH	STANDARD	BATCH	STANDARD
WEIGHT-lbs./gal.:	D 1475	58.6	58.6	8.35	8.24-8.64
VISCOSITY-CPS :	Fed #4287	1000	200-2000	600	200-600
WT. SOLIDS-% :	Formula	(info only)	100	(info only)	29.2-35.2
GRIND :	N/A				
FLASH POINT :	D 1310	(info only)	77 Deg. F	(mixed, as applicable)	
MIXING RATIO :	14.9 Lbs. Powder : 6.3 Lbs. Liquid				

MIXED MATERIAL	ASTM or OTHER	BATCH	STANDARD
VISCOSITY :	N/A		
RECOAT TIME :	24 HRS. at 77 Deg. F		
FULL CURE TIME :	2 HRS. at 77 Deg. F / 50% Relative Humidity		

RIP # 4457

ZINC PIGMENT	ASTM or OTHER	BATCH	STANDARD
METALLIC ZINC-% :	Formula	(info only)	69.4
SIEVE ANALYSIS :	N/A		

We hereby certify that the coating materials described above were manufactured with the same formulation, raw materials, production methods, and quality control standards as the coating materials on which the original acceptance was granted by Bechtel.

BECHTEL 743

QUALITY CONTROL CHEMIST:
SIGNED: [signature]
DATE : May 15, 1984

QUALITY ASSURANCE MANAGER:
SIGNED: [signature]
DATE : May 15, 1984

WP:11381

COPY

201 North Berry
Post Office Box 1...
Brea, California 92821
(714) 529-1951 Telex: 655342

Ameron
Protective Coatings
Division

May 17, 1984

Purchasing Department
Custom Blast
2550 Genoa Red Bluff
Houston, Texas 77571

Reference: Purchase Order 3-5750
Ameron Order 7004482

CERTIFICATE OF COMPLIANCE

This is to certify that the following Ameron product

Amercoat 101 Thinner
2 x 50 gallons
Batch Number B510844H

was manufactured in accordance with the standard Ameron Protective Coatings Division quality control procedures applicable to this Amercoat product.

RIP # 4457

David L. Berry
Quality Assurance Supervisor

DLB:s

cc: Ameron Houston

BECHTEL
743

COPY

FORM 2

CLEANING AND COATING VERIFICATION RECORD

PROJECT NAME South Texas Project NO. Lot A 9-11-84

PO/SUBCONTRACT NO. 2657/2659 ITEM/AREA N/A

INSTRUCTIONS

1. Use a separate Cleaning and Coating Verification Record Form for each item, lot or area.
2. Record all readings, tests, and other data in appropriate boxes on this form for the item, lot or area identified above. If an appropriate box cannot be found, record data under "Comments".
3. Provide all inspection and test data required by the specification. Mark other boxes "N/A" if the data is not required by the specification.
4. Use a separate Coating Record — Part II sheet for each coat applied to the same item, lot or area.

RIP # 4457

CLEANING RECORD — PART I

Witness Points	Date	Time	Released	Initials	Comments

AMBIENT CONDITIONS

Spec'd. Air/Surface Temp., °F: 40-105° RH, %: 35-95° Dew Point, °F: 5°

Date	Time	Dry/Wet Bulb	RH	Dew Point	Surf. Temp.	Comp. Air Test	Abrasive Test	Operation Permitted	Initials	Comments
9.11	8:00	80/76	83	75	86	ok	ok	yes	R.S.	
9.11	12:00	91/78	56	74	98	ok	ok	N/A	R.S.	final reading

SURFACE PREPARATION

Substrate: Fab Pipe Spec'd. Surface Preparation Std: SSPC-SP10 Profile, mils: 1.0-3.0

Type Abrasive: Steel Abrasive / Silica Sand Size/Grit: 40.90 / #3 Inspection Instrument: [illegible] Profile Std SSPC-[illegible] (1971)

Date	Time	Readings Vis 1	Readings Profile	Comments	Date	Time	Readings Vis 1	Readings Profile	Comments
9.11	8:15	CSA2½	2.5						
9.11	8:15	CSA2½	2.5						BECHTEL
9.11	8:30	CSA2½	2.5						743
9.11	8:30	CSA2½	2.5						
9.11	9:00	CSA2½	2.5		Total		CSA2½	12.5	Released / Initials / Date
					Average			2.5	yes / R.S. / 9.11

COPY

FORM - -

CLEANING AND COATING VERIFICATION RECORD - CONT'D.

- Lot A 9.11.84

CLEANING AND COATING RECORD — PART II

COATING RECORD — PART II

(Circle One): touch-up, (1st), 2nd, 3rd Coat. Manufacturer: Ameron

Color/No: Reddish Gray

Product/No: D6N & A101

Date/Time Completed: 9.11.84 @ 12:00

Date/Time Started: 9.11.84 @ 8:00

Witness Points	Date	Time	Released	Initials	Comments
					RIP # 4457

AMBIENT CONDITIONS

RH, %: 35-95% Dew Point, °F: 5°

Spec'd. Air/Surface Temp., °F: 40-105°

Date	Time	Dry/Wet Bulb	RH	Dew Point	Surf. Temp.	Comp. Air Test	Operation Permitted	Initials	Comments
						ok	yes	J.S.	
9.11	8:00	90/76	83	75	86	ok	N/A	J.S.	final wash dry
9.11	12:00	91/78	86	74	98				

MIXING RECORD

Pot Life: 24 hrs @ 70°F

Mixing Time: 5 min minimum

Spec'd. Material Temp. °F: N/A

Date	Time	Product No.	Batch No.	Material Temp.	Mix Time	Initials	Date	Time	Product No.	Batch No.	Material Temp.	Mix Time	In
					5	J.S.							
9.11	8:30	D6N	108126	N/A	5	J.S.							
9.11	8:30	D6N	108522	N/A	5	J.S.							
9.11	8:30	A101	BS[illegible]	N/A									

INSPECTION RECORD

Run Sags %: 150 max. 8[illegible]

Dry Film, mils: 1.5-6.0

Spec'd. Wet Film, mils: N/A

Inspection Instrument: Magnetic Thickness Gauge

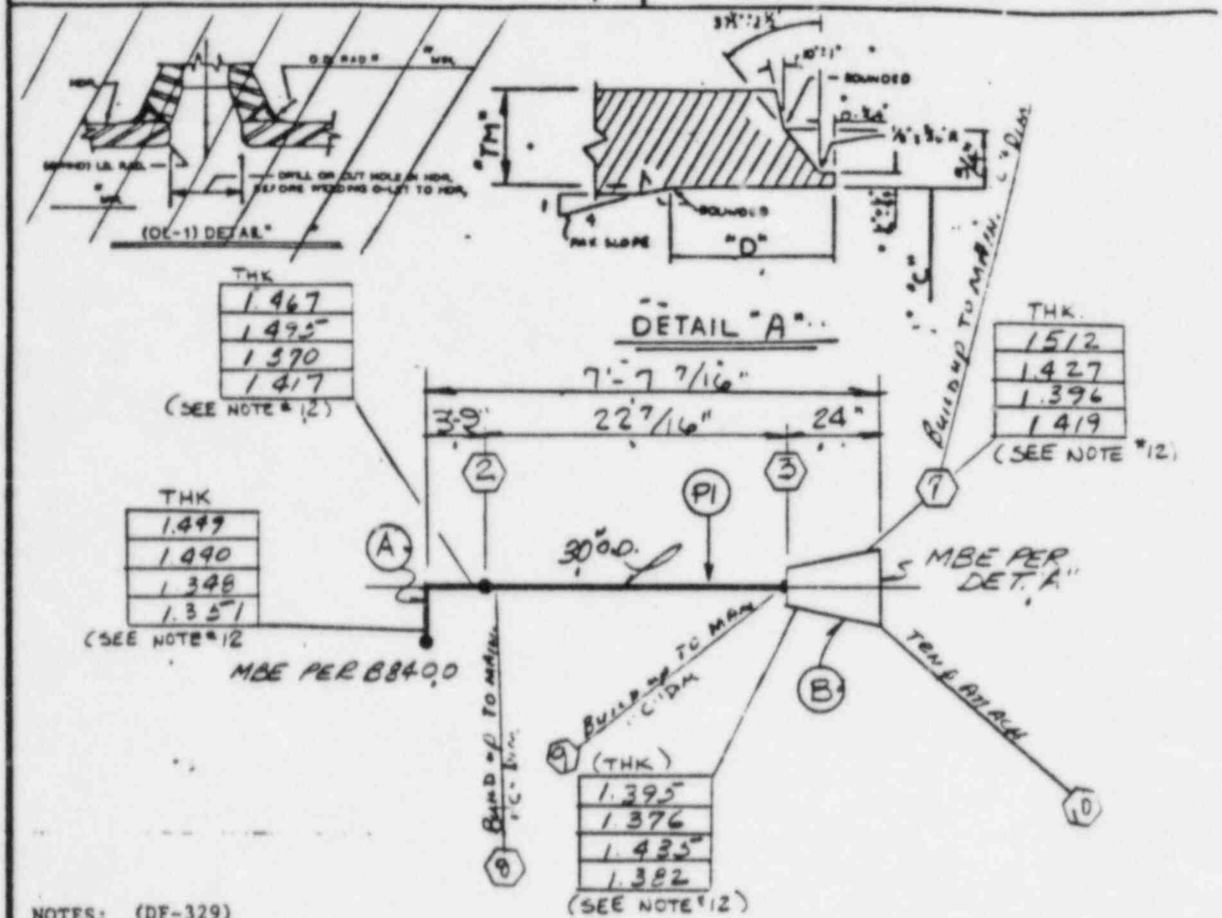
Date	Time	Thickness Wet	Thickness Dry	Comments
9.12	11:00		3.5	
9.12	11:00		3.5	
9.12	11:00		3.0	
9.12	11:00		4.5	
9.12	11:00		3.0	
9.12	11:00		3.0	
9.12	11:00		2.75	

Date	Time	Thickness Wet	Thickness Dry	Comments
9.12	11:00		4.0	
9.12	11:00		3.25	
9.12	11:00		2.75	
9.12	11:00		3.0	
	Total		33.25	Released / In
	Average		3.3	yes / [illegible]

COPY

NAT L BD

SER ⬡ 29270 COPY



NOTES: (DF-329)

(1) SEE SPECIAL BEND NOTES
(2) MIG. WELDING ALLOWED ON .375"W THK. OR LESS.
(3A) MIG. WELDING LIMITED TO ROOT PASS ON ALL WALL THK. OVER .375"W THRU 1.500"W.
(3B) NO MIG WELDING ALLOWED OVER 1-1/2" WALL THK.
(4) NO E-6010 ALLOWED.
(5) FCAW LIMITED TO 1-1/2" WALL THK. AND LESS.
(6) ALL SHOP WELDS REQUIRE "C" BORES.
(7) DISTANCE BETWEEN WELDS SHALL BE 2T + 4" OR 6", WHICHEVER IS GREATER.
(8) FOR WELD MAPPING, SEE PROCEDURE 2657 R/0
(9) GRIND ALL BW'S PER EP-8210 R/0
(10) TOTAL WEIGHT OF SPOOL TO BE INCLUDED WITH OTHER MARKINGS ON SPOOL. IF TOTAL THEORETICAL WEIGHT EXCEEDS 10,000#, PIECE MUST BE WEIGHED AND RECORDED. [ ]
(11) SILICA-GEL DESSICANT REQUIRED 5 BAGS.
(12) RECORD MEASURED MIN. WALL ON SPECIFIED MIN. WALL FTGS. AND PIPE-4 PLACES AT END-90° APART AT ALL BW'S AND OPEN ENDS.
(13) NOTIFY BECHTEL INSPECTOR FOR INSPECTION OF MATERIAL SURFACE AFTER REMOVAL OF ALL TEMPORARY ATTACHMENTS.
(14) ATTACH SUPPLIERS DEVIATION DISPOSITION REQUEST #17-0591

SOUTH TEXAS UNIT 1 BECHTEL JOB# 14926-001 SYSTEM MAIN STEAM

MK: 2C369P-MS-1001-GA2-1-A		S.O. Q 2657-MS SHT. 1
CLEANING & SHIPPING PREP: PROC. EP-8212 R/0	COLOR CODE NONE	JOB SHT.

MT	YES	OR PT O.D. & ACCESSIBLE I.D. OF ALL WELDS NOT R.T. EXAMINED & TEMPORARY ATTACH. AREAS
PT	YES	SEE MT
RT	YES	ALL GIRTH & LONG. BW'S: ALL BRANCH TO HDR WELDS GREATER THAN 4" NPS.
UT	NO	

PREHEAT 200°F MIN	SURF PREP SOLVENT CLEAN (SSPC-SP-1) ANY OIL OR GREASE PRIOR TO NEAR WH BLAST (SSPC-SP-10) PER APPROVED PROCEDURE 1002-NUC-83 R/1.
PWHT	PAINT (INORGANIC) DIMETCOTE #6N PER APPROVED PROCEDURE 1002-NUC-83 R/1.

MK	QUA	DESCRIPTION	UNIT WT	QUA	UNIT	TOTAL	DISC
		ALL BEVELS 37 1/2° (XAW)					COPY
		SA420-WPL6 CHARPY V-NOTCH TEST @ +40 F° OR LESS PER NC2300 LATERAL EXP. 25 MILS MIN.					
A	1.	30"O.D. 90° (1.375" MIN. W) LR ELL W/ IMBE C= 27.250" $\pm^{.010}_{.000}$ TM= 1.250" D= 1/4" MIN ⚠ & IMBE PER B8400 C= 27.250" TM= 1.250" ⚠ D= 1/4" MIN.					
		HT# 8889626 S/N LR-9087					
B	k (?)	32"O.D. X 30"O.D (1.375 MW) CONC. CONE RED. X 24" LG. W/32" END MBE PER DET. "A" THIS DWG. C= 29.365" $\pm^{.010}_{.000}$. TM= 1.3125" D= 2.750" & 30" END MBE C= 27.250" $\pm^{.010}_{.000}$ TM= 1.250" D= 1/2" ⚠					
		HT# D6817 S/N CC-4009					
		(1.375" W) SA155 KCF-70 CL.1 WLDD (CHARPY V-NOTCH TEST @ 40°F OR LESS PER NC2300 LATERAL EXP. 25 MILS MIN.)					
D	1.	30"O.D. 22 7/16" 2MBE C= 27.250" $\pm^{.010}_{.000}$ TM= 1.250" ⚠ D= 2.750".					
		HT# JY4UH S/N 404					
	1.	32" OPEN END PROTECTOR					
	1	30" OPEN END PROTECTOR					

RIP # 4457 1

DECNTE. 743

REV	DATE	DESCRIPTION	T	BY	CK
⚠ (?)	4/3/84	ADDED AS BUILT DATA		JH	MP
⚠ (?)	8/3/84	REVISED "C"-BORE & TM PER Q.#564 (S.C.C.)		LB	
⚠ 0	9/20/84	ISSUED FOR FAB 8-29	67	SDP	HK

SPEC GA — REF DWG EC369P-MS-1001-1/3

DF-329 — TOTAL 34 Pcs

≤ 4" — | > 4" (2)

WT FLG	WT FTGS	WT PIPE	TOTAL
	3350	807	4157 (?)

FAB CODE: ASME III — CLASS: 2 (ISI)

EDITION: 1974 — ADDENDA: WINTER 1975

DATE-BY — CUST: HOUSTON LIGHTING & POWER

CK — PO: 35-1197-6014

CK — SO: Q 2657-MS — SHT 1

SOUTHWEST FABRICATING & WELDING CO., INC. Houston, Texas

MANUFACTURING R_CORD SHEET

CL 2 CARBON MR COPY

Section	DATA, OPERATIONS, OR DOCUMENTATION	ITEM NO.	ITEM ROD	S.F.&W. Q.C. INSP.	ATH. I.	REPORT REQUIRED	1	2	3
	S.F. & W. WELDING PROCEDURE (SHOW LINE NO. OF APP'D. PROCEDURE)	1	✓	✓			H	CDE	CDE
WELDER SYMBOL	GTAW:	2	✓	✓			03 12	03	03
	SMAW	3	✓	✓					
	GMAW	4	✓	✓				3	3
	SAW	5	✓	✓				N	N
HEAT NUMBERS	GTAW WIRE:	6	✓	✓		✓	74649	40911	40911
		7							
		8							
	SMAW ELECTRODE:	9	✓	✓		✓			
		10							
		11							
	GMAW WIRE:	12	✓	✓		✓		12132	12132
		13							
		14							
	SAW WIRE:	15	✓	✓		✓		40925	40925
		16							
	SAW FLUX (TYPE) 860	17	✓	✓		✓		1375	1375
	Weld Rework Documentation By	18	✓	✓					
	WELD DOCUMENTATION BY:	19	✓	✓			8/24/84 DH	8/17/84 CH	8/17/84 CH
BEND	COLD BENDING PER PROCEDURE: 4-106 R/5 S/1	20							
	HOT BENDING PER PROCEDURE: 4-108 R/4	21							
NONDESTRUCTIVE EXAM. & INSPECTION	FIT UP:	22	✓	✓			8/15/84 WA	8/15/84 WA	8/15/84 WA
	ROOT PASS:	23							
	FINAL: (A1)	24	✓	✓	✓		8/29/84 DF	8/29/84 DF	8/29/84 DF
	LIQUID PENETRANT PER PROCEDURE: PT-5 R/4	25	✓	✓		✓	8/28/84 JW		
		26							
	MAGNETIC PARTICLE PER PROCEDURE: MT-3 R/5	27	✓	✓		✓			
	CHECK AND RECORD WALL THK OF BENDS PER PROC: UT-1 R/6 S/1	28							
	RADIOGRAPH PER PROCEDURE: RT-10 R/7 (A1 ALL)	29	✓	✓	✓	✓		8/29/84 DF	8/29/84 DF
	MIN. WALL CHECK OF "C" BORE:	30							
OPERATION ON FABRICATED PIECE	PREHEAT: 200 °F MIN	31	✓	✓			8/24/84 DH	8/17/84 CH	8/17/84 CH
	HEAT TREAT PER PROCEDURE: HT-P1-2 R/4	32							
		33							
		34							
	DIMENSIONAL CHECK (FINAL):	35	✓	✓			8/25/84		
	HYDRO TEST PER PROCEDURE: 10-101 R/1	36							
		37							
		38							
	CORRECTED DOCUMENTATION ENTRY:	39							
		40							
DOCUMENT'N.	REPORT OF NONCONFORMANCE:	41							
	CERTIFIED MATERIAL TEST REPORTS:	42	✓	✓			8/31/84 JH		
	DATA REPORT & RECORDS OF HEAT TREATMENT EXAMINATIONS, TESTS, & INSPECTIONS:	43	✓	✓			[illegible]/84		

APPROVED WELD'G. PROCEDURES

LINE NO.	PROCEDURE NO.	REV.	SUPP.	MAX. HT. CYCLE	LINE NO.	PROCEDURE NO.	REV.	SUPP.	MAX. HT. CYCLE	LINE NO.
A	01.01.030	2	1	540	J	9-103	3	–	–	S
B	01.01.031	3	1	540	K					T
C	01.01.037	5	1	540	L					U
D	01.01.038	7	3	540	M					V
E	01.01.040	7	1	540	N					W
F	01.01.044	4	1	540	P					X
G					Q					Y
H	01.08.006	4	1	–	R					Z

(DF- 329 [redacted])

COPY

4	5	6	7	8	9	10			
			C E-B	E	E	C			
			12			03			
			1						
			1	1	1				
			40911			40911			
			411X0991						
			40925	40925	40925				
			1375	1375	1375				
			8/24/84 DH						
			8/13/84 DH	8/13/84 DH	8/13/84 DH	8/15/84 DH			
			8/29/84 SMW DF	8/29/84 SMW DF	8/29/84 SMW DF	8/29/84 DF			
			8/27/84 JM	8/27/84 JM	8/27/84 JM	8/27/84 JM			
			8/24/84 DH	8/13/84 DH	8/13/84 DH	8/15/84 DH			

Use [illegible] →

KIP # 4457

BECHTEL 743

PROCEDURE NO.	REV.	SUPP.	MAX HT. CYCLE

SOUTHWEST FABRICATING & WELDING CO. INC.
P.O. BOX 9449 HOUSTON, TEXAS 77011 713 / 928-3451

AUTH. INSP.	DATE	S.F. & Q.A.	DATE
[signature]	8-31-84	[signature]	8/31/84

PC. MK.	S.O.	SHT. NO.	REV.
2CS469P-MS-1001-GA2-1-A	02457-MS	1	2

A-11971

QUESTIONS ON MATERIAL OR DIMENSIONS

QUEST. NO. ASKED BY RCGJR DATE 7/19/84 APPROVED BY RC

564) 30" MAIN STEAM PIPING UNDER SPECIFICATION GA2 REQUIRES 30" 1.375" NOM WALL PIPE AND 1.375" MIN WALL FITTINGS. WE ARE HOLDING A MINIMUM WALL OF 1.365" ON ALL FABRICATION OTHER THAN MIN WALL REQUIREMENT OF 1.375" ON FITTING WALLS. WITH THE C-BORE REQUIREMENTS SET BY BECHTEL AND ISI 2t COUNTERBORES, AN EXCESSIVE AMOUNT OF WELD METAL BUILDUP IS REQUIRED TO HOLD MANUFACTURER'S MINIMUM WALL OF 1.365. PLEASE REVIEW YOUR DESIGN WALL REQUIREMENTS AND ADVISE IF A WALL THICKNESS LESS THAN 1.365 WOULD BE PERMITTED. A SIMILAR SITUATION EXISTS IN SPECIFICATIONS JC AND EG. SF&W WILL REVIEW THESE AND ADVISE IF REVISED MIN WALL REQUIREMENTS WOULD BE DESIRED.

ANSWERS TO QUESTIONS

ANSWER NO. ANSWERED BY R. SHIELDS DATE 7-31-84 APPROVED BY Robert K. Shields

BECHTEL HAS REVIEWED THE MIN. WALL REQUIREMENTS FOR THE MAIN STEAM SYSTEM UNDER MATERIAL CLASS "GA". WE CAN PERMIT A MIN. WALL REQUIREMENT TO 1.25". TO THE MAIN STEAM PIPING IN THE "GA" MATERIAL CLASS

1ST COPY: RETAINED IN SOUTHWEST ENGINEERING QUESTION FILE
2ND COPY: RETAINED BY COMPANY ANSWERING QUESTIONS
3RD COPY: RETURN TO SOUTHWEST (RETURN ADDRESS SIDE OUT)

JOBSITE WADSWORTH TX
YOUR P.O. NO. 35-1197-6014
OUR S.O. 2657-2661

LOS ANGELES POWER DIVISION

CALCULATION COVER SHEET

PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001 SHEET 1 OF 1

SUBJECT MAIN STEAM PIPING - STEAM HAMMER ANALYSIS TOTAL NO. OF SHEETS 1

FILE NO. N/A

ORIGINATOR SIG. N/A DISCIPLINE PS&G DATE ______ CALC. NO. 5N170 PC 0004

CHECKER SIG. N/A DATE ______ QUALITY CLASSIF. 5

RECORD OF ORIGINAL ISSUE AND REVISIONS							
REV. NO.	REVISION DESCRIPTION	DATE	ORIG	CKR	GL	GS	CHIEF
0	REVIEWED AND ACCEPTED FOR USE	2/10/84	N/A	N/A	[illegible]	[illegible]	N/A

RESULTS OF CHECKER REVIEW

ITEM DESCRIPTION			ORIG. ISSUE	REVISION NO.					
MUST INITIAL ONE	FINAL RESULT NUMERICAL DIFFERENCES ARE NOT SIGNIFICANT. NO CORRECTIONS NECESSARY	INITIAL	N/A						
		DATE							
	FINAL RESULT NUMERICAL DIFFERENCES ARE SIGNIFICANT. NECESSARY CORRECTIONS HAVE BEEN MADE.	INITIAL							
		DATE							
	CHECK MADE BY ATTACHED ALTERNATE CALCULATIONS.	INITIAL							
		DATE							

COMMITTED

This calculation is for ☐ Unit 1; ☐ Unit 2: ☒ Units 1 & 2

CALCULATION NO. 5N170 PC0004 IS ASSIGNED FOR MAIN STEAM PIPING - STEAM HAMMER ANALYSIS WHICH WAS PREPARED BY LOS ANGELES POWER DIVISION - PLANT DESIGN.

NOTE: THE STEAM HAMMER LOADS FROM THIS ANALYSIS WILL BE COMBINED WITH THE LOADS FROM STRESS CALC. # [illegible], [illegible], [illegible], [illegible], [illegible] & [illegible]

LAO-1888 9/80

CALCULATION TITLE SHEET

LOS ANGELES POWER DIVISION

PROJECT: SOUTH TEXAS PROJECT — JOB NO. 14926-001 — DISCIPLINE: Plant Design

SUBJECT: MAIN STEAM LINES INSIDE AND OUTSIDE CONTAINMENT STEAM HAMMER ANALYSIS — FILE NO.

