BROWN & ROOT, INC. CPSES JOB 35-1195	PROCEDURE NUMBER	REVISION	EFFECTIVE DATE	PAGE
	CI-CPM 8.2	5	4/29/83	1 of 3

TITLE: CONTROL OF SPARE PARTS QCn#1	ORIGINATOR: [signature] 26 APR 83 DATE REVIEWED BY: [initials] 4/26/83 [signature] B&R QA 4/26/83 DATE [signature] TUGCO QA 4/27/83 DATE APPROVED BY [signature] CONSTRUCTION PROJECT MANAGER 4-28-83 DATE

FOR OFFICE AND ENGINEERING USE ONLY

0.1 TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this procedure is to control the storage, issuance, and use of bulk spare parts and W renewal parts.

2.0 PROCEDURE

2.1 RECEIPT

Spare parts shall be received in accordance with CPM 8.1.

2.2 STORAGE

These parts shall be stored by segregating from other parts and shall be identified as spare parts by physically marking each part, the parts' container, or storing in a segregated area designated by signs or barriers as spare parts storage.

2.3 ISSUANCE

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2.3.1 Bulk Spare Parts

Issuance of bulk spare parts, and return of spare parts to the warehouse, shall be in accordance with CP-CPM 8.1. The issuance of spare parts procured other than QA Code "A" and/or non-safety related (as referenced in TNE-PR-3) shall be authorized by a Component Parts Safety Evaluation form (CPSE; Exhibit 8.1) approved by TUSI Nuclear Engineer (TNE) before issuance of the

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JOB 35-1195
Comanche Peak Steam Electric Station

Construction Procedure
DOCUMENT CHANGE NOTICE NUMBER 1

This notice applies to Construction Procedure No. 35-1195- CPM-8.2 Revision 5 .

This change will be incorporated in the next revision of the procedure.

Change the procedure as follows:

Replace the following with the attached:

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	Reviewed by:
Originator Date 5/31/83	Brown & Root Quality Assurance Date 6/1/83
	Reviewed by:
Approved by:	TUGCO Quality Assurance Date 6/1/83
Construction Project Manager Date 6-2-83	June 3, 1983 Effective Date

purchase order or upon requisitioning the items from the warehouse. Those items procured QA Code "A" designated to specified equipment tag number(s) do not require a CPSE. Those items procured Non-Safety Related also do not require CPSE.

Additionally one of the following documents shall accompany the CPSE form:

1. Operation Traveler (OT; prepared in accordance with CP-CPM 6.3 and approved by the discipline CPPE);
2. Maintenance Action Request (MAR: prepared in accordance with SAP-6).

Either form shall specify exactly on which item the spare part will be used, and exactly where on the item the spare part will be used. Additionally, either form shall reference the purchase order number by which the spare part was purchased.

Component Parts Safety Classification Evaluation Form

Items 1-12(c) are completed by the requisitioning party. The remaining items are completed by TNE in accordance with TNE-PR-3.

After completion, the OT or MAR and evaluation form are returned to the requisitioning party.

2.3.2 W/NSSS Renewal Parts

Issuance of W/NSSS renewal parts shall be in accordance with CP-CPM 8.1 and paragraph 2.3.1, except the CPSE form shall not be required.

2.3.3 ASME Parts other than Westinghouse

Issuance of ASME spare/replacement parts need only be documented on an Operation Traveler and controlled in accordance with this instruction. The balance of this procedure is not applicable to ASME items.

2.4 CONTROL OF USAGE

The item shall be used as specified on the OT or MAR. Deviations to the specified usage shall not be permitted unless the changes are approved by TNE and documented on the OT or MAR in accordance with the applicable procedure.

The use of a higher quality classed item than that which was specified is permitted without additional approval (e.g., an "A" item may be used when a "C" item is specified). A lower quality classed item shall not be used when a higher class is specified (e.g., a "C" item cannot be used when an "A" item is specified).

EXHIBIT 8.1

COMPONENT PARTS
SAFETY CLASSIFICATION EVALUATION
(TYPICAL)

1. FIELD REQUISITION NO. ______________ 2. TNE REFERENCE NO. ____________
3. EQUIPMENT ______________ 4. MODEL/TYPE ____________
5. VENDOR ______________ 6. P.O. NO. ____________
7. EQUIPMENT SAFETY CLASSIFICATION & FUNCTION:

ANS SC-1______, SC-2______, SC-3______, NNS______, N/A______

IEEE 1E______, Associated 1E______, NON-1E______, N/A______

SEISMIC CAT. I.______, II______, NONE______

EQUIPMENT SAFETY FUNCTION ______________

8. MANUFACTURER ______________ 9. TAG NUMBER ____________
10. MANUFACTURER'S REFERENCE DRWG. ______________
11. CPSES REFERENCE DRWG. ______________
12. COMPONENT PART OR MATERIAL ______________

(a)Name or Description	(b)Manufacturer	(c)Part No.	(d)Safety/ Non-Safety	(e)Procurement Code	(f)Generic Applicability

13. REMARKS ______________

14. SOURCE DOCUMENTS USED TO DETERMINE PARTS 12(d) & 12(e) ______________

ORIGINATOR ______________ EXT. ________ DATE: ________

EVALUATOR ______________ DATE: ________

APPROVED BY ______________ DATE: ________

NOTES:

1) No evaluation is needed when a salvaged support or part is to be used on a lower Code class than for which it was originally supplied.

2) No evaluation is needed for NPT stamped component standard supports, if it is to be used on the same Code Class as originally manufactured.

3) Special Requirements for Snubber Salvaging

NPSI and ITT Grinnel parts or hardware should not be interchanged.

Snubbers and associated hardware may be used on component supports from the same vendor (NPSI, ITT), other than those for which they are designated, provided requirements of this instruction are met.

3.2 MATERIAL IDENTIFICATION

3.2.1 Material Identification Requirements

3.2.1.1 Vendor Supplied Component Supports

Vendor supplied NPT stamped component supports shall bear marking (i.e., name plate) traceable to the design drawing. Component supports requiring field welds at installation shall bear mechanically marked unique identification on each part traceable to the vendor data package.

3.2.1.2 Component Support Standards (Catalog items)

Component support standards such as shown in Attachment 15, shall be traceable to a Certificate of compliance until the material is received and verified by QC, and controlled until issuance for fabrication/installation in accordance with Brown & Root Quality Procedure CP-QAP-8.1.

The acceptability of the component support standard and fasteners for fabrication/installation is ensured by the vendors unique identification (i.e., letter code, MIC no., serial no., etc.) or a Brown and Root applied color code (Class 1 - Black, Class 2 and 3 - Green).

3.2.1.3 Brown and Root Fabricated/Modified Component Supports

Brown and Root fabricated class 1 component supports shall bear unique marking on each item of structural steel used in the fabrication of the component traceable to a Certified Material Test Report (CMTR). Structural steel used in the fabrication of class 2 and 3 component supports shall bear unique identification traceable to a Certificate of Compliance (C of C). Materials used to modify vendor supplied component supports shall also comply with the preceeding requirements.

3.2.1.4 Material Traceability Requirements

Material for component supports shall carry identification markings which will remain distinguishable until the fabrication and installation of the component support is accepted. If the original identification markings are cut off or the material is to be divided, the identification shall be accurately transferred to assure identification of each piece of material during subsequent fabrication or installation. QC shall verify marking transfer prior to separation.

3.2.2 Material Identification Documentation

3.2.2.1 Material Identification Log (MIL)/Structural Assembly Verification Card (SAVC)

During fabrication/installation of component supports material acceptability shall be verified by use of the MIL/SAVC. The QCI shall sign and date the MIL/SAVC to indicate that the materials listed are properly identified and documented.

NOTE: The shop/field QCI shall compare the entries on the MIL/SAVC to the respective MR to assure that the material has been verified by Receiving QCI, and is acceptable for its intended use. Copies of MR's for bulk material verified by shop QCI are not required to be included in the support package.

3.2.2.2 Material Requisition (MR)

The MR is used by Construction to requisition material for fabrication/installation. The entries on the MR shall be compared to the material being requisitioned and acceptable verification shall be denoted by Receiving QCI signature on the MR.

3.3 MATERIAL DIMENSIONAL CONTROL

The completed hanger shall be inspected to ensure compliance with the dimensional sketch on the hanger drawing.

NOTE: Any questions concerning component support standards' size and/or dimensional requirements shall be brought to the attention of QC Supervision. QC Supervision shall refer to PSE and the applicable vendor specifications. If a discrepancy exists, it shall be reported per CP-QAP-16.1.

3.3.1 General Fabrication and Installation Tolerances

Fabrication and installation shall be performed in accordance with the drawing detail and the following permissible tolerances:

3.3.1.1 Installation Tolerances

1. Base plate attachment ±1/4"

2. Hole Location ± 1/4" or as shown on the design drawing

3. Seismic Restraints

   a. Restraints, anchors, guides, etc.

      1) Pipe diameter 2½" and larger (Class 1, 2 and 3) and 2" and smaller ASME Class 1, support location shall be determined by Field Engineering. The QCI shall verify that the support is installed on the correct line and at the approximate elevation and location as shown on the design drawing (BRHL/GHH).

         NOTE: In certain cases Class 2 and 3, 2" and smaller supports have the same requirements as above (1). These are identified by the presence of a stress problem number on the design drawing.

      2) Location; pipe diameter 2" and smaller. ASME Class 2 and 3.

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Category 33 AQH 22 CP5

TO SSER Proofread 9/15/84

SSER

1. Allegation Group: Mechanical and Piping Category 33 (Heat Number Missing on Piece

2. Allegation number: AQH-22

3. Characterization: It was alleged that there was no heat number (HT. No.) marked on piece number 5 installed in pipe support mark no SI-2-073-401-S32R.

4. Assessment of safety significance: In a TRT interview with the alleger and a review of traveler package documentation the alleger provided clarification. He stated that although HT. Nos. were available in the receiving inspection report (RIR) 21236 QA Record Package (vault) the alleger could not determine the correct number to apply to piece 5. A dispute with the craft resulted, and the QC Inspection Supervisor deduced the correct number from the documentation and assigned a different inspector, not the alleger, to verify the transfer of HT. No. marking and QC sign off in the traveler documents.

The TRT reviewed support traveler documents consisting of the support drawing, material requisition (MR), request hanger or parts (request

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to fabrication shop), material identification log (MIL), weld data card, NPS Industries (NPSI) material tracer (shipper) and Brown & Root (B&R) RIR 21236.

THE TRT review of the above noted documentation found that the allegation, as described in the technical interview, with the alleger, was substantiated.

The TRT found that piece No. 5 was supplied by NPSI but erroneously identified on the NPSI material tracer as piece No. 6. The tracer documents the shipment of two different material items as piece No. 6. The TRT concurs with the deduced logic of the QA supervisor based on the following:

a. The correctly identified piece 6 on the NPSI tracer is for SA-240 TP 304 stainless steel plate, received at CP as bulk plate HT. No. (MIC) 8391NF to be cut by the B&R fab shop and issued as 3 pieces 3/4" x 14 ½" x 10½".

b. The erroneously identified piece No. 6 on the NPSI tracer (actually piece No. 5), was received at CP as SA-36 carbon steel 1 piece 3/4" 12 ½" x 12 ½" HT. No. (MIC) 5734NF.

There were three pieces of stainless steel plate of a specified dimension and one piece of carbon steel plate to a different specified dimension. Since the visible dimensions and material cosmetic differences are readily apparent the TRT finds that the error on the tracer is obvious.

The technical interview with the alleger inter infers an impropreity on the part of the QC Supervisor and General Foreman "So they got some poor 'ol inspector who wasn't too bright" in bypassing the alleger and assigning a different QC Inspector to verify transfer of the HT. No. deduced by the supervisor as the correct number.

The TRT interviewed the QC Supervisor who stated that the "Poor 'ol inspector" was under his supervision at the time. The supervisor also acknowledged that his endorsed correction on the MIL merely corrected a transcription error, in the HT. No., made by the inspector who verified the transfer. The TRT finds that the action performed by the supervisor did not violate any procedure. The TRT suggests however, that the QC Supervisor was remiss in not following up to obtain a corrected NPSI tracer.

The TRT does not agree with the alleger's inference of impropriety and finds that the QA Supervisor acted within his responsibility to identify and evaluate problems and assist in providing solutions. The TRT also finds it reasonable for a supervisor to select and assign personnel and to provide direction for personnel under his supervision.

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The TRT interviewed the B&R Material control Supervisor to confirm the error on the NPSI material tracer. The supervisor initiated immediate corrective action by telecon with NPSI. A corrected copy of the tracer was teletyped to B&R Material Control by NPSI September 13, 1984. The TRT verified the availability of the corrected copy. The erroneously identified item 6 was corrected to read item 5.

The TRT accepted a reasonable explanation by the B&R Material Control Supervisor that receiving inspection acceptance of the material with an error in the documentation was a random event in the large volume of shipments by NPSI to CP.

The TRT verified that the corrected tracer was added to the RIR 21236 QA Record Package and the Support (Hanger) Package.

5. Conclusion and staff positions: Since the assessment verified documented evidence and traceability of the correct heat number for the alleged piece number 5, the TRT concludes that there is no safety significance nor generic implication to the allegation.

6. Actions Required: None.

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[redacted]

8. Attachments: None

9. Reference documents:

   1. Receiving Inspection Record 21236
   2. Hanger Package SI-2-073-401-S32R
   3. Technical Interviews with Allerger, August 8 and 23, 1984

10. This statement prepared by: ______________________ ____________

Name Date

Reviewed by: ______________________ ____________

Group Leader Date

Approved by: ______________________ ____________

Project Director Date

SSER

1 - ALLEGATION GROUP   MECHANICAL & PIPING CATEGORY 53
HEAT NUMBER MISSING ON PIECE

2 - ALLEGATION NUMBER   AQH 22

3 - CHARACTERIZATION

IT WAS ALLEGED THAT THERE WAS NO HEAT NUMBER (HT. NO.) MARKED ON PIECE NUMBER 5 INSTALLED IN PIPE SUPPORT MARK NO SI-2-073-401-S32 R.

4 - ASSESSMENT OF SAFETY SIGNIFICANCE

IN A TRT INTERVIEW WITH THE ALLEGER AND A REVIEW OF TRAVELER PACKAGE DOCUMENTATION THE ALLEGER PROVIDED CLARIFICATION. HE STATED THAT ALTHOUGH HT. NOS. WERE AVAILABLE IN THE RECEIVING INSPECTION REPORT (RIR) 21236 QA RECORD PACKAGE (VAULT) THE ALLEGER COULD NOT DETERMINE THE CORRECT NUMBER TO APPLY TO PIECE 5. A DISPUTE WITH THE CRAFT RESULTED AND THE QC INSPECTION SUPERVISOR DEDUCED THE CORRECT NUMBER FROM THE DOCUMENTATION AND ASSIGNED A DIFFERENT INSPECTOR, NOT THE ALLEGER, TO VERIFY THE TRANSFER OF HT. NO. MARKING AND QC SIGN OFF IN THE TRAVELER DOCUMENTS.

THE TRT REVIEWED SUPPORT TRAVELER DOCUMENTS CONSISTING OF THE SUPPORT DRAWING, MATERIAL REQUISITION (MR), REQUEST HANGER OR PARTS (REQUEST TO FABRICATION SHOP), MATERIAL IDENTIFICATION LOG (MIL), WELD DATA CARD, NPS INDUSTRIES (NPSI) MATERIAL TRACER (SHIPPER) AND BROWN & ROOT (B&R) RIR 21236.

THE TRT ~~REVIEW~~ REVIEW OF THE ABOVE NOTED DOCUMENTATION FOUND THAT THE ALLEGATION, AS DESCRIBED IN THE TECHNICAL INTERVIEW,

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APH 22 [illegible]

WITH THE ALLEGER WAS SUBSTANTIATED.

THE TRT FOUND THAT PIECE NO. 5 WAS SUPPLIED BY NPSI BUT ERRONEOUSLY IDENTIFIED ON THE NPSI MATERIAL TRACER AS PIECE NO 6 THE TRACER DOCUMENTS THE SHIPMENT OF TWO DIFFERENT MATERIAL ITEMS AS PIECE NO. 6. THE TRT CONCURS WITH DEDUCED LOGIC OF THE QA SUPERVISOR BASED ON THE FOLLOWING:

1- THE CORRECTLY IDENTIFIED PIECE 6 ON THE NPSI TRACER IS FOR SA-240 TP 304 STAINLESS STEEL PLATE, RECEIVED AT CP AS BULK PLATE HT. NO. (MIC) 8391NF TO BE CUT BY THE B&R FAB SHOP AND ISSUED AS 3 PIECES 3/4" X 14 1/4" X 10 1/4".