CALC. NO. STP-MS

ORIGINATOR SIG. [signature] — DATE 11/10/83 — QUALITY CLASSIF. Q

CHECKER SIG. [signature] — DATE 11/11/83 — NO. LAST PAGE 13

Sheet 1 of 11

P.E. STAMP IF REQ'D

ORIGINAL ISSUE

	NAME	ACTION REQ'D	DATE	SIGNATURE
GROUP LEADER	R. Gashu	Approval	10/28/83	[signature]
GS	S. Mohamed	Approval	10/28/83	[signature]
SPECIALIST	J. Lee	Review	11/23/83	[signature]
CHIEF	L. R. Brown	Approval	11/28/83	[signature]
OTHER				

RECORD OF REVISIONS

NO	REVISION	DATE	ENG	CKR	GL	GS	SPEC	CHIEF
△								
△								
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△								
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Issue to project for implementation in the design.

CALCULATION SHEET

BECHTEL — LAO 0513 6-73

CALC. NO. STP-MS

SIGNATURE MWeiner DATE 11/10/83 CHECKED F. Fok DATE 11/11/83

PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001

SUBJECT MSL STEAM HAMMER ANALYSIS SHEET ii OF ii SHEETS

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1.0 INTRODUCTION

This report prepared by the Plant Design Staff of Bechtel Power Corporation, Los Angeles Power Division, for South Texas Project describes the analysis performed to determine the dynamic structural response of the main steam piping systems. The analysis evaluates effects of the steam hammer loadings resulting from closure of the turbine stop valves.

The analysis described in this report covers each main steam line piping system from the steam generator to the turbine stop valves. Dynamic loading on the piping systems can be induced during a turbine trip event by a sudden closure of the turbine stop valves which are located in the turbine valve chest. Closure of these valves creates pressure and momentum transients throughout the piping systems, resulting in a significant time-varying force at points of the piping system direction change (elbows) until steady-state flow is achieved.

The purpose of the analysis reported herein is to evaluate the maximum dynamic response, i.e., stresses, displacements, support reactions and nozzle loads in the subject piping systems due to the steam hammer loadings. Transient dynamic force histories were generated (Reference 1) and applied to the piping systems. The response of the piping systems was then evaluated by developing a three-dimensional structural model and performing a dynamic time-history analysis. The worst case loading was assumed to occur for the condition of simultaneous closure of all four stop valves in the main steam supply system.

Section 2.0 of this report describes the configuration and important parameters of the main steam supply system. Section 3.0 provides a general description of the analytical approach used. Details of the analysis assumptions and procedures are discussed in Section 4.0, and the results are discussed in Section 5.0.

In summary, the displacements and stresses of the main steam supply system under the steam hammer loadings are found to be well within the acceptable design limits.

It is noted that the results presented herein should be combined with those obtained for other applicable simultaneous loading cases and evaluated for compliance with relevant criteria in the ASME Section III Code (Reference 2), and the PSAR/FSAR of the South Texas Project.

2.0 SYSTEM DESCRIPTION

The main steam piping system for the South Texas Project consists of four (4) main steam lines designed for the primary function of delivering steam from the steam generators to the turbine. The piping systems under consideration, support locations and orientations are shown on the following drawings supplied by the South Texas Project:

(A) Main Steam System MS-01 Stress Isometric No. 1-R-0505-2

(B) Main Steam System MS-02 Stress Isometric No. 1-R-0506-5

(C) Main Steam System MS-03 Stress Isometric No. 1-R-0507-4

(D) Main Steam System MS-04 Stress Isometric No. 1-R-0508-2

(E) Composite Piping - Isolation Valves Cubicle, Plan at El. 50'-0", Area I1, Drawing No. 5G-15-9-P-0054, Rev. 0, (Appendix F)

(F) Main Steam Stress Isometric No. 1-R-0004-F, Sheet 2

(G) Main Steam Bypass (MS-2) Stress Isometric No. 1-R-0005-L, Sheet 1

(H) Main Steam Bypass (MS-3) Stress Isometric No. 1-R-0006-I, Sheet 2

(I) Piping Fabrication Drawing Nos. 2G369P-MS-1001, Sheet 3, Rev. 1; 2G369P-MS-1002, Sheet 2, Rev. 1; 2G369P-MS-1003, Sheet 3, Rev. 1; and 2G369P-MS-1004, Sheet 3, Rev. 1

Pipe properties and support stiffnesses used in the computer model were also supplied by the South Texas Project (References 6 and 7).

Analysis of each main steam line was divided into two independent problems, separated by an anchor-containment wall penetration. The two different problems are:

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SUBJECT MSL STEAM HAMMER ANALYSIS SHEET 4 OF 13 SHEETS

(A) Main steam line inside the containment building, from the steam generator to the containment wall penetration.

(B) Main steam line outside the containment building, from the containment wall penetration to the turbine stop valves including bypass lines to the condenser.

Since the layout of the main steam line MS-02 inside the containment is a mirror image of the main steam line MS-01 layout with identical pipe support types and locations, only one dynamic analysis using higher steam hammer forces was performed for those two piping systems.

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PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001

SUBJECT MSL STEAM HAMMER ANALYSIS

3.0 METHOD OF ANALYSIS

The analysis to obtain the structural response of the main steam piping system following the sudden closure of the four turbine stop valves consists of the thermal hydraulic analysis (Reference 1) to obtain force histories acting on the piping system, and dynamic structural analysis to determine response to these transient forces. Since the distortion of the piping is relatively small, the interaction between the structural response and the fluid forces is not significant, and the overall analysis can be performed in two distinct phases — thermal hydraulic and structural analysis.

The method of analysis consists of the following steps:

(A) Development of thermal-hydraulic model of the system.

(B) Performance of the thermal-hydraulic analysis using program GAFT to determine transient state histories at discrete locations throughout the piping system.

(C) Integration of the transient state histories to develop force histories applicable to different sections of the piping systems.

(D) Development of a lumped mass structural model of the piping system.

(E) Utilizing program ME-101 to perform the structural dynamic analysis of the system with forces developed in Step (C).

Steps (A), (B) and (C) above comprise the thermal-hydraulic analysis phase discussed in Reference 1. Steps (D) and (E) comprise the structural analysis phase which is discussed in the following subsection.

3.1 Method of Structural Response Analysis

In order to evaluate the dynamic structural response of the main steam lines due to the transient steam hammer forces, a time-history analysis was performed. The time-history analysis is based upon the normal mode superposition method using a closed form integration technique for the evaluation of the responses associated with each mode. A finite element model consisting of lumped masses connected by three-dimensional elastic piping elements was developed to represent the structural piping system. The lumped masses correspond to the data points which were located at carefully selected locations in order to adequately represent the dynamic behavior of the system, and the beam elements were provided with elastic properties equivalent to the actual elastic properties of the pipe.

The time varying forcing functions, representing the transient thermal-hydraulic forces developed as described in Reference 1, were applied at the locations of direction changes in the piping model (elbows and tees). Location and direction of these forces is schematically illustrated by arrows in Figures A2, A4, A6, A9 and A16 representing forces on MS-01, MS-02, MS-03, MS-04 and MS-Common, respectively. Each of these forces represents the net unbalanced force per pipe segment between two elbows. A positive value indicates a force acting on the pipe in the direction opposite of the steady-state flow (Reference 8).

Bechtel's proprietary program ME-101, References 3 and 4, was used to perform the dynamic time-history analysis. A description of the program features is covered in the User's Manual listed in Appendix F. Finite element modeling procedure allows to write the equations of motions of the system as a finite set of the following simultaneous ordinary differential equations:

$$M\ddot{u}(t) + C\dot{u}(t) + Ku(t) = F(t)$$

where M, C and K are the system mass, damping and stiffness matrices, respectively, and F(t) is the time dependent vector of the externally applied loads. $\ddot{u}(t)$, $\dot{u}(t)$ and $u(t)$ are the structural system time dependent vectors of acceleration, velocity and displacement, respectively. The solution to the above equations is based upon the normal mode superposition method. A description of the procedure of the integration method is presented in Reference 4.

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PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001

SUBJECT MSL STEAM HAMMER ANALYSIS SHEET 8 OF 13 SHEETS

4.0 DISCUSSION OF ANALYSIS

The lumped mass structural model of each main steam line is shown on the following figures:

MS-01	Figure A1	- Inside Containment
MS-02	Figure A3	- Inside Containment
MS-03	Figure A5	- Inside Containment
MS-04	Figure A7	- Inside Containment
MS - Common	Figures A9 through A15	- Outside Containment

These figures show the piping layout of each system, location of the structural nodes (lumped masses) and location of supports for the piping systems. The integration time step for the time-history analysis was selected to be fine enough to include accurately the structural response to the highest frequency components noted in the load history. For all piping systems inside the containment building, a time step of .001 seconds was used, which is considered to be accurate for evaluation of structural modes with maximum frequency of 125 cps. Similarly, for the main steam lines outside the containment building, a time step of .00164 second was used which is considered to be accurate for structural modes with maximum frequency of 76 cps. The structural response was analyzed for a minimum duration of 1.7 seconds and 7.5 seconds for piping located inside and outside the containment, respectively.

Since in all cases the transient shock loads reached a steady-state condition at much earlier time, it was reasonable to expect that no significant excitation of the system could occur after the time period analyzed; and that the structural response has been accurately obtained.

For all analyses, a critical damping value of two percent was used for all modes of piping system vibration. This is based on the recommendations of Regulatory Guide 1.61 (Reference 6).

5.0 DISCUSSION OF RESULTS

The results of the dynamic structural analysis of the main steam lines are presented in the following appendices:

MS-01 and MS-02	Appendix B
MS-03	Appendix C
MS-04	Appendix D
MS - Common	Appendix E

From the time-history analysis of each main steam line, the maximum pipe displacements, stresses at all nodal points, support and anchor reactions were obtained and are summarized in Tables B.1, C.1, D.1 and E.1 for MS-01 and MS-02, MS-03, MS-04 and MS - Common, respectively.

To facilitate a realistic combination of the containment penetration loads from both sides, the following figures provide the time dependent load plottings for each penetration reactions:

Penetrations M3	Figures B2 through B7
	Figures E2 through E7
Penetration M2	Figures B2 through B7
	Figures E8 through E13
Penetration M4	Figures C2 through C7
	Figures E14 through E19
Penetration M1	Figures D2 through D7
	Figures E20 through E25

Caution should be taken in combining the penetration loads because two different global coordinate systems were used in modeling the main steam lines inside and outside the containment building according to drawings provided by the project.

The peak responses of the main steam piping systems are summarized below:

MS-01 and MS-02

Maximum displacement is .0434 inch in the -y direction at data point C02E,

Maximum pipe stress is 1860 psi at data point 54,

Maximum support reaction is 24,434 lbs at data point 18A

MS-03

Maximum displacement is .043 inch in the -y direction at data point C02E,

Maximum pipe stress is 1382 psi at data point 1B,

Maximum support reaction is 18,445 lbs. at data point 33A.

MS-04

Maximum displacement is .0446 inch in the -y direction at data point C02E,

Maximum pipe stress is 1444 psi at data point 1B,

Maximum support reaction is 20,064 lbs. at data point 33A.

MS - Common

Maximum displacement is .831 inch in the -y direction at data point 183,

Maximum pipe stress is 7215 psi at data point 940,

Maximum support reaction is 58,472 lbs. at data point 938.

The above maximum responses are considered to be within acceptable design limits for the system; however, in order to get a complete evaluation, the results reported herein should be combined with other applicable concurrent loadings being considered for the system in accordance with the South Texas Project PSAR and FSAR.

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CALCULATION SHEET

CALC. NO. STP-MS

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PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001

SUBJECT MSL STEAM HAMMER ANALYSIS

Some selected response time-history plots of displacements, accelerations and support reactions are presented in Figures B8 through B13 for MS-01 and MS-02, in Figures C8 through C11 for MS-03, in Figures D8 through D14 for MS-04 and in Figures E25 through E29 for MS - Common. They all indicate that the maximum response occurs well within the time duration for which the analysis was performed.

From discussion with mechanical group, the steam hammer transient loads on branch lines from bypass line 24" MS-1013-HC on isometric Nos. 1-R-0004-F and 1-R-0005-L are insignificant during the transient period under consideration. Therefore, those branch lines were not included in the time-history analysis.

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CALC. NO. STP-MS

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PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001

SUBJECT MSL STEAM HAMMER ANALYSIS SHEET 12 OF 13 SHEETS

6.0 COMPUTER RUNS LOG

CALCULATION	TYPE OF ANALYSIS	PROGRAM	SNUM NO.	DATE
MS-01 & MS-02 Inside Cont.	Time-History	ME-101	NA 755	10/26/83
MS-01 & MS-02 Inside Cont.	Post Run	ME-101	NA 771	10/27/83
MS-03 Inside Cont.	Time-History	ME-101	NA 756	10/26/83
MS-03 Inside Cont.	Post Run	ME-101	NA 788	10/27/83
MS-04 Inside Cont.	Time-History	ME-101	NA 778	10/27/83
MS-04 Inside Cont.	Post Run	ME-101	NA 794	10/27/83
MS - Common Outside Cont.	Time-History	ME-101	X 7129	11/8/83
MS - Common Outside Cont.	Post Run	ME-101	X 9094	11/9/83

7.0 REFERENCES

1. Mechanical Discipline, LAPD, "South Texas Project Transient Analysis of Main Steam Line due to Valve Closure" dated October 20, 1983.

2. ASME Boiler and Pressure Vessel Code, Section III.

3. Bechtel User's Manual ME-101 "Linear Elastic Analysis of Piping System", Rev. J4-28, 6/20/83.

4. Theoretical Manual ME-101 "Linear Elastic Analysis of Piping System", Rev. 4, Nov. 1982.

5. U.S. Nuclear Regulatory Commission "Damping Values for Seismic Design of Nuclear Power Plants", Regulatory Guide 1.61, October 1973.

6. South Texas Project "Criteria for Piping Design" 5L019PS004, Rev. 2, dated 5/12/83.

7. South Texas Project "Piping Stress Analysis Criteria" 5L010RQ1002, Rev. 1, dated 9/2/83.

8. Memorandum from K. C. Chiang of Mechanical Group to S. A. Mohamed, dated October 27, 1983.

BECHTEL

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. ______

SUBJECT: PRESSURE SURGE IN MS DUE TURBINE TRIP

SHEET NO. ______

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
	JYC	6/26/85	PD	6/26					

PURPOSE :

TO CALCULATE PRESSURE SURGE IN MAINSTEAM LINES CAUSED BY STEAM HAMMER DUE TO TURBINE TRIP. (Main Stop Valve Closure).

REFERENCE : CALCULATION 5S109MC5667, REV. 0, "TRANSIENT ANALYSIS OF MAIN STEAM LINE DUE TO VALVE CLOSURE."

CALCULATION :

- MAXIMUM PEAK FORCE IN PIPE IS 38400. LB @ PIPE RUN 16 (REF. FIG 31 ON SHEET 69)

- PIPE OD = 30", t = 1.375", ID = 27.25"
  OPERATING PRESSURE = 1100 PSI

- PRESSURE SURGE

$$\Delta P = \frac{F}{A} = \frac{38400}{\frac{\pi}{4}(27.25)^2} = 66 \text{ PSI}$$

- TOTAL (PEAK) PRESSURE

$$P_{PEAK} = 1100 + 66 = 1166 \text{ PSI}$$

STP 1310 (7/84)

CALCULATION SHEET

CALC. NO. 5510-9MC-167

SIGNATURE Chi H Chen DATE 10-10-83 CHECKED [illegible] DATE 10/26/83

PROJECT STP JOB NO. 14026.001

SUBJECT Transient Analysis of Main Steam Line Due to Valve Closure SHEET 69 OF 112 SHEETS

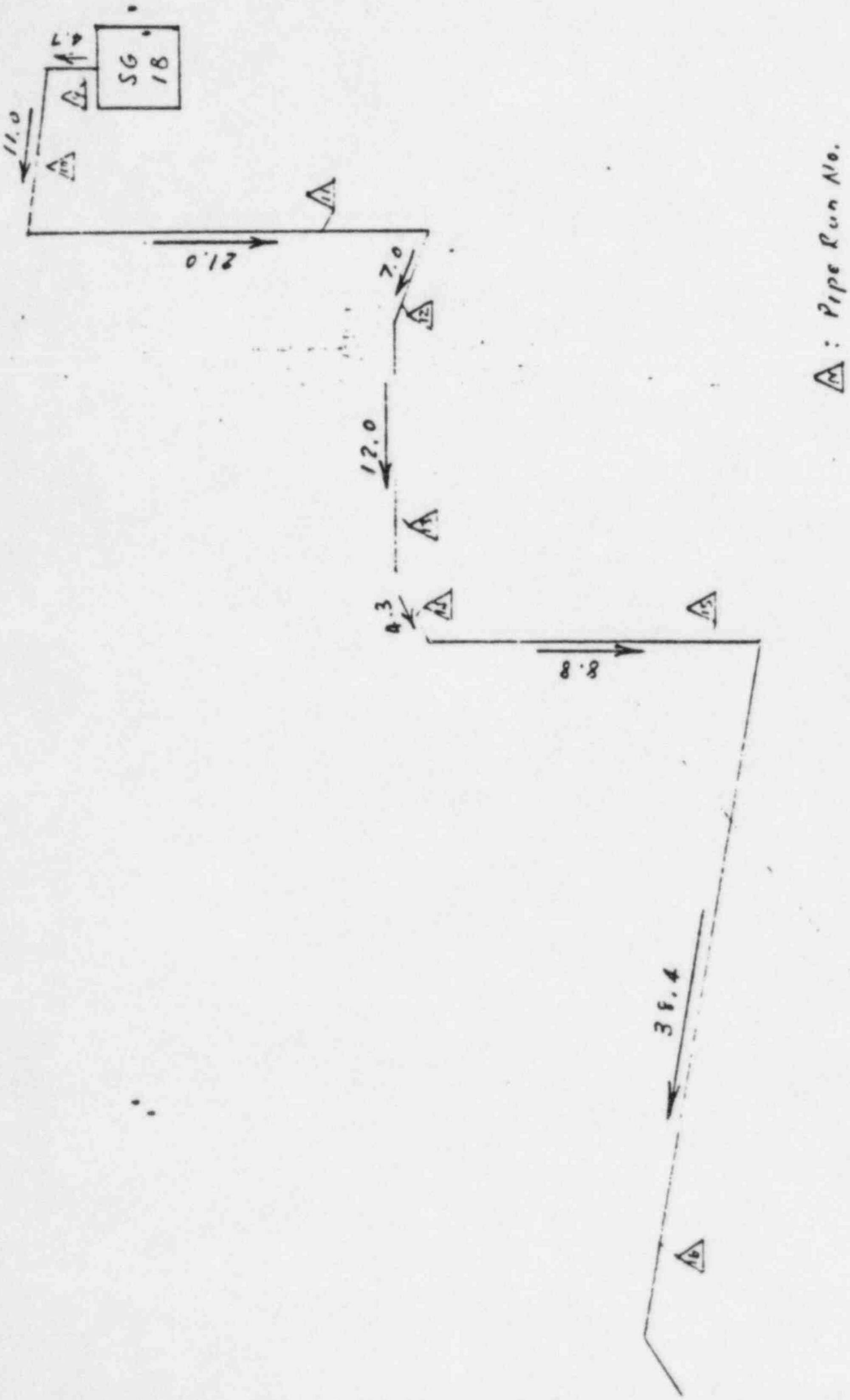


Fig. 31 Locations of Pipe Runs and Peak Forces (in Kips) (Part 1)

Note: Forces shown are acting on pipes.

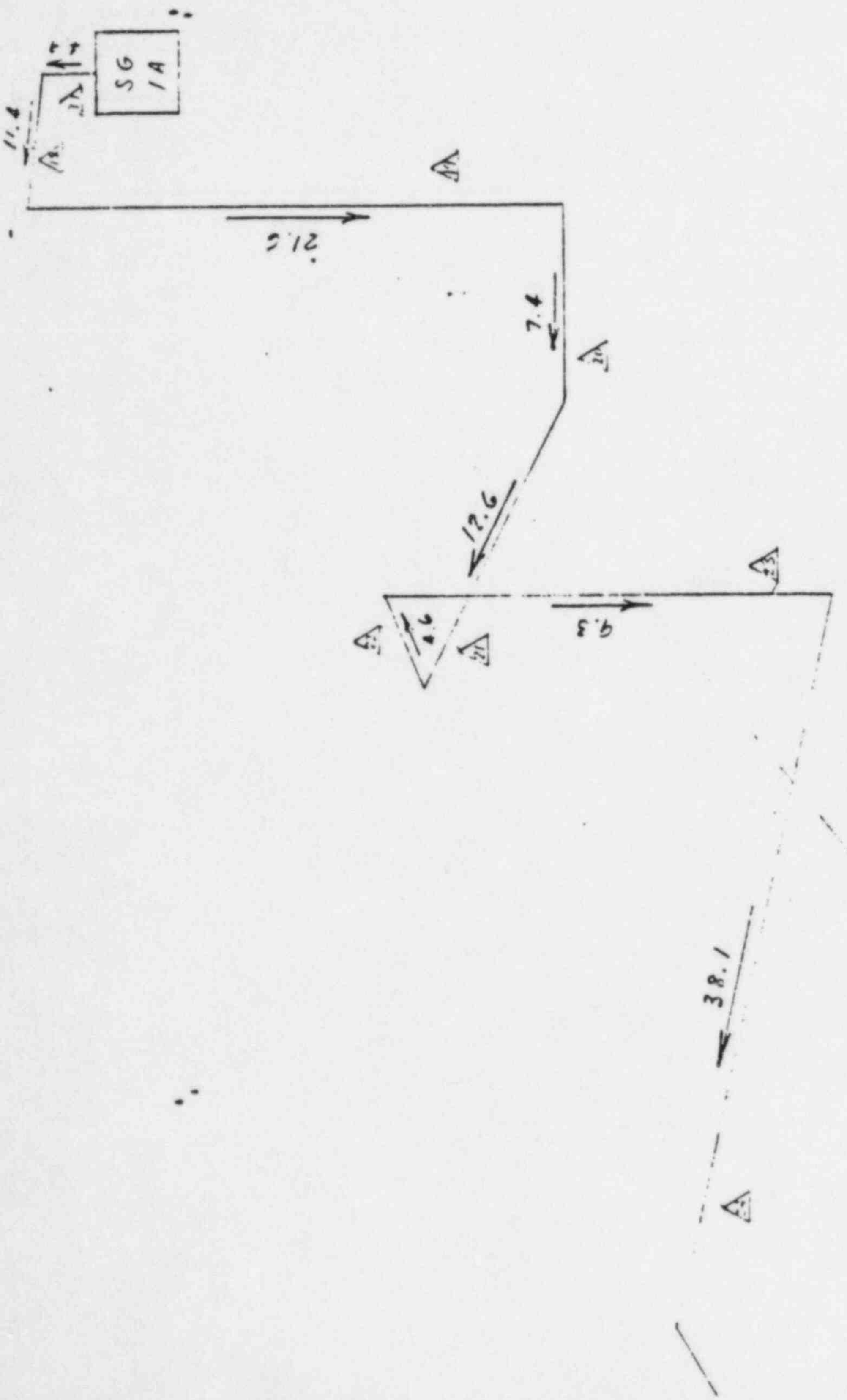
CALCULATION SHEET

CALC. NO. ES109MC665

SIGNATURE C. H. Chen DATE 10-10-83 CHECKED [illegible] DATE [illegible]

PROJECT [illegible] JOB NO. 12976-001

SUBJECT Transient Analysis of Main Steam [illegible] SHEET 70 OF 112 SHEETS



△ : Pipe Run No.

Fig 32 Locations of Pipe Runs and Psal. Forces (in Kips) (Part 1)

Note: Forces shown are acting on pipes

Continued

LAO 0513 6-73

CALCULATION SHEET

CALC. NO 5510 9NC 5667

SIGNATURE Ch. H Chen DATE 10-10-83 CHECKED J. Lee DATE 10/26/83

PROJECT STP JOB NO. 14926-001

SUBJECT Transient Analysis of Main Steam Line Due to [illegible] SHEET 71 OF 112 SHEETS

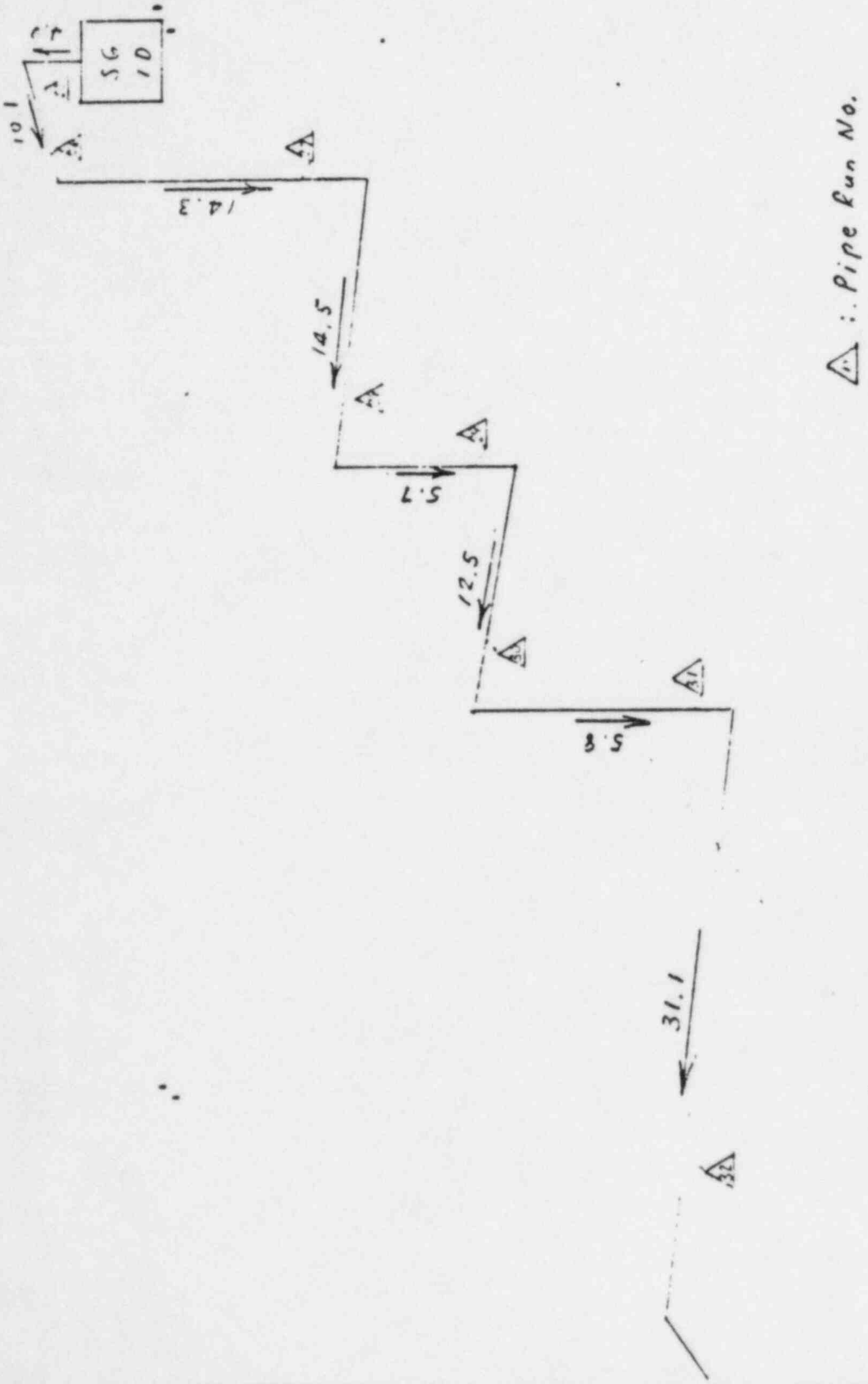


Fig. 33 Locations of Pipe Runs and Peak Forces (in Kips) (Part 1)

Note : Forces shown are acting on pipes

CALCULATION SHEET

CALC. NO. SS109MC5667

SIGNATURE [illegible] DATE 10-11-83 CHECKED [illegible] DATE 10/26/83

PROJECT STP JOB NO. 14926-001

SUBJECT Transient Analysis of Main steam Line [illegible] Valve [illegible] SHEET 72 OF 112 SHEETS

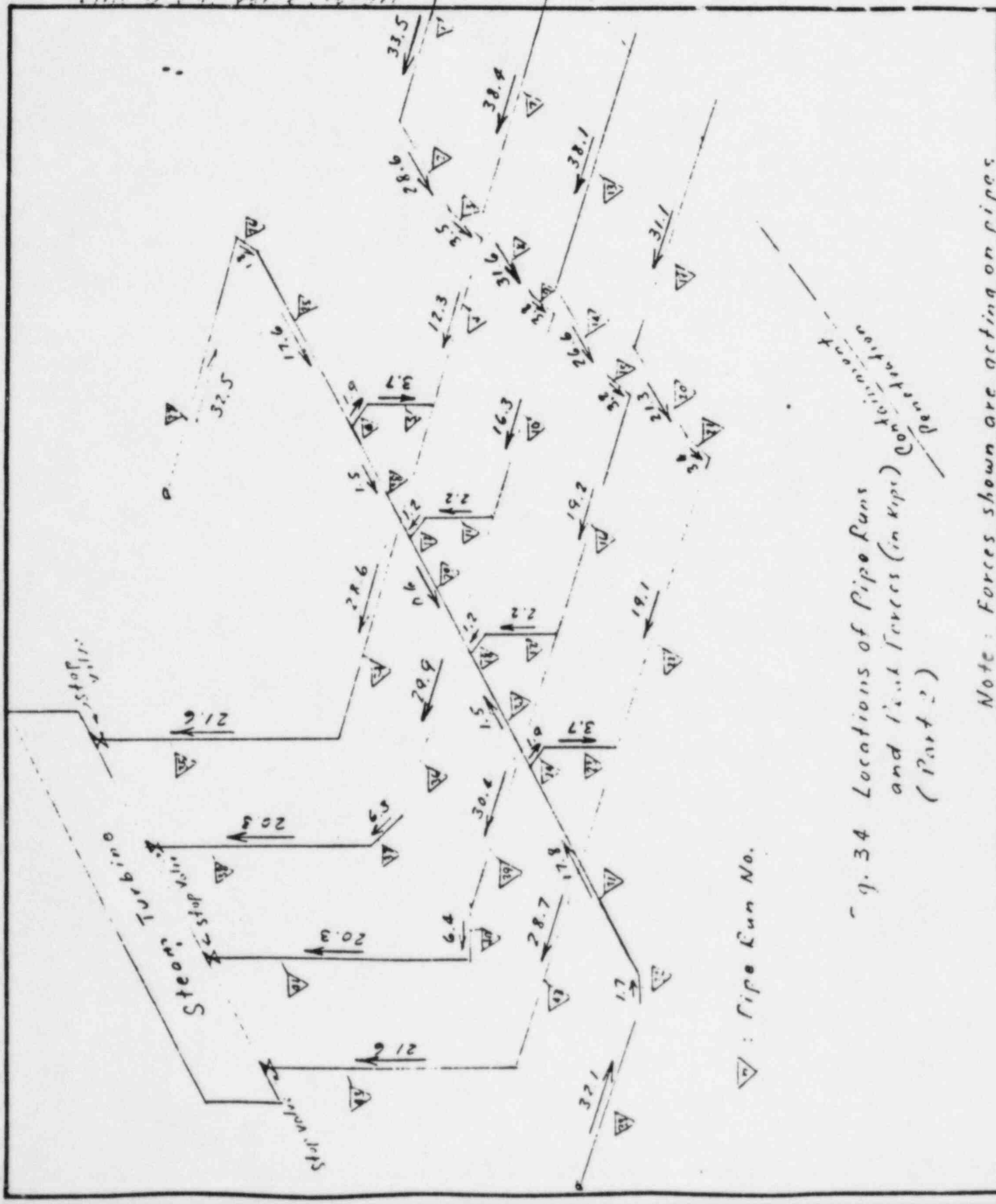


Fig. 34 Locations of Pipe Runs and Limit Forces (in kips) (Part 2)

Note: Forces shown are acting on pipes

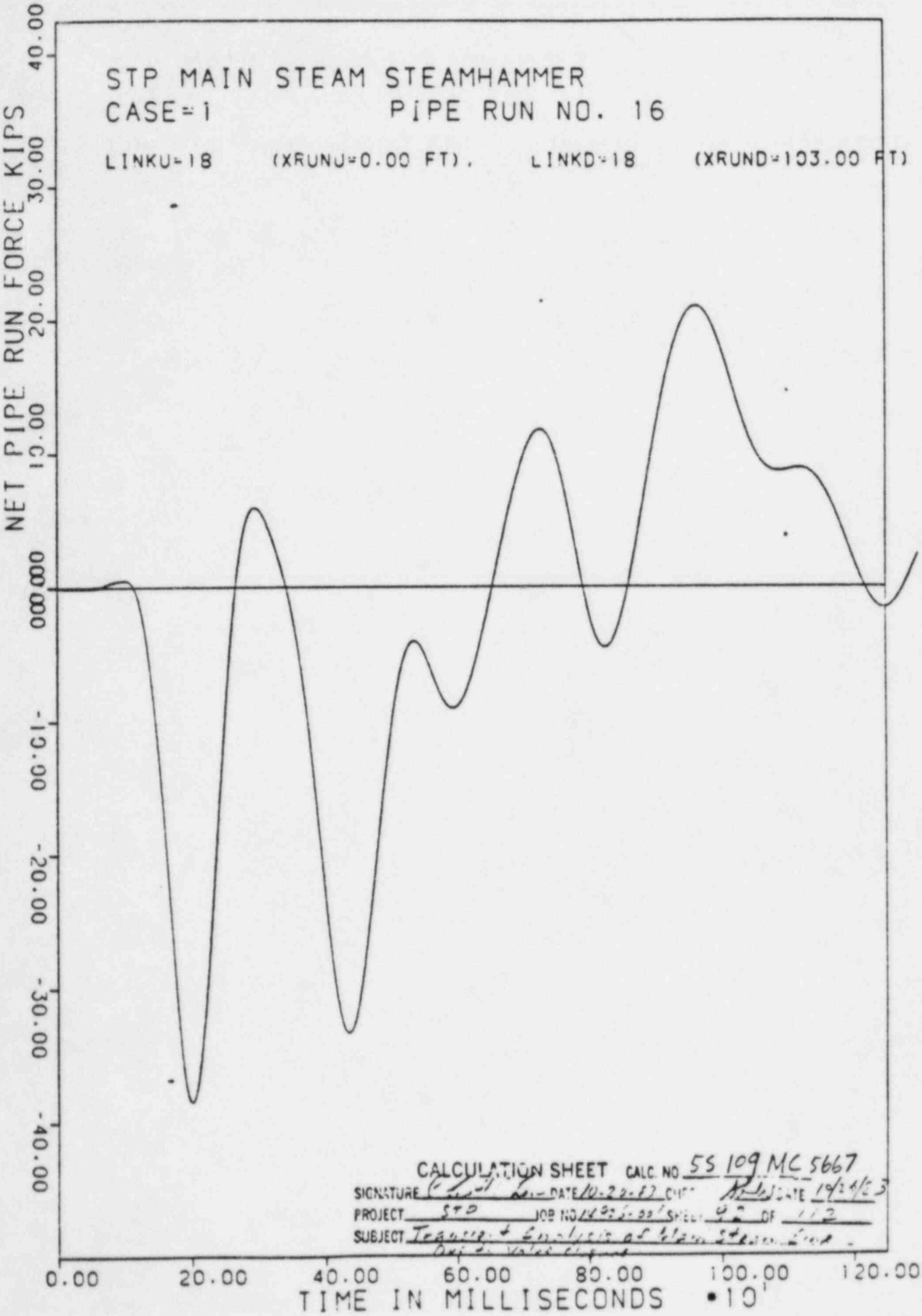

STP MAIN STEAM STEAMHAMMER
CASE=1
PIPE RUN NO. 16
LINKU=18 (XRUNU=0.00 FT), LINKD=18 (XRUND=103.00 FT)
NET PIPE RUN FORCE KIPS
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
TIME IN MILLISECONDS •10'
CALCULATION SHEET CALC. NO 5S 109 MC 5667
SIGNATURE
DATE 10-20-83
PROJECT STP
SHEET
OF
SUBJECT

Fig. 50

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. [redacted]

SHEET NO. 19

SUBJECT SEE THE COVER SHEET

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	Pleucalentoom	9/17/84	S Pinwan	10-1-84					

4.8 SUPPORT DATA SUMMARY

* THIS VALUE WAS ESTIMATED PER PRELIMINARY SUPPORT DESIGN CALCULATION.

DATA PT.	DIR	TYPE	SUPT. MARK NO.	CLASS	PIPE SIZE	PIPE SCH.	OPER TEMP	INS. THK	MATERIAL	STIFFNESS	REF.
12A	Z	SNB	~~M3-1002~~ -HL5016	2	30	80	567	3"	SA155-KCF-70	6.0E5 *	2.24
[illegible]	[illegible]	SNB	-HL5015	↓	↓	↓	↓	↓	↓	6.0E5 *	2.24
14	SKEWED	RAD	-HL5009							1.3E6	2.5
18A	X,Y,Z	SNB	-HL5007							7.8949E5	2.24
18	Y	SPD	-HL5008							—	—
29A	LAT.	RAD	-HL5006							1.3E6	2.5
32A	Y	SNB	-HL5004							4.3832E5	2.24
40A	X	RAD	-HL5003							1.3E6	2.5
41A	Y	SPD	-HL5017							—	
46	X	RAD	-HL5001							1.390348E6	2.24
45	Z	RAD	-HL5002	↓	↓	↓	↓	↓	↓	1.3E6	2.5
									**	AA = 1.3E6	2.5
										AB = 1.3E6	↓
1	ALL	ANC	ST. GEN. NOZZLE	–	32	80	567	3"	SA155-KCF-70	AC = 1.3E6	
										ARA = 1.9E9	
										ARB = 1.9E9	
										ARC = 1.9E9	↓
										AA = 1.37E7	2.25
										AB = 1.37E7	↓
60	ALL	ANC	CMT. PEN. M-3	–	30	—	567	3"	SA155-KCF-70	AC = 1.37E7	
										ARA = 8.32E9	
										ARB = 8.32E9	
										ARC = 8.32E9	↓

** SEE GENERAL ASSUMPTIONS SHT # 8

HOUSTON OFFICE ISSUED
INFORMATION ONLY
STP 14926

STP 1310 (7/84)

JOB NO. 14926-001

REV	ORIGINATOR	DATE	CHECKER	DATE
1	Phuc Nhu Tran	9/17/84	S. Srinivas	10-2-84

STRESSS CAL. NO.: [redacted] SHT. 52

HOUSTON OFFICE ISSUED
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STP 14926

RESTRAINT LOAD SUMMARY

TITLE : MAIN STEAM FROM S.G. #[illegible] TO PEN. # M-3
PROJECT NUMBER : 14926001
PROBLEM NUMBER : 2C159RC5039
USER : PTRAN
LOAD CASE :

DATA PT	TYPE	LOAD	TITLE	GLOBAL FORCES (LBS) FX	FY	FZ	GLOBAL MOMENTS (FT-LB) MX	MY	MZ	DISPLACEMENTS (IN) DX	DY	DZ
1	ANC		S.G. NOZZLE									
		HYDRO		526.	-9605.	836.	5364.	12950.	8714.	.000	-.007	.001
		NORMP		9782.	4486.	542.	3478.	8393.	81431.	.000	3.250	.000
		NORMN		0.	-6201.	-3799.	-103046.	-73297.	0.	-1.012	-.005	-2.135
		UPSETP		19345.	9985.	17997.	108850.	137350.	126572.	.362	3.271	.286
		UPSETN		-9421.	-11700.	-21254.	-208418.	-202254.	-39477.	-1.374	-.025	-2.420
		FAULTP		28491.	18701.	33126.	198645.	256022.	205035.	.616	3.404	.966
		FAULTN		-18367.	-20417.	-36383.	-298213.	-320926.	-117939.	-1.628	-.159	-2.701
12A	RAD											
		HYDRO		0.	0.	0.	0.	0.	0.	.013	-.026	.007
		NORMP		0.	0.	0.	0.	0.	0.	.497	1.954	.005
		NORMN		0.	0.	0.	0.	0.	0.	.000	-.017	-1.441
		UPSETP		0.	0.	18538.	0.	0.	0.	.539	1.974	.036
		UPSETN		0.	0.	-18538.	0.	0.	0.	-.034	-.037	-1.471
		FAULTP		0.	0.	37473.	0.	0.	0.	.573	1.998	.067
		FAULTN		0.	0.	-37473.	0.	0.	0.	-.068	-.061	-1.503
12B	RAD											
		HYDRO		0.	0.	0.	0.	0.	0.	.013	-.026	.004
		NORMP		0.	0.	0.	0.	0.	0.	.635	1.884	.003
		NORMN		0.	0.	0.	0.	0.	0.	.000	-.017	-1.369
		UPSETP		20068.	0.	0.	0.	0.	0.	.668	1.904	.018
		UPSETN		20068.	0.	0.	0.	0.	0.	-.025	-.037	-1.384
		FAULTP		37464.	0.	0.	0.	0.	0.	.697	1.929	.034
		FAULTN		37464.	0.	0.	0.	0.	0.	-.054	-.061	-1.400
14	RAD		MS1002HL5009									
		HYDRO		3038.	0.	3038.	0.	0.	0.	.014	-.026	-.009
		NORMP		41725.	0.	41725.	0.	0.	0.	1.149	1.626	.000
		NORMN		0.	0.	0.	0.	0.	0.	.000	-.017	-1.089
		UPSETP		48524.	0.	48524.	0.	0.	0.	1.203	1.646	.057
		UPSETN		-4826.	0.	-4826.	0.	0.	0.	-.045	-.037	-1.152
		FAULTP		55215.	0.	55215.	0.	0.	0.	1.252	1.670	.116
		FAULTN		-11517.	0.	-11517.	0.	0.	0.	-.093	-.061	-1.211
18A	RAD		MS1002HL5007									
		HYDRO		0.	0.	0.	0.	0.	0.	.000	-.004	-.022
		NORMP		0.	0.	0.	0.	0.	0.	1.508	.968	.000
		NORMN		0.	0.	0.	0.	0.	0.	.000	-.002	-.961
		UPSETP		703.	7607.	703.	0.	0.	0.	1.558	.984	.071
		UPSETN		-703.	-7607.	-703.	0.	0.	0.	-.049	-.018	-1.047
		FAULTP		1660.	17975.	1660.	0.	0.	0.	1.602	1.003	.151
		FAULTN		-1660.	-17975.	-1660.	0.	0.	0.	-.093	-.037	-1.127

nps Industries, Inc. an nps group company	NPS INDUSTRIES, INC. COMPONENT SUPPORT CERTIFIED DESIGN REPORT SUMMARY	CDRS No. SMY PAGE 7 OF 9 REV. 0 DATE 8-1-83

...ducts covered by this Certified Design Report Summary are included in S Section of NPS Industries' Catalog

Bechtel Comment: LEQ. 323°F

Design Level C/D @ 1 g side load - snubber size - load in (KIPS) @ 300°F

Size No.	40	70	150	500	1600	5500	12500	
Min. C-C (in)	18-1/2	21-5/16	24-3/8	30-1/8	34-3/8	50-5/16	66-3/16	SMA*
C-C (in)	11-1/8	13-5/16	16-1/8	20-1/4	22-7/8	31-9/16	42-3/16	SMF
10	.53/.6	.93/1.05	1.995/ 2.25					
20	.5[illegible]/.6	.93/1.05	1.995/ 2.25	6.65/ 7.5	21./24.			
30	.53/.6	.93/1.05	1.995/ 2.25	6.65/ 7.5	21./24.	67.5/ 82.5		
40	.53/.6	.93/1.05	1.9[illegible]5/ 2.25	6.65/ 7.5	21./24.	67.5/ 82.5	163./ 187.5	
50	.53/.6	.[illegible]3/1.05	1.995/ 2.25	6.65/ 7.5	21./24.	67.5/ 82.5	163./ 187.5	
60	.53/.6	.93/1.05	1.995/ 2.25	6.65/ 7.5	21./23.2	67.5/ 82.5	163./ 187.5	
66	53/.6	.93/1.05	1.995/ 2.25	6.65/ 7.5			163./ 187.5	
70				6.65/ 7.5	20.8	67.5/ [illegible]1.1	163./ 187.5	
80				6.65/ 6.7	17.8	67.5/ 79.2	163./ 187.5	
86				5.70	-		163./ 187.5	
90					14.7	67.5/ [redacted]	1[illegible]3./ 187.5	
100					12.3	[illegible].5/ 73.8	163./ 187.5	
110						67.5/ 70.9	163./ 187.5	
120						67.2	163./ 187.5	
Max. C-C Length (in)	18-1/2 66	21-[illegible]/16 66	[illegible]-3/8 65	30-1/8 86	34-3/8 100	50-5/16 120	66-3/16 120	SMF SMA

Bechtel Comment

see p. 2

FOR INFORMATION ONLY
JOB 14926

* SMA Min. C-C dimensions are with no adjustment.

FOR INFORMATION ONLY
JOB 14926

8

CALCULATION SHEET
P. O. BOX 2166
HOUSTON, TEXAS 77252-2166

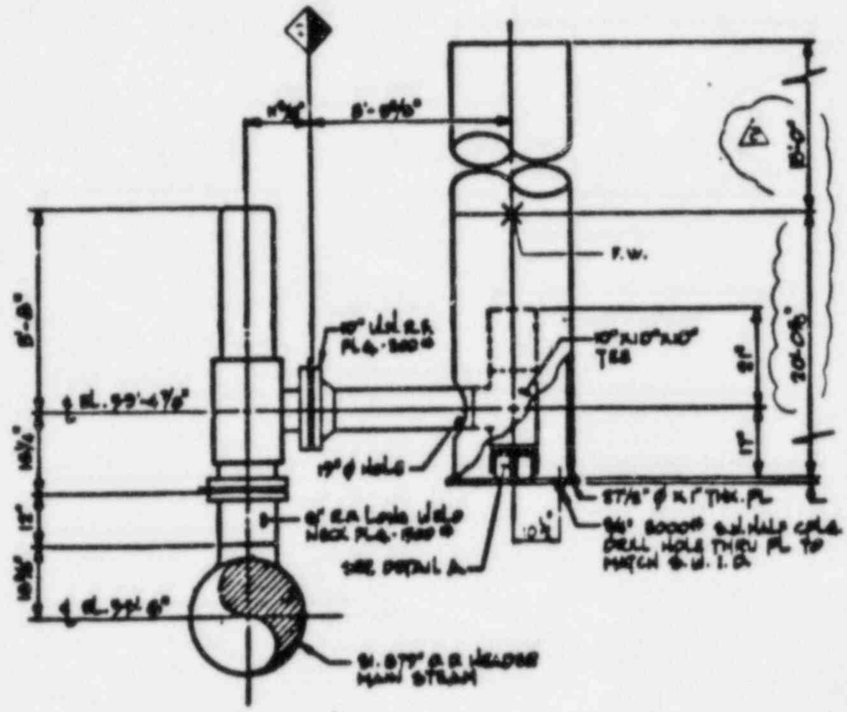
CALC. NO. RC6548-C

SIGNATURE [signature] DATE 7-24-84 CHECKED E. Shen DATE 8/1/84

PROJECT STP JOB NO. 14926-001

SUBJECT See Calc. Cover Sh. SHEET 20 OF — SHEETS

4.2A Relief Valve Loading



A Steady State: Steady state blowdown loads due to hydraulic forces will be zero. This is a net load neglecting tension resulting from balanced, opposing fluid forces in both legs of the blowdown piping. Loads due to fluid friction are also considered negligible due the small lengths of pipe involved and the nature of the fluid itself (steam).

B. Transient: Due to the small lengths of run pipe involved, a pressure wave would travel the length of the longer leg in approximately 3 milliseconds. Since the valve takes considerably longer than this to open, conditions favorable to creation of a transient loading condition do not exist.

These conclusions were reached jointly with the Mechanical Group as reflected by the signature of the Responsible Engineer for the Main Steam System.

V. Starks
R.E.

Date 6-6-84

HO-00101 (10/81)

DOCUMENT PAGE PULLED

* OVERSIZE DUPLICATE DRAWINGS

SEE APERTURE CARDS

APERTURE CARD NO# 8508060314

AVAILABILITY PDR ✓ CF NMSS

NUMBER OF PAGES. 1

ADDITIONAL APERTURE CARD NUMBERS BELOW.

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION COVER SHEET

SHEET 1

CALC. NO. 5L029RC9966

SUBJECT MAIN STEAM SAFETY VALVES – TRANSIENT LOADS & PISTON – T ASSEMBLY DESIGN CHECK

FILE NO. N/A

DISCIPLINE PLANT DESIGN/STRESS

RECORD OF ISSUE

REV. NO.	DESCRIPTION	TOTAL NO. OF SHEETS	ORIG	CKR	GL	GS	CHIEF	DATE
0	ISSUED FOR USE COMMITTED DESIGN		NLC	[signature]	JSS			

INFORMATION ENTERED IN THIS SPACE:

- SHOW PROFESSIONAL ENGINEER STAMP, IF REQUIRED.
- ENTER REFERENCE TO INCLUSION OF CHECKER'S ALTERNATE CALCULATIONS, IF USED.
- PROVIDE ANY NOTES TO ASSIST CHECKING AND APPROVAL.
- MAY LIST STANDARD COMPUTER PROGRAM (SCP) IDENTIFICATION INCLUDING VERSION AND OPTION USED.

FOR INFORMATION ONLY
JOB 14926

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC 9966

SUBJECT SEE THE COVER SHEET

SHEET NO. 2

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	N. KUMAR	6-25-85	[illegible]	6-26-85					

FOR INFORMATION ONLY
JOB 14926

1. INTRODUCTION:

THE SECONDARY SIDE OF EACH STEAM GENERATOR IS PROVIDED WITH 5 SAFETY VALVES INSTALLED ON EACH MAIN STEAM HEADER. THIS CALCULATION PROVIDES THE "TRANSIENT DYNAMIC FORCES FOR THE VALVE INLET (F_V) AND VALVE DISCHARGE (F_H).

2. REFERENCES:

(1) Stress Report
Dresser 3707R Main Steam Safety Valve SR-370-15
Bechtel log # 14926-4034-01032-ADI
Dresser's document # SR-370-15 Rev 0

(2) Bechtel's "MS" Mainsteam drawing #
5G369P-MS-646 Sht 03 Rev 2

(3) Valve Drawing # Dresser's No. — Bechtel's log #

(a) 3NC1012 Sht 4 Rev 9 — 14926-4034-01004-BDI

(b) 3NC1012 Sht 6 Rev 8 — 14926-4034-0006-ADI

(4) Pipe Line List 5L229P6000l Rev 9

(5) ANSI B31.1 - 1973 APPENDIX II, WINTER 1975 ADDENDA

(6) THERMODYNAMICS BY VAN WYLEN, G. J.
JOHN WILEY & SONS INC.