2- THE ERRONEOUSLY IDENTIFIED PIECE NO. 6 ON THE NPSI TRACER (ACTUALLY PIECE NO. 5), WAS RECEIVED AT CP AS SA-36 CARBON STEEL 1 PIECE 3/4" X 12 1/4" X 12 1/4" HT. NO. (MIC) 5734 NF.

THERE WERE THREE PIECES OF STAINLESS STEEL PLATE OF A SPECIFIED DIMENSION AND ONE PIECE OF CARBON STEEL PLATE TO A DIFFERENT SPECIFIED DIMENSION. SINCE THE VISIBLE DIMENSIONS AND MATERIAL COSMETICS ARE READILY APPARENT THE TRT FINDS THAT THE ERROR ON THE TRACER IS OBVIOUS.

THE TECHNICAL INTERVIEW WITH THE ALLEGER INFERS AN IMPROPRIETY ON THE PART OF THE QC SUPERVISOR AND GENERAL FOREMAN — "SO THEY GOT SOME POOR 'OL INSPECTOR WHO WASN'T TOO BRIGHT" — IN BY PASSING THE ALLEGER AND ASSIGNING A DIFFERENT QC INSPECTOR TO VERIFY TRANSFER OF THE HT. NO. DEDUCED BY THE SUPERVISOR AS THE CORRECT NUMBER.

THE TRT INTERVIEWED THE QC SUPERVISOR WHO STATED THAT THE "POOR OL INSPECTOR" WAS UNDER HIS SUPERVISION AT THE TIME. THE SUPERVISOR ALSO ACKNOWLEDGED THAT HIS ENDORSED CORRECTION ON

THE MIL MERELY CORRECTED A TRANSCRIPTION ERROR, IN THE HT. NO., MADE BY THE INSPECTOR WHO VERIFIED THE TRANSFER. THE TRT FINDS THAT THE ACTION PERFORMED BY THE SUPERVISOR DID NOT VIOLATE ANY PROCEDURE. THE TRT SUGGESTS HOWEVER THAT THE QC SUPERVISOR WAS REMISS IN NOT FOLLOWING UP TO OBTAIN A CORRECTED NPSI TRACER.

THE TRT DOES NOT AGREE WITH THE ALLEGER'S INFERENCE OF IMPROPRIETY AND FINDS THAT THE QA SUPERVISOR ACTED WITHIN HIS RESPONSIBILITY TO IDENTIFY AND EVALUATE PROBLEMS AND ASSIST IN PROVIDING SOLUTIONS. THE TRT ALSO FINDS IT REASONABLE FOR A SUPERVISOR TO SELECT AND ASSIGN PERSONNEL AND TO PROVIDE DIRECTION FOR PERSONNEL UNDER HIS SUPERVISION.

THE TRT INTERVIEWED THE B & R MATERIAL CONTROL SUPERVISOR TO CONFIRM THE ERROR ON THE NPSI MATERIAL TRACER. THE SUPERVISOR INITIATED IMMEDIATE CORRECTIVE ACTION BY TELECON WITH NPSI. A CORRECTED COPY OF THE TRACER WAS TELETYPED TO B & R MATERIAL CONTROL BY NPSI SEPTEMBER 13 198[illegible] THE TRT VERIFIED THE AVAILABILITY OF THE CORRECTED COPY. THE ERRONEOUS IDENTIFIED ITEM 6 WAS CORRECTED TO READ ITEM 5.
THE TRT ACCEPTED A REASONBLE EXPLANATION BY THE B & R MATERIAL CONTROL SUPERVISOR THAT RECEIVING INSPECTION ACCEPTANCE OF THE MATERIAL WITH AN ERROR IN THE DOCUMENTATION WAS A RANDOM EVENT IN THE LARGE VOLUME OF SHIPMENTS BY NPSI TO CP.

THE TRT VERIFIED THAT THE CORRECTED TRACER WAS ADDED TO THE RIR 21236 QA RECORD PACKAGE AND THE SUPPORT (HANGER) PACKAGE.

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PAGE 4

5- CONCLUSION AND STAFF POSITION

SINCE THE ASSESSMENT VERIFIED DOCUMENTED EVIDENCE AND TRACEABILITY OF THE CORRECT HEAT NUMBER FOR THE ALLEGED PIECE NUMBER 5, THE TRT CONCLUDES THAT THERE IS NO SAFETY SIGNIFICANCE NOR GENERIC IMPLICATION TO THE ALLEGATION.

6- ACTIONS REQUIRED - NONE

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[redacted]

8- ATTACHMENTS - NONE

9- REFERENCES

1- RECEIVING INSPECTION RECORD 21236
2- HANGER PACKAGE SI-2-073-401-S32R
3- TECHNICAL INTERVIEWS WITH ALLEGER AUGUST 8 AND 23 1984

10. This statement prepared by: [signature] Name 9/14/84 Date

Reviewed by: Group Leader Date

Approved by: Project Director Date

TRANSFORMED TO B. MATTHEWSON

Draft 4 11/2/84 Rev 11/7

Category 33 AQH 22 CP5

SSER

1. Allegation Group: Mechanical and Piping Category No. 33
   Heat Number Missing on Piece

2. Allegation Number: AQH-22

3. Characterization: It is alleged that there was no heat number marked on plate piece number 5 which was installed in a pipe support (Mark No. SI-2-073-401-S32R).

4. Assessment of Safety Significance: The alleger stated in an interview with the NRC Technical Review Team (TRT) that although heat numbers were available from receiving inspection report (RIR) 21236 in the quality assurance QA record package, he could not determine the correct number to apply to piece number 5. ~~This resulted in a dispute with craft personnel.~~ The quality control (QC) Inspection Supervisor deduced the correct number from the documentation, then assigned someone else to verify the transfer of the heat number marking and sign-off for QC in the traveler documents.

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The TRT reviewed the traveler documents, which consisted of the support drawing, the material requisition (MR), the request hanger or parts form (request to fabrication shop), the material identification log (MIL), and weld data card (WDC). The NPS Industries (NPSI) shipper material tracer and a Brown & Root (B&R) RIR No. 21236 were also included in the traveler.

The TRT found that plate piece number 5 was supplied by NPSI, but was erroneously identified on the NPSI material tracer as piece number 6. The tracer showed that two different material items were shipped as piece number 6. The TRT determined that the QA supervisor correctly identified the heat number for piece number 5 by using the following information from the travelers:

a. The correctly identified piece number 6 on the NPSI tracer was for SA-240 TP 304 stainless steel plate, which was received at Comanche Peak Steam Electric Station (CPSES) as bulk plate and was marked heat number (MIC) 8391NF. The bulk plate was to be cut by the B&R fabrication shop and issued as three 3/4-inch x 14½-inch x 10½-inch pieces.

b. The piece erroneously identified as piece number 6 on the NPSI tracer, and which, in fact, was piece number 5 was received at CPSES as one piece of SA-36 carbon steel, which measured 3/4-inch 12½-inches x 12½-inches, and was marked as heat number (MIC) 5734NF.

Because there were three pieces of stainless steel plate of a specified dimension and one piece of carbon steel plate to a different specified dimension, and because the visible dimensions and material cosmetic differences are readily apparent, the TRT determined that the tracer contained an obvious error.

The TRT interviewed the alleger who said, "So they [the QC Supervisor and General Foreman] got some poor 'ol inspector who wasn't too bright...," thus implying that bypassing him and assigning another QC inspector to verify transfer of the heat number was improper.

The TRT also interviewed the QC Supervisor who stated that the "Poor 'ol inspector" who verified the heat number was under his supervision at the time. The supervisor also stated that his endorsed correction on the MIL merely corrected a transcription error in the heat number that had been made by the inspector who verified the transfer.

The TRT disagreed with alleger's inference of impropriety and determined that the QC Supervisor acted within his responsibility to identify and evaluate problems and assist in providing solutions to them. The TRT also determined that it is reasonable for a supervisor to select and assign personnel and to provide direction for personnel under his supervision.

The TRT interviewed the B&R Material Control Supervisor to confirm the error on the NPSI material tracer. The TRT learned that the supervisor initiated immediate corrective action by telecon with NPSI, and that a corrected copy of the tracer was teletyped to B&R material control by NPSI on September 13, 1984. The B&R Material Control Supervisor's said, accepting material with an error in the documentation during a receiving inspection was a random event in the large volume of shipments by NPSI to CP. The TRT determined that this explanation was a reasonable one.

The TRT verified the availability of the corrected copy of the NPSI material tracer and found that the piece erroneously identified as number 6 had been corrected to show the piece number as 5. The TRT also verified that the corrected tracer had been included in both the RIR 21236 QA record package and the support (hanger) package.

5. Conclusion and Staff Positions: The TRT finds that the action performed by the supervisor did not violate any procedure. The TRT suggests however, that the QC Supervisor was remiss in not following up to obtain a corrected NPSI tracer. Since the TRT assessment verified documented evidence of traceability for the correct heat number on piece number 5, the TRT concludes that this allegation has neither safety significance nor generic implications.

6. Actions Required: None.

[redacted]

8. Attachments: None.

9. Reference Documents:

   1. Receiving Inspection Record 21236.
   2. Hanger Package SI-2-073-401-S32R.
   3. Interviews with Alleger, August 8 and 23, 1984.

10. This statement prepared by:

	~~Name~~	Date
Reviewed by:	Group Leader	Date
Approved by:	Project Director	Date

ORIGINAL

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NUCLEAR REGULATORY COMMISSION

Technical Review Team Staff

EXCERPTED FOR MECH & PIPING CAT 33 - AQH - 22

Date: November 14, 1984

Reporter: Brenda C. Hein, CSR

C S R Associates
Professional Building
303 West Tenth
P. O. Box 17706
Fort Worth, Texas 76102-7071
(Metro) 429-3279

FOIA-85-59 CC/241

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
TECHNICAL REVIEW TEAM

TECHNICAL INTERVIEW

Wednesday, November 14, 1984
Granbury, Texas

The interview was commenced at 4:15 p.m.

PRESENT:

MR. JOHN ZUDANS
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. BOB HUBBARD
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. SHOU HOU
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. ROBERT MASTERSON
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. JAMES MALONSON
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. CHARLES RICHARD
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

PRESENT: (Continued)

MR. CHARLES HAUTHNEY
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

[redacted] 7C.

FORM SEL 711 REPORTERS PAPER & MFG. CO. 800-626-6313 welds, welds seams do not match drawing location on the floor around unit one reactor vessel. Now, does that ---

[redacted] No.

MR. HOU: Could be other people's.

[redacted] No, I don't believe I -- I raised that issue. I don't believe I did. I may have.

MR. HOU: I think we may have other people [redacted]

MR. RICHARD: Yeah. So it's obviously other people. We do have another person ---

MR. HOU: That's right.

MR. RICHARD: --- listed that concern.

[redacted] Probably [redacted] I don't think I raised that issue.

MR. ZUDANS: Okay. We appreciate you being frank with that because we have some -- a significant number and sometimes these things are mixed up between one or the other.

[redacted] Well, with all the -- with everything you people have to go through, I can understand something getting mixed up.

MR. HOU: There are several hundred of these.

MR. ZUDANS: All right. We'll defer that one to the appropriate individual.

CAT 33-AQH-22

Jim Malonson, would you cover yours?

MR. MALONSON: I'd like to go off the record for a minute.

MR. ZUDANS: Okay. Fine.

(Whereupon, an off-the-record discussion was had after which the proceedings continued as follows.)

MR. MALONSON: Your concern was in regard to a missing or an incorrect heat number that was marked on a piece of cut plate carbon steel plate that was used in a pipe support in a penetration in unit two, Comanche Peak unit two.

[redacted] You're using the term "cut plate".

MR. MALONSON: It was a cut piece of plate, dimensions. 7c

[redacted] Go ahead.

MR. MALONSON: It was dimension to some inch dimensions.

[redacted] Okay. Go ahead.

MR. MALONSON: Okay. And it was in a support marked [redacted] You stated, I believe, you were concerned that when you were asked to verify the transfer of the heat number you couldn't do it because there was a -- some anomaly in the paper work. It involved national -- excuse me, nuclear ~~type~~ PIPE support industries, NPSI, piece number six listed twice on the material tracer.

[redacted] Right. 7c

MR. MALONSON: Okay. I've started out with the support package and traced down the material requisition that

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ordered the material from the shop. The material requisition stated that it was a vendor supplied piece. I then went to the receiving inspection records to verify whether or not that piece was received in ths shop and I found the material tracer and I found two item numbers -- two item number six. Obviously some kind of an error because one of the items was a stainless steel plate, piece of stainless steel, and one was a piece of carbon steel plate. I then traced the material requisition to the fab shop where they cut the balance of the material, the other plate items, item number six, for instance.

[redacted] Uh-huh.

MR. MALONSON: And I looked at the inspection records and the material identification log and so forth and I talked with [redacted] and we resolved the item to the point where the NPSI tracer was in error. We got a corrected copy of the tracer from NPSI to identify the right piece. It was placed in the hanger package to document what was there and I talked with [redacted] about [redacted] endorsements on the MIL, the (SPELLING) M-I-L, and [redacted] said [redacted] endorsement was solely to correct a transcription error when the other inspector verified the transfer of the heat number.

I essence, what you said in -- what you stated in your concern was correct, but it was only correct to the extent that there was an error in the paper work, not that the piece wasn't traceable.

[redacted] Well, true. I realize that, but I also realize I could not sign it off until it was resolved, the error.

MR. MALONSON: Well, you had some concern because he went and got another inspector to resolve it.

[redacted] Yes, he did.

MR. MALONSON: And my deductions of the events as they occurred, if you will, without -- if you -- prior to the time I spoke to [redacted] -- is that his first name?

[redacted]

[redacted] Yeah.

MR. MALONSON: Was that it was solely an error in paper work because there were four pieces of cut plate involved, some to a -- three pieces of stainless steel and one piece of carbon steel and if I went to the drawing and just took the dimensions, I know that the carbon steel plate that I have was one of the item sixes in error on the NPSI tracer.

[redacted] Uh-huh.

MR. MALONSON: And then I went to [redacted] and asked him why his signature on the M-I-L, and his signature on the M-I-L was because the other inspector had transcribed the number wrong onto the M-I-L. So there was three or

7c

four places where the number was recorded correctly, but when the inspector's verification of the piece number was written on the M-I-L, he wrote the number out of position and I found really that it was reasonable for [redacted] when he couldn't -- you know, when he couldn't get agreement with you -- [redacted] when he couldn't get agreement with you, that the numbers he deduced were the correct numbers that it was reasonable for him to go get another inspector to move the job. I also found out that the supervisor -- [redacted] was -- should have followed up to get the corrected paper work or perhaps should have discussed that with you.

[redacted] Yeah.

MR. MALONSON: Now, to verify everything that I've told you, I went through the records for the support, the component modification cards involved in the support, I discussed it with the welding engineering people because in its initial stages it looked like a bimetal weld, stainless steel to carbon steel which was later corrected to be all carbon steel, and I went to the Receiving Inspection Department and talked to the receiving inspection foreman. I pointed out the error to him, the error on the NPSI tracer. He -- while I was with him, he called NPSI and asked them to verify their paper work. He did it initially through the site representative for NPSI ---

7c

[redacted] Uh-huh.

MR. MALONSON: --- and they telecopied a corrected report which I walked down to assure that it was put into the hanger package. So we come to the point where the number that's recorded as the heat number is the number that's recorded as the corrected item five on the NPSI tracer. So I found, I believe, that it was reasonable for [redacted] to keep the job going by getting another inspector to verify it. I -- once again I'm repeating myself, but he should have done the follow through to get the corrected paper work.

[redacted] Well, I accept it as long as you found it's right. It's simple as that.

MR. ZUDANS: Okay.

MR. MALONSON: Do you have any other questions in regard to it?

[redacted] No. It just wasn't right when I was involved with it and when he pulled this other person aside, the craftsman, and said, "Don't worry. I'll take care of it." Then that's when I said, "Okay."

MR. ZUDANS: Maybe the language that was used was the problem.

[redacted] Yeah, right, very inappropriate.

MR. MALONSON: Thank you.

MR. ZUDANS: All right. That's it?

7C END CAT 33 AQH-22

MR. MALONSON: Yes.

MR. ZUDANS: .Okay. You may or may not know this, but the results of all the items that we talked about will be published in a safety evaluation report on or about January 1985. If you wish, we will gladly send you a copy of the items which involve your concerns and the NCR's. For that purpose, we'll probably need your address to send it to you.

[redacted] You'll have one.

MR. ZUDANS: Okay. As you have seen, where we found the concerns that you have brought up significant we have -- we plan to take corrective action on -- against TUGCO and this is obviously for the safe of good procedure and also safety for the plant for the future.

We'd like to know at this time whether you have anything further to add to this record, any more concerns or anything like that that you might have regarding the Comanche Peak facility.

[redacted] Well, yeah. What happened to the allegation of signing off NCR's before the work was completed?