(7) CRANE TECHNICAL PAPER NO. 410

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	[signature]	6-25-85	[signature]	6-26-86					

FOR INFORMATION ONLY
JOB 14926

3. DESIGN DATA:

VALVE #	SIZE	SET PRESSURE (REF. 3b) PSIG	FLOW RATE, LBm/HR REF. 3b	OPERATING TEMP °F	REMARK
1	6X10 (REF. 3b)	1325	1.032845×10^6	585 °F	
2	↓	1315	↓	↓	
3	↓	1305	↓	↓	
4	↓	1295	↓	↓	
5	↓	1285	↓	↓	

NOTE:
FORCE ANALYSIS FOR VALVE #1 WILL BE DONE. FORCES OBTAINED FROM THIS ANALYSIS WILL BE USED FOR ALL THE VALVES IN THE MAIN STEAM PIPING STRESS ANALYSIS.

4. FORCE ANALYSIS:

WHEN THE SAFETY VALVE IS BLOWING, A SIGNIFICANTLY LARGE REACTION FORCE (STEADY STATE) "F_R" IS ACTING ON THE DISCHARGE PIPE. IN ORDER TO AVOID UNDESIRABLE STRESSES IN THE PIPING AND THE MAIN STEAM HEADER VALVE CONNECTION, THE DESIGN SHOWN ON THE FOLLOWING PAGE IS UTILIZED. THIS DESIGN HELPS TRANSFER THE REACTION FORCE "F_R" TO THE SUPPORTING STRUCTURE THRU PISTON.

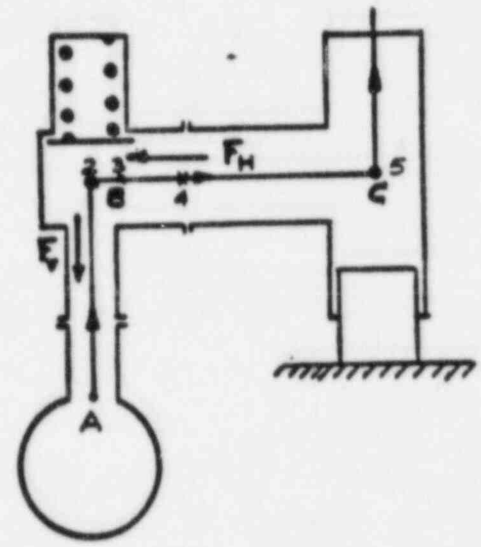
THE METHODOLOGY USED FOR CALCULATING TRANSIENT FORCES, F_H & F_V, IS BASED ON SIMPLIFICATION OF THE FLOW PROCESS. F_H & F_V DO NOT REACH MAXIMUM AT THE SAME TIME. HOWEVER, THEY WILL BE CONSIDERED SIMULTANEOUSLY IN CHECKING STRESSES AT THE EXTRUSION.

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	NW	6-25-85	[illegible]	6-26-85					

FOR INFORMATION ONLY
JOB 14926

METHODOLOGY

SAFETY VALVES OPEN 70% OF THE VALVE LIFT IN 40 MILLISECOND, (REF. 1 PAGE # 1 OF 3 OF APPENDIX A). JUST PRIOR TO VALVE OPENING, THE STEAM FLOW AT POINTS A, B AND C IS ZERO IN THE DIRECTION SHOWN. WHEN THE SAFETY VALVE POPS OPEN, THE FLOW AT THESE THREE POINTS INCREASES GRADUALLY UNTIL STEADY-STATE FLOW IS REACHED. IT SHOULD BE NOTICED, HOWEVER, THAT DURING THE TRANSIENT $\dot{W}_A > \dot{W}_B > \dot{W}_C$. THIS IS OBVIOUSLY DUE TO THE TIME REQUIRED FOR THE STEAM TO TRAVEL FROM A TO B TO C. SINCE FLOW VARIATION WITH TIME IS NOT AVAILABLE, THE FLOW RATE – TIME RELATION IS ASSUMED LINEAR. THIS IS APPLICABLE AT ALL THREE POINTS, NAMELY A, B, & C. THE VARIATION OF FLOW RATE $\dot{W}$ WITH TIME t AT THESE LOCATIONS IS SHOWN BELOW.



$\dot{W}_A$ FLOW RATE AT 'A'
$\dot{W}_B$ FLOW RATE AT 'B'
$\dot{W}_C$ FLOW RATE AT 'C'

FIGURE 1

FOR THE INLET PIPE A-B

$$\Delta t_{AB} = \frac{L_{AB}}{V_1}$$

WHERE L_{AB} IS THE DISTANCE BETWEEN A & B. SIMILARLY, FOR THE DISCHARGE PIPE B-C

$$\Delta t_{BC} = \frac{L_{BC}}{V_e^*}$$

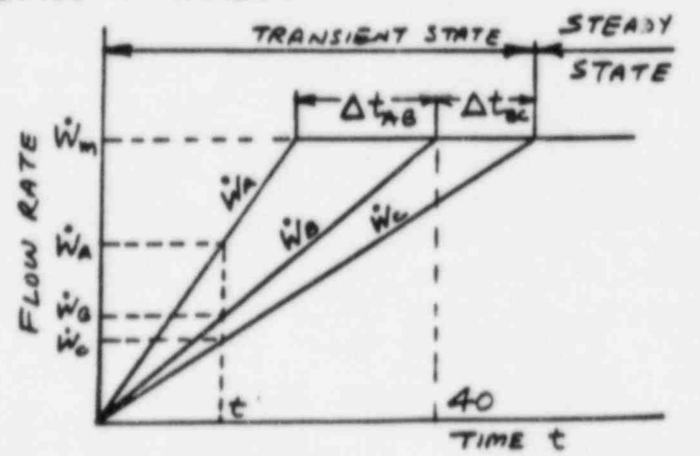


FIGURE 2

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC 9966

SUBJECT: SEE COVER SHEET

SHEET NO. 5

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	NK	6-25-85	[signature]	6-26-85					

WHERE L_{BC} IS THE DISTANCE BETWEEN B & C. V_c^* IS THE SONIC VELOCITY AT THE ORIFICE. IT IS ASSUMED THAT VELOCITY INCREASE DUE TO INCREASED SPECIFIC VOLUME IS MINIMAL. LOWER VELOCITY (V_c^*) WILL GIVE CONSERVATIVE RESULTS.

$\dot{W}_A$, $\dot{W}_B$ AND $\dot{W}_C$ ARE GIVEN BY THE FOLLOWING:

POINT A

$t < 40 - \Delta t_{AB}$ $\quad \dot{W}_A = \frac{t}{40 - \Delta t_{AB}} \dot{W}_m$

$t \geq 40 - \Delta t_{AB}$ $\quad \dot{W}_A = \dot{W}_m$

POINT B

$t < 40$ $\quad \dot{W}_B = \frac{t}{40} \dot{W}_m$

$t \geq 40$ $\quad \dot{W}_B = \dot{W}_m$

POINT C

$t < 40 + t_{BC}$ $\quad \dot{W}_C = \frac{t}{t_{BC} + 40} \dot{W}_m$

$t \geq 40 + t_{BC}$ $\quad \dot{W}_C = \dot{W}_m$

$\dot{W}_m$ IS THE STEADY STATE FLOW RATE

THE FLOW PROCESS IS SHOWN ON THE MOLLIER DIAGRAM IN FIGURE 3.

THE POINTS 1, 2, 3, 4 & 5 ARE EXPLAINED ON THE NEXT PAGE.

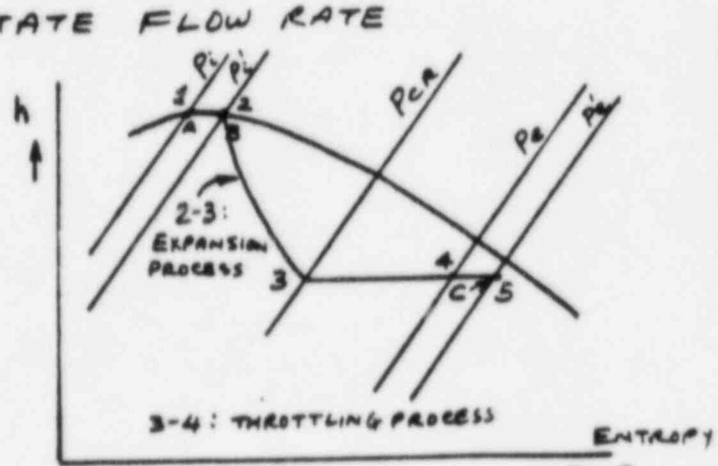


FIGURE-3

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	NLK	6-25-85	[illegible]	6-26-85					

POINT 1: REPRESENTS THE STEAM CONDITION AT THE ENTRANCE OF INLET PIPE

POINT 2: STEAM CONDITION AT THE VALVE ORIFICE INLET. THE PRESSURE DROP ($P_i - P_i'$) IS DUE TO THE FRICTION LOSSES IN THE INLET PIPE AND THE VALVE PASSAGES. VELOCITY OF STEAM V_i' IS SLIGHTLY LARGER THAN V_i DUE TO INCREASED SPECIFIC VOLUME.

POINT 3: IS THE STEAM CONDITION DIRECTLY AFTER EXPANSION TAKES PLACE IN THE VALVE THROAT (ORIFICE) WHERE PRESSURE DROPS FROM P_i' TO P_{cr}. THE CRITICAL PRESSURE $P_{cr} = 0.577 P_i'$ FOR SATURATED STEAM (REFERENCE 6 P. 373 EQ 13.48). DUE TO ENTHALPY DROP, THE KINETIC ENERGY INCREASES AND THE VELOCITY AT THIS POINT IS V_e^*.

POINT 4: REPRESENTS THE STATE OF STEAM DIRECTLY WHEN IT STARTS FLOWING THRU THE DISCHARGE PIPE. NOTE THAT THERE IS NO ENTHALPY DROP. THE PRESSURE DROP FROM P_{cr} TO P_e IS DUE TO INCREASE OF FLOW AREA (THROTTLING PROCESS). THE VELOCITY OF STEAM IS CONSTANT AT V_e^* SINCE THE INCREASE IN FLOW AREA IS SUBSTITUTED BY HIGHER SPECIFIC VOLUME.

POINT 5: STEAM CONDITION AT DISCHARGE TO THE STACK. SLIGHT PRESSURE DROP ($P_4 - P_5$) DUE TO FRICTION LOSSES IN THE DISCHARGE PIPE AND SLIGHT INCREASE IN VELOCITY DUE TO HIGHER SPECIFIC VOLUME.

FOR INFORMATION ONLY
JOB 14926

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC9966

SUBJECT: SEE COVER SHEET

SHEET NO. 7

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	NB	6-25-85	[signature]	6-26-85					

FOR INFORMATION ONLY
JOB 14926

FORMULAS FOR F_V & F_H

FOR THE INLET PIPE A-B, THE TRANSIENT FORCE F_V AT TIME t IS GIVEN BY THE RELATION

$$F_V = \frac{\dot{W}_A V_A}{g} - \frac{\dot{W}_B V_B}{g} + \Delta P_{AB} A_i \quad \text{—(1)}$$

WHERE THE FIRST AND SECOND TERMS REPRESENT THE CHANGE IN MOMENTUM AND THE THIRD TERM IS FRICTION FORCE. THE FORMULA IS BASED ON FORCE EQUILIBRIUM ON A CONTROL VOLUME IN THE INLET PIPE.

$$V_A = V_i = \frac{\dot{W}_A v_i}{A_i}$$

$$V_B = \frac{\dot{W}_B v_i'}{A_i} \approx \frac{\dot{W}_B v_i}{A_i} = \frac{\dot{W}_B V_i}{\dot{W}_A}$$

NOTE THAT IN THE ABOVE EQUATION v_i' IS ASSUMED EQUAL TO v_i. SINCE v_i' IS SLIGHTLY LARGER THAN v_i, THE ABOVE ASSUMPTION RESULTS IN LARGER F_V, SEE EQ. 1.

THE PRESSURE DROP ΔP_{AB} IS GIVEN BY

$$\Delta P_{AB} = \frac{0.00000336\, f\, L'_{AB}\, \dot{W}_A^2\, v_i}{d_i^5} \quad \text{(REF. 7)}$$

WHERE f = FRICTION FACTOR

L'_{AB} = EQUIVALENT LENGTH OF THE INLET PIPE INCLUDING INLET LOSSES AND VALVE LOSSES.

THE MAXIMUM TRANSIENT FORCE IN THE INLET PIPE A-B, F_V, IS DEVELOPED AT $t = 40 - \Delta t_{AB}$. F_V IS ALWAYS IN THE VERTICAL DOWNWARD DIRECTION.

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	[signature]	6-25-85	[signature]	6-26-85					

FOR THE HORIZONTAL PIPE B-C, THE HORIZONTAL FORCE, F_H, IS CALCULATED ON THE BASIS OF FORCE BALANCE ON CONTROL VOLUME IN THE DISCHARGE PIPE. F_H IS GIVEN BY,

$$F_H = \underbrace{\frac{\dot{W}_B}{g} V_e^* - \frac{\dot{W}_C V_e^*}{g}}_{①} + \underbrace{\frac{\dot{W}_B}{\dot{W}_m} P_e A_e - \frac{\dot{W}_C}{\dot{W}_m} P_e A_e}_{②} + \underbrace{\Delta P_{BC} A_e}_{③} \quad (2)$$

TERMS IN ① REPRESENT CHANGE IN MOMENTUM

TERMS IN ② REPRESENT CHANGE IN PRESSURE FORCE

TERM ③ REPRESENT THE FRICTION FORCE

WHERE P_e IS THE EXIT PRESSURE IN THE DISCHARGE PIPE AND IS CALCULATED FROM REF. 5 AND IS GIVEN BY

$$P_e = \frac{\dot{W}_m}{A_e} \frac{(b-1)}{b} \sqrt{\frac{2(h_o - a)J}{g_c(2b-1)}}$$

$\dot{W}_m$ = ACTUAL MASS FLOW RATE lbm/sec
A_e = EXIT AREA OF DISCHARGE PIPE
h_o = STAGNATION ENTHALPY AT INLET OF VALVE
J = 778 ft·lb/Btu
g = 32.2
a = 251 } FOR WET STEAM FROM REF. 5
b = 11 }

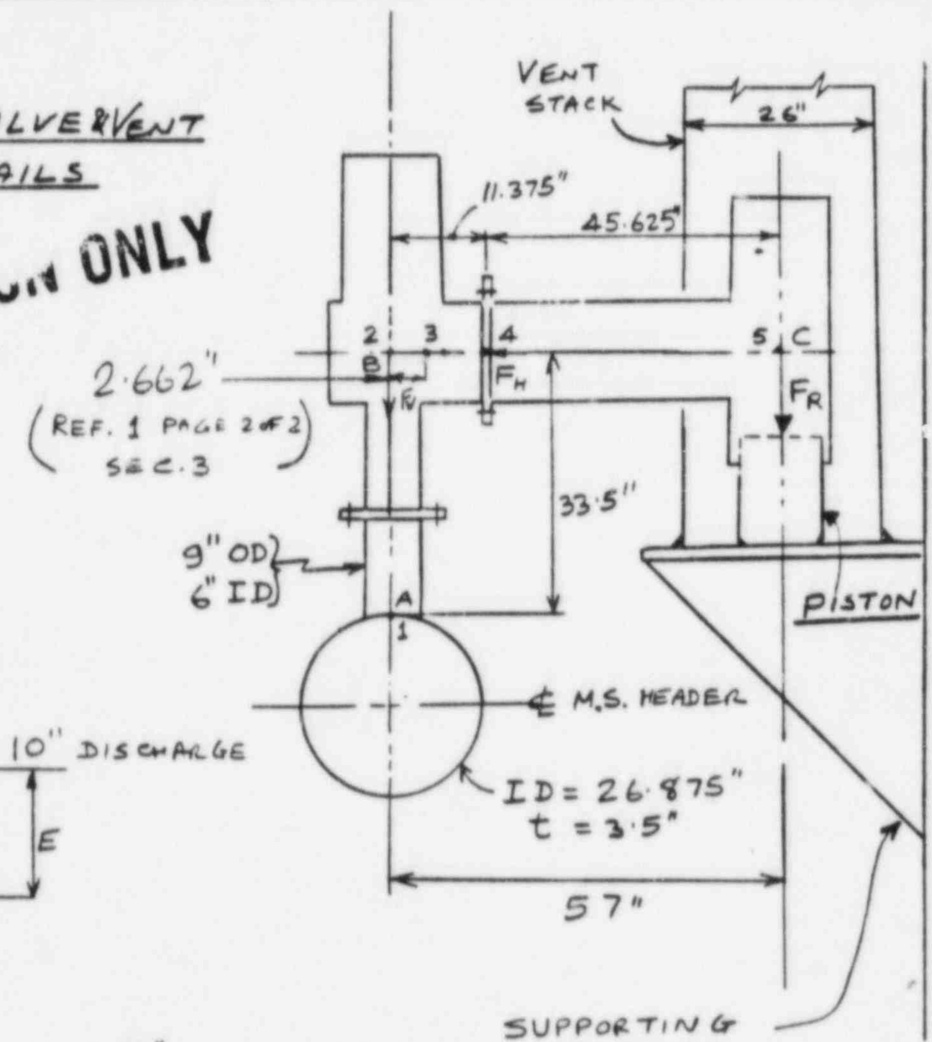
$$\Delta P_{BC} = 0.00000336 \frac{f\, L_{BC} \dot{W}_B^2 v_e}{d_e^5}$$

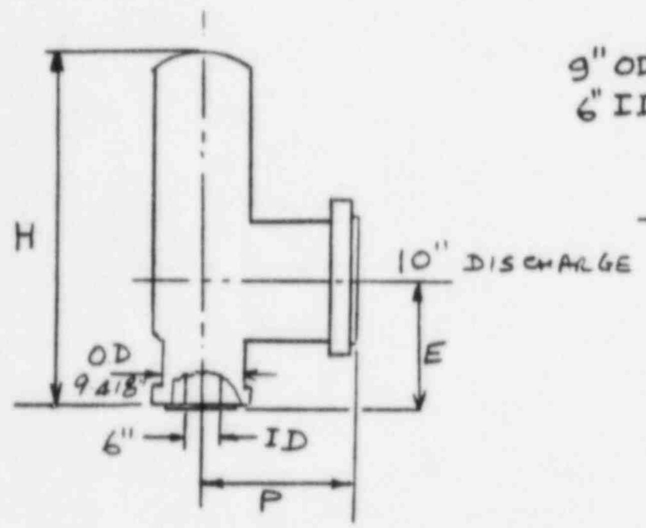
v_e IS THE SPECIFIC VOLUME AT EXIT

F_H WILL BE MAXIMUM AT t = 40 MILLISECONDS

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	NLL	6-28-85	[signature]	6-26-85					

SAFETY VALVE & VENT STACK DETAILS





P = 11.188" , E = 16.062"

H = 60.56"

FORCE IS CALCULATED FOR MAX. SET PRESSURE.

SET PRESSURE $P_s = 1325$ PSIG

INLET PRESSURE TO SAFETY VALVE, P_i

$$P_i = 1.03\,P_s + P_A = 1.03 \times 1325 + 14.7 = 1379.5 \text{ PSIA}$$

P_i : MAX INLET PRESSURE AT ~~PRESSURE~~ POINT #1

P_S : SET GAUGE PRESSURE, PSIG

3% : ACCUMULATION

P_A : ATMOSPHERIC PRESSURE, PSIA

SUBJECT SEE COVER SHEET

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
0	[illegible]	6-25-85	[illegible]	6-26-85					

CALCULATION OF FV

SUBSTITUTING FOR V_A, V_B, & $\dot{W}_B$ AT $t = 40 - t_{AB}$ IN EQ. 1

$$F_V = \frac{\dot{W}_A V_i}{g} - \frac{\dot{W}_B^2}{g \dot{W}_A} V_i + \Delta P_{AB} A_i$$

$$= \frac{\dot{W}_A V_i}{g}\left(1 - \frac{\dot{W}_B^2}{\dot{W}_A^2}\right) + \Delta P_{AB} A_i$$

$$= \frac{\dot{W}_A V_i}{g}\left(1 - \frac{(40 - t_{AB})^2}{40^2}\right) + \Delta P_{AB} A_i \quad \text{— (1A)}$$

$\dot{W}_A = \dot{W}_m$ AT $t = 40 - t_{AB}$

$\dot{W}_A = \dot{W}_m = 1.11 \times 1.032845 \times 10^6 / 3600$ (REF. 5)

$= 318.46$ lbm/sec

INLET PIPE SIZE

$ID = 6'' \Rightarrow A_i = 28.26\ IN^2$

STEAM CONDITION (ASSUMED SATURATED) AT

$P_i = 1379.5$ PSIG

$T = 585$ °F

$h_1 = 1175.2$ Btu/lb

$\vartheta_1 = 0.3072$ ft³/lb

STEAM VELOCITY AT POINT #1

$$V_i = \frac{\dot{W}_A \vartheta_1}{28.26} \times 144 = \frac{318.46 \times 0.3072 \times 144}{28.26}$$

$= 498.5$ ft/sec

$$t_{AB} = t_{12} = \frac{L_{12}}{12} \times \frac{1000}{V_i} = \frac{33.5 \times 1000}{12 \times 498.5} = 5.6 \text{ MILLI SEC}$$

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CALCULATION OF ΔP_{AB}

AT $P = 1379.5$ PSIG, $T = 585°F$

$\mu = 0.047$ CENTIPOSE FROM REF. 7 A-2.

REYNOLDS NO., Re,

$$Re = 6.31 \times \frac{\dot{W}_A \times 3600}{d_i\ \mu} = \frac{6.31 \times 318.46 \times 3600}{6 \times 0.047} = 2.56 \times 10^7$$

(REF. 7, 3-2)

$\therefore f = 0.015$ (REF. 7 A-25)

ENTERANCE LOSSES

$$Le = (K \times D)/f$$

WHERE $K = 0.44$ (REF. 7 A-27) ON THE BASIS OF $\frac{d_1}{d_2} = \frac{6}{26.875} = 0.2233$

$(33.875 - 7) = 26.875$ FOR STEAM HEADER

$$Le = \frac{0.44 \times 6}{12 \times 0.015} = 15 \text{ ft}$$

$v_1 = 0.3672\ ft^3/lb$

$$L'_{AB} = Le + \frac{L_{12}}{12} = 15 + \frac{33.5}{12} = 17.79'$$

$$\Delta P_{AB} = \frac{3.36 \times 10^{-6} \times f\ L'_{AB}\ (3600\ \dot{W}_A)^2 \times v_1}{d_i^5}$$ (REF. 7 3-2)

$$= \frac{3.36 \times 10^{-6} \times 0.015 \times 17.79\ (3600 \times 318.46)^2 \times 0.3072}{(6)^5}$$

$$= 46.56 \text{ PSI}$$

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$$V_3 = V_e^* = \left[\frac{2gJ(h_o - a)}{(2b-1)}\right]^{1/2} \quad \text{(REF. 5)}$$

$$= \left[\frac{2 \times 32.174 \times 778.16\,(1180.16 - 251)}{(22-1)}\right]^{1/2}$$

$$= 1488.46 \text{ ft/sec}$$

V_e^* REMAINS CONSTANT AS EXPLAINED IN POINT 4

ABSOLUTE STATIC PRESSURE AT POINT 4

$$P_4 = \frac{\dot{W}_A}{A_e} \times \frac{b-1}{b} \times \left[\frac{2J(h_o - a)}{g(2b-1)}\right]^{1/2} \quad \text{(REF. 5)}$$

$$= \frac{318.46}{78.54} \times \frac{(11-1)}{11} \times \left[\frac{2 \times 778.16\,(1180.16 - 251)}{32.174\,(22-1)}\right]^{1/2}$$

$$= 170.53 \text{ PSIA}$$

A_e IS BASED ON DISCHARGE PIPE SIZE OF 10", t = 0.365"

$$P_e = P_4 - 14.7 = 170.53 - 14.7 = 155.83 \text{ psig} \quad \text{(REF. 5)}$$

CALCULATION OF ΔP_{BC}

AT P_4 = 170.53 PSIA, AND SATURATED STEAM T = 368°F

μ = 0.0152 (REF. 7 A-2)

$$Re = \frac{6.31 \times \dot{W}_A \times 3600}{d_i\,\mu} = \frac{6.31 \times 318.46 \times 3600}{10.02 \times 0.0152} = 4.75 \times 10^7$$

f = 0.014 (REF. 7 A-25)

v_3 = 2.6738 ft³/lb

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USING EQ. 1A, WE GET

$$F_V = \frac{\dot{W}_A V_i}{g}\left(1-\left(\frac{40-t_{AB}}{40}\right)^2\right) + \Delta P_{AB} \times A_i$$

$$= \frac{318.46 \times 498.5}{32.174}\left(1-\left(\frac{40-5.6}{40}\right)^2\right) + 46.56 \times 28.26$$

$$= 1284.86 + 1315.79$$

$$= 2601 \text{ lbs}$$

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USE DLF = 2.0

$$F_{VD} = 2601 \times 2 = \underline{5202 \text{ lbs}}$$

CALCULATION OF F_H

EQ. 2 GIVES THE FORMULA FOR CALCULATING F_H

$$F_H = \frac{\dot{W}_B V_e^*}{g} - \frac{\dot{W}_C V_e^*}{g} + \frac{\dot{W}_B}{\dot{W}_m} P_e A_e - \frac{\dot{W}_C}{\dot{W}_m} P_e A_e + \Delta P_{BC} A_e$$

P_e IS CALCULATED AT POINT 4

$V_e^* = V_4$ SEE EXPLANATION OF POINT 4 STEAM PROPERTIES

F_H IS MAXIMUM AT $t = 40$ MILLISECONDS

$$\dot{W}_B = \dot{W}_A = \dot{W}_m$$

$$\dot{W}_C = \frac{40}{t_{BC}+40}\dot{W}_m$$

$$F_H = \frac{\dot{W}_A V_e^*}{g}\left(1-\frac{40}{t_{BC}+40}\right) + P_e A_e\left(1-\frac{\dot{W}_C}{\dot{W}_B}\right)\frac{\dot{W}_B}{\dot{W}_m} + \Delta P_{BC} A_e$$

$$F_H = \left(\frac{t_{BC}}{t_{BC}+40}\right)\left(\frac{\dot{W}_A V_e^*}{g} + P_e A_e\right) + \Delta P_{BC} A_e \quad \text{— } \underline{2A}$$

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC 9966

SUBJECT: SEE COVER SHEET

SHEET NO. 14

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$$\Delta P_{45} = \frac{3.36\times10^{-6} \times 0.014 \times L_{45} \times (3600 \times 318.46)^2 \times 2.6738}{12 \times (10.02)^5}$$

($L_{45} = 45.625''$)

$= 6.23$ PSI

$$t_{BC} = t_{45} = \frac{L_{45}}{12} \times \frac{1000}{V_e^*} = \frac{45.625}{12} \times \frac{1000}{1488.46}$$

$t_{45} = 2.55$ MILLISECONDS

SUBSTITUTING IN EQ. 2A

$$F_H = \left(\frac{2.55}{2.55+40}\right)\left(\frac{318.46 \times 1488.46}{32.174} + 155.83 \times 78.54\right) + 6.23 \times 78.54$$

$= 2105.7$ lbs

ASSUMING DLF = 2.0

$F_{HD} = 2105.7 \times 2 =$ **4211 lbs**

$F_{VD} =$ **5202 lbs**

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STP 1310 (7/84)

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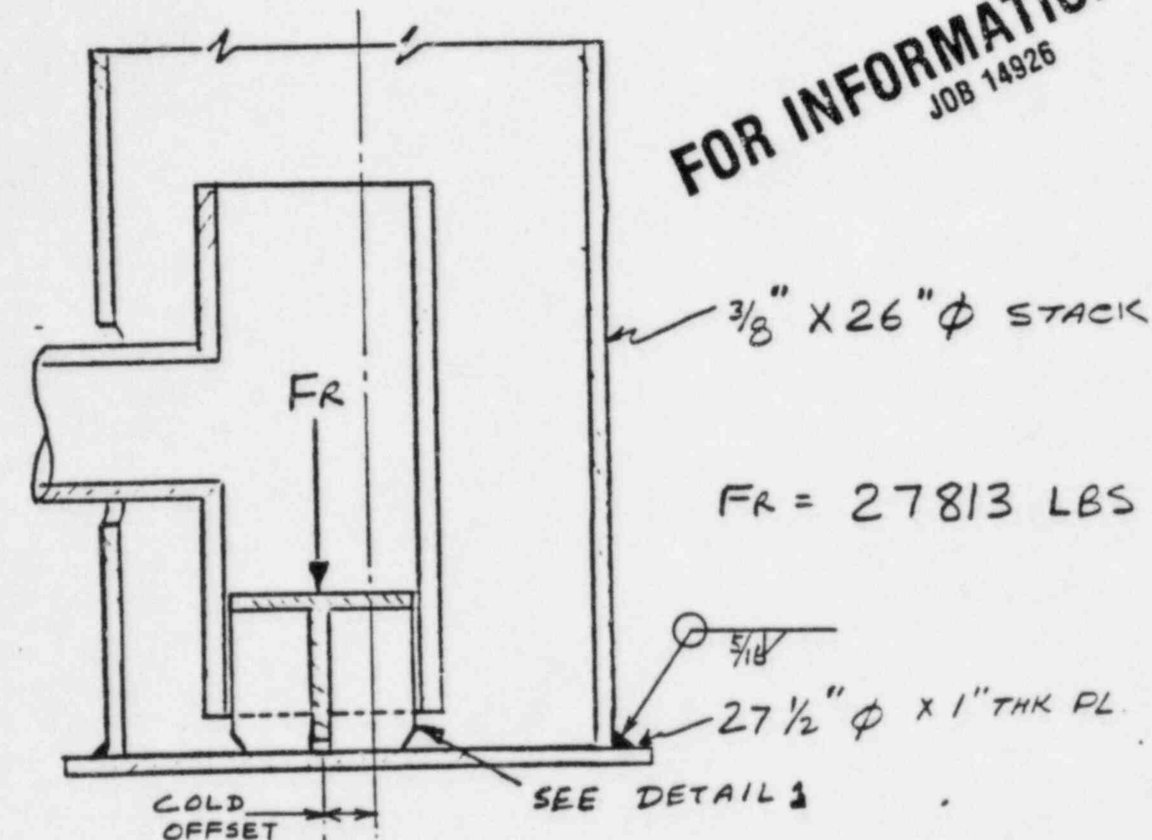
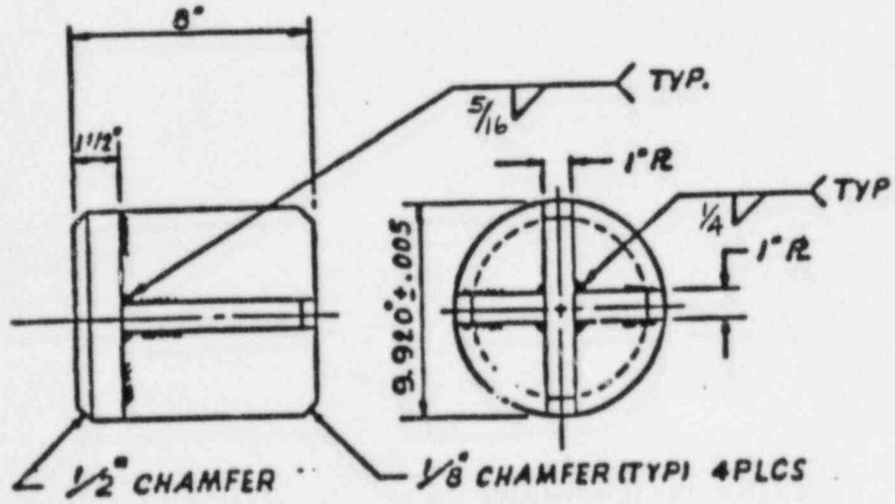
CALCULATIONS FOR PISTON - T ASSEMBLY





DETAIL 1

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC 9966

SUBJECT: SEE COVER SHEET

SHEET NO. 16

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STRESS CHECK FOR PISTON

$FR = 27813$ LBS

1. COMPRESSIVE STRESS IN THE PISTON

COMPRESSIVE AREA $= (9.92 - 2 \times 1/8) \times 1'' +$
$(9.92 - 2 \times 1/2 - 1) \times 1''$

$= 9.67 + 8.67$

$= 18.34 \text{ IN}^2$

COMPRESSIVE STRESS $= \dfrac{27813}{18.34} = 1516.5$ PSI

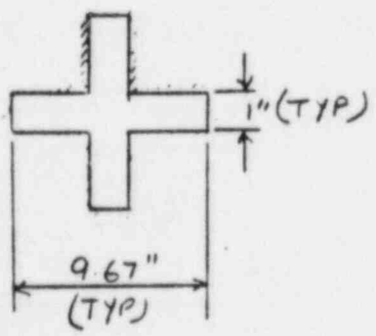
$= 1517$ PSI < 18860 PSI OK
(SEE SHT. 4)

2. SHEAR STRESSES IN THE STACK BOTTOM PLATE

SHEAR AREA FOR 1" THICK STACK BOTTOM PLATE

$= (1+1+1+1) \times 1 + (8.67 \times 4) \times 1$

$= 38.68 \text{ IN}^2$



SHEAR STRESS $= \dfrac{27813}{38.68}$

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O.K.

STP 1310 (7/84)

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC9966

SHEET NO. 17

SUBJECT: SEE COVER SHEET

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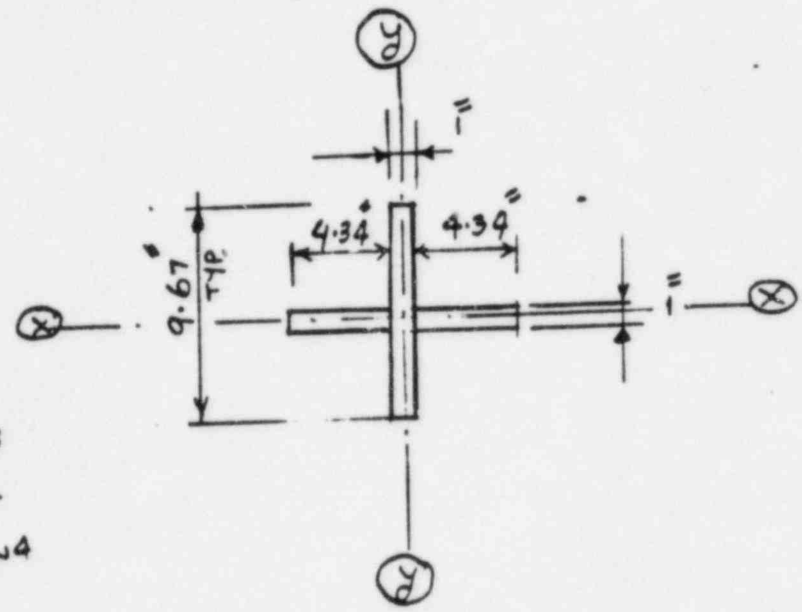

$$I_{xx} = \frac{(1)(9.67)^3}{12} + \frac{2 \times 4.34 (1)^3}{12}$$

$$= 75 + 0.72 = 75.72 \text{ IN}^4$$

$$I_{yy} = \frac{(1)(4.34)^3 \times 2}{12} + 1 \times 4.34 \times \left(\frac{4.34}{2} + 0.5\right)^2 \times 2 + (9.67)(1)^3/12$$

$$= (13.6 + 61.87 + 0.81) = 76.28 \text{ IN}^4$$

$$\therefore r_{xx} = r_{yy} = \sqrt{\frac{I}{A}} = \sqrt{\frac{75.72}{18.34}} = 2.03$$

length of composite section $= (8 - 1\frac{1}{2}) = 6.5''$ (For Fig. see Detail 1 sht. 15)

Assume section as cantilever

$\therefore K = 2.1$

$$\therefore \frac{KL}{r_{xx}} = \frac{KL}{r_{yy}} = \frac{2.1 \times 6.5}{2.03} = 6.72$$

STP 1310 (7/84)

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Assumed A-36 Material

Assume 310°F

for $Kl/r = 6.72$ $F_{a\,allow} = 18.86^{KSI} \gg 1.52^{KSI}$ O.K

CHECK 2/3 CRITICAL BUCKLING

$$F_{acr} = \frac{2}{3}\left[1 - \frac{\left(\frac{Kl}{r}\right)^2}{2C_c^2}\right]F_y = \frac{2}{3}\left[1 - \frac{(6.72)^2}{2\times(130.3)^2}\right]\times 31.8$$

$$= \frac{2}{3}\left[1 - .0013\right]\times 31.8 = 21.09^{KSI} > 1.52^{KSI}$$ OK

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = \left(\frac{2\times 3.14^2\times 27360}{31.8}\right)^{\frac{1}{2}} = 130.3$$

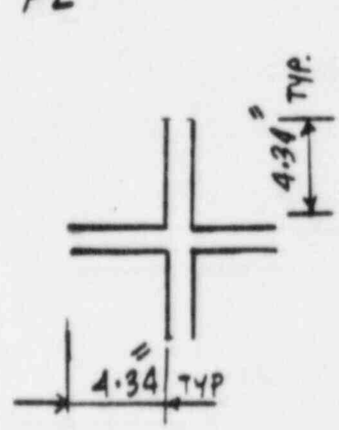
WELD DESIGN (for fig. see Detail 1 Sht. 15)

weld betwn $1\frac{1}{2}$" Horizontal PL & Vertical 1" PL

Force $F_R = 27813^{lbs}$

length of weld $= 8\times 4.34 = 34.72$"

∴ force per inch $= \frac{27.82}{34.72} = 0.8^{K/''}$



∴ w size reqd $= \frac{0.8}{.4\times 31.8} = 0.063$"
or

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w size reqd $= \frac{0.8}{.707 \times 21} = 0.053''$

use $5/16''$ fillet min. reqd per AISC

Weld between 1" vertical PL

length of weld $= 4 \times 6 = 24''$

Force transferred through this weld $= \frac{27.8}{2} = 13.9^K$

$\therefore$ force/" $= \frac{13.9}{4 \times 6} = 0.58^{K/"}$

No of welds ↑ ↖ length of weld.

$\therefore$ w size reqd $= \frac{0.58}{.707 \times 21} = 0.04''$

or

$\frac{0.58}{.4 \times 31.8} = 0.05''$ Governs

Use $1/4''$ fillet weld

CONCLUSIONS:

1. THE STACK DESIGN IS SIZED CORRECTLY
2. F_{HD} & F_{VD} SHOULD BE CONSIDERED SIMULTANEOUSLY IN CALCULATIONS FOR MAIN STEAM HEADER

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DISTRIBUTION TO: FOR. REVIEW	INFO.
MECHANICAL	✓
BALANCE OF PLANT	
BOILER/NSSS	
PLANT UTILITIES	
PLANT DESIGN	
CONTROL SYSTEMS	
~~ELECTRICAL~~ E.Q. ② ✓	
WIRING	
CONDUIT	
MOS	
PAINTING & COATINGS	
CIVIL/STRUCTURAL	
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PUMP SEISMIC AND A.S.M.E. CODE ANALYSIS -

PKG. # 4637

14926-4022-01018-BHT

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14926-8022-01018-BHT

IMPORTANT

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SECTION 2.3.8/1-0
Page: 1
Date: March 31, 1
Supersedes:
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PUMP ~~SIESMIC~~ SEISMIC 10/17/83 AND A.S.M.E. CODE ANALYSIS - ISSUE & REVISIONS (DTG

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PUMP SEISMIC AND A.S.M.E. CODE ANALYSIS - ISSUE & REVISIONS

1.0 Object

To show that structural integrity and operability will not be impaired during or after a seismic event.

2.0 General Approach

2.1 Horizontal Pumps

On all horizontal pumps, the pump and motor are separately analysed, the motor being analysed by the motor vendor. The only interface between the pump and the motor is the coupling. It is realized that the only time any load, other than torsional can be carried across the coupling, is if there is permanent set in some component. Thus, by assuring there is no permanent set in any component we can assure there will be no axial load interaction between the pump and the motor.

All pump and support component stresses are calculated per section 5.0.

All pump and support component deflections are calculated per section 5.0.

The motor supports are modelled as pump supports and analysed per section 5.0.

2.2 Vertical Pumps

Vertical pumps are modelled as beams and analysed by finite element methods using the NASTRAN program. The motor is analysed as a beam mounted above the pump. The pump is assumed to be rigidly attached at the mounting plate and to be simply supported at the radial supports.

The stiffness is based on only the outer shell minus the corrosion allowance. The mass is based on the total weight including the corrosion allowance, shafting, enclosing tubes and water.

The NASTRAN analysis is not duplicated here as it is publically available.

PUMP SEISMIC AND A.S.M.E. CODE ANALYSIS

3.0 Structural Integrity

3.1 Criteria

3.1.1 Allowable Stress

If the specified material is an A.S.M.E. Code material, allowable stresses are taken from the A.S.M.E. Code Section III, Appendix I. If the specified material is not a Code material, the allowable stress is taken as 60% of yield. The allowable stresses for half and full earthquake loadings are modified only as stated in the customers specification.

3.1.2 Code Criteria

Where applicable all parts are analysed to the A.S.M.E. Code Section III. See section 5.0 below for specific references.

3.2 Loadings

All nozzle loads are as given in the customers specification or greater. If the loadings are greater, a comparison of the specified load to the loads used in the calculations is given in section 6.3.0. If the direction of the nozzle load is uncertain, the most conservative direction is assumed.

Flange loadings are calculated based on an equivalent pressure as given in section 5.1.7 .

Seismic loadings are as given in the customers specification or greater. If the loadings are greater a comparison of the specified load to the load used in the calculation is given in section 6.0 .

NOTE: Any modifications of the specified loads are always done in such a way as to produce conservative results.

3.2 Methods

3.3.1 Nozzle Stresses

Nozzle stresses are calculated according to the A.S.M.E. Code Section III Article A 2212 and the methods shown in section 5.2.1 below. The nozzles are modelled as cylinders and an equivalent pressure is used to calculate the load, as calculated in section 5.1.7 below.

3.3.2 Casing Stresses

3.3.2.1 Horizontal Pumps

The minimum casing thickness is calculated by the methods of A.S.M.E. Code Section III NB 3442 as is shown in section 5.2.2.1. below.

The casing flange stresses are calculated by the methods of A.S.M.E. Code Section III Article ND 3442 as is shown in section 5.2.2.1 below.

The casing is modelled as a cylinder and analysed by the methods of the A.S.M.E. Code Section III Article A 2212 as shown in section 5.2.1 below.

3.3.2.2 Vertical Pumps

The casing is modelled as a cylindrical beam, fixed at one end. The stresses are analysed according to the A.S.M.E. Code Section III Article A 2212 and using the methods shown in section 5.2.2.2 below.

3.3.3 Flange Stresses

The suction and discharge flange stresses are calculated, by the methods of section 5.2.3 below, according to the A.S.M.E. Code Section III Appendix XI and, an equivalent pressure, according to the A.S.M.E. Code Section III NB 3647 as is shown in section 5.1.7 below.

3.3.4 Backcover and Gland Stresses

Since the calculations involving these two items are identical they are both listed together. These items are analysed in accordance with the A.S.M.E. Code, Section III NC 3325 and ND 3325 by the methods shown in section 5.2.4 below.

PUMP SEISMIC AND A.S.M.E. CODE ANALYSIS - ISSUE & REVISIONS

3.3.5 Bolt Stresses

3.3.5.1 Horizontal Pumps

There are six different sets of bolts which are separately analysed by four different programs. The bolts are analysed according to the following sections of the A.S.M.E. Code Section III:

Casing Bolts	ND 3442
Gland Bolts	ND 3325
Flange Bolts	NB 3647

The attachment, pedestal and foundation bolts are analysed according to the methods outlined in section 5.2.5 below.

3.3.5.2 Vertical Pumps

All bolts are analysed according to DESIGN OF MACHINE ELEMENTS, V. M. Faires, using the methods shown in section 5.2.5 below.

3.3.6 Shaft Stresses

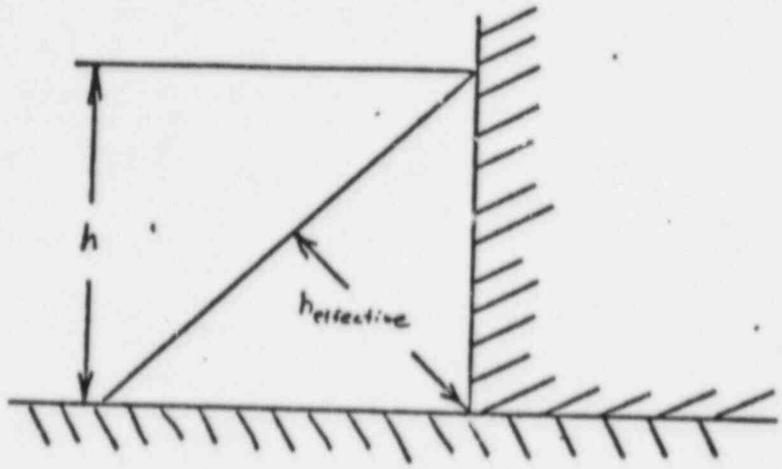
The pump shaft is modelled as a simply supported beam with concentrated masses for hydraulic loads, impeller weight and coupling weight; and uniform loading for the shaft weight. It is analysed by the methods shown in section 5.2.6 below. All the hydraulic loads are calculated in accordance with CENTRIFUGAL & AXIAL FLOW PUMPS, A. J. Stepanoff. Keyway stress concentration factors are taken from STRESS CONCENTRATION FACTORS, R. C. Peterson.

3.3.7 Pedestal Stresses

The pedestals are modelled as vertical beams with all loads acting at the centroid of the attachment bolts. The pedestals are analysed by standard beam analysis using the equations for stress from FORMULAS FOR STRESS AND STRAIN, R. J. Roark, and the methods shown in section 5.2.7 below.

3.3.8 Weld Stresses

The welds are modelled as beams with cross-sectional areas equal to the effective area across the weld throat.



The welds are analysed according to the methods of section 5.2.8 below.

4.0 Operability

4.1 Criteria

The reed natural frequency and the critical speed shall not be within ±25% of the operating speed.

The deflections of pumps and components will be deemed acceptable if they are such that no permanent set remains after a seismic event; as calculated in section 5.2.

The missalignment of the coupling will be deemed to be acceptable if the missalignment does not exceed manufacturers specifications for the coupling in use.

Shaft deflections and wear ring clearances will be deemed to be acceptable if it is shown that no interference occurs before or during a seismic event and that no permanent set remains after a seismic event; as calculated in section 5.2.

4.2 Loadings (as 3.2)

4.3 Methods

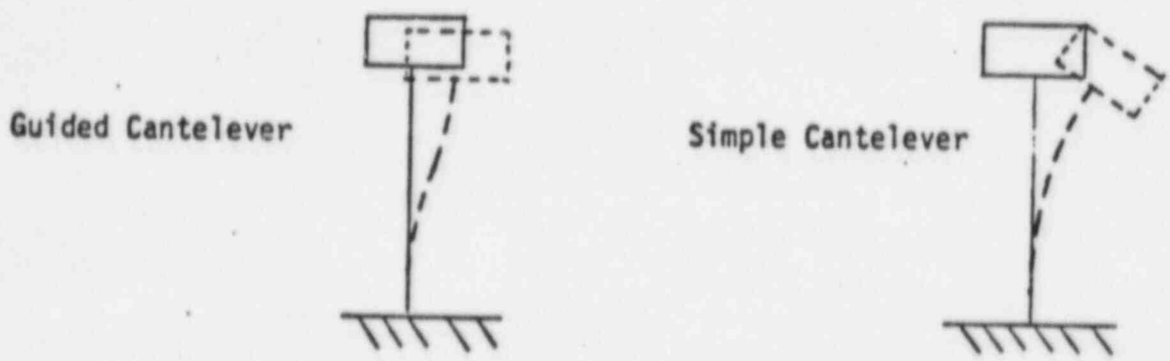
4.3.1 Natural Frequencies

4.3.1.1 Shaft Natural Frequency

The shaft is modelled as a simply supported beam and the critical speed is calculated using an energy balance method. Calculations are done in accordance with the methods shown in section 5.3.1.1.

4.3.1.2 Pedestal Natural Frequency

If there are two pedestals in the axis of concern the pedestal is modelled as a guided cantilever with a concentrated mass on top. Otherwise it is modelled as a simple cantilever with a concentrated mass on top.



The natural frequency is calculated by the methods of: MECHANICAL VIBRATIONS, J. P. DenHartog and using the equations of FORMULAS FOR STRESS AND STRAIN, R. S. Roark as shown in section 5.3.1.2.

4.3.1.3 Vertical Pump Columns

The column is modelled as a cylindrical beam which is rigidly attached at the mounting flange and simply suppo: at the radial stiffeners. Credit is not taken for the corrosion allowance in the calculation of rigidity but i: included, along with the water, in calculation of the ma:

The pump natural frequency is calculated using the "NASTI general finite element computer program.

4.3.2 Shaft Deflections

The shaft is modelled as a beam with static and operating loads superimposed. The hydraulic loads are calculated i accordance with" CENTRIFUGAL & AXIAL FLOW PUMPS, A. J. Stepanoff. The deflections are calculated by numerical integration as per: KINEMATICS AND DYNAMICS OF MACHINES, G. H. Martin.

4.3.3 Bearing Analysis

For anti-friction bearings the B-10 bearing life is calculated according to the specifications listed in the manufacturer's manual.

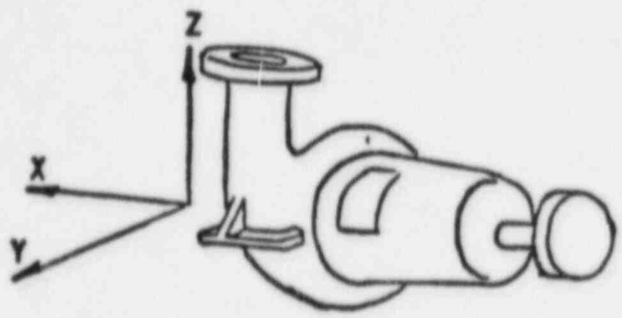
For sleeve bearings the load is calculated by a simple summation of forces and moments by the methods of section 5.3.5.