MR. HUBBARD: Elucidate. What -- tell us a little more. I can't recall that [redacted] 7c

[redacted] On the VA line up in the eight something, an auxillary building where [redacted] signed off the NCR's

7c

it's repetitious, but I just wanted to make sure on this record that we get the detail of the outstanding issue which we still have to contact you on.

[redacted] Yeah.

MR. ZUDANS: Okay. Would you like to receive both the NCR and the transcript of this interview today?

[redacted] Yes, I would. I need it. Has nothing to do with you people.

MR. ZUDANS: No, that's fine.

[redacted] Another action I have and I do need it.

MR. ZUDANS: Okay. Would you please give the Court Reporter your address and any other contact information which we might be able to have. You could write it on that piece of paper.

[redacted] Are we off the record now?

MR. ZUDANS: No, I have one more question to ask you and then we can go off.

Have you given this statement to us today freely and voluntarily?

[redacted] Yes, I have.

MR. ZUDANS: Okay. We can go off the record now.

Supplement:

MR. ZUDANS: Okay. For the record, my name is John Zudans and this morning at approximately 9:00 [redacted]

7c

[redacted] came to [redacted] and called me to -- called on me to talk further on one of [redacted] concerns that we presented a feedback report to him on 11-14-84.

The concern which he was still -- the concern that he wanted to discuss again was concern AQH-22 which involved missing or incorrect heat numbers on a plate.

When I came to speak [redacted] felt that [redacted] was still confused about how we resolved that particular issue so I called Mr. Jim Malonson, (spelling) M-A-L-O-N-S-O-N, and Mr. Malonson came to the meeting room with his materials since he was the Technical Review Team Reviewer on this topic and he presented his material to [redacted] in additional detail in order to try to eliminate any confusion that [redacted] might have had with regard to our resolution.

At the conclusion of Mr. Malonson's presentation, additional discussion ensued; however, at the completion of that discussion [redacted] told us that [redacted] was satisfied that [redacted] understood how we resolved that particular issue and [redacted] now was -- did not have any more concerns.

This is added to the 11-14-84 record for completeness.

(End of proceedings.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
TECHNICAL REVIEW TEAM

TECHNICAL INTERVIEW

Wednesday, November 14, 1984
Granbury, Texas

The interview was commenced at 4:15 p.m.

PRESENT:

MR. JOHN ZUDANS
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. BOB HUBBARD
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. SHOU HOU
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. ROBERT MASTERSON
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. JAMES MALONSON
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

MR. CHARLES RICHARD
Technical Review Team Staff
Nuclear Regulatory Commission
Washington, D. C. 20555

7C [redacted] (2)

- HANGER IN A PENETRATION - CLASS II
AUX BLDG INTO REACTOR
ISO SI 2-073-401 532R REV 0

PC #5 FINAL INSP - NO HEAT #
DON POINTED OUT THERE WAS NO HEAT #

NO HEAT #

VAULT RECORDS 2 - #6
1 - 2
1 - 3

NO RECORD THAT THIS ITEM EVER ARRIVED ON JOB SITE. THEY SAID ONE OF #6 IS ACTUALLY #5.
GEN FOREMAN & TED NOGGY - NOGGY SAID HE WOULD TAKE CARE

MATL IDENT FORM

MIL H 30382
VENDOR ITEM WAS MARKED THROUGH
& → HEAT # H30382

MARK KAPLAN QC INSP INCVP.

REQ ON WAREHOUSE "A"
PART #5 HEAT # N/A VENDOR SUPPLIED
- TOM ELLIS - VIEW PIECE & VERIFIED THERE WAS NO HEAT #

HEAT # 5734NF

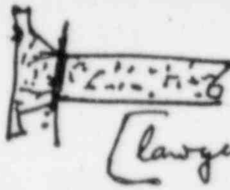
Lack of Hanger material traceability (Mech./piping

(4)

FOIA-85-59

CC/242

7C



[lawyer → ELOY GAITAN] GAP

VETRA WATSON
OGARY

[redacted]

PAT STP [redacted]

[redacted]

Former employee

Hired by Ironworker
6 mo Later was QC
Came to CP 2-82
as QC insp

LEVEL II "A" INSPECTOR
CERT - WELD INSP -
ALL LEVEL II
ASME VT INSPECTOR
" PT "
MT
UT
" MECH Equip
" MECH - INSPECTOR
" NS DOC VISUAL INSP

AL SMITH

SUPER NS
GREG BOUCHSON

BOB SEIVERS
ASST SITE QA MGR
GREG IMM SUPERVISOR

DID ALL INSPECTIONS AT COM PEAK

ISO VA2-AB-002 9/10/83
12" LINE Elev 873 AUX BLDG
BOLTED FLANGE
NCR WRITTEN By DON

SALVAGED A FLANGE FROM UNIT 1
CUT SPOOL @ WELD & REPLACED w/
SALVAGE FLANGE.
WILL NOT SIGN OFF NCR UNTIL SPOOL IS BACK
IN - PLACE.
DOUG SNOW
- SIGNED OFF BEFORE FIN DIM GIVEN -

(4) Flange NCR improperly closed (Suggest QA handle it)

MATL TRAC

[redacted] ADDRESSED him to sign off

Welds on top were to be numbered the ~~not~~ same as the Bottom.

- Vendor accepted welds - -

3/4" SS Pipe
Class ~~#~~ 2

Used in Unit 1

Traceability was hard to trace
- Used on Unit Two

Piece of Scrap was

- Annotate on MWDC -
3/4" comes off 12" ~~--~~ 1 Elev 790

12" Runs N & S near ceiling -

NCR was made by DON sometime in 1983

Nothing to show on MWDC ~~xxx~~ that material traceability

NPS INDUSTRIES

MATERIAL TRACER

OPERATION	PRODUCTION RELEASE NO	MATERIAL	SPEC	DATE	PAGE
• DK2053 ••	16715TIJ			10/29/82	1

QUAN	MARK NUMBER	REV	ITEM #	DIMENSION	ROUTING	MIC	QC

DRAWING NO- SI-2-073-401-S32R

ITEM#	PART NO.	QTY LVL	DESCRIPTION	ROUTING	
002	10582	3 0	.....TS 6 X 6 X1/2 A500B LENGTH OR C-C: 3- 1/16	CT-10	6048 NT
003	11021	32 0	.....PL 3/4 SA240/304	CT-7	8391 NF
006	11021	67 0	.....PL 3/4 SA240/304	CT-4	8391 NF
006	10731	32 0	.....PL 3/4 SA36	CT-8	5734 NF

DOC. REVIEWED NPSI	
Q.A. KC	DATE 1/28/83

WHERE DID THESE COME FROM - NPSI ??

RIR-21236

DATE

FOR INFORMATION ONLY

RIR 21236

FOIA-85-59

cc/243

FORM NO. NPSI PDX 016 REV

nps industries, inc.
10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

PERM. PLT. RECORD

RTM 4	FILE LOC. TT.2.57.13
SUBFILE LOC.	SI-2-073-401-S32R

TUGCO P.O. # CP-0046A.1

ASME DOCUMENTATION CHECKLIST

CODE DATA REPORT	N/A
MATERIAL RECORD	X
SHOP DRAWINGS	X
NONDESTRUCTIVE EXAMINATION REPORT	N/A
NONCONFORMANCE REPORT	N/A
WELD REPAIR REPORT	N/A
WELD DATA SHEET	N/A
CERTIFIED MATERIAL TEST REPORTS	X
CERTIFICATES OF COMPLIANCE	X
NPSI CERTIFICATE OF CONFORMANCE	X

INFORMATION COPY PPRW

RIR 21236

We certify that Support Mark No. SI-2-073-401-S32R Rev. 0 on our Shipping Notice AUS- 15237/TDA has been fabricated in accordance with Gibbs & Hill Specification 2323-MS-46A and conforms to ANSI N45.2, 10CFR50 Appendix B and Section III, Division I of the ASME Boiler and Pressure Vessel Code, Subsection NF 2000/4000, 1974 Edition, Winter 1974 Addenda.

Prepared by: Katherine Cramer Date: 1-28-83

Q.A. Approval: [signature] Date: 1/28/83

FOIA-85-59

CC/244

nps industries, inc.
10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

DATE: 1-28-83

CERTIFICATE OF CONFORMANCE

REFERENCE: Texas Utilities Services, Inc.
P.O. Number CP-0046A.1

We certify that material supplied for Support Mark No. SI-2-073-401-S32R Rev. 0 on Shipping Notice AUS-15237/TDA conforms to the referenced purchase order and to the applicable requirements of ASME Section III, Subsection NF, Class 2, 1974 Edition, Winter 1974 Addenda.

INFORMATION
COPY
PPRV
RIR 21236

Gloria Yurkovich
Plant Manager of Quality Assurance

ASME Certificate of Authorization Number N2323-2
Expires July 13, 1985

** DR-053 **

NPS INDUSTRIES

MATERIAL TRACER

OPERATION	PRODUCTION RELEASE NO	MATERIAL	SPEC	DATE	PAGE
	16715TUS			10/29/82	1

QUAN.	MARK NUMBER	REV	ITEM #	DIMENSION	ROUTING	MIC	QC

1 DRAWING NO- SI-2-073-401-S32R

ITEM#	PART NO.	QTY	LVL	DESCRIPTION	ROUTING	
0002	10582	3	0	.....TS 6 X 6 X1/2 A500B LENGTH OR C-C: 3- 1/16 "	CI-10	6048 NT
0003	11021	32	0	.....PL 3/4 SA240/304	CI-7	8391 NF
0006	11021	67	0	.....PL 3/4 SA240/304	CI-6	8391 NF
0006	10731	32	0	.....PL 3/4 SA36	CI-8	5734 NF

SHOULD THIS BE ITEM 5 DAVE RENTCHER

DOC. REVIEWED NPSI Q.A. RC DATE 1/28/83

INFORMATION COPY PPRV

RIR 21236

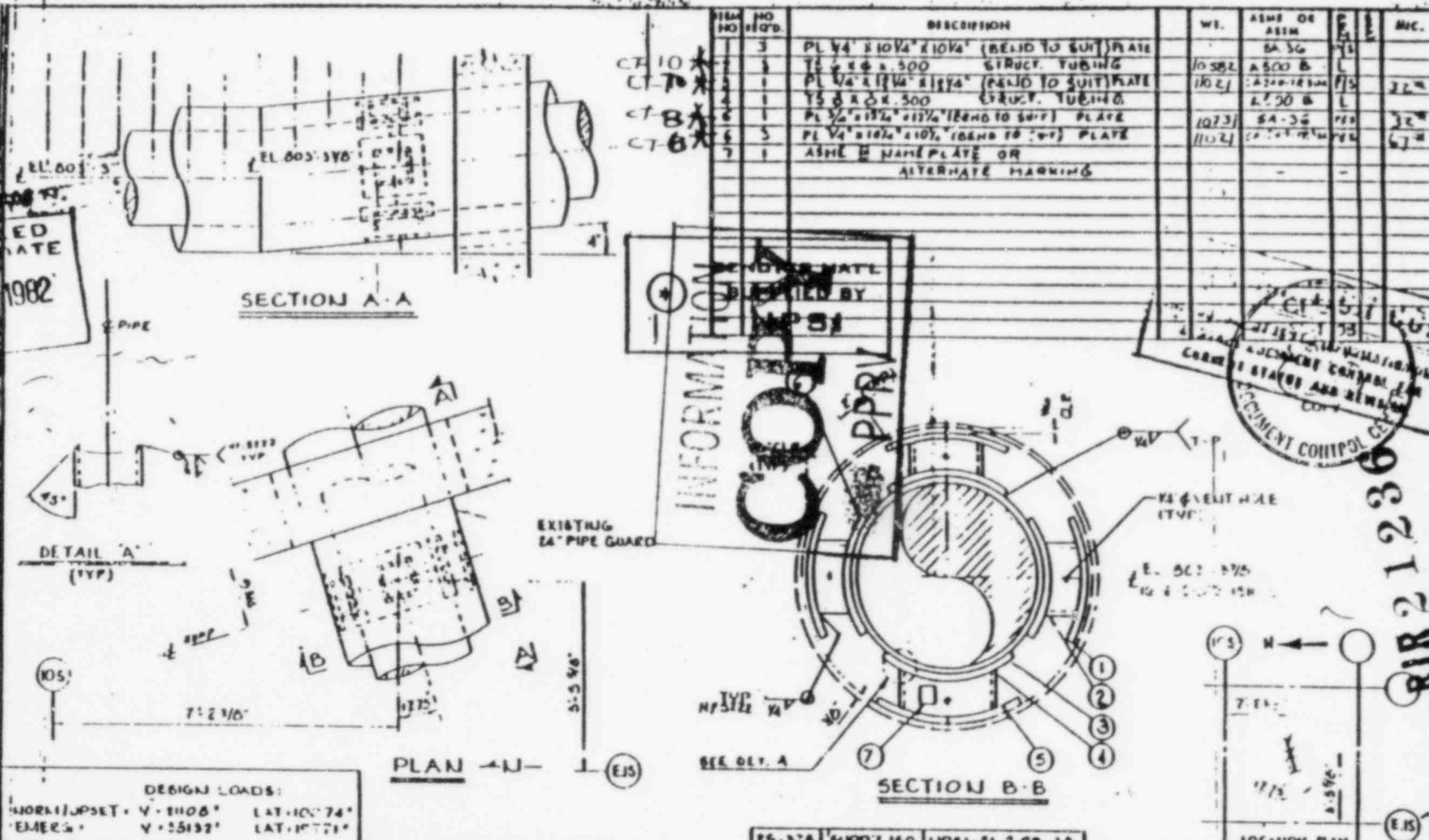
FORM NO. NPSI PDX-058 REV

Fab items 2, 3, 5 & 6

* CMA- 23,743

Page 126 of

ITEM NO.	NO REQ'D.	DESCRIPTION	WT.	ASME OR ASTM		MK.
1	3	PL 1/4" x 10 1/4" x 10 1/4" (BEND TO SUIT) PLATE		SA-36		
2	1	TS 6 x 6 x .500 STRUCT. TUBING	10582	A500 B	L	
3	1	PL 1/4" x 11 1/4" x 11 1/4" (BEND TO SUIT) PLATE	11021	[illegible]		22#
4	1	TS 8 x 8 x .500 STRUCT. TUBING		A500 B	L	
5	1	PL 3/8" x 13 1/4" x 13 1/4" (BEND TO SUIT) PLATE	10731	SA-36		32#
6	3	PL 1/4" x 10 1/4" x 10 1/4" (BEND TO SUIT) PLATE	11021	[illegible]		67#
7	1	ASME III NAMEPLATE OR ALTERNATE MARKING				



REFERENCE DRAWINGS: G & H ISOMETRIC 2323-MF-3133-51 (REV. C); FAB. ISOMETRIC 51-2-RB-66 (REV. 3); PIPING 2323-MF-0603; STRUCTURAL 2323-S1-0602; ELECTRICAL 2323-E1-0601-01 (REV. 4); H.V.A.C. 2323-M2-0651 (REV. 5)

25-373 SUPP'T ISO. NPSI-51-2-RB-66

OWNER: TEXAS UTILITIES SERVICES INC.

PROJECT: COMANCHE PEAK UNITS NO. 1 & 2

ENGINEER: GIBBS & HILL INC.

Brown & Root, Inc.