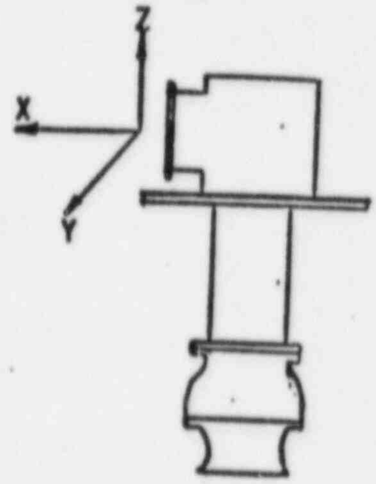
4.3.4 Fatigue Analysis

Evaluation of fatigue life and safety factors for shafting follows the methods outlined in: MECHANICAL ENGINEERING DESIGN, J. E. Shigley.

5.0 Calculation Methods

All calculations are based on the following co-ordinate system except cylindrical stresses which are based on the system as illustrated in section 5.2.1.





5.1 Loading

Generally, the following loads are given:

1. Nozzle Loads
2. Seismic Loads
3. Nozzle Loads for Seismic Conditions
4. Shaft Horsepower
5. Design Pressure
6. Hydrostatic Test Pressure

These loads must then be converted to the appropriate values such that they are useful for calculations. This is done by the methods illustrated in this section.

5.1.1 Nozzle Loads

For calculation of bolt loads, the forces and moments are tranformed by the following equations:

$$Fx_c = \Sigma Fx_i$$

$$Fy_c = \Sigma Fy_i$$

$$Fz_c = \Sigma Fz_i$$

$$Mx_c = \Sigma Mx + \Sigma(Fy_i\ (Zc - Zi) + Fz_c\ (Yc - Yi)\ )$$

$$My_c = \Sigma My + \Sigma(Fx_i\ (Zc - Zi) + Fz_c\ (Xc - Xi)\ )$$

$$Mz_c = \Sigma Mz + \Sigma(Fx_i\ (Yc - Yi) + Fy_c\ (Xc - Xi)\ )$$

Where i = 1, 2, 3, etc. for each loading point, i.e. nozzles, C. of G., etc.

5.1.2 Seismic Loads

Seismic loads are calculated by the following equations:

Fx = Horizontal Acceleration (g) * Weight ($lb._f$)
Fy = Horizontal Acceleration (g) * Weight ($lb._f$)
Fz = Vertical Acceleration (g) * Weight ($lb._f$)

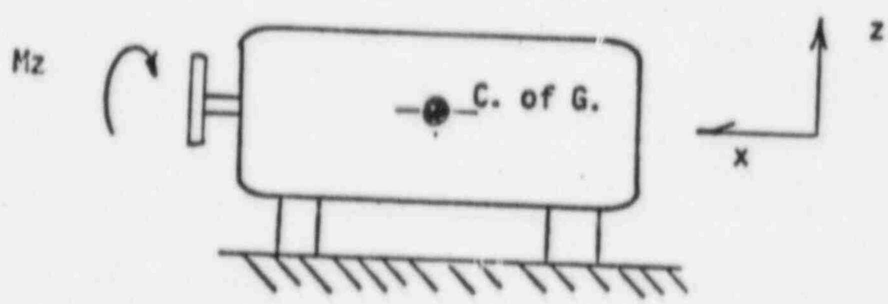
Note that these forces are assumed to act at the centre of gravity of the pump.

5.1.3 Nozzle Loads for Seismic Conditions

When stated in the Customers specification, all nozzle loads are multiplied by the multipliers for seismic conditions.

5.1.4 Shaft Horsepower

In the motor pedestal analysis the motor is modelled as a pump with the only nozzle load being Mx. The moment, Mx, is calculated from the shaft horsepower and the shaft speed (N) by the standard conversion equation shown below:



$$Mx = \frac{\text{Horsepower} \times 550 \times 60}{2\pi * N} \text{ ft.-lbs.}$$

5.1.5 Design Pressure

The design pressure is calculated as the maximum shut off pressure plus the maximum suction pressure.

5.1.6 Hydrostatic Test Pressure

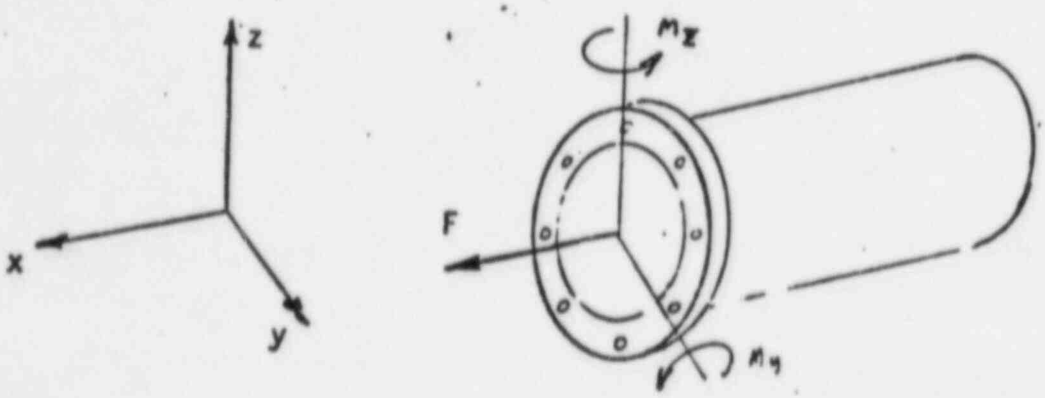
The hydrostatic test pressure is calculated as 1.5 times the design pressure times the ratio of the code allowable stress cold over the code allowable stress at design temperatures.

$$P_{HYD\ TEST} = 1.5 * PDES * (\sigma allow_{cold} / \sigma allow_{hot})$$

5.1.7 Equivalent Pressure

In the analysis of flanged joints the nozzle loads must be combined with the pressure to form an equivalent pressure. This is done by the following equation from A.S.M.E. Code Section III Article NB 3647:

$$P_{equiv.} = P + \frac{16\ M}{\pi G^3} + \frac{4F}{\pi G^2}$$



Where: F is the force perpendicular to the face of the flange

M is the bending moment in in-lbf.

$$M = \sqrt{My^2 + Mz^2}$$

G is the diameter at the effective gasket load

5.2 Integrity Calculations

5.2.1 Stress in a Cylinder

This analysis applies to nozzles, vertical pump columns, and casings.

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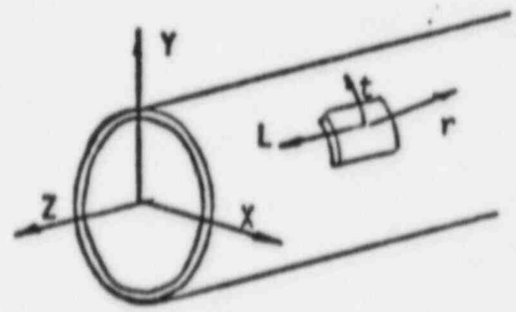
Ref Article A2212, ASME III

$$\sigma_t = P(1+Z^2)/(Y^2-1)$$

$$\sigma_l = P/(Y^2-1) + F_z/A + \sqrt{M_x^2 + M_y^2} * R/I$$

$$\sigma_r = P(1-Z^2)/(Y^2-1)$$

$$T_{lt} = M_z * R/J$$



R = Radius to test point

I = Moment of inertia about transverse axis

J = Torsional Moment of inertia

A = Area of nozzle

P, Z, Y, σ_t, σ_l, σ_r are as defined in Article 2000.

T_{lt} is shear stress across the face of the nozzle.

From these principal stresses are calculated

$$\sigma_1, \sigma_2 = \frac{\sigma_t + \sigma_l}{2} \pm \sqrt{\left(\frac{\sigma_t - \sigma_l}{2}\right)^2 + T_{lt}^2}$$

$$\sigma_3 = \sigma_r$$

The maximum shear stress is the greater of

$$SS = \frac{\sigma_1 - \sigma_2}{2}, \frac{\sigma_2 - \sigma_3}{2}, \frac{\sigma_3 - \sigma_1}{2}$$

This is compared to the code allowable stress divided by 2 to obtain a safety factor.

$$SAF = \frac{Sallow}{SS * 2}$$

Standard Issued by:

Approved by:

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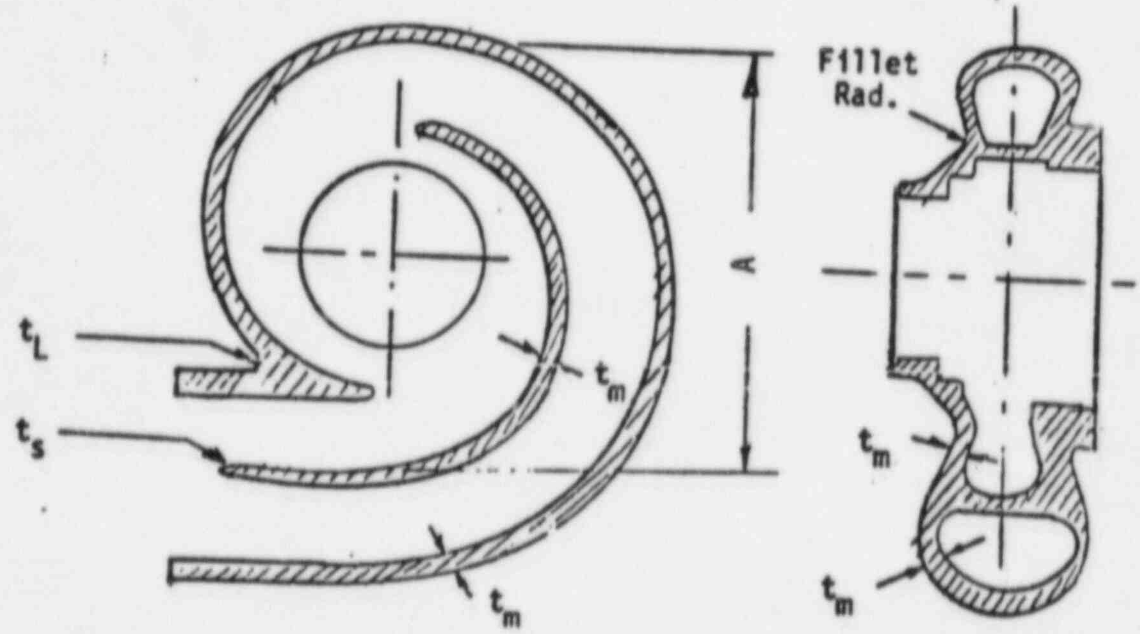
5.2.2 Casing Stresses

5.2.2.1 Horizontal Pumps

The casing minimum wall thickness is:

Ref: ASME III NB 3442



Casing wall minimum thickness $t_m = \frac{0.63 \times P \times A}{S_m}$

Minimum Volute and Casing flat wall $= t_m$

Crotch radius $t_c = 0.3 \times t_m$

Cutwater and splitter radius $t_s = 0.05 \times t_m$

Fillet Radius $0.1\ t_m$ or .25 in.

The casing is analysed per section 5.2.1.

5.2.2.2 Vertical Pumps

The cylindrical sections of a vertical pump are analysed per section 5.2.1.

The stress in the pressure loaded top plate is analysed as shown below.

The pump column is modelled as a beam and analysed by the "NASTRAN" finite element computer program. The column is assumed to be rigidly attached at the mounting bracket and simply supported at the radial supports.

Any corrosion allowance is not included in the calculation of the rigidity but is included in the calculation of the weight. The applicable loads include weight, nozzle loads and seismic loads. These are then combined by the "NASTRAN" program to obtain the internal forces and moments. These internal loads are then used to calculate column stresses by the methods of section 5.2.1 and flange stresses by methods of 5.2.3.

Flat plates used as closure for cylindrical walls such as suction covers and top covers are analysed in accordance with A.S.M.E. Code Section III Article NC 3225.

5.2.3 Flange Stresses

Flange stresses are calculated according to A.S.M.E. Code Section III Appendix XI based on an equivalent pressure calculated according to A.S.M.E. Code Section III Article NB 3647.

Nozzle loads are taken into account by calculating an equivalent pressure in accordance with NB 3647.1

$$P_{eg} = P + \frac{16M}{\pi G^3} + \frac{4F}{\pi G^2}$$

M = Bending Moment in in-lbs.
F = Axial Force in lbs.
G = Diameter of Effective Gasket Load

The bolt loads are calculated as

For Operating Conditions

$$W_{m1} = .785 \times G^2 \times P + 2 \times b \times 3.14 \times G \times m \times P$$

For Gasket Seating

$$W_{m2} = 3.14 \times b \times G \times y$$

The bolt area required is the greater of:

$$A_{m1} = W_{m1}/S_b$$

$$A_{m2} = W_{m2}/S_a$$

The flange bolt load is the greater of:

$$W = W_{m1}$$

$$W = \frac{(A_m + A_b)\ S_a}{2}$$

The stress is given by:

Longitudinal hub stress $S_H = \dfrac{f \times M_o}{L x g_1^2 x B} + \dfrac{P \times B}{4 x g_o}$

Radial flange stress $S_R = \dfrac{(1.33 x t x e x 1) x M_o}{L x t^2 x B}$

Tangential flange stress $S_t = \dfrac{Y \times M_o}{t^2 \times B} - Z \times S_R$

Ref. NB 3647.1 (d)

The design safety factors are:

Longitudinal Hub Stress $SF_H = \dfrac{1.5 \times S_m}{S_H}$

Radial Flange Stress $SF_R = \dfrac{1.5 \times S_m}{S_R}$

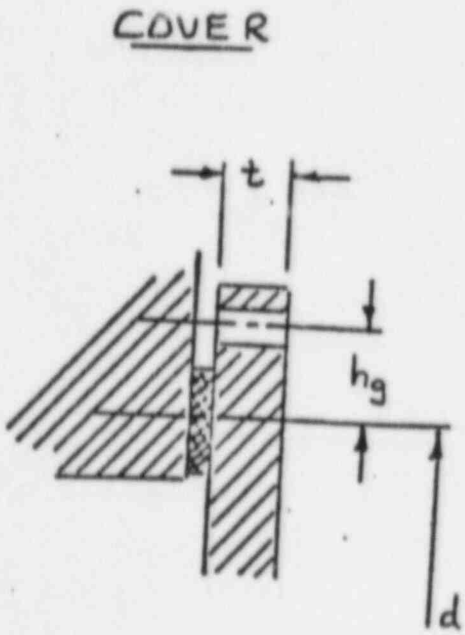
Tangential Flange Stress $SF_T = \dfrac{1.5 \times S_m}{S_T}$

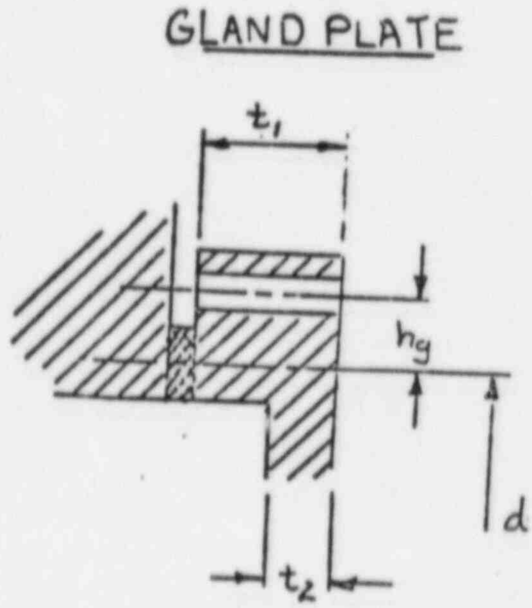
5.2.4 Backcover and Gland Stresses

Reference:

The calculations are done in accordance with articles NC 3325 and ND 3325.

Since the analysis is identical for the covers in question, the nomenclature of NC 3325 will be used.





For Operating Conditions:

$$t = d\sqrt{C*P/S = 1.78 * W*hg/S*d^3} \qquad (1)$$

where C = .3 (Fig. NC 3325-1-d and e)

P = design pressure

S = allowable stress at Design Temp. (Table I - 7.0, Appendix I)

W = total bolt load (XI-3223 (3) and (4))

= W_{mI} (for operating conditions)

For a grooved peripheral gasket, the minimum cover plate thickness under the groove or between the groove and the outer edge shall be,

$$tm = d\sqrt{1.78\&W*hg/S*d3}$$

For gasket Seating:

Eq^n (I) above shall be used

and P = design pressure = 0

S = allowable stress at atmospheric temp. (Table I - 7.0, Appendix I)

$W = (A_n + A_b)\ Sa/2$

Where S_a = allowable stress of bolts at atmospheric temp.

A_b = total basic min. minor area of bolts ($in.^2$)

$WmI = .785 * G^2P + 2b * G * m * P * 3.4$

Where P = design pressure
M = gasket factor (Table XI - 3221.1-2)

b_o = basic gasket seating width (Table XI - 3221.1-2)

For $b_o \leq .25$ in., $b = b_o$ and $G = d$

For $b_o > .25$ in., $b = \frac{b_o}{2}$ and $G = d - 2b$

$W_{m2} = 3.14\ b*G*Y$

A_m = the greater of $\frac{W_{m1}}{Sb}$ or $\frac{W_{m2}}{Sa}$

where Y = gasket seating pressure (Table XI - 3221.1-1)

S_a = allowable stress of bolts at atmospheric temp.

S_b = allowable stress of bolts at design temp.

Note - tables XI-3221.1-1 and XI-3221.1-2 are attached as Appendix I and II.

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5.2.5 Bolt Loading (Attachment, Pedestal & Foundation)

Foundation and attachment bolt loading is analysed by the methods shown below.

It is assumed that the baseplate is rigid with respect to the attachment bolting.

The load absorbed by each bolt is directly proportional to the distance from the axis of the resultant bending moment. (M_R)

Where: $M_R = \sqrt{Mx^2 + My^2}$

Mx is the resultant moment in the x-direction as calculated in section 5.1 .

Therefore: the force in the bolt is:

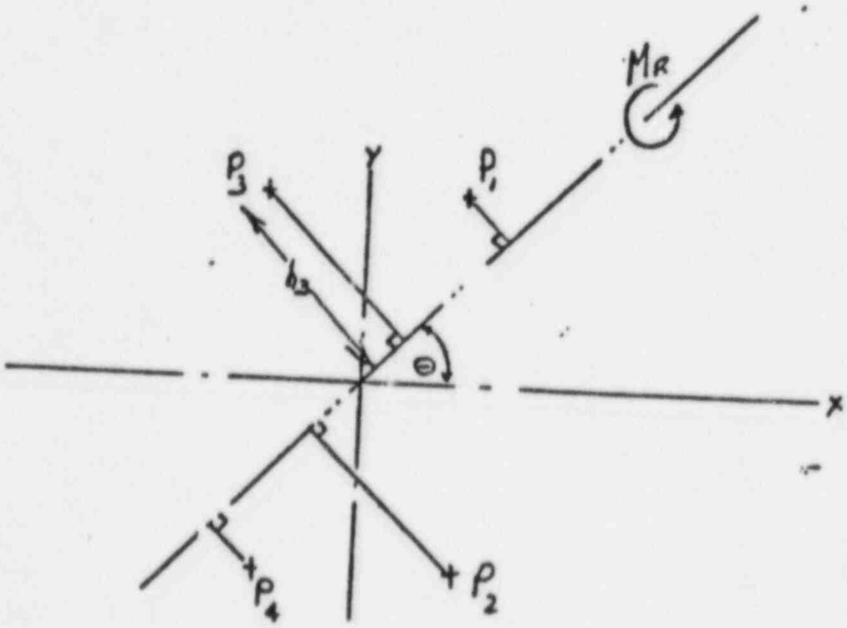
$$Fi = K\ h_i$$

Where: h_i is the perpendicular distance form the bolt to the axis of the resulting bending moment.

$$K = M_R \sum h_i^2$$

Therefore: the vertical reaction is:

$$Fz_i = -\frac{Fz}{4} - K * h_i$$



For circular bolt distribution, i.e. mounting flanges, this load becomes:

$$Fi = \frac{4\ M_R}{3\ NR} + \frac{Fz}{N}$$

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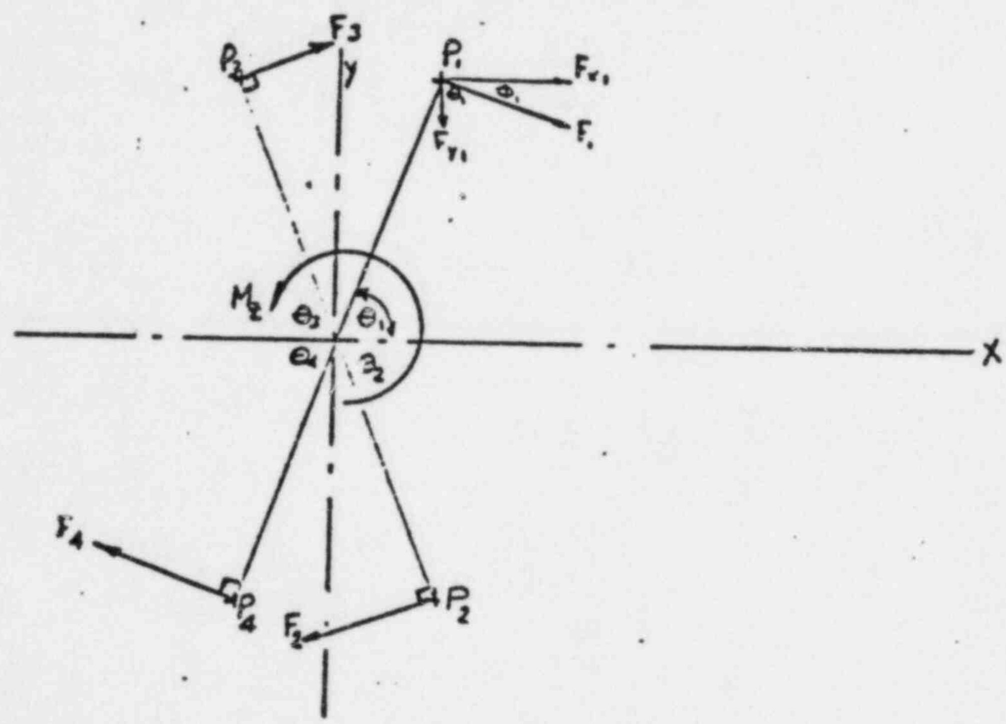
To calculate the horizontal reactions it is assumed that plane horizontal forces are shared equally by each bolt and that the reaction to the vertical moment is proportional to the distance from the centroid to the bolt. This reaction acts in a direction perpendicular to the line from the centroid to the bolt.



$$Fi = KDi = K \ (x_i - x_c)^2 + (Yi - Yc)^2$$

Where: $K = M_z/Di^2$

$$FX_{total} = Fi + Fx/N$$

5.2.5.1 Bolt Stress (Attachment, Pedestal and Foundation Bolts)

Ref: Faires, Design of Machine Elements
MacMillan, New York, 1965.

Load F_x, F_y, F_z where Z is along the axis of the bolt.

Initial Bolt Force $F_i = 1.5 * (K_p/(K_p + K_b)) * F_z$

Where $K = \frac{E\ A}{L}$

Where E = Young's Modulus
A = Bolt or part stress area
L = Effective length
K_p = K for part
K_b = K for the bolt

Initial Torque T = .2 * Bolt Size * F_i/12. ft.-lbs.

Bolt size = Nominal size in inches.

Bolt Axial Stress $S = (F_i + F_z * K_b/(K_b + K_p))/A$ psi

Shear Stress $SS = \sqrt{F_x^2 + F_y^2}\ /A$

Note for gaskets present

$$K_p = \frac{1}{\frac{L_p}{E_p\ A_p} + \frac{L_G}{E_g\ A_G}}$$

Principal Stresses

$$\sigma_1, \sigma_2 = \frac{S}{2} + \sqrt{(\frac{S}{2})^2 + SS^2}$$

Max. Shear Stress $(\tau\ max) = \frac{\sigma_1 - \sigma_2}{2}$

Safety Factor $= \frac{S\ allow}{2\ \tau\ max}$

NOTE: The allowable bolt stress is as given in the A.S.M.E. Code Section III Appendix XI for all code bolting and in 60% of yield for all other parts as specified in the A.S.M.E. Code Section III, NF.

5.2.6 Shaft Stress

The pump shaft analysis is based on modelling the rotating shaft as a simply supported beam under the influence of static and operating loads, and applies to all pump types.

The loads applied include: static weight, hydraulic thrusts - radial and axial, and seismic loads.

For conservative results the seismic loads are taken to act in the same direction as the resultant of the static and hydraulic loads.

Calculations made include: bearing loads, shaft deflection, critical speed, and stresses.

For all of these the hydraulic load on the impellers are calculated in accordance with: A. J. Stepanoff, - Centrifugal & Axial Flow Pumps, John Wiley & Sons, New York, 1967.

Shaft stresses include axial stress due to thrust and bending, tangential stresses due to keyways, and shear stress due to torque.