HOUSTON, TEXAS

P.O. NO. CP-0064A.1

DWG. NO. 2-073-401-S32R REV. 0

SHEET 1 OF 1

PR# 16715

RIR 21236

TELECOPY RECEIVED
Date 9-21 Time 3:50

WELDED TUBE COMPANY OF AMERICA

MANUFACTURERS OF ELECTRIC WELDED CARBON-ALLOY STEEL TUBING

1255 E. 122nd ST. CHICAGO, ILLINOIS 60633
PHONE: (312) 646-4500

MIC NO 6048 NT NUCLEAR

9-18-81

MILL TEST REPORT WELDED STRUCTURAL STEEL TUBING

RIR 2 1236

INFORMATION COPY PPRV

SOLD TO: Dubose Steel, Inc.
P.O. Box 1098
Roseboro, N.C. 28382

Revised
DATE: 9-18-81 NO: - CH51974

SHIPPED TO: N.P.S.
10429 Metric Blvd
Austin Texas 78758

CUSTOMER P.O. No. 4703-61

HEAT NO.	OD SIZE	GA.	LENGTH	NO. PCS.	TOTAL FT.	YIELD psi	TENS. psi	ELONG. 2" %	C.	MN.	P.	S.	SI.
11771	6" x 6"	1/2"	20'0"	84	1680'0"	61,200	71,700	29%	.19	.72	.010	.017	.010
WTA81F2980 Internal Code No													
329621	6" x 6"	3/8"	20'0"	36	720'0"	58,500	74,100	37%	.22	.71	.007	.021	
WTA81F2677 Internal Code No.													
329507	SAME			72	1440'0"	55,900	66,800	39%	.22	.76	.006	.015	
WTA81F2678 Internal Code No.													
254207	SAME			18	360'0"	58,600	70,800	39%	.23	.78	.015	.023	.04
WTA81F2580 Internal Code No.													
WTA81F2585 " " "													
WTA81F2676 " " "													

NPSI REC'V INSPECTION CODE ACCEPTED
NP ☐ Q-1 ☒ QCC ☐
QC TJO DATE 10-9-81

QA REVIEW SATISFACTORY
MJW 9/21/81
INITIAL - DATE -

NPSI AUSTIN
MIC NO. 6048NT
PO NO. Aus 2476 Co #1
SHEET 1 OF 3

BECHTEL 277

THIS MATERIAL MEETS MINIMUM SPECIFICATIONS SET FORTH IN ASTM-500-80 GRADE "B"
CODE CASE 1644-6 NUCLEAR REQUIREMENTS

THE ABOVE FIGURES APPEAR IN THE RECORDS OF WELDED TUBE COMPANY OF AMERICA AND ARE CERTIFIED AS BEING CORRECT BY:
Manager of Quality Assurance & Technical Service

CUSTOMER'S COPY

NUCLEAR

WELDED TUBE COMPANY OF AMERICA

1855 EAST 122ND STREET, CHICAGO, ILLINOIS 60633

312/646-4500
WATS LINE: 800-621-0125
TELEX: 910-221-4347
CABLE: WELCO

September 16, 1981

Mr. M. E. Shipp
Quality Assurance Manager
DUBOSE STEEL, INC.
P.O. Box 1098
Roseboro, North Carolina 28382

Dear Mr. Shipp:

The following information is a requirement as per your Purchase Order Numbers as shown on attached Test Report CH 51974

CERTIFICATE OF COMPLIANCE

Cold formed Welded Structural tubing supplied against your above purchase orders was produced in accordance with:

1. Welded Tube Company of America's Assurance Program was approved by DuBose Steel, Inc. on January 30, 1981.

2. United States Nuclear Regulatory Commission's 10 CFR. Part 21 "Reporting of defects and non-compliance".

3. ASTM Specification A-500-80 GRADE "B"

Test Reports attached.

INFORMATION COPY PPRV

NPSI REC'V INSPECTION CODE ACCEPTED

NPT ☐	Q-1 ☒	QCC ☐
QC JO	DATE 10-9-81	

NPSI AUSTIN
MIC NO. 6048NT
PO NO. Aus 2476 Co#1
SHEET 2 OF 3

BECHTEL
277

TELECOPY RECEIVED
Date 9-21 Time 3:50

Letter to Mr. M. H. Shipp:
September 16, 1981*

Coil Heat No.	Date of Purchase	C.	MN.	P.	S.	Si.
11771	6-10-81	.29	.72	.010	.017	.010
329621	4-8-81	.22	.71	.007	.021	
329507	3-20-81	.22	.76	.006	.015	
254207**	3-26-81	.23	.78	.015	.023	.04

REVISIONS:

* Original Issue of Letter was July 20, 1981

** Coil Heat No. 254207 Added

NPSI REC'V INSPECTION CODE ACCEPTED
NPT ☐ Q-1 ☒ QCC ☐
QC TJO DATE 10-9-81

Very truly yours,
Welded Tube Co. of America

Stanley J. Laskowski
Manager of Quality Assurance
and Technical Service

NPSI AUSTIN
MIC NO. 6048NT
PO NO. Aus 2476 C#1
SHEET 3 OF 3

SJL/mr

INFORMATION COPY PPRV

RIR 21236

BECHTEL 277

TELECOPY RECEIVED
Date 9-21 Time 3:50

MIC NO 839INF

P.O. Box 1975
Baltimore, Maryland 21203
Telephone: (301) 288-2000

EASTERN STAINLESS STEEL COMPANY

DIVISION OF Eastmet CORPORATION

CERTIFIED MATERIAL TEST REPORT

We certify that all of the test results and the statements of performed operations recorded here are in compliance with the ordered material specifications and the applicable material requirements.

MANIFEST NO. 7632

DATE 11/29/82

SHIP TO: NPSI AUS-3733

MAIL TO: HUB INC.
2146 FLINTSTONE DRIVE
TUCKER GA 30084

COPY 1 OF 1

J. S. Foley
QUALITY CONTROL DEPARTMENT
11/29/82

RIR 21236

SALES ORDER: N25935 CUSTOMER'S P.O. NO.: 8129510 M— 1 S— O— 1

ITEM	HEAT NO.	M.P.O.	TYPE	FINISH	GAUGE	WIDTH / O.D.	LENGTH / I.D.	PIECES	GROSS	NET	
04	F20983	23022	304	NO. 1	0.7500	48.0000	96.0000				AIR QUENCHED
03	F20993	23062	304	NO. 1	0.7500	48.0000	96.0000				AIR QUENCHED
08	F21023	23063	304	NO. 1	0.7500	48.0000	96.0000				AIR QUENCHED

INFORMATION COPY

PPRV

MATERIAL SPECIFICATIONS AND REQUIREMENTS

SPECS ASME SA240 SECT III NC2000 NCA3800 1980ED S82 ADD
MATERIAL PRODUCED UNDER ASME QUALITY SYSTEM CERTIFICATE (MATERIALS) NO QSC29[illegible] (DATE OF EXPIRATION 7/1/83)
MATERIAL FREE FROM MERCURY CONTAMINATION MINIMUM SOLUTION ANNEALING TEMPERATURE 1900 F
MATERIAL PRODUCED IN ACCORDANCE WITH 10CFR21

HEAT NO.	TYPE	C %	MN %	P %	S %	SI %	CR %	NI %	CU %	TI %	CB+TA %	MO %	CO %	N %
F20983	304	.044	1.68	.020	.016	.54	18.29	8.29	.25			.28	.15	.075
F20993	304	.046	1.63	.023	.010	.52	18.10	8.20	.25			.42	.14	.069
F21023	304	.043	1.69	.021	.015	.69	18.54	8.46	.28			.33	.12	.066

WITH SHIPMENT COPY

CORROSION TEST CODES

CODE	DESCRIPTION
A.	ASTM A262-PRACTICE 'A' (OXALIC)
B.	ASTM A262-PRACTICE 'B' (STREICHER)
C.	ASTM A262-PRACTICE 'C' (HUEY)
D.	ASTM A262-PRACTICE 'E' (CUCUSO4)
E.	QQS - 766 (CUSO4)

NPSI REC'V INSPECTION
CODE ACCEPTED
NPT ☐ Q-1 ☒ QCC ☐
QC CV. DATE 1-7-83

NPSI AUSTIN
MIC NO. 839INF
PO NO. AUS3733
SHEET 1 OF 1

HEAT NO.	M.P.O.	TRANSVERSE OR FRONT: TENSILE PSI	YIELD PSI	ELONG %	HARDNESS	BEND	R/A %	LONGITUDINAL OR BACK: TENSILE PSI	YIELD PSI	ELONG %	HARDNESS	BEND	R/A %	GR	C	CORROSION TEST: CODE	RESULT	MACROETCH TEST	SOLUTION ANNEAL: TIME MINUTES	TEMP. °F
F20983	23022	92100	45800	54	HB170		63													
F20993	23062	92600	45500	56	HB165		66													
F21023	23063	92500	45100	54	HB167		66													

BECHTEL
GROUP 332
QA
APPROVED
[signature]
12/7/82
Q.A. Inspector
ENERGY AND PROCESS DIV.

BECHTEL
277

18597 (Rev.A 12-77)

BETHLEHEM STEEL CORPORATION
METALLURGICAL DEPARTMENT
REPORT OF TESTS AND ANALYSES

BURNS HARBOR PLANT

SHIPMENT NO	DATE SHIPPED	CAR OR VEHICLE NO	
603-14706	7-16-81	CR-SSW-SP DELY	PAGE 1

SOLD TO: NPS INDUSTRIES INC
10420 METRIC BLVD
AUSTIN TX 78758

SHIP TO: NPS INDUSTRIES INC
10420 METRIC BLVD
AUSTIN TX 78758

SERIAL NUMBER	PAT. NO.	HEAT NUMBER	NO. PCS.	THICKNESS INCHES	WIDTH OR DIA. INCHES	LENGTH INCHES	WEIGHT POUNDS	YIELD POINT PSI	TENSILE STRENGTH PSI	ELONG. IN	ELONG. %	RED %
PLATES - ASME SA36 1980 EDITION &&												
MFST - LIFT MAX 5 TON ACCEPTED IN ACCORD QA PROG DTD 12/13/78 PER ASME SECT III NCA 3800 NUCLEAR-NON-VESSELS-ASME SECT 3												
CO# AUS2542 GH 024-3343												
		801L14780	1	3/4	84	120	2144	39200	65800	8	29	
		801N25430	18	3/4	84	120	38592	45300 42500	69900 69800	8 8	23 28	
		801P00440	5	3/4	84	120	10720	40400	70000	8	22	
		802N55790	14	3/4	84	120	30016	44000 44000	70900 70800	8 8	27 26	
		812L31700	6	5/8	72	120	9186	38000	62200	8	26	
		801N21480	1	3/8	72	120	919	45400	67200	8	29	
		803N81290	1	3/8	72	120	919	43200	67500	8	25	

Q—QUENCH TEMPERATURE T—TEMPER TEMPERATURE

INFORMATION COPY
PPRV

SERIAL NUMBER	PAT. NO.	HEAT NUMBER	HARD	BEND	THICKNESS INCHES	TYPE	SIZE	DIR.	TEST TEMP F	CHARPY IMPACT ENERGY FT. LBS 1	2	3	SHEAR (%) 1	2	3	LAT. EXP. MILS 1	2	3

NPSI AUSTIN
MIC NO. 5734 NF
PO NO. Aus 2542
SHEET 1 OF 1

Page 130 of 141

CHEMICAL ANALYSIS

HEAT NUMBER	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	McQUAID GRAIN SIZE
01L14780	.20	.98	.014	.029												
01N25430	.16	1.10	.016	.019												
01P00440	.21	1.02	.013	.026												
02N55790	.24	1.05	.011	.025												
12L31700	.21	.78	.013	.025												
01N21480	.24	.80	.016	.028												
03N81290	.22	.83	.011	.018												

NPSI RECV INSPECTION
CODE ACCEPTED
NPT ☐ Q-1 ☒ QCC ☐
QC DZC DATE 7-30-81

RIR 21236

BECHTEL
277

MIC NO 5734 NF

CERTIFY THAT THE ABOVE RESULTS ARE A TRUE AND CORRECT COPY OF RECORDS PREPARED AND MAINTAINED BY BETHLEHEM IN COMPLIANCE WITH THE REQUIREMENTS OF THE SPECIFICATION CITED ABOVE.

CHIEF METALLURGIST J. F. EMIG PER CJV

HANGER NUMBER: SI-2-073-401-S32R

FILE NUMBER. 17.2.57.13

SUBFILE NO. HANGER NUMBER.

ARMS
INDEXED

DATE:

FOR OR NO. 3323/ QAA-2985

REF. HANGER NO. CS-2-063-407-S22R

FILE: 17.2.49.13

SUBFILE: REF. HANGER NUMBER

RIR NUMBER: 21236

MRR NUMBER: CP-11416

INFORMATION
COPY
PPRV

nps industries, inc.
10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

PERM. PLT. RECORD

RTN 4	FILE LOC. 17.2.57.13
SUBFILE LOC. SI-2-073-401-S32R	

TUGCO P.O. # CP-0046A.1

ASME DOCUMENTATION CHECKLIST FOR INFORMATION ONLY

CODE DATA REPORT.................................. N/A
MATERIAL RECORD.................................. X
SHOP DRAWINGS.................................. X
NONDESTRUCTIVE EXAMINATION REPORT.................................. N/A
NONCONFORMANCE REPORT.................................. N/A
WELD REPAIR REPORT.................................. N/A
WELD DATA SHEET.................................. N/A
CERTIFIED MATERIAL TEST REPORTS.................................. X
CERTIFICATES OF COMPLIANCE.................................. X
NPSI CERTIFICATE OF CONFORMANCE.................................. X

RIR 21236

We certify that Support Mark No. SI-2-073-401-S32R Rev. 0 on our Shipping Notice AUS- 15237/TDA has been fabricated in accordance with Gibbs & Hill Specification 2323-MS-46A and conforms to ANSI N45.2, 10CFR50 Appendix B and Section III, Division I of the ASME Boiler and Pressure Vessel Code, Subsection NF 2000/4000, 1974 Edition, Winter 1974 Addenda.

Prepared by: Katherine Cramer Date: 1-28-83

Q.A. Approval: Gloria Yurbcik Date: 1/28/83

a subsidiary of nuclear power services inc.

[redacted]

nps industries, inc.

10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

DATE: 1-28-83

FOR INFORMATION ONLY

CERTIFICATE OF CONFORMANCE

REFERENCE: Texas Utilities Services, Inc.
P.O. Number CP-0046A.1

We certify that material supplied for Support Mark No. SI-2-073-401-S32R Rev. 0 on Shipping Notice AUS-15237/TOR conforms to the referenced purchase order and to the applicable requirements of ASME Section III, Subsection NF, Class 2, 1974 Edition, Winter 1974 Addenda.

for Plant Manager of Quality Assurance

RIR 21236

ASME Certificate of Authorization Number N2323-2
Expires July 13, 1985

48597 (Rev.A 12-77)

BETHLEHEM STEEL CORPORATION
METALLURGICAL DEPARTMENT

REPORT OF TESTS AND ANALYSES

BURNS HARBOR PLANT

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.
603-14706	7-16-81	CR-SS■-SP DELY

SOLD TO: NPS INDUSTRIES INC
10420 METRIC BLVD
AUSTIN TX 78758

SHIP TO: NPS INDUSTRIES INC
10420 METRIC BLVD
AUSTIN TX 78758

SERIAL NUMBER	PAT. NO.	HEAT NUMBER	NO. PCS.	THICKNESS INCHES	WIDTH OR DIA. INCHES	LENGTH INCHES	WEIGHT POUNDS	YIELD POINT PSI
PLATES - ASME SA36 1980 EDITION &&								
MFST - LIFT MAX 5 TON ACCEPTED IN ACCORD QA PROG DTD 12/13/78 PER ASME SECT III NCA 3800 NUCLEAR-NON-VESSELS-ASME SECT 3								
CO# AUS2542 GM 024-3343								
		801L14780	1	3/4	84	120	2144	39200 6
		801N25430	18	3/4	84	120	38592	45300 6 42500 6
		801P00440	5	3/4	84	120	10720	40400 7
		802N55790	14	3/4	84	120	30016	44000 7 44000 7
		812L31700	6	5/8	72	120	9186	38000 6
		801N21480	1	3/8	72	120	919	45400 6
		803N81290	1	3/8	72	120	919	43200 6

Q—QUENCH TEMPERATURE T—TEMPER TEMPERATURE N—NORMALIZE TEMPERATURE

SERIAL NUMBER	PAT. NO.	HEAT NUMBER	HARD	BEND	THICKNESS INCHES	TYPE	SIZE	DIR.	TEST TEMP F	CHARPY IMPACT ENERGY FT. LBS. 1	2	3	SHEAR (%) 1	2

FOR INFORMATION ONLY

NPSI AUSTIN
MIC NO. 5734 NF
PO NO. AUS 2542
SHEET 1 OF 1

Page 130 of __

CHEMICAL ANALYSIS

HEAT NUMBER	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb
01L14780	.20	.98	.014	.029										
01N25430	.16	1.10	.016	.019										
01P00440	.21	1.02	.013	.026										
02N55790	.24	1.05	.011	.025										
12L31700	.21	[illegible]	.013	.025										
01N21480	.24	.80	.016	.028										
03N81290	.22	[illegible]	.011	.018										

RAR 21236

NPSI REC'V INSPECTION
CODE ACCEPTED
NPT ☐ Q-1 ☒ QCC ☐
QC DHC DATE 7-30-81

WE CERTIFY THAT THE ABOVE RESULTS ARE A TRUE AND CORRECT COPY OF RECORDS PREPARED AND MAINTAINED BY BETHLEHEM IN COMPLIANCE WITH THE REQUIREMENTS OF THE SPECIFICATION CITED ABOVE.

CHIEF METALLURGIST J. F. EMIG

Letter to Mr. M. H. Shipp:
September 16, 1981*

Coil Heat No.	Date of Purchase	C.	MN.	P.	S.	Si.
11771	6-10-81	.29	.72	.010	.017	.010
329621	4-8-81	.22	.71	.007	.021	
329507	3-20-81	.22	.76	.006	.015	
254207**	3-26-81	.23	.78	.015	.023	.04

REVISIONS:

* Original Issue of Letter was July 20, 1981
** Coil Heat No. 254207 Added

NPSI REC'V INSPECTION
CODE ACCEPTED
NPT ☐ Q-1 ☒ QCC ☐
QC TJO DATE 10-9-81

Very truly yours,
Welded Tube Co. of America

Stanley J. Laskowski
Manager of Quality Assurance
and Technical Service

NPSI AUSTIN
MIC NO. 6048NT
PO NO. Aus 2476 Co #1
SHEET 3 OF 3

SJL/mr

FOR INFORMATION ONLY

RIR 21236

BECHTEL
277

TELECOPY RECEIVED
Date 9-21 Time 3:50

9-16-81

NPS INDUSTRIES

MATERIAL TRACER

** DR-053 **

OPERATION	PRODUCTION RELEASE NO	MATERIAL	SPEC	DATE	PAGE
	16715TUS			10/29/82	1

QUAN.	MARK NUMBER	REV	ITEM #	DIMENSION	ROUTING	MIC	QC
	DRAWING NO-			SI-2-073-401-S32R			

ITEM#	PART NO.	QTY	LVL	DESCRIPTION	ROUTING	
0002	10582	3	0	......TS 6 X 6 X1/2 A500B	CT-10	6048 NT
				LENGTH OR C-C: 3- 1/16 "		
0003	11021	32	0	......PL 3/4 SA240/304	CT-7	8391 NF
0006	11021	67	0	......PL 3/4 SA240/304	CT-6	8391 NF
0006	10731	32	0	......PL 3/4 SA36	CT-8	5734 NF

DOC. REVIEWED NPSI
Q.A. KC DATE 1/28/83

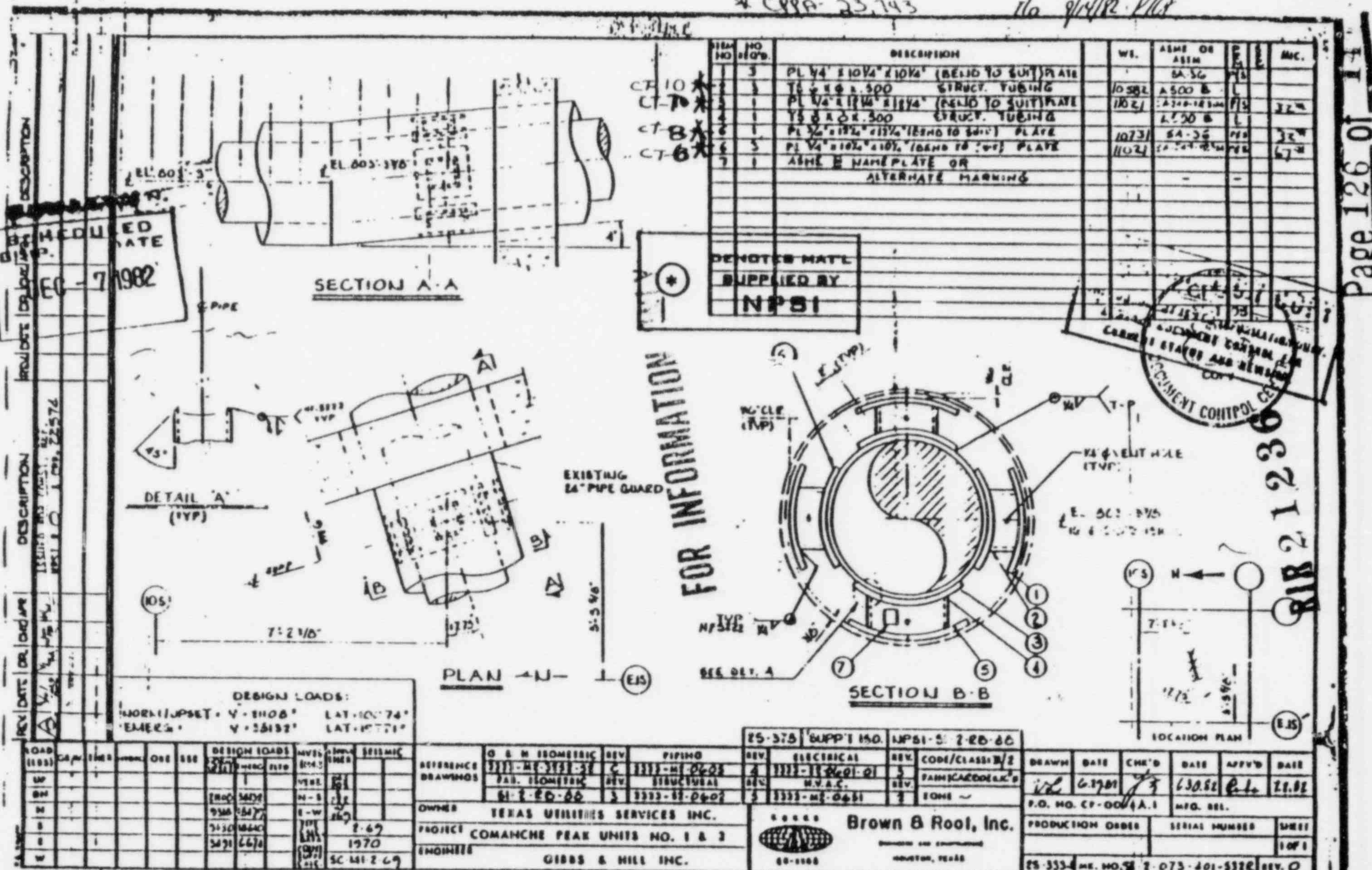
FOR INFORMATION ONLY

RII 21236

FORM NO. NPSI PDX 058 REV

Fab items 2, 3, 5 & 6

* CE8A-23,743   lla 12/7/82 RRS



Page 126 of 14

PR# 16715

HANGER NUMBER: SI-2-073-401-S32R

FILE NUMBER. 17.2.57.13

SUBFILE NO. HANGER NUMBER.

ARMS
INDEXED

DATE:

FOR OR NO. 3323/ QAA-2985

FOR INFORMATION ONLY

REF. HANGER NO. CS-2-063-407-S22R

FILE: 17.2.49.13

SUBFILE: REF. HANGER NUMBER

RIR NUMBER: 21236

MRR NUMBER: CP-11416

Brown & Root, Inc.

QUALITY ASSURANCE
RECEIVING INSPECTION REPORT

REPORT NO. 21236

UNIT	SYSTEM	COMPONENT	IDENTIFICATION/SPIN NO.	DWG./SPECIFICATION & REV.
1/2/x	Mech	Hanger's	See Below	MS-046A

P.O.	MRR	CHARACTERISTIC INSPECTION:
CP046A.1	CP 11416 c/c/	~~CI~~ CP QAP ~~7.2~~ 8.1 — SAT. ✓ UNSAT. ☐ NCR ____ HOLD TAG N/A

VENDOR	SW/QR/QAA	APPARENT RESPONSIBILITY FOR UNSATISFACTORY ITEMS:
NPSI Austin Texas	3323 2985	B&R ☐ VENDOR ☐ TRANSPORTER ☐ — DATE DEFICIENCY CLOSED N/A

ITEM	QTY.	DESCRIPTION/REMARKS
		Shipping Notice Aus-15237/TDA
—	11ea ~~12ea~~ HCS 2-18-83	Pipe Hanger Support's
		~~-CC-1-050-701-A435~~ HCS 2-18-83 - SI-2-074-401-S32R.
		- CS-2-063-407-S22R ✓
		- CT-2-013-416-S32R HCS 2-18-83
		- DO-2-029-401-D43R.
		- DO-2-029-404-D43R'
		- RC ~~RH~~ -2-052 ~~05?~~ HCS -418-C41S' (2-18-83)
		- SF-X-002-002-F53S.
		- SI-2-073-401-S32R.
		- SI-2-087-416-C42K'
		- SI-2-148-402-C41K.
		- SI-2-172 ~~148~~ 2-18-83 -402-C41K.

ARMS INDEXED

DATE:

QA RECORD — RTN. — QA REVIEW DCS 2/12/83 — FILE NO. 8.1 — SUBFILE NO. 21236

INFORMATION COPY PPRV

DOCUMENTATION COMPLETE
144 pages
DATE 2-11-83
SIGNED Henry E. Sicher

AUTHORIZED NUCLEAR INSPECTOR NOTIFICATION:

DATE: ____ TIME: ____ MEDIA: ____ N/A ✓ ____ INIT. ____

ANI WITNESS: SAT. ____ ☆☆ UNSAT. ____ ☆☆ WAIVED ____ DATE: ____

☆☆ ANI'S INITIALS REQUIRED

STORAGE LOCATION:	QC ENGINEER/INSPECTOR	DATE
Whs 'B' Annex — TYPE: E	Henry E. Sicher	2-11-83

QC-1.1/3-1

FOIA-85-59

CC|245

MATERIAL RECEIVED RECORD

Job No. 35-1195

COMANCHE PEAK S. E. S.

PAGE 1 OF 1

MR NO. CP11416 C/O 1

SHIPPED TO: B & R ☐ G & H ☐ F & N ☐ W ☐ TUSI XX OTHER ☐

P. O. NO. CP0046A.1

REQ. NO.

VENDOR:
NPS INDUSTRIES, INC.
SECAUCUS, NJ

DATE: 2-10-83

SHIPPER:
SAME
AUSTIN, TEXAS

F.O.B. AUSTIN

Partial XX 428 Complete ☐

QUANTITY	UNIT	ITEM	MATERIAL DESCRIPTION	LOCATION
			NOTE: THIS CHANGE ORDER IS ISSUED TO CORRECT THE ORIGINAL MRR.	
			DID READ:	
			SI-2-148-402-041K SI-2-172-402-041K SI-2-087-416-042K RC-2-052-418-041S	
			SHOULD READ:	
			SI-2-148-402-C41K SI-2-172-402-C41K SI-2-087-416-C42K RC-2-052-418-C41S	
			NOTE: ALL OTHER INFORMATION REMAINS THE SAME.	

INFORMATION COPY

THIS INSPECTION DOCUMENTED ON IR NO. 21234

C.A. Freas
RECEIVED BY:

MW?2-10-83

Q.C. CHECK BY	EXP.	PP	TEX PAK	UPS	PREPAID	COLLECT
XX PPRV					XX	

VENDOR
DELIVERING CARRIER

F B NO.	CAR NO.
114947	

MATERIAL RECEIVED RECORD

Job No. 35-1195

COMANCHE PEAK S. E. S.

CP

PAGE 1 OF ____

MR NO. 11416

SHIPPED TO: B & R ☐ G & H ☐ F & N ☐ W ☐ TUSI ☒ OTHER ☐

REQ. NO.

P. O. NO. CP0046A.1

VENDOR:
NPS INDUSTRIES, INC.
SECAUCUS, NJ

DATE: 2-8-83

SHIPPER:
SAME
AUSTIN, TEXAS

F.O.B. AUSTIN

Partial ☒ 428 Complete ☐

QUANTITY	UNIT	ITEM	MATERIAL DESCRIPTION	LOCATION
[redacted]				
			SHIPPING NOTICE NO.AUS-15237/TDA	
[redacted]				
1	ea.		[illegible]32R Rev.0	
1	ea.		CC-2-050-[illegible]-A43S Rev.0	
[redacted]				
1	ea.		[illegible]2-029-40[illegible] Rev.0	DOCUMENTED ON
[redacted]				
XXX 1	ea.		SI-2-087-416-C42K Rev.0	21236
[redacted]				
			NOTE: THESE HANGERS ARE LISTED ON PACKING LIST	
			XXXXXXXXXXXXXX AS 041K, 042K, 041S	
[redacted]				
1	lot		CERTS RECEIVED WITH SHIPMENT	ISSUED QA REC.
[redacted]				
			NOTE: THE SHIPMENT IS IN GOOD CONDITION AND	
			THERE IS NO EVIDENCE OF LOAD SHIFTING, HUMPING,	
[redacted]				

COPY

C.A. Freas

RECEIVED BY:

MW/2-9-83

Q.C. CHECK BY	EXP.	PP	TEX PAK	UPS	PREPAID	COLLECT
XXXX RRV					XX	

VENDOR

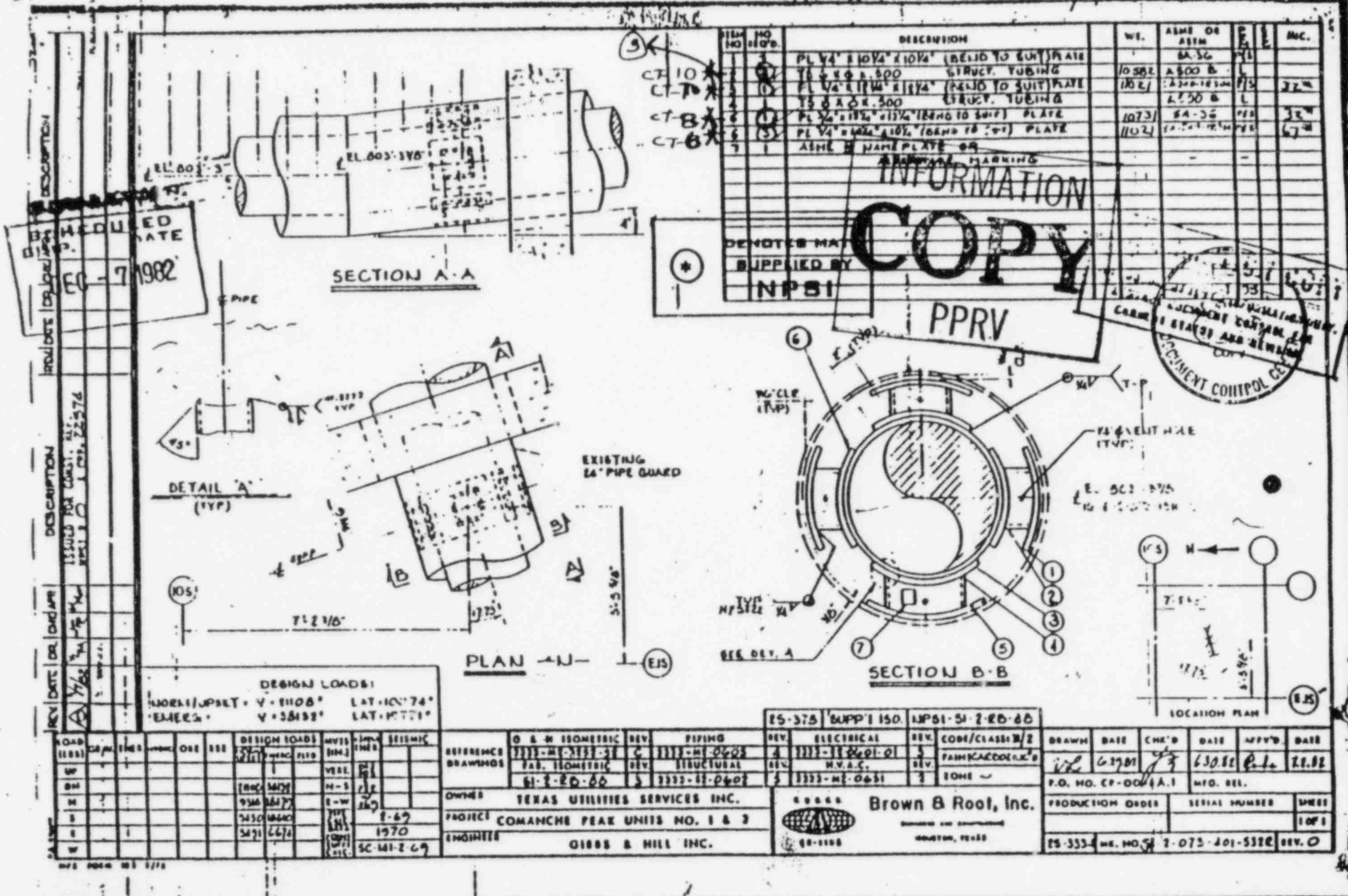
DELIVERING CARRIER

F B NO.	CAR NO.
114947	

Fab items 2, 3, 5 & 6

CPPA 23,743

ilo 9/14/82 PRt



PR# 16715

BROWN & ROOT INC.
Quality Assurance Department

RECEIVING TUGCO/G&H SAFETY RELATED EQUIPMENT

RIR 21236

		SAT	UNSAT	N/A
1.	Check documents received with shipment.	✓		
a.	G&H Quality Assurance Release (QAR) obtained?	✓		
b.	Are "Review Checklist" items on QAR accepted?	✓		
c.	Was final inspection performed by TUGCO/G&H?	✓		
d.	ASME Code Data Report obtained?	✓		
e.	Authorization for shipment?	✓		
2.	Equipment Identification			
a.	Do Data Reports and Equipment Code Plate agree?	✓		
b.	Do Data Report and G&H agree?	✓		
c.	Does Identification Tab/spin number compare with G&H QAR?	✓		
3.	Was there any damage?			✓