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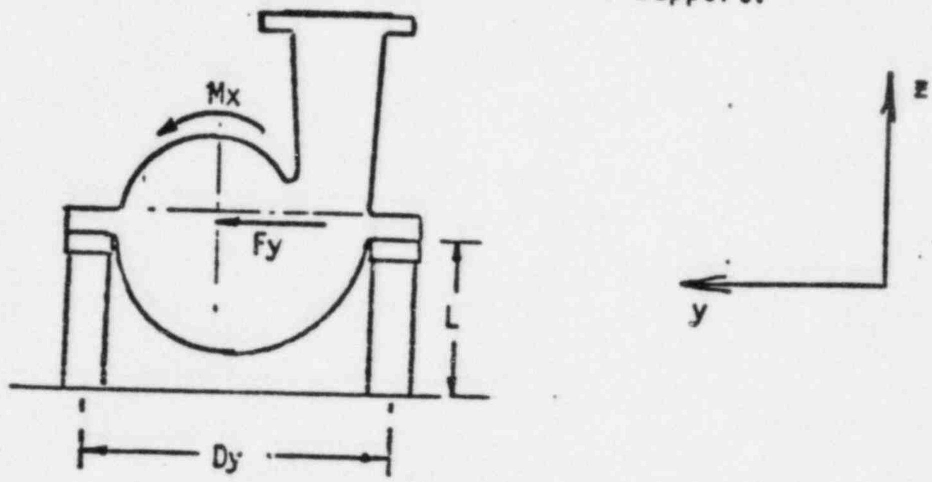
Multistage Vertical Pump shafts may be analysed by the "NASTRAN" finite element computer program, in which case the bearings are modelled as springs.

The allowable stress for shafts is 60% of the yield stress.

5.2.7 Pedestal Stresses

This applies to pumps with centreline support.



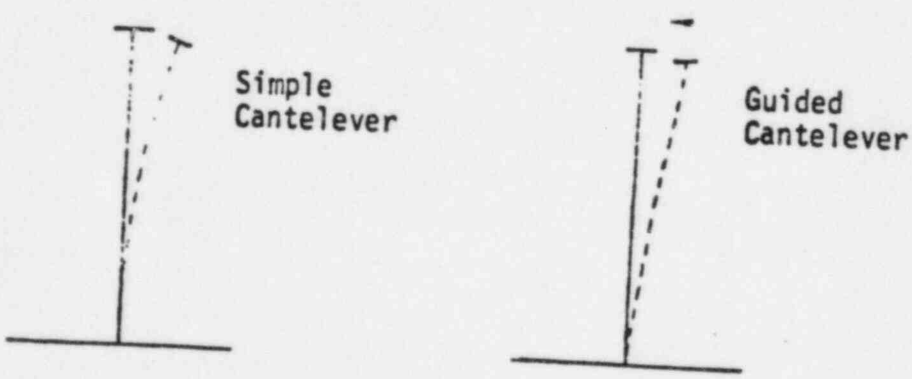
(a) The pump is assumed to be rigid.

(b) Misalignment in the pump axis is neglected.

(c) When two pedestals are in the axis of deflection, the pedestal act as a guided centreline.

(d) When only one pedestal is in the axis of deflection, the pedestal act as a simple cantilever.

i.e. for 2-pedestal systems the deflections in the x-direction are as simple cantilever and those in the y-direction are as guided cantilevers. For 4-pedestal systems all horizontal deflections are guided cantilevers.

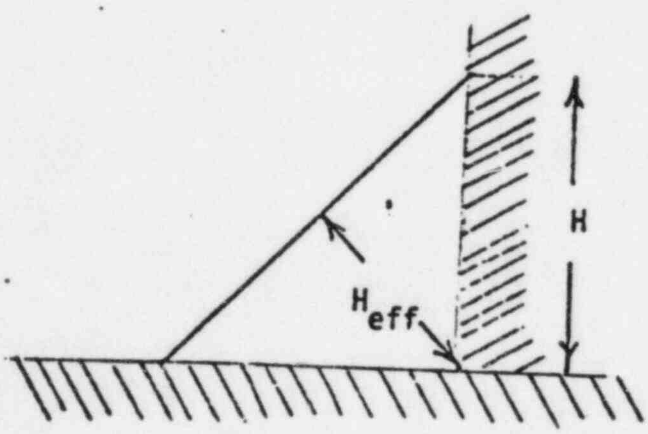


5.2.8 Weld Stresses

The weld stress is calculated the same as the pedestal stress; that is

$$\sigma = \frac{Mxx\ Y}{Ixw*N} + \frac{Myy\ Y}{Iyw*N} + \frac{F}{WAREA*N}$$

where Ixw = the weld moment of inertia per pedestal (x-direction)
Iyw = the weld moment of inertia per pedestal (y-direction)
WAREA = the effective cross-sectional area of the weld



5.3 Operability Calculations

5.3.1 Natural Frequencies

5.3.1.1 Shaft Natural Frequencies

The pump shaft is analysed by numerical integration using the "SHAFT" program assuming stiff bearings. Multistage vertical pump shafts may be analysed by the "NASTRAN" finit element computer program, in which case the bearings are modelled as springs.

The critical speed is calculated using an energy balance method in accordance with: KINEMATICS AND DYNAMICS OF MACHINES, G. H. Martin.

The effect of axial thrust is not taken into account.

The general equation used is:

$$w_c^2 = \frac{g \sum W y}{\sum W y^2} \quad \text{Rad/sec}$$

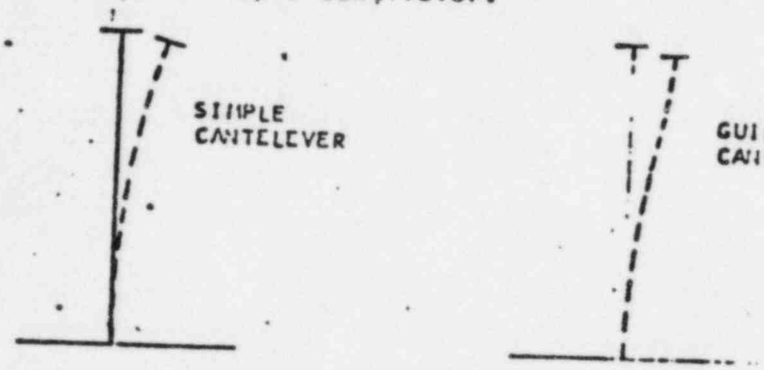
Where W is the concentrated weight and y is the deflection at this weight.

5.3.1.2 Pedestal Natural Frequency

The pump is modelled as a rigid mass mounted on top of the pedestal.

(a) When two pedestals are in the axis of deflection the pedestals act as guided cantelevers.

(b) When only one pedestal is in the axis of deflection, the pedestal acts as a simple cantilever.



i.e. for 2-pedestal systems the deflections in the x-direction are as simple cantilever and those in the y-direction are as guided cantilevers. For 4-pedestal systems all horizontal deflections are as guided cantilevers.

Natural frequency for simple cantilevers is given by:

$$W_n = \frac{1}{2\pi}\sqrt{\frac{3EIg}{WL^3}} \text{ cps}$$

Where I is the total moment of inertia.

Natural frequency for guided cantilevers is given by:

$$W_A = \frac{1}{2\pi}\sqrt{\frac{12EIg}{WL^3}} \text{ cps}$$

Natural frequency in the z-direction is given by:

$$W_n = \frac{1}{2\pi}\sqrt{\frac{A\,Eg}{W\,L}}$$

Where A is equal to the total cross-sectional area of the pedestals.

5.3.1.3 Vertical Pump Columns

The casing is modelled as a beam, fixed at one end and simply supported at the radial stiffeners. The corrosion allowance is not included in the calculation of the rigidity but is included in the weight along with the water and the enclosing tube.

The natural frequency is calculated by use of the "NASTRAN" finite element computer program.

The motor is modelled as a cantelever supported above the pump. It is also assumed to rigidly attached at the mounting flange and analysed by the "NASTRAN" program.

The stiffness of parts with equally spaced radial stiffeners is calculated by:

$$I = I_{cylinder} + \frac{N}{2} \cdot \left(\frac{bh^3}{12} + bh * R^2\right)$$

Where: R is the distance from the centre of the cylinder to the centroid of the radial stiffeners.

N is the number of radial supports.

5.3.2 Shaft Deflections

The loads applied include: static weight, hydraulic thrusts - radial and axial, and seismic loads.

For all of these the hydraulic load on the impellers are calculated in accordance with: A. J. Stepanoff, CENTRIFUGAL & AXIAL FLOW PUMPS, John Wiley & Sons, New York, 1967.

Shaft deflection is calculated by a double integration method.

$$y = \iint \frac{M}{EI} dx$$

Where M is the applied bending moment and is a function of X.

y is the deflection at point X

I is the shaft moment of inertia in bending

For this integration axial loads intermediate bushing and wear ring support are not taken into account.

5.3.3 Coupling Missalignment

Pedestal deflections are calculated as shown below:

Two pedestals

The deflection at the pump centreline in the x-direction is given by:

$$V_x = \frac{(F_x + M_z/(D_y/2))L^3}{3\ EI} + \frac{M_y\ L^3}{2\ EI}$$

The deflection at the pump centreline in the y-direction is given by:

$$V_y = \frac{F_y\ L^3}{12\ EI}$$

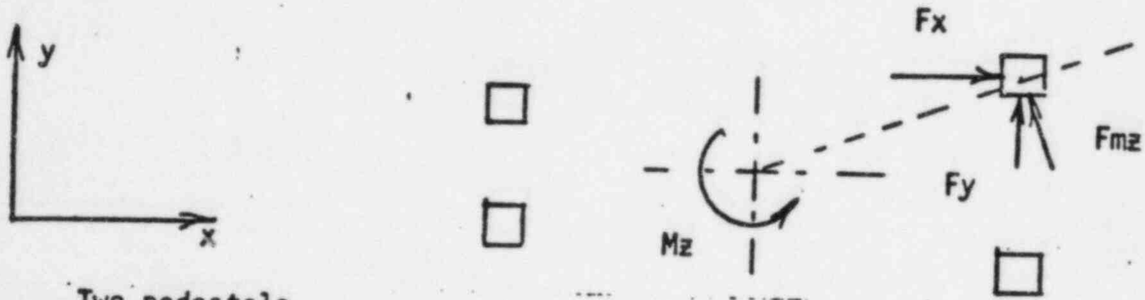
Four pedestals

The deflection at the pump centreline is given by:

5.3.3 Coupling Misalignment (Cont'd)

$$V = \frac{Fi\ L^3}{12\ E\ I}$$

Where Fi is the sum of the appropriate horizontal force (Fx or Fy) and the force due to the vertical moment (Mz).



Two pedestals

The horizontal angle of rotation of the pedestals is given by:

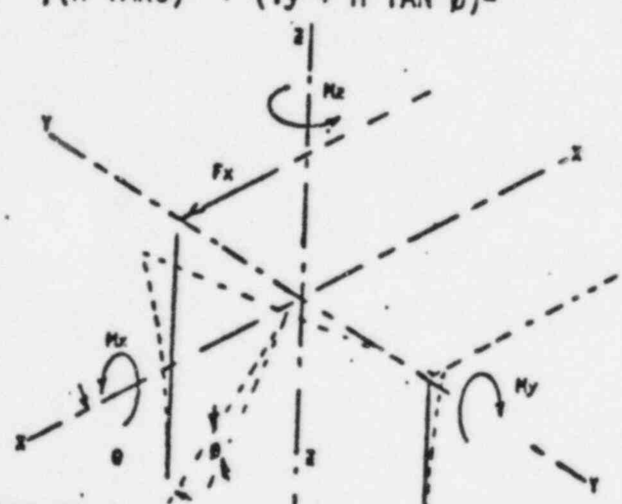
$$\theta = \frac{(Fx + Mz/(Dy/2))L^2}{2\ EI} + \frac{My\ L}{EI}$$

The vertical angle of rotation of the pedestals is given by:

$$\emptyset = \text{ARCTAN}\ (2\ Vx/(Dy/2))$$

The total misalignment is given by:

$$\text{Misalignment} = \sqrt{(H\ \text{TAN}\theta)^2 + (Vy + H\ \text{TAN}\ \emptyset)^2}$$



Four Pedestals

The horizontal angle of rotation of the pedestal is given by:

$$\theta = \text{ARCTAN}\left(\frac{FxL^3}{12\ EIy} * \frac{1}{Dy}\right) + \text{ARCTAN}\left(\frac{FyL3}{12\ EI_x} * \frac{1}{Dx}\right)$$

This creates a displacement equal to:

$$\text{Displacement}_H = H \text{ TAN } \theta$$

The vertical displacement is given by:

$$\text{displacement}_v = \frac{L' My}{D_x\ EA} * \frac{H}{Dx/2}$$

The total misalignment equals:

$$\text{misalignment} = \sqrt{\text{displacement}_v^2 + \text{displacement}_H^2}$$

NOTE: Motor pedestals are analysed similarly and the coupling misalignment due to the shaft deflection.

5.3.5 Bearing Analysis

Bearing loads are the reactions at two support points to the loads applied to the shaft, and are calculated by a simple summation of forces and moments.

The B - 10 bearing life is calculated in accordance with the bearing manufacturers manual based on all normal operating loads, and based on peak loads including the Design Base Earthquake.

5.3.6 Fatigue Analysis

For shafts a system of alternating and mean stress components is assumed and a safety factor based on an endurance limit is calcualted using method outlined in: MECHANICAL ENGINEERING DESIGN, J. E. Shigley.

6.0 Report

The Seismic Analysis Report shall contain the following:

6.1 Issue and Revision Sheet plus table of contents using the form of Appendix I.

6.2 Summary of Analysis using the form of Appendix I.

6.3 Summary of Loadings using the form of Appendix I.

6.4 Detailed calculations including Computer input/output.

6.5 Computer program description including a sample run plus parallel verification calculation.

6.6 Any other required support Engineering Standards.

SEISMIC ANALYSIS REPORT

REPORT No. ______

Revision	Issue Date	Replaces	Pages Revised	Issued By	Approve

TABLE OF CONTENTS

SEISMIC ANALYSIS REPORT

1.0 Summary of Analysis Results

1.1 Structural Integrity

The unit has been shown to satisfy all the Structural requirements of A.S.M.E. Section III and the Contract Specification under the defined loading conditions.

All stress levels are within the allowable limits. Details of results maybe found in section 6.4 .

1.2 Operability

The pump has been shown to maintain operability through all the operational and environmental events defined in the contract specification.

Maximum Coupling Misalignment

	Running	OBE	DBE
Pump Misalignment			
Motor Misalignment			
Shaft Misalignment			
Total Misalignment			
Allowable Misalignment			
Safety Factor			

Minimum Wear Ring Clearances

Clearances at wear rings (Unloaded)

Deflections at wear rings

	Running
	OBE
	DBE

SEISMIC ANALYSIS REPORT

Bearing Loads

Location	Running	OBE	DBE

The bearing B-10 life has been shown to be ___________.
The maximum bearing load pressure has been shown to be ____________ PSI.

Shaft Stress

Axial

Alternating

Endurance Limit

2.0 Loading Summary

Load		Specified Load Running	OBE	DBE	Load Used in Calculation Running	OBE	DBE
Suction	Fx						
	Fy						
	Fz						
	Mx						
	My						
	Mz						
Discharge	Fx						
	Fy						
	Fz						
	Mx						
	My						
	Mz						
Accelerations OBE	H						
	V						
DBE	H						
	V						

SEISMIC ANALYSIS REPORT

Load	Specified Load			Load Used in Calculation		
	Running	OBE	DBE	Running	OBE	DBE
Design Pressure						
Gland Pressure						
Test Pressure						
Design Temp.						
Q-Rated						
Q-BEP						
Suction Pressure						
TDH						
BHP						
RPM						
Pump Weight						
Base Weight						
Motor Weight						
Class						

DISTRIBUTION TO	FOR RE[illegible]	INFO
• MECHANICAL		
• BALANCE OF PLANT		
• BOILER/NSSS		X
PLANT UTILITIES		
• PLANT DESIGN		
• CONTROL SYSTEMS		
• ELECTRICAL		
WIRING		
CONDUIT		
• MOS		
• PAINTING & COATINGS		
• CIVIL/STRUCTURAL		
• NUCLEAR		
• STRESS		
• ARCHITECTURAL		
• STARTUP		
• CONSTRUCTION		
• NOT REQ'D BY ENGRG		
• CLIENT		

IDENTIFYING TITLE OF THIS DOCUMENT

PKG.#1634

4022-01055-AHT

Bechtel Log No.

14926-8022-01055-AHT

IMPORTANT

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

DATE RECEIVED 5-14-82

Signed [signature]

Date 5/29/82

DOCUMENT STATUS

1 [X] WORK MAY PROCEED.

2 [ ] REVISE AND RESUBMIT WORK MAY PROCEED SUBJECT TO INCORPORATION OF CHANGES INDICATED.

3 [ ] REVISE AND RESUBMIT. WORK MAY NOT PROCEED

4 [ ] REVIEW NOT REQUIRED WORK MAY PROCEED

[ ] INFORMATION ONLY

[ ] DISTRIBUTION REQ'D

H0960121(3/78)

Hay... - ..fler
PUMP COMPANY

HYDROSTATIC TEST CERTIFICATE

R209XR.241AHT

HTC-1

HT-BR-1051

CONTRACT 2-0173-8641	
EQUIPMENT/ASSEMBLY Casing assembly	SERIAL NUMBER 8041-01 / DATE 3/2/78
PROJECT NAME 18x20x26 NHD(?)	PART NUMBER 01-500-021
CUSTOMER P.O.	TEST PROCEDURE 2.3.7/3-1 Rev 4 / DATE 2/3/77

ITEM	PARTS INCLUDED	PART NUMBER	BATCH/SERIAL
Casing assy	upper & lower	01-500-021	E979-001. E979-002
Gland	Gland	20-15133	E871-002 E875-002
tubing	seal flush tubing	01-500-04	G071

START TIME 10:05 AM	FINISH TIME 10:35 AM	DURATION 30 min MIN.	
TEST MEDIUM COLD WATER@ 45 DEGREES F		TEST PRESSURE 232 PSIG	
GAUGE NO. HTS 21-011	RANGE 0-400	CALIBRATED 3/2/78	BY RP

DEVIATIONS NOTED DURING TEST

NONE

Received by STP RMS 5-14-82
DATE
at Revision — [illegible]
RMS

Q.A. 22

TEST ACCEPTANCE OF THE ABOVE PARTS TO THE ABOVE PROCEDURE

A.I. J. McLanahan	DATE 3/3/78	CUSTOMER	DATE
OPERATOR R Pfannenstiel	DATE 3/2/78	INSPECTOR R.W. McMillan	DATE 3/2/78

R209XR.1241A HT

14926-4022-01055 AHT
14926-8022-01055 AHT TURNOVER

151

Maximum Allowable

Nozzle Loads

Nozzle	Conditions	Force (lbs.)			Moment (ft.-lb.)		
		Fx	Fy	Fz	Mx	My	Mz
Suction	Normal	8000	8000	8000	20,000	20,000	20,000
Discharge	Normal	6500	6500	6500	16,000	16,000	16,000
Suction	Faulted	10,000	10,000	10,000	25,000	25,000	25,000
Discharge	Faulted	8000	8000	8000	20,000	20,000	20,000

PUMP SUCTION

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION COVER SHEET

SHEET 1

CALC. NO. 5R209RC0034

SUBJECT: STRESS ANALYSIS FOR COMPONENT COOLING WATER SYSTEM FROM ANCHOR CH-1080-[illegible].5002 TO PENET. M-26, M-34 AND CCW PUMP 1A. FROM 30"CC-1435 HEADER TO CCW PUMP 1B & 1C. AND PENET. M-38, M-22, M-26 & M-28

FILE NO. N/A

DISCIPLINE PSSG

RECORD OF ISSUE								
REV. NO.	DESCRIPTION	TOTAL NO. OF SHEETS	ORIG	CKR	GL	GS	CHIEF	DATE
0	COMMITTED CALC. ISSUED FOR USE	←	SEE	MICROFICHE			N/A	→
1	COMMITTED CALC. REVISED DUE TO RELOCATION OF SUPPORTS	311	[signature]	G.Z.	JSS	GKP	N/A	6/14/85
							N/A	

INFORMATION ENTERED IN THIS SPACE:

- SHOW PROFESSIONAL ENGINEER STAMP, IF REQUIRED.
- ENTER REFERENCE TO INCLUSION OF CHECKER'S ALTERNATE CALCULATIONS, IF USED.
- PROVIDE ANY NOTES TO ASSIST CHECKING AND APPROVAL
- MAY LIST STANDARD COMPUTER PROGRAM (SCP) IDENTIFICATION INCLUDING VERSION AND OPTION USED.

This calculation is for ☐ Unit 1; ☐ Unit 2: ☒ Units 1 & 2

ME 101 Version: K2

Date Released: March 21, 1985

SNUM Nos.: VX060 , VX153B

Date of Run: 5/25/85 , 5/25/85

STP 1309 (7/84)

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-0034

SUBJECT SEE THE COVER SHEET

SHEET NO. 100

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	[signature]	5/29/85	G.Z.	6/12/85					

5.2 Nozzle Load Summary

EQUIPMENT/TPNS # CCW PUMP 1A (3R201NPA101A) SUCTION

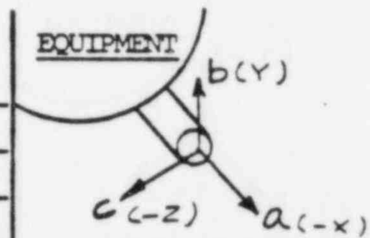
PIPE SIZE & NOZZLE DESCRIPTION 20"

REFERENCE FOR NOZZLE ALLOWABLES 3R209NS011-D

DATA POINT 295 MEETS THE ALLOWABLE (YES/NO)

CAD/FAB ISO NO. 5M369PCC207 SHT 07, Rev. 3 LINE NO. 20"CC-1110-WA3

EQUIPMENT



Local Axis Orientation

LOAD CASE		FORCES (LB) Fa AXIAL	Fb SHEAR	Fc SHEAR	Fv or Fr	MOMENTS (FT-LB) Ma TORSION	Mb BENDING	Mc BENDING	Me or Mr
NORMAL (P)									
NORMAL (N)									
UPSET (P)									
UPSET (N)									
FAULTED (P)									
FAULTED (N)									
NORMAL	CALC.	419	2681	1954		2135	5216	7451	
	ALLOW	8000	8000	8000		20,000	20,000	20,000	
UPSET	CALC.								
	ALLOW					N/A			
FAULTED	CALC.	3709	7240	7014		9244	15249	18861	
	ALLOW	10,000	10,000	10,000		25,000	25,000	25,000	
	CALC.								
	ALLOW								

NOTES:

1. Fv = SRSS of two shear components
   M_B = SRSS of two bending components
2. Fr = SRSS of all three force components
   Mr = SRSS of all three moment components
3. Local 'a' is towards GLOBAL -X (NORTH)
4. NORMAL AND FAULTED LOAD COMBINATIONS
   SEE NEXT PAGE

STP 1310 (7/84)

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-0034

SHEET NO. 101

SUBJECT SEE THE COVER SHEET

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	Sze-cheng Fong	5/28/85	G.Z.	6/13/85					

5.2 NOZZLE LOAD SUMMARY (CONT'D)

DATA POINT : 295

LOAD CASE	FORCES (LB)			MOMENTS (FT-LB)		
	Fa	Fb	Fc	Ma	Mb	Mc
	AXIAL	SHEAR	SHEAR	TORSION	BENDING	BENDING
WEIGHT	67	-619	-295	-270	831	18
THRM1	93	-2041	-1164	-1117	3562	-7124
THRM2	344	292	385	2234	2831	-633
THRM3	327	95	457	2085	2402	-1167
THRM4	89	-1829	-1659	-1677	4385	-6845
THRM5	66	-2062	-1577	-1865	3868	-7469
THRM6	352	366	355	2266	2967	-446
NORMAL	419	2681	1954	2135	5216	7451
THRM7	-4	-2526	-2840	-3605	5744	-9231
MRS2 (S.S.E)*	3290	4095	3879	5369	8674	9648
SAM2 (S.S.E)	1	7	5	7	4	16
FAULTED	3709	7240	7014	9244	15249	18861

NOTE : 1. NORMAL = THERMAL + WEIGHT

2. FAULTED = THERMAL + WEIGHT + $[(S.S.E)^2 + SAM2\,(S.S.E)^2]^{1/2}$

* FROM ME101 RUN# VX153B, DATED 5/25/85

STP 1310 (7/84)

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-0034

SUBJECT SEE THE COVER SHEET

SHEET NO. 102

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	[signature]	5/28/85	G.Z	6/13/85					

5.2 Nozzle Load Summary

EQUIPMENT/TPNS # CCW PUMP 1B (3R201NPA101B) SUCTION

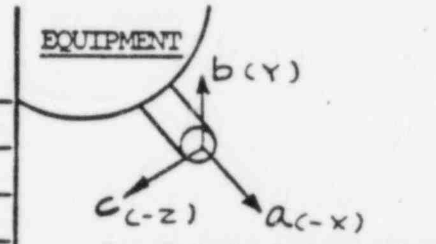
PIPE SIZE & NOZZLE DESCRIPTION 20"

REFERENCE FOR NOZZLE ALLOWABLES 3R209NS011-D

DATA POINT 435 MEETS THE ALLOWABLE (YES/NO)