Comments: ~~H~~ NONE

Receiving Inspector [signature] Date 2-11-83

INFORMATION COPY PPRV

RIR 21236

pages 67 thru 75 have been removed & placed with RIR 21243

[illegible] 3-1-83

INFORMATION
COPY
PPRV

BR... , INC. NO. 225651

CPSES

MATERIAL REQUISITION

Q DATE 2-18-83

QUANTITY	DESCRIPTION & TAG NUMBER	HEAT/LOT/SERIAL NUMBER	CODE CLASS	QC
	2-3-56			
1	SI-2-073-401-S32R	RIR # 21236	2	[illegible] 2-18-8
	#2 (3) TS 6x6x1/2			
	#3 (1) PL 3/4" 12 1/4 x 12 1/4			
	#5 (1) 3/4" PL 12 1/4 x 12 1/4			
	#6 (3) 3/4" PL 10 1/4 x 10 1/4			
	MATERIAL REQUEST FROM WHAREHOUSE			
	RIR 21236 SHOWS ACCEPTION AUS 15237 2/11/83 1 SUPPORT			

INTENDED USE: SAFEGUARD #2

RECEIVED: [signature] NAME 8017

AUTHORITY: McDonald / Crosby SUPT. OR FOREMAN

ISSUED: [signature] WAREHOUSEMAN

FOIA-85-59

REQUISITIONER

CC/246

RM 2/18/83

REQUEST HANGER OR PARTS. Date: 4 / 1 / 83

FOREMAN: Stevenson HANGER NO.: SI-2-073-401-S33R REV.: 0

ITEMS NEEDED PER PRINT: #1 #2 #4 #5

ITEMS NEEDED PER CMC: #8 #9

CMC NO.: 90-257 REV.: 0 T/O No.:

REQUEST MISC. MATERIAL FOR ABOVE HANGER

REQUEST ITEMS REFABBED & REASON APPARENTLY NPSI SUPPLIED THIS ITEM CUT TO SIZE 3/4" X 12 1/4 X 12 1/4 SA36

REQUEST RECEIVED BY: DATE: TIME: VOID

BELOW TO BE FILLED OUT AT WAREHOUSE "A"

REQUEST REVIEWED BY: Mannin DATE: 4-11-83 TIME: 2:30

ITEMS TO TO BE FURNISHED BY WAREHOUSE:

ITEMS TO BE FABBED ON SITE: 1, 2, 4, 5, 8, 9, CMC

ITEMS NOT AVAILABLE ON JOB SITE — ORDERED ON CPPA:

JMC 4-19-83

TO FILLED OUT AT FAB SHOP

CC 247

FABBED BY: SKIP DATE: 4-19-83

ITEMS FABBED		HT. NO.'S	
#1 PLT. 3/4" x 10 1/4" x 10 1/4"	(3) ← SA36	H-30882	N.P.
#2 TS. 6"x6"x1/2"x6"	(3)	811N05270	Q.P.
#4 TS. 8"x8"x1/2"x6"	(1)	038131	Q.P.
* #5 PLT. 3/4"x12 1/4"x12 1/4"	(1)	N/A VENDOR SUPPLIED	
#8 PLT. 3/4"x7"x7"	(3)	66746	Q.P.
#9 PLT. 3/4"x9"x9"	(1)	D-43730	Q.P.

4-21-83 ALL ITEMS. Bracett

REQUEST RETURNED TO FIELD: DATE:

REASON: Check Laydown for #5 Delivery

BROWN & ROOT, INC. CPSES	PROCEDURE NUMBER	REVISION	EFFECTIVE DATE	PAGE
	CP-CPM 9.10	11	JAN 11 1984	1 of 17

TITLE: FABRICATION OF ASME-RELATED COMPONENT SUPPORTS OCN #1 #6 OCN #2 #3 #4 #5	ORIGINATOR [signature]	12-19-83 Date
	REVIEWED BY: [signature] B&R QA	1-9-84 Date
	[signature] W.E. Baker PROJECT WELDING ENGINEER	12-22-83 Date
	APPROVED BY: [signature] CONSTRUCTION PROJECT MGR	1-10-84 Date

FOR OFFICE AND ENGINEERING USE ONLY

0.1 TABLE OF CONTENTS

1.0 INTRODUCTION

This procedure provides the criteria for the fabrication and installation of ASME III, Subsection NF, Classes 1, 2, and 3 component supports. Moment restraints are not within the scope of this procedure.

2.0 GENERAL

2.1 MATERIAL

2.1.1 Material Control

Materials used in the fabrication of NF supports shall be materials acceptable for ASME use and do not necessarily include all materials acceptable for "Q" applications. Evidence of material acceptability, including shim material, will be provided through the use of a Material Identification Log (Attachment 1). The log shall be completed by the craft based on the information provided in the Hanger Package. The log shall then be presented to QC for material verification and signature.

NOTE: Heat numbers shall be recorded for Class 1 and for impact tested support materials.

Welding material shall be controlled in accordance with CPM 6.9B.

2.1.2 Material Identification

Prior to cutting, the heat or identification (MIC, code, etc.) number shall be transferred by mechanical marking, and this marking shall remain distinguishable throughout the fabrication process. When mechanical markings on the parts are not possible, such as on all-thread rods, the markings may be applied to bands or labels which are applied to the parts. The transfer of the markings shall be verified by QC prior to division. This verification is documented on the MIL. Additionally, the support assembly shall be mechanically identified with the hanger mark number which shall remain distinguishable throughout the installation.

FOIA-85-59

CC/249

COMANCHE PEAK STEAM
ELECTRIC STATION (CPSES)

COMPONENT MODIFICATION CARD (CMC)

SERIAL NO. 90257 REV 4

(1) APPLICATION: PIPE SUPPORT WELD MOD. [✓] Q [✓] NON-Q [NA] DESIGN CHANGE/DEVIATION [✓]

(2) DWG. NO. BRH SHEET 1 OF 1 REV. 0
SI-2-073-401-S32R

(3) LINE NO./COMPONENT NO.
16" SI-2-073-151R-2

(4) REASON FOR CHANGE: FEASIBILITY OF DESIGN.
△1 DUE TO EXCESSIVE GAP CAUSED BY THE CONFIGURATION OF GUARD PIPE.
△2 ADD SHIM TO MAINTAIN CLR.
△4 SHIMS OUT OF TOL.
△3 INCORRECT SECT CALL OUT & ADD NOTE

(7) ORIGINATOR
JOHN WITHERS
NAME
[✓] CPPE
[NA] ORIGINAL DESIGNER

(5) INSTRUCTIONS:

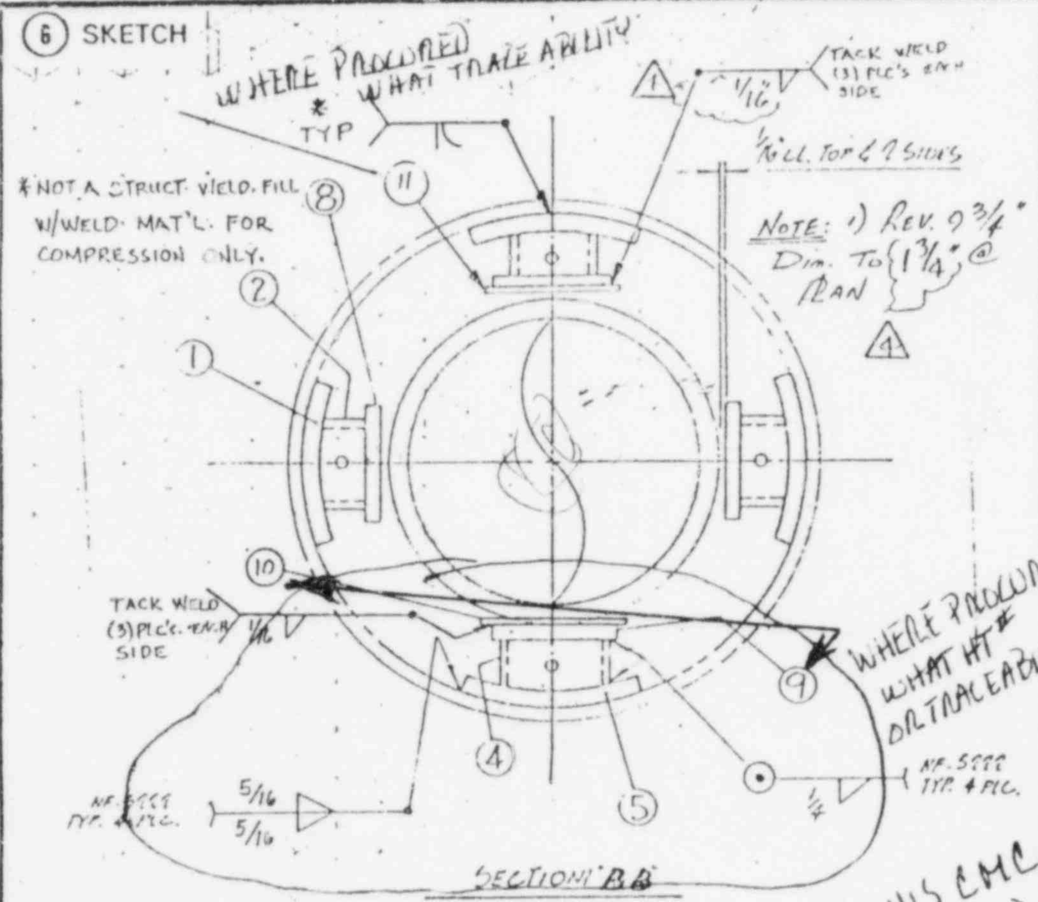
REMOVE [✓]

DELETE ITEMS #3 & #6.
DELETE ITEM #7 FROM B.O.M.

ADD [✓]

ITEM #8(3) PL 3/4" x 7" x 7" (SA-36 OR SA-515 GR. 65)
ITEM #9(1) PL 3/4" x 9" x 9" (SA-36 OR SA-515 GR. 65)
ITEM #10-(1)-PL 1/16" x 10" x 10" LG. SA-36 OR SA-515 GR. 65.
ITEM #11-(1)-PL 1/16" x 8" x 8" LG. SA-36 OR SA-515 GR. 65. △4

(6) SKETCH



NOTE: 1. DELETE DETAIL "A".
2. REVISE PLAN VIEW AND SECTION "A-A" ACCORDINGLY.
3. GUARD PIPE MATERIAL IS (SA-537 CLASS 2 OR SA-516 GR. 70).

3/19/84

IS THIS CMC INCORPORATED IN DWG.

(8) APPROVED BY:

JW [signature]	4-6-83 DATE
△1 [signature]	3/83 DATE
△2 Tim Sullivan	5-25-83 DATE
△3 Tim Sullivan	8-9-83 DATE
△4 Tim Sullivan	3-16-84 DATE
	DATE

(9) DISTRIBUTION

	DCC CNTL NO.	QTY
TECH SERVICES	INFO	2
SITE DAMAGE STUDY GROUP	INFO	
ST... PLANNING	INFO	1

THIS REVISION VOIDS AND SUPERSEDES DOCUMENT SERIAL NO.
CMC No. 90257 Rev. 3

nps industries, inc.

10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

PERM. PLT. RECORD

R/N	FILE LOC.
L	17 2.57.13
SUBFILE LOC.	
SI-2-073-401-S32R	

TUGCO P.O. # CP-0046A.1

ASME DOCUMENTATION CHECKLIST

CODE DATA REPORT.. N/A

MATERIAL RECORD.. X

SHOP DRAWINGS.. X

NONDESTRUCTIVE EXAMINATION REPORT.. N/A

NONCONFORMANCE REPORT.. N/A

WELD REPAIR REPORT.. N/A

WELD DATA SHEET.. N/A

CERTIFIED MATERIAL TEST REPORTS.. X

CERTIFICATES OF COMPLIANCE.. N/A

NPSI CERTIFICATE OF CONFORMANCE.. X

FOR INFORMATION ONLY

We certify that Support Mark No. SI-2-073-401-S32R Rev. 0 on our Shipping Notice AUS-19246 has been fabricated in accordance with Gibbs & Hill Specification 2323-MS-46A and conforms to ANSI N45.2, 10CFR50 Appendix B and Section III, Division I of the ASME Boiler and Pressure Vessel Code, Subsection NF 2000/4000, 1974 Edition, Winter 1974 Addenda.

Prepared by: Sandra Tagle Date: 6-4-84

Q.A. Approval: Betty Meyers Date: 6-4-84

FOIA-85-59

CC|250

a subsidiary of nuclear power services inc

nps industries, inc.

10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

DATE: June 4, 1984

CERTIFICATE OF CONFORMANCE

REFERENCE: Texas Utilities Services, Inc.
P.O. Number CP-0046A.1

We certify that material supplied for Support Mark No. SI-2-073-401-S32R Rev. 0 on Shipping Notice AUS- 19246/mA conforms to the referenced purchase order and to the applicable requirements of ASME Section III, Subsection NF, Class 2, 1974 Edition, Winter 1974 Addenda.

Betty Myers for
Plant Manager of Quality Assurance

FOR INFORMATION ONLY

ASME Certificate of Authorization Number N2323-2
Expires July 13, 1985

nps industries, inc.

10420 metric boulevard
austin, texas 78758
telephone 512-836-4161

PL 3/4 x 10 1/4 x 10 1/4 SA 36

MATERIAL TRACER RECORD

MARK NO. SJ-2-073-401-S32R REV. 0 PROD. RELEASE 62817 CODE ASME III CL 2

ITEM NO.	01	02	03	04	05	06	07	08	09	10
MIC. NO.	9073JF									
ITEM NO.	11	12	13	14	15	16	17	18	19	20
MIC. NO.										
ITEM NO.	21	22	23	24	25	26	27	28	29	30
MIC. NO.										

SUBASSEMBLIES

DRAWING/ITEM NO.

MATERIAL	MIC. NO.

DRAWING/ITEM NO.

MATERIAL	MIC. NO.

DRAWING/ITEM NO.

MATERIAL	MIC. NO.

DRAWING/ITEM NO.

MATERIAL	MIC. NO.

DRAWING/ITEM NO.

MATERIAL	MIC. NO.

Q.A. REVIEW: Sandra Fogle

a subsidiary of nuclear power services inc.

United States Steel Corporation

Metallurgical Test Report

MIC NO 9073NF-CV
PAGE 2 of 2

JOB. CONTRACT NO

P.O. DATE	PURCHASE ORDER NO.		
	AUS4040 05/08/83		
SHIPPERS NO.		MILL ORDER NO.	INVOICE NO.
H13580	5/12/83	BH56735	324-05555
VEHICLE IDENTITY	SP 590318		100

TEXAS WORKS
BAYTOWN, TX. 77520

NPS INDUSTRIES INC
ONE HARMON PLAZA
SECAUCUS N J 07094

SHIP TO:
NPS INDUSTRIES INC
10420 METRIC BLVD
AUSTIN TEXAS 78758

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MFGD., SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS REQUIREMENTS IN SUCH RESPECTS

PREPARED BY THE OFFICE OF:
D. A. VENSERET
CHIEF METALLURGIST
DATE 05/12/83

FOR INFORMATION ONLY

SPEC. CARBON PLATE ASME SA-36 1980 EDITION WINTER 1981 ADDENDA NUCLEAR QUALITY SECTION 2 & 3 NCA3800 10CFR21 QA CERT REQ

PLATES
01 MILL CERTIFIED T/R QUALITY ASSURANCE CERT REQ THE APPL PROVISIONS OF 10 CFR PART 21 APPLY & CERT NBR AND EXPIRATION DAT E 1 T/R TO NPS INDUSTRIES INC 10420 METRIC BLVD ATTN PURCHASHING

ITEM NO	THICKNESS OR SECTION	WIDTH DIA OR FT WT	LENGTH	QUANTITY	WEIGHT	HEAT NO.	TEST OR PIECE IDENTITY	YIELD PT. PSI	TENSILE STR. PSI	ELONGATION % IN 8"	ELONGATION % IN 2"	% RED. OF AREA	BEND
10	3/4	72	120	10	18380	1G2227		44700	69000	24.0			
								36000	64000	24.0			

QUALITY SYSTEM CERTIFICATE NO QSC-365 EXPIRES MARCH 5, 1985. THE MATERIAL DESCRIBED HEREIN HAS BEEN MANUFACTURED, TESTED AND INSPECTED IN ACCORDANCE WITH THE SPECIFICATION REQUIREMENTS AS DESIGNATED BY THE PURCHASER.

END-OF-DATA

NPSI REC'V INSPECTION CODE ACCEPTED
NPT ☐ Q1 ☑ QCC ☐
QC CN DATE 5-20-83

NPSI AUSTIN
MIC NO. 9073NF-CV
PO NO. AUS4040
SHEET 1 OF 2
7/4/83

HEAT NO	TYPE	C	MN	P	S	SI	CU	NI	CR	MO	SN	AL	N	V	B	TI	CB	CO
1G2227	HEAT	16	94	008	018	22												

END-OF-DATA

RECEIVED BY NPSI
MAY 18 1983
AUSTIN, TEXAS

BECHTEL
277

012759

POSITION OF ELEMENT ... INDICATED BY THE LEFT MARGIN VERTICAL DOTTED LINE OR DECIMAL POINT

CPPA 37,673

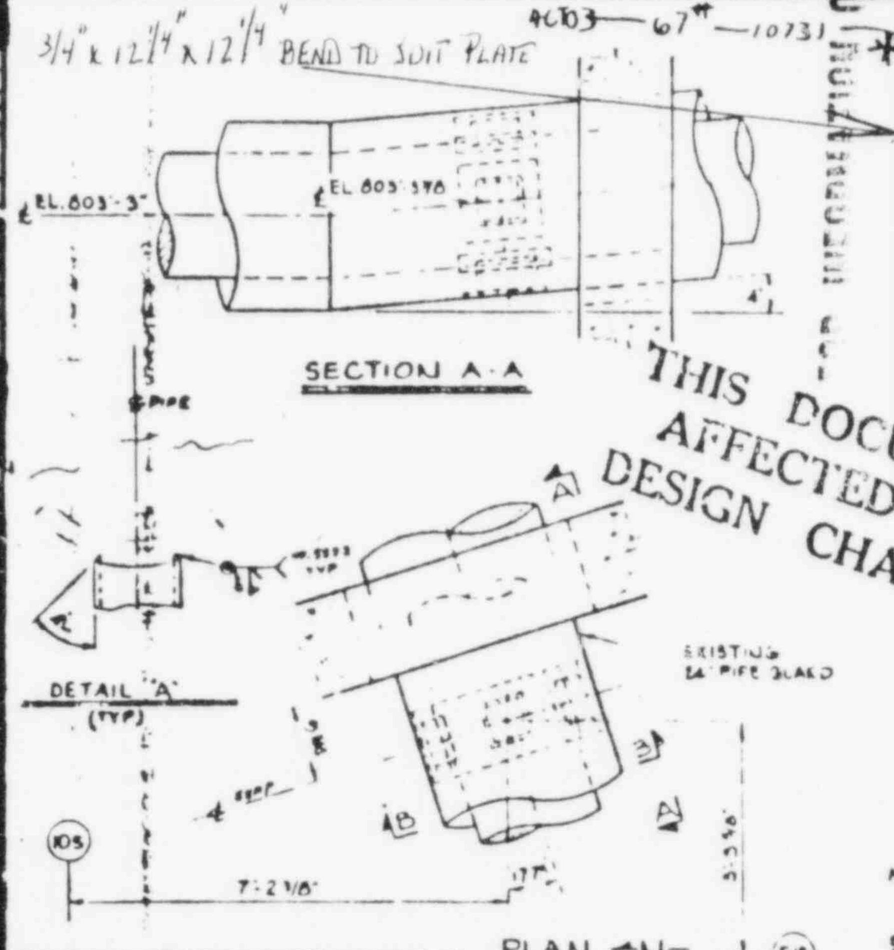
ITEM NO	NO REQ'D	DESCRIPTION	WT.	ASME OR ASTM
1	3	PL 3/4 x 10 1/4 x 10 1/4 (BEND TO SUIT) PLATE		A36
2	3	TS 3 x 6 x 300 STRUCT. TUBING		A500 B
3	1	PL 1/4 x 12 1/4 x 12 1/4 (BEND TO SUIT) PLATE		[illegible]
4	1	TS 3 x 3 x 300 STRUCT. TUBING		A500 B
5	1	PL 3/4 x 12 1/4 x 12 1/4 (BEND TO SUIT) PLATE	SA36	SA36
6	3	PL 3/4 x 10 1/4 x 10 1/4 (BEND TO SUIT) PLATE		[illegible]
7	1	ASME NAMEPLATE OR ALTERNATE MARKING		-

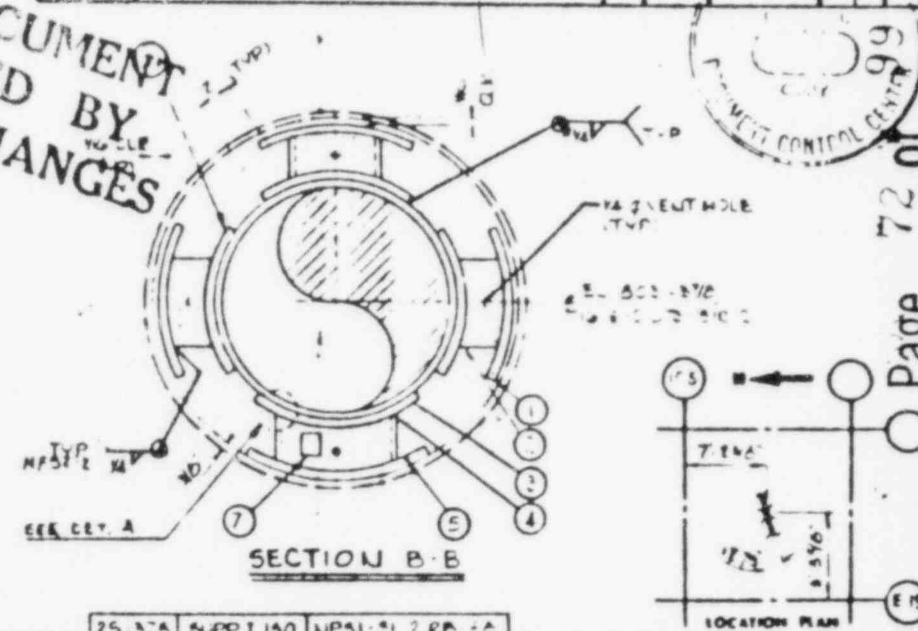
FOR OFFICE AND ENGINEERING USE ONLY

THIS DOCUMENT AFFECTED BY DESIGN CHANGES

3/4" x 12 1/4" x 12 1/4" BEND TO SUIT PLATE

4CT03 — 67" — 10731





PR# 62817

DESIGN LOADS:
NORM/UPSET: Y - 1108# LAT - 10274#
EMERG: Y - 38192# LAT - 10771#

25 37A SUPP'T 130 NPSI-SI-2 RB-26

REFERENCE DRAWINGS	G & H ISOMETRIC	REV	PIPING	REV	ELECTRICAL	REV
	2323-MI-2557-52	C	2323-MI-0603	3	2323-E1-0601-01	5
	FAB. ISOMETRIC	REV	STRUCTURAL	REV	H.V.A.C.	REV
	SI-2-RB-26	3	2323-S1-0602	3	2323-MI-0651	2

CODE/CLASS B/2

OWNER: TEXAS UTILITIES SERVICES INC.
PROJECT: COMANCHE PEAK UNITS NO. 1 & 2
ENGINEER: GIBBS & HILL INC.

Brown & Root, Inc.

ISSUED FOR CONST.

S-I-2-073-401-S32R

RECEIVED BY ...

MAR 2 ...

DOCUMENT CONTROL CENTER

Page 72 of 99

HANGER NUMBER: SI-2-073-401-S32R

ARMS INDEXED

FILE NUMBER. 17.2.57.13

DATE:

SUBFILE NO. HANGER NUMBER.

FOR OR NO. QAA-4146/ QAA-4255

REF. HANGER NO. CC-2-031-407-S435

FILE: 17.2.11.13

SUBFILE: REF. HANGER NUMBER

RIR NUMBER: 24750

MRR NUMBER: CP.11955

FOR INFORMATION ONLY

3.1.1.4 Engineering Vendor Certified/Design Reviewed Drawings (VCD/DRD)

Prior to final QA acceptance of a component support, Engineering will issue a VCD (Large Bore) or DRD (Small Bore) drawing. This drawing will incorporate all outstanding CMC's, and will be design reviewed by Engineering to assure compatibility with as-built loads and stress.

Design drawings and all applicable CMC's may be used as the basis for QC to verify as-constructed acceptability. The above documentation shall be reviewed by Quality Control Engineering (QCE) or Quality Engineering (QE) for compliance to the VCD/DRD as the basis for final QA acceptance of the support.

3.1.1.5 Construction Procedures

Construction Procedures are developed and issued by Construction to provide the methodology and criteria necessary to assure fabrication and installation of component supports in accordance with design requirements. Construction Procedures or procedure revisions are reviewed and approved by QE to assure compliance with specification requirements and compatibility with this instruction.

3.1.2 <u>Component Support Fabrication/Installation Process</u>

3.1.2.1 Component Support Fabrication/Installation Process Flow, Attachment 3, presents the typical process flow from Engineering issuance of the drawing, to final acceptance of the component support.

3.1.2.2 Component Support Package (HP) Contents

Welding Engineering, upon receipt of the controlled Engineering drawing, will prepare the fabrication/installation HP. The typical completed HP will contain the following documents, as applicable:

a. Controlled copy of the Vendor Certified/Design Reviewed Drawing (VCD/DRD) (Attachment 4 - Typical)

b. Material Requisition(s) (MR) for material used in fabrication/installation (Attachment 5 - Typical)

c. Weld Data Card(s) (WDC/MWDC) for B&R installed welds (Attachment 6 - Typical)

FOIA-85-59

d. Weld Filler Material Log(s) (WFML) for weld filler material consumed in B&R welds (Attachment 7 - Typical)

e. Manufacturing Record Sheet (MRS) for fabrication or modification (Attachment 8 - Typical)

f. Material Identification Log/Structural Assembly Verification Card (MIL/SAVC) to provide traceability of installed items or material (Attachment 9 - Typical)

g. Repair Process Sheets (RPS) for B&R repaired welds (Attachment 10 - Typical)

h. Construction Operation Travelers (OT) for mechanical assembly activities (Attachment 11 - Typical)

i. Vendor Supplied Component Modification Record for modification of component support standards (Attachment 12 - Typical)

j. Vendor supplied Code Data Reports (Attachment 13 typical).

k. Vendor supplied material reports (Attachment 14 typical).

3.1.3 Material Salvaging

Salvaging of component support parts such as structural steel, snubbers, moment restraints, etc., shall be accomplished as follows:

3.1.3.1 Salvaging

When an item is salvaged for use on a support other than the one for which it was designated, the original support mark and serial number; or original mark, MIC or heat number; or original mark and heat code shall remain distinguishable on the item.

If vendor fabricated supports or B&R fabricated supports have been previously accepted and the identification numbers are not distinguishable, the identification numbers may be determined by the applicable documentation used to originally accept the material. The numbers shall be transfered to the items being salvaged.

NOTES:

1) No evaluation is needed when a salvaged support or part is to be used on a lower Code class than for which it was originally supplied.

2) No evaluation is needed for NPT stamped component standard supports, if it is to be used on the same Code Class as originally manufactured.

3) Special Requirements for Snubber Salvaging

NPSI and ITT Grinnel parts or hardware should not be interchanged.

Snubbers and associated hardware may be used on component supports from the same vendor (NPSI, ITT), other than those for which they are designated, provided requirements of this instruction are met.

3.2 MATERIAL IDENTIFICATION

3.2.1 Material Identification Requirements

3.2.1.1 Vendor Supplied Component Supports

Vendor supplied NPT stamped component supports shall bear marking (i.e., name plate) traceable to the design drawing. Component supports requiring field welds at installation shall bear mechanically marked unique identification on each part traceable to the vendor data package.

3.2.1.2 Component Support Standards (Catalog items)

Component support standards such as shown in Attachment 15, shall be traceable to a Certificate of compliance until the material is received and verified by QC, and controlled until issuance for fabrication/installation in accordance with Brown & Root Quality Procedure CP-QAP-8.1.

The acceptability of the component support standard and fasteners for fabrication/installation is ensured by the vendors unique identification (i.e., letter code, MIC no., serial no., etc.) or a Brown and Root applied color code (Class 1 - Black, Class 2 and 3 - Green).

3.2.1.3 Brown and Root Fabricated/Modified Component Supports

Brown and Root fabricated class 1 component supports shall bear unique marking on each item of structural steel used in the fabrication of the component traceable to a Certified Material Test Report (CMTR). Structural steel used in the fabrication of class 2 and 3 component supports shall bear unique identification traceable to a Certificate of Compliance (C of C). Materials used to modify vendor supplied component supports shall also comply with the preceeding requirements.

3.2.1.4 Material Traceability Requirements

Material for component supports shall carry identification markings which will remain distinguishable until the fabrication and installation of the component support is accepted. If the original identification markings are cut off or the material is to be divided, the identification shall be accurately transferred to assure identification of each piece of material during subsequent fabrication or installation. QC shall verify marking transfer prior to separation.

3.2.2 Material Identification Documentation

3.2.2.1 Material Identification Log (MIL)/Structural Assembly Verification Card (SAVC)

During fabrication/installation of component supports material acceptability shall be verified by use of the MIL/SAVC. The QCI shall sign and date the MIL/SAVC to indicate that the materials listed are properly identified and documented.

NOTE: The shop/field QCI shall compare the entries on the MIL/SAVC to the respective MR to assure that the material has been verified by Receiving QCI, and is acceptable for its intended use. Copies of MR's for bulk material verified by shop QCI are not required to be included in the support package.

3.2.2.2 Material Requisition (MR)

The MR is used by Construction to requisition material for fabrication/installation. The entries on the MR shall be compared to the material being requisitioned and acceptable verification shall be denoted by Receiving QCI signature on the MR.

DOCUMENTATION COMPLETE
99 pages
DATE 6-20-84
SIGNED [signature]

Brown & Root, Inc.

QUALITY ASSURANCE
RECEIVING INSPECTION REPORT

REPORT NO. 24750

UNIT	SYSTEM	COMPONENT	IDENTIFICATION/SPIN NO.	DWG./SPECIFICATION & REV.
2	Mech	Pipe Hanger Support	See Below	MS-046A

P.O.	MRR	CHARACTERISTIC INSPECTION:
CP-046A.1	CP 11955	~~QI-QAP-7.2~~ CP-QAP 8.1; SAT. ✓ UNSAT. ~~X~~ NCR ___ HOLD TAG ~~X~~ ✓
VENDOR	**SW/QR (QAA)**	**APPARENT RESPONSIBILITY FOR UNSATISFACTORY ITEMS:**
NPSI Austin Texas	4255 4146 QAR# 3543	B&R ☐ VENDOR ✓ TRANSPORTER ☐ DATE DEFICIENCY CLOSED 6-20-84

QA RECORD — RTN. L — QA REVIEW [initials] — FILE NO. 8.1 — SUBFILE NO. 24750

ITEM	QTY.	DESCRIPTION/REMARKS
		Shipping Notice Aus-19246/10A Class 2 & 3 NF use
—	7ea	Pipe Hanger Support, * Partial release 6-13-84 HED

ARMS INDEXED

mk#	Item # (BRH)	QTY	~~mat~~ DATE
* 1) CT-2-039-014-C92S	6	1	Same as mk#
* 2) CC-2-031-407-S43S	14	1	" "
* 3) SI-2-073-401-532R	1	3	9073NF
* 4) MS-2-004-401-C72S	26	1	Same as mk#
* 5) MS-2-004-414-S72R	15	1	895INF
6) MS-2-004-413-S72R	19	1	895INF
7) FW-2-~~004~~ 020 -404-C42K	~~6~~18	4	(2ea) 0145NF & 8917NF (2ea)

N/A TO CAT 33 AQH-22

"Hold"

~~1) ... CC-2-031-407-S43S ... 10296NR HED 6-13-84~~
~~2) ... ... NR~~
~~3) ... ... QAR ...~~ HED 6-20-84

INFORMATION COPY PPRV

AUTHORIZED NUCLEAR INSPECTOR NOTIFICATION:
DATE: ___ TIME: ___ MEDIA: ___ N/A ✓ INIT. ___

ANI WITNESS: SAT. ___ ☆☆ UNSAT. ___ ☆☆ WAIVED ___ DATE: ___

☆☆ ANI'S INITIALS REQUIRED

STORAGE LOCATION: Whs "B" Area	QC ENGINEER/INSPECTOR	DATE
TYPE: B&E	[signature]	6-13-84

QC-1.1/3-1

FOIA-85-59

CC/252

MATERIAL RECEIVED RECORD

COMANCHE PEAK S. E. S.

CP

Job No. 35-1195

MR NO. 11955

PAGE 1 OF 1

P. O. NO. CP-0046A.1

SHIPPED TO: B & R ☐ G & H ☐ F & N ☐ W ☐ TUSI ☒ XX OTHER ☐

REQ. NO.