CAD/FAB ISO NO. 5M369PCC207 SHT. 22, REV. 4 LINE NO. 20"CC-1210-WA3

EQUIPMENT



Local Axis Orientation

LOAD CASE		FORCES (LB) Fa AXIAL	Fb SHEAR	Fc SHEAR	Fv or Fr	MOMENTS (FT-LB) Ma TORSION	Mb BENDING	Mc BENDING	Mb or Mr
NORMAL (P)									
NORMAL (N)									
UPSET (P)									
UPSET (N)									
FAULTED (P)									
FAULTED (N)									
NORMAL	CALC.	925	2092	3075		2082	10550	2652	
	ALLOW	8000	8000	8000		20000	20000	20000	
UPSET	CALC.				N/A				
	ALLOW								
FAULTED	CALC.	3951	5773	9073		8113	23633	9135	
	ALLOW	10000	10000	10000		25000	25000	25000	
	CALC.								
	ALLOW								

NOTES:

1. Fv = SRSS of two shear components
   M_B = SRSS of two bending components
2. Fr = SRSS of all three force components
   Mr = SRSS of all three moment components
3. Local 'a' is towards GLOBAL -X (NORTH)
4. NORMAL AND FAULTED LOAD COMBINATIONS SEE NEXT PAGE

STP 1310 (7/84)

SUBJECT SEE THE COVER SHEET

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	Jyncheng Feng	5/28/85	G.Z.	6/13/85					

5.2. NOZZLE LOAD SUMMARY (CONT'D)

DATA POINT: 435

LOAD CASE	FORCES (LB)			MOMENTS (FT-LB)		
	Fa	Fb	Fc	Ma	Mb	Mc
	AXIAL	SHEAR	SHEAR	TORSION	BENDING	BENDING
WEIGHT	99	16	-527	-729	1016	1473
THRM1	-652	220	96	1910	3481	994
THRM2	-928	-2108	-2069	-918	7671	-3915
THRM3	-505	161	48	1413	2802	749
THRM4	-1024	-1495	-2488	-729	9534	-2407
THRM5	-647	301	81	2008	3625	1179
THRM6	-841	-1565	-2548	-1353	8681	-2706
NORMAL	925	2092	3075	2082	10550	2652
THRM7	-1142	-1806	-3812	-1779	12933	-2917
MRS2 (S.S.E) *	2908	3681	4734	5605	9684	7691
SAM2 (S.S.E)	8	18	31	30	59	35
FAULTED	3951	5773	9073	8113	23633	9135

NOTE: 1. NORMAL = THERMAL + WEIGHT

2. FAULTED = THERMAL + WEIGHT + $[(S.S.E)^2 + SAM2(S.S.E)^2]^{1/2}$

* FROM ME101 RUN# VX153B, DATED 5/25/85

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-0034

SUBJECT: SEE THE COVER SHEET

SHEET NO. 104

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	Jyrcheng Feng	5/28/85	G.Z	6/13/85					

5.2 Nozzle Load Summary

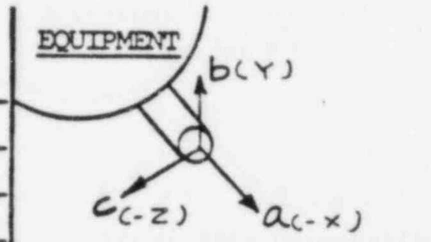
EQUIPMENT/TPNS # CCW PUMP 1C (3R201NPA101C) SUCTION

PIPE SIZE & NOZZLE DESCRIPTION 20"

REFERENCE FOR NOZZLE ALLOWABLES 3R209NS011-D

DATA POINT 750 MEETS THE ALLOWABLE (YES/NO) _

CAD/FAB ISO NO. 5M369PCC207 SHT. 01 Rev. 2 LINE NO. 20"CC-1310-WA3



Local Axis Orientation

LOAD CASE		FORCES (LB) Fa AXIAL	Fb SHEAR	Fc SHEAR	Fv or Fr	MOMENTS (FT-LB) Ma TORSION	Mb BENDING	Mc BENDING	Mb or Mr
NORMAL (P)									
NORMAL (N)									
UPSET (P)									
UPSET (N)									
FAULTED (P)									
FAULTED (N)									
NORMAL	CALC.	501	3762	1930		2361	4728	6599	
	ALLOW	8000	8000	8000		20000	20000	20000	
UPSET	CALC.				N/A				
	ALLOW								
FAULTED	CALC.	4544	9825	5660		7252	14652	20089	
	ALLOW	10000	10000	10000		25000	25000	25000	
	CALC.								
	ALLOW								

NOTES:

1. Fv = SRSS of two shear components
   M_B = SRSS of two bending components
2. Fr = SRSS of all three force components
   Mr = SRSS of all three moment components
3. Local 'a' is towards GLOBAL -X (NORTH)
4. NORMAL, AND FAULTED LOAD COMBINATIONS SEE NEXT PAGES

STP 1310 (7/84)

BECHTEL

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-0034

SUBJECT SEE THE COVER SHEET

SHEET NO. 105

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	Yu-cheng Fang	5/28/85	G.Z.	6/13/85					

5.2 NOZZLE LOAD SUMMARY (CONT'D)

DATA POINT : 750

LOAD CASE	FORCES (LB)			MOMENTS (FT-LB)		
	Fa	Fb	Fc	Ma	Mb	Mc
	AXIAL	SHEAR	SHEAR	TORSION	BENDING	BENDING
WEIGHT	103	-87	-623	-758	1372	1230
THRM1	-147	399	-233	142	1293	1109
THRM2	-62	514	-309	-88	1057	1278
THRM3	-542	-3675	-1131	-1523	2647	-7829
THRM4	-152	629	-315	261	1660	1658
THRM5	-604	-3661	-1217	-1313	3356	-7699
THRM6	-498	-3528	-1307	-1603	3046	-7512
NORMAL	501	3762	1930	2361	4728	6599
THRM7	-715	-4795	-1994	-2021	5129	-10115
MRS2 (S.S.E)*	3932	4943	3043	4473	8151	11203
SAM2 (S.S.E)	15	52	18	18	58	130
FAULTED	4544	9825	5660	7252	14652	20089

NOTE: 1. NORMAL = THERMAL + WEIGHT

2. FAULTED = THERMAL + WEIGHT + $[(S.S.E)^2 + SAM2\ (S.S.E)^2]^{1/2}$

* FROM ME101 RUN# VX1538, DATED 5/25/85

STP 1310 (7/84)

PUMP DISCHARGE

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION COVER SHEET

SHEET 1

CALC. NO. 3R209RC0035

SUBJECT STRESS ANALYSIS OF COMPONENT COOLING WATER FROM 30" HEADER TO HEAT EXCHANGERS 1A, 1B, 1C & PUMPS 1A, 1B & 1C

FILE NO. N/A

DISCIPLINE PSSG

RECORD OF ISSUE								
REV. NO.	DESCRIPTION	TOTAL NO. OF SHEETS	ORIG	CKR	GL	GS	CHIEF	DATE
0	COMMITTED CALC. ISSUED FOR USE	← SEE MICROFICHE					N/A	→
1	COMMITTED CALC. REANALYSED DUE TO RELOCATION OF SUPPORTS	200	[signature]	[signature]	G.Z. / [signature]	[signature]	N/A	3/15/85
2	COMMITTED CALC. SHEETS 54 THRU 58 REVISED	200	[signature]	G.Z.	[signature]	[signature]	N/A	5/10/85

INFORMATION ENTERED IN THIS SPACE:

- SHOW PROFESSIONAL ENGINEER STAMP, IF REQUIRED.
- ENTER REFERENCE TO INCLUSION OF CHECKER'S ALTERNATE CALCULATIONS, IF USED.
- PROVIDE ANY NOTES TO ASSIST CHECKING AND APPROVAL.
- MAY LIST STANDARD COMPUTER PROGRAM (SCP) IDENTIFICATION INCLUDING VERSION AND OPTION USED.

This calculation is for ☐ Unit 1; ☐ Unit 2: ☒ Units 1 & 2

ME 101 Version: K1**

Date Released: April 15, 1984

SNUM Nos.: VX661 & VX663

Date of Run: 2/14/85 & 2/15/85 RESPY.

** Version K1 was loaded on Univac System B on July 10, 1984

STP 1309 (7/84)

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-035

SUBJECT SEE THE COVER SHEET

SHEET NO. 48

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	[signature]	2/21/85	[signature]	3/15/85					

5.2 Nozzle Load Summary

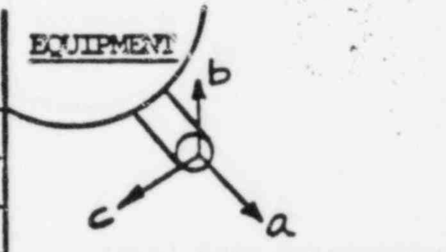
EQUIPMENT/TPNS # 3R201NPA101A /R209X001EHT

PIPE SIZE & NOZZLE DESCRIPTION 18" PUMP DISCHARGE

REFERENCE FOR NOZZLE ALLOWABLES 3R209NS011-D

DATA POINT 910 MEETS THE ALLOWABLE (YES/NO) — YES circled

CAD/FAB ISO NO. 5M369PCC207SH.10 LINE NO. 18"-CC-1101-WA3



Local Axis Orientation

LOAD CASE		FORCES (LB) Fa AXIAL	Fb SHEAR	Fc SHEAR	Fv or Fr	MOMENTS (FT-LB) Ma TORSION	Mb BENDING	Mc BENDING	Mb or Mr
NORMAL (P)		51	0	690		1677	0	250	
NORMAL (N)		83	2480	0		815	3849	2751	
UPSET (P)		1359	1659	2644		4567	3635	5762	
UPSET (N)		1392	4772	1905		3705	9038	8264	
FAULTED (P)		1914	2299	3232		5873	5697	7439	
FAULTED (N)		1947	5412	2494		5011	11099	9941	
NORMAL	CALC.	83	2480	690		1677	3849	2751	
	ALLOW	6500	6500	6500		16000	16000	16000	
UPSET	CALC.								
	ALLOW								
FAULTED	CALC.	1947	5412	3232		5873	11099	9941	
	ALLOW	8000	8000	8000		20000	20000	20000	
	CALC.								
	ALLOW								

NOTES:

1. Fv = SRSS of two shear components
   M_B = SRSS of two bending components
2. Fr = SRSS of all three force components
   Mr = SRSS of all three moment components
3. Local 'a' is towards GLOBAL X

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-035

SUBJECT SEE THE COVER SHEET

SHEET NO. 49

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	A. Paz	2/21/85	McDesen	3/15/85					

5.2 Nozzle Load Summary

EQUIPMENT/TPNS # 3R201NPA101B/R209X001EHT

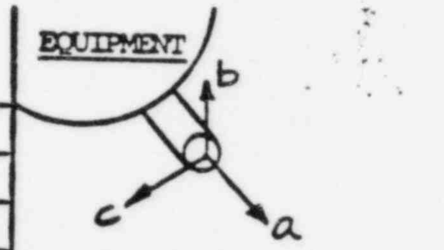
PIPE SIZE & NOZZLE DESCRIPTION 18" PUMP DISCHARGE

REFERENCE FOR NOZZLE ALLOWABLES 3R209NS011-D

DATA POINT 645 MEETS THE ALLOWABLE (YES/NO) (YES circled)

CAD/FAB ISO NO. 3M369PCC207 SH.13 LINE NO. 18"-CC-1201-WA9

EQUIPMENT



Local Axis Orientation

LOAD CASE		FORCES (LB) Fa AXIAL	Fb SHEAR	Fc SHEAR	Fv or Fr	MOMENTS (FT-LB) Ma TORSION	Mb BENDING	Mc BENDING	Mв or Mr
NORMAL (P)		15	0	1339		7954	0	371	
NORMAL (N)		114	3100	0		0	285	5685	
UPSET (P)		1618	2018	3057		10608	4602	5007	
UPSET (N)		1717	5471	1640		2575	5041	10321	
FAULTED (P)		1931	2527	3529		11445	5998	6191	
FAULTED (N)		2029	5979	2111		3412	6437	11505	
NORMAL	CALC.	114	3100	1339		7954	285	5685	
	ALLOW	6500	6500	6500		16000	16000	16000	
UPSET	CALC.								
	ALLOW								
FAULTED	CALC.	2029	5979	3529		11445	6437	11505	
	ALLOW	8000	8000	8000		20000	20000	20000	
	CALC.								
	ALLOW								

NOTES:

1. Fv = SRSS of two shear components
   M_B = SRSS of two bending components

2. Fr = SRSS of all three force components
   Mr = SRSS of all three moment components

3. Local 'a' is towards GLOBAL X

SOUTH TEXAS PROJECT
JOB NO. 14926
CALCULATION SHEET

CALC NO. RC-035

SUBJECT SEE THE COVER SHEET

SHEET NO. 50

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	A.S. Pelz	2/21/85	McDesar	3/15/85					

5.2 Nozzle Load Summary

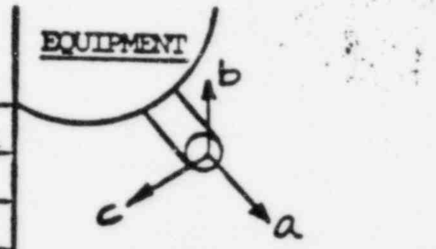
EQUIPMENT/TPNS # 3R201NPA101C/R209X001EHT

PIPE SIZE & NOZZLE DESCRIPTION 18" PUMP DISCHARGE

REFERENCE FOR NOZZLE ALLOWABLES 3R209NS011-D

DATA POINT 410 MEETS THE ALLOWABLE (YES/NO) — YES circled

CAD/FAB ISO NO. 4M369PCC207 SH.9 LINE NO. 18"-CC-1301-WA3



Local Axis Orientation

LOAD CASE		FORCES (LB) Fa AXIAL	Fb SHEAR	Fc SHEAR	Fv or Fr	MOMENTS (FT-LB) Ma TORSION	Mb BENDING	Mc BENDING	MB or Mr
NORMAL (P)		45	0	870		4582	576	300	
NORMAL (N)		0	1623	0		0	469	2808	
UPSET (P)		1076	2407	1825		6098	2921	6366	
UPSET (N)		998	4395	823		1450	2814	8873	
FAULTED (P)		1419	3237	2230		6624	4079	8192	
FAULTED (N)		1341	5225	1228		1976	3972	10700	
NORMAL	CALC.	45	1623	870		4582	576	2808	
	ALLOW	6500	6500	6500		16000	16000	16000	
UPSET	CALC.								
	ALLOW								
FAULTED	CALC.	1419	5225	2230		6624	4079	10700	
	ALLOW	8000	8000	8000		20 000	20000	20000	
	CALC.								
	ALLOW								

NOTES:

1. Fv = SRSS of two shear components
   M_B = SRSS of two bending components
2. Fr = SRSS of all three force components
   Mr = SRSS of all three moment components
3. Local 'a' is towards GLOBAL X

June 26, 1985
~~June 25, 1985~~

TO: Bill Guerin, Licensing

REF: Conversation with Mr. E. Radobaugh on 6/25/85 regarding faulted stresses in the TGX RCP casing suction nozzle, Table I of E.M. 5003, Rev. 1.

REPLY: We repeated the calculation performed by Mr. Rodabaugh and have resolved the difficulty as follows:

1. E.M. 5003, Rev. 1, Table VII, does not contain the footnote (2) on safe-end evaluation found in Table V of Interim Rev. 2 to G-952342-2, Rev. 2, which defines the nozzle loads. This was not clearly defined in the report, which has the effect of eliminating the pipe rupture cases (labeled "a" and "b" in Table VII) from consideration at the safe-end. Therefore, the stresses reported in Table I of E.M. 5003, Rev. 1, do not include any contribution from the safe-end Elements 1 and 2 for rupture cases "a" and "b." The footnote discussed above will be added to EM 5003 in a subsequent revision

2. The reported 33,000 psi stresses in E.M. 5003, Rev. 1, are generated from the remaining case "a" blowdown. We generated, manually, for Elment 1, the same values generated by the computer after 1) combining the applied moments and forces per the rules of specifications (or Table V of E.M. 5003, Rev. 1) and 2) calculating tensile and shear stresses. We used the 3099 in.^{3} section modulus obtained by treating the nozzle safe-end (Element 1) as a simple pipe. Combining all the tensiles and shears, the loading generates, approximately, a 29,000 psi stress intensity. The reported 33,000 value is obtained by combining casing hoop stresses (generated by pressure in the casing) with the shear stress due to loading on the nozzle.

Our conclusion is that there is nothing wrong with the reported values. Admittedly, the report is unclear on the treatment of the safe-end of the nozzle. We trust that this explanation will be sufficient at this time.

I can be reached at 412/963-5565 if there are any questions.

R. F. Guerin

WESTINGHOUSE ELECTRO-MECHANICAL DIVISION
MOTOR OPERATED GATE VALVE TEST REPORT

SHEET 1 OF 1
PAGE 1

WEMD VALVE ID 08000GM84FEB0D025W750001
CUSTOMER IDENTIFICATION VALVE I.D. 8-GM74FCA
ASME PRESSURE CLASS 316 DESIGN PRESSURE 600 PSI AT 400 °F
VALVE SIZE 8 INCHES SHOP ORDER H048 ASME CLASS 1
MOTOR OP MFG. Limitorque MODEL SB NO. 246834
TESTED IN ACCORDANCE WITH TEST SPECIFICATION 7?5099 REV. H

TEST INSTRUCTIONS PER: ☒ ROUTING
☐ VTP NO. 10 REV. ______
☐ ______

HYDROSTATIC SHELL TEST	TEST GAGE INSTRUMENT # 3441 CALIBRATION DATE 11-7-77 TEST PRESSURE 1220 (PSIG) TEST DURATION 10 (MIN) AUTHORIZED INSPECTOR [signature] SIGNATURE 11-9-77 DATE IDENT. STAMP [stamp] TEST COMPLETED BY J.J. Lammert SIGNATURE 11-9-77 DATE
BACKSEAT LEAKAGE TEST	TEST DURATION 10 MINUTES MINIMUM TEST PRESSURE 1220 (PSIG) LEAK RATE 0.6 (CC/HR) TEST COMPLETED BY J.J. Lammert SIGNATURE 11-9-77 DATE
PACKING LEAKAGE TEST	TEST DURATION 10 MINUTES MINIMUM TEST PRESSURE 615 (PSIG) LEAK RATE 0.0 (CC/HR) TEST COMPLETED BY J.J. Lammert SIGNATURE 11-9-77 DATE
DISC HYDROSTATIC LEAKAGE TEST	TEST GAGE INSTRUMENT # 3431 CALIBRATION DATE 10/20/77 TEST DURATION 10 (MINUTES EACH SEAT) TEST PRESSURE 920 (PSID) LEAK RATE "A" SEAT 1.8 (CC/HR) TEST PRESSURE 920 (PSID) LEAK RATE "B" SEAT 1.2 (CC/HR) AUTHORIZED INSPECTOR [signature] SIGNATURE 11-9-77 DATE IDENT. STAMP [stamp] TEST COMPLETED BY J.J. Lammert SIGNATURE 11-9-77 DATE
COMMENTS	VDP-PAGE 6 OF ____

BECHTEL
LOS ANGELES POWER DIVISION

CALCULATION COVER SHEET

3

PROJECT South Texas Project JOB NO. 14926-001 SHEET 1 OF —

SUBJECT Containment Spray Pump Discharge Train A TOTAL NO. OF SHEETS 85

FILE NO. N/A

ORIGINATOR SIG. [signature] DISCIPLINE PSSG DATE 6/22/82 CALC. NO. 5N129RC0011

CHECKER SIG. [signature] PSSG DATE 7/12/82 QUALITY CLASSIF. 2

RECORD OF ORIGINAL ISSUE AND REVISIONS

REV. NO.	REVISION DESCRIPTION	DATE	ORIG	CKR	GL	GS	CHIEF
0	Issued For use.	7/12/82	[signature]	[signature]	[signature]	[signature]	—
1	Revised & issued for use	6/25/83	[signature]	[signature]	L. Syed	[signature]	—
2	Revised Sh's 34, 58, 59, 61, 63. New Support numbers.	10/20/83	[signature]	[signature]	L. Syed	[signature]	—
3	Added valve and incorporated support changes	4/12/84	[signature]	E.S.	LS/[signature]	[signature]	—

RESULTS OF CHECKER REVIEW

	ITEM DESCRIPTION		ORIG. ISSUE	REVISION NO. 1	2	3			
MUST INITIAL ONE	FINAL RESULT NUMERICAL DIFFERENCES ARE NOT SIGNIFICANT; NO CORRECTIONS NECESSARY	INITIAL	RKD	[initials]	[initials]	E.S.			
		DATE	7/12/82	6/25/83	10/20/83	4/18/84			
	FINAL RESULT NUMERICAL DIFFERENCES ARE SIGNIFICANT, NECESSARY CORRECTIONS HAVE BEEN MADE.	INITIAL							
		DATE							
	CHECK MADE BY ATTACHED ALTERNATE CALCULATIONS.	INITIAL							
		DATE							

This calculation is for Units 1&2.

ME101 Version J5
Released 12/15/83

SNUM: X2002, X2024
Run Date: 4/2/84, 4/2/84

Open Items: See Sheet 8.

3

COMMITTED

LAO-1855 9/80

CALCULATION SHEET
P. O. BOX 2166
HOUSTON, TEXAS 77252-2166

SIGNATURE [signature] DATE 4/2/84 CHECKED E. Shen DATE 4/3/84 CALC. NO. PCQ011

PROJECT SOUTH TEXAS PROJECT JOB NO. 14926-001

SUBJECT See Calc. Cover Sh. SHEET 63 OF — SHEET

5.7 PIPING END LOADS FOR ACTIVE VALVES - (WESTINGHOUSE VALVES ONLY)

Valve No. XCS001A — Pipe Size, OD = 8.625 IN

Data Pt. 36, 42 — Metal Area, A = 8.4 IN^2

Piping Mat. SA312TP304L — Section Modulus, Z = 16.81 IN^3

Yield Strength σ_y = 19870 Ref 2.19 — Thickness, t = 0.322 IN

(at MAX. OP TEMP)

LOADING CONDITION	FORCES (LB)			MOMENTS (IN-LB)		
	Fa Axial	Fb Shear	Fc Shear	Ma Torsion	Mb Bending	Mc Bending
(t) Thermal	1225	117	-286	4382	-45777	-22156
(1) Gravity	-10	-1448	0	1171	113	9021/-11786
(2) SSE	336	259	185	2214	6129	11471
(3) SAM (SSE)	166	20	69	810	12409	3545
(4) DBA	13	-13	-7	-141	-1350	2313
Other (Note: 2) N/A	—	—	—	—	—	—
(5) Total (Note: 3)	1603	1721	490	7911	60854; $\sqrt{Mb^2 + Mc^2}$ = 76253	45948
(6) Allowables (Note: 1)	X	X	X	167,000	167,000	
(7) Maximum Principal Stresses	σ max = 7500			Ratio = (σ max/.75 σ_y) = 0.50		

Notes: (1) Torsional Moment = 0.5 σ_y Z (IN-LB)
Bending Moment = 0.5 σ_y Z (IN-LB)
Design Pressure P= 400 PSIG

(2) Other: (Specify) Water Hammer, Steam Hammer, Thrust Load, etc.

(3) Load combination in accordance with Table 4 of piping stress analysis criteria

Fa/A	$\sqrt{Mb^2+Mc^2}$ / Z	$\sqrt{Fb^2+Fc^2}$ / A	Ma/2Z	PD/4t	σ_a=(a)+(b)+(e)	$\sigma_\phi = \frac{PD}{2t}$	T=(c)+(d
(a)	(b)	(c)	(d)	(e)	(f)	(h)	(j)
191	4536	213	235	2679	7406	5357	448

Principal Stresses $\sigma_1, \sigma_2, \sigma_3$	$\sigma_1, \sigma_2 = 0.5 [(\sigma_a + \sigma_\phi) \pm \sqrt{(\sigma_a - \sigma_\phi)^2 + 4T^2}]$	σ_3 = P
σ_{max} = Max of ($\sigma_1, \sigma_2, \sigma_3$)	σ_1 = 7500 , σ_2 = 5263	σ_3 = 400

HO-90101 (10/81)

Attachment C

LIST OF ATTENDEES

N. P. Kadambi	USNRC Project Manager
Y. C. (Renne) Li	USNRC MEB
E. Rodabaugh	USNRC MEB Consultant
S. E. Moore	USNRC MEB Consultant
M. R. Wisenburg	HL&P Manager, Nuclear Licensing
C. A. Ayala	HL&P Licensing
J. G. White	HL&P Engineering
G. D. Purdon	HL&P Engineering
C. R. Allen	HL&P Engineering
A. B. Poole	HL&P Engineering
S. D. Antonio	HL&P Engineering
R. A. Witthauer	Bechtel Engineering
R. Singh	Bechtel Engineering
J. Shiu	Bechtel Engineering
M. V. Contaoi	Bechtel Engineering
R. Qasha	Bechtel Engineering
C. Chern	Bechtel Engineering
M. Khallafallah	Bechtel Engineering
D. Getman	Bechtel Engineering
M. Jante	Bechtel Engineering
G. Borden	Bechtel Engineering
W. F. Guerin	Westinghouse
A. T. Paterson	Westinghouse
T. Matty	Westinghouse
D. Tome	Westinghouse
C. Boyd	Westinghouse
D. J. Roarty	Westinghouse