VENDOR: ~~MRS INDUSTRIES~~ NPS INDUSTRIES
SECAUCUS, NJ

DATE: 6-8-84

SHIPPER: SAME
AUSTIN, TEXAS

F.O.B. AUSTIN

Partial ☒ XX 542 Complete ☐

QUANTITY	UNIT	ITEM	MATERIAL DESCRIPTION	LOCATION
			SHIPPING NOTICE NO. AUS.-19246	QA REC.
1	ea.	6	CT-2-029-014-C92S Rev. 0	
1	ea.	14	CC-2-031-407-S43S Rev. 0	
3	ea.	1	[illegible]-2-073-401-S32R Rev. 0	
1	ea.	26	MS-2-004-401-C72S Rev. 1	
1	ea.	15	MS-2-004-414-S72R Rev. 0	
[illegible]	ea.	[illegible]	MS-2-00[illegible]-[illegible]13-S72R Rev. 0	
2	ea.	[illegible]	FW-2-020-404-C42K Rev. 0	
2	ea.	8	FW-2-020-404-C42K Rev. 0	
1	lot		CERTS RECEIVED WITH SHIPMENT	ISSUED QA REC.

INFORMATION COPY

THIS INSPECTION DOCUMENTED ON MR NO. 24250
PPRV

J. Biggerstaff
RECEIVED BY

Q.C. CHECK BY	EXP.	PP	TEX PAK	UPS	PREPAID	COLLECT
XXX					XXXX	

GJ/ 6-11-84

VENDOR
DELIVERING CARRIER

F B NO.	CAR NO.
62476	

ACCTS. PAYABLE

BROWN & ROOT INC.
Quality Assurance Department

RECEIVING TUGCO/G&H SAFETY RELATED EQUIPMENT

24750

	SAT	UNSAT	N/A
1. Check documents received with shipment.	✓	✓	
a. G&H Quality Assurance Release (QAR) obtained?	✓	✓	
b. Are "Review Checklist" items on QAR accepted?	✓	✓	
c. Was final inspection performed by TUGCO/G&H?	✓		
d. ASME Code Data Report obtained?	✓		
e. Authorization for shipment?	✓		
2. Equipment Identification			
a. Do Data Reports and Equipment Code Plate agree?	✓		
b. Do Data Report and G&H agree?	✓		
c. Does Identification Tab/spin number compare with G&H QAR?	✓	✓	
3. Was there any damage?	✓		

Comments: ~~[illegible]~~

~~[illegible]~~

INFORMATION COPY PPRV

Receiving Inspector [signature] Date 6 13 84

HANGER NUMBER: CC-2-031-407-S435

FILE NUMBER. 17.2.11.13

SUBFILE NO. HANGER NUMBER.

FOR OR NO. QAA-4146/ QAA-4255

REF. HANGER NO. CC-2-031-407-S435

FILE: 17.2.11.13

SUBFILE: REF. HANGER NUMBER

RIR NUMBER: 24750

MRR NUMBER: CP.11955

Ref
SI-2-073-401-S22R

TEXAS UTILITIES GENERATING COMPANY

SKYWAY TOWER • 400 NORTH OLIVE STREET, L.B. 81 • DALLAS, TEXAS 75201

QAA- 4146

PERM. PLT. RECORD

RTN	FILE LOC.
L	17.2.11.13
SUBFILE LOC.	
CC-2-031-407-5435	

TEXAS UTILITIES GENERATING COMPANY
COMANCHE PEAK STEAM ELECTRIC STATION
PURCHASE ORDER NO. CP-0046-1
AUTHORIZATION FOR SHIPMENT

By copy of this letter, TUGCO Quality Assurance releases the following equipment to be shipped by NPS Industries, Austin, Texas:

See Attachment "A" and "B" QAA 4146

INFORMATION COPY PPRV

[✓] Final shipment inspected, QAP No. 3543

[ ] Final inspection waived

Edward J McGee — TUGCO QA Inspector

6/7/84 — Date

A DIVISION OF TEXAS UTILITIES ELECTRIC COMPANY

Attachment 1 Sht 414c

Supports

Mark #	Discription	Item	QTY
CT-2-029-014-C92S/0	VSG	6	1
CC-2-031-407-S43S/0	RWE-08	14	1
SI-2-073-401-S32R/0	Plate	1	3 — 3/4 x 10 1/4 x 10 1/4
MS-2-004-401-C72S/1	CVB	26	1
MS-2-004-414-S72R/0	SSC Clamp	15	1
MS-2-004-413-S72R/0	SSC Clamp	19	1
FW-2-020-404-C42K/0	SSC Clamp	6	2

INFORMATION COPY PPRV

DATE: June ~~6~~ 7, 198[illegible]

TUSI SALES RELEASE

CPPA	DESCRIPTION	ITEM#	QTY	NPS ORDER #
3656[illegible]	FHW-03	8	106[illegible]	NA-1597
3656[illegible]	FHW-0[illegible]	9	420	NA-1597
25037	SMTT-35	1	7	MRA-372
38705	PDC-320-0624	5	2	NA-1620
3870[illegible]	SPC-06-160	7	1	NA-1620
23602	PSG-004	6	50	MRA-422
2360[illegible]	PSG-008	7	50	MRA-42[illegible]
2360[illegible]	PSG-010	8	50	MRA-422
2360[illegible]	PSG-01[illegible]	9	50	MRA-422
2360[illegible]	PSG-020	10	5[illegible]	MRA-422

INFORMATION COPY PPRV

Attention: Mick Bledsoe

TEXAS UTILITIES GENERATING COMPANY

SKYWAY TOWER • 400 NORTH OLIVE STREET, L.B. 81 • DALLAS, TEXAS 75201

QAA- 4255

TEXAS UTILITIES GENERATING COMPANY
COMANCHE PEAK STEAM ELECTRIC STATION
PURCHASE ORDER NO. CP-0046A.1
AUTHORIZATION FOR SHIPMENT

By copy of this letter, TUGCO Quality Assurance releases the following equipment to be shipped by NPSI Austin:

Qty: 2 Rolled Plates
Item #8 FW-2-020-404-C42 K/O

INFORMATION COPY PPRV

[ ] Final shipment inspected, QAR No. ______

[X] Final inspection waived

Pilwood [signature] 6/20/84

TUGCO QA Inspector — Date

TRANSMITTAL NUMBER 1027

TO: Mechanical Drafting/Welding Engineering

Subject: Transmittal of Field Modified Hanger Sketches/Packages

Attached for your action are the following Field Modified Hanger Sketches/Packages and original CMCs.

MARK NO.	CMCs	T/O
1. MS-2-003-501-Y36R		
2. ST-2-116-403-S33R		24901
3. SW-2-132-442-S33R		
4. ST-2-073-401-S32R	90257	
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

Note: Please return original blueline to [illegible] for [illegible] E2418

[signature] 9-11-84
Hanger Engineering Date

[signature] 9-11-84
Received by Mech. Drafting Date

[signature] 9-11-84
Received by Welding Engr. Date

cc: Systems Planning

FOIA-85-59

CC/253

CORRECTED COPY 9/13/84 [initials] 9.13.84

** DR-053 **

NPS INDUSTRIES

MATERIAL TRACER

OPERATION	PRODUCTION RELEASE NO	MATERIAL	SPEC	DATE	PA
	16715TUS			10/29/82	1

QUAN	MARK NUMBER	REV	ITEM #	DIMENSION	ROUTING	M/C	QC

DRAWING NO- SI-2-073-401-S32R

ITEM#	PART NO.	QTY	LVL	DESCRIPTION	ROUTING	
0002	10582	3	0	.....TS 6 X 6 X1/2 A500B LENGTH OR C-C: 3- 1/16 "	C1-10	6048 NT
0003	11021	32	0	.....PL 3/4 SA240/304	C1-7	8391 NF
0006	11021	67	0	.....PL 3/4 SA240/304	C1-6	8391 NF
~~0006~~ 0005*	10731	32	0	.....PL 3/4 SA36	C1-8	5734 NF

DOC. REVIEWED NPSI
Q.A. KC DATE 1/28/83

*CORRECTION MADE TO CHANGE ITEM 6 TO 5 IN ACCORDANCE WITH DWG. NO. SI-2-073-401-S32R REV. 0. [initials] 9.13.84

Telecopy
Attn: Roy Wright
From: T. O'Connell
9-13-84
Pg. 1 of 1

UPDATE

DATE

RIR: 2126

TED NEELY 835

FOIA-85-59

CC|254

Comanche Peak Open Issue Action Plan

Task: Missing/Incorrect Heat Number on Plate (Traceability)

Ref. No.: AQH-22

Characterization: There was no heat number marked on a piece of plate installed as part of a pipe support. (Vendor supplied piece)

Initial Assessment of Significance: Material traceability was indeterminate.

Source: Mechanical and Piping Category 33

Approach to Resolution:

1. Review the detail of alleger's statement in the technical interview with alleger, August 8, 1984.
2. Review documentation and QC record entries in hanger package.
3. Verify receiving records for the plate to track the heat number.
4. Interview QC Inspection Foreman.
5. Refer any examples of wrongdoing or significant deficiencies to TRT manager.
6. Evaluate allegations for generic/safety implications.
7. Report on results or review/evaluation or allegations.
8. Evaluate generic/safety implications and potential violations.

Related Open Issue Identification: None

Category No. 33

Review Lead: Mechanical & Piping, J. H. Malonson

CLOSURE:

Reviewed By: ____________________

TRT Leader

SI-2-073-401-S32R
Hanger Number

CC/256

MATERIAL IDENTIFICATION LOG

	Mat'l Spec	Material Description	Quantity	Heat/ID Number	Salvaged Hanger Number (where applicable)	QC Verification & Date	Notes
#1	SA-36	R 3/4" X 10 1/4" X 10 1/4"	3	H-30882	N/A	4-18-83 / 8-3-83	MR 251808
#2	A500GRB	T.S. 6"X6"X1/2"X6"	3	811N05270	N/A	Radcliffe 4-14-83 / McDowell 8-8-83	MR 130245
#4	A500GRB	T.S. 8"X8"X1/2"X6"	1	238131	N/A	Radcliffe 4-14-83 / McDowell 8-8-83	MR 251055
#5	SA-36	R 3/4"X12 1/4"X12 1/4"	1	5734NF / H-30382	N/A	McCallwell 8-17-83	
#8	SA-36	R 3/4"X7"X7"	3	66746	N/A	Radcliffe 4-18-83 / McDowell 8-8-83	MR 220103
#9	SA-36	R 3/4"X9"X9"	1	D43730	N/A	Radcliffe 4-18-83 / McDowell 8-8-83	MR 201921
1	SA36	3/4X10 1/4X10 1/4	2				
2	A500GRB	TS 1/2X6X6X6"	2	C11645	NA	3-24-84	MR-130246
1			2				
2			2				
8	SA36	R 3/4X7X7	2	D43730	NA	3-20-84	MR 202051
11			2				
11	SA36	R					
11	A500 GRB	R 1/16X8X8	1	W10513	NA	3-20-84	MR 159068

#1, #2, #4, #8 & #9 FABBED FABBED PER CMC-90257 R [illegible] 4-19-83

Verify Ht# transfer of item 5 (5734 NF) M Kahler 8/4/83

FAB #2 PRINT 8,11 PER CMC 3/26/84

8/8/83 — WHO IS THIS?

Heat # for #5 is 5734NF McCallwell 8-17-83

ATTACH 13

72768

CMC LOG

40257 R.4 3/5/84

MULTIPLE WELD DATA CARD

WDC SERIAL #
DRAWING #
LINE # NA

ITEM NO.	WPS NO.	REV.		WELD FILLER MATERIAL	WELD NOS.	P NO.	FAB CODE & CLASS/ ACC. STD.
NA	11022	9 10		E7018	NA	1-1	ASME III - 2
NA	11020	6	1	E70S-2	NA	1-1	CPM-3.10

NOTES: 1. APPLICABLE QC/ANI HOLD POINTS SHALL BE INDICATED BY CHECKMARK
2. ANI INSPECTION POINTS INDICATED BY (X).
3. DENOTE SATISFACTORY INSPECTIONS BY AN "S": UNSATISFACTORY INSPECTIONS BY A "U".

OPERATION #	OPERATIONS	#	OPERATIONS
1	Support Number Identification	7	Spherical Bearings
2	Size, Configuration, Tolerance/Dwg.	8	All Welds/Dwg. & WPS (T.T.)
3	Material Correct/Dwg.	9	Installation Complete
4	Fasteners Correct & Complete	10	Final PT/MT (as required)
5	Location & Elevation/Dwg.	11	
6	Spring Can Stops Installed	12	

PREP: Wells Buckingham 10-14-82 PRODUCTION RELEASE

WELD NO.	OPERATION	HOLDPOINTS WT	QC	ANI	CONST	SAT UNSAT	QC OR WT	NDE CERT LEVEL	ANI	NDE/V REV.	M&TE # CALIB DUE DATE
NA	1	NA	✓	NC		SAT	P McDowell 9-9-82	II			
NA	2	NA	✓	NC	(+)	UNSAT	P McDowell 9-9-82	II			
NA	3	NA	✓	NC		SAT	P McDowell 9-9-82	II			
NA	5	NA	✓	NC		SAT	P McDowell 9-9-82	II			
NA	8	NA	✓	NC		SAT	P McDowell 9-9-82	II			
NA	9	NA	NA	NA			6/1/83				
REVIEWED:							10/15/82		10/15/82		
NA	9	NA	NA	NA			8/8/83				
REREVIEWED:							8/8/83				

CMC 40257 REV 4

* HIDDEN WELDS ITEM 3 TO ITEM 8, WELDS 1,2 & 3, SAT 4-27-83

* Hidden welds joining items 4 to items 8 & 9 (welds 4,5) SAT 5/19/83

* Hidden welds joining item 3 to 10 (SAT) 5/25/83

* Hidden welds Between Item # 1 and Item # 2 (2 places) SAT 5-24-83 II welds 12 & 14
* Hidden weld Between Item # 1 and Item # 2 (Top) SAT 5-24-83 II weld 13
* Hidden welds Between Item # ... and Item # ... (2 places) SAT 5-26-83 II welds 15

(+) See IR # AM 00605 8-17-83

WELD NO.	OPERATION	WT	QC	ANI	CONST	SAT UNSAT	QC OR WT	NDE CERT LEVEL	ANI		
NA	2	NA	✓	NC							
REVIEWED	W						3/1/84		3/1/84		
NA	1	NA	✓	NC							
NA	3	NA	✓	NC							
NA	8	NA	✓	NC							
NA	9	NA	NA	NA							
REVIEWED:							3/20/84		3/20/84		

* RE-ESTABLISHED PER UNSAT IR # AM-00605 3/20/84

WE 6/1/83 QC ANI

APPROVAL SIGNATURES SHALL BE AFFIXED IN THE LINE IMMEDIATELY BELOW THE LAST STEP IN EACH SEQUENCE. WE 8/8/83

* Operations 1-8 are Final Inspections.

INSTALLATION TO BE IN ACCORDANCE WITH PROCEDURES REFERENCED IN CPM-6.11

CC/257

JRM INITIAL ASSESSMENT CAT 33 AQH-22

1 - ITEM 5 CALLS FOR 1 PIECE SA 36 PLATE 3/4" x 12 1/4" x 12 1/4"

2 - IR 21236 SHOWS SOMETHING ? SHIPPED FOR SUPPORT
SI-2-073-401-S32R PER NPSI SHIPPER ADS 15327 TDA
GET COPY ADS 15237 TDA
IS ITEM 5 ON IT. - WHAT FORM. 1 PC PL 3/4 x 12 1/4 x 12 1/4

3 - MATERIAL REQ'N 225651 7/18/83 REQUESTS ITEMS
2 - TUBE STEEL
3 - PL 3/4 x 12 1/4 x 12 1/4 SA 240
5 - PL 3/4 x 12 1/4 x 12 1/4 SA 36
6 - PL 3/4 x 10 1/4 x 10 1/4 SA 240

SECT NF 2150
~~CODE CL~~ 2 DOES NOT REQUIRE HT # MARKING FOR MATL
FURNISHED ON C of C. - e.g. SA-36 HOWEVER
DOES REQUIRE IDENT.

4 (1) MATERIAL IDENT LOG SHOWS QC VERIF OF HT #
(VENDOR ITEM) H 30382 AND 5734NF 8/17/83 BY CALDWELL
& FOOT NOTE
(2) NOTE SHOWS VERIFICATION OF HT # TRANSFER ITEM 5
HT # 5743NF BY M KAPLAN 8/4/83 - CORRECTED
TO 5734 BY STRIKE OUT - INITIAL TRN 8/4/83

FOIA-85-59

CC/258

9/12/81
JRM

ROADMAP CAT 33 AQH-22

ALLEGATION — HEAT # TRACEABILITY LOST ON SUPPORT MEMBER
— PIECE #5 — HANGER SI-2-073-401-S32R.

1- REVIEW HANGER PACKAGE

2- REVIEW RIR 21236 NPSI 0046A

3- GET DRG SI-2-073-401-S32R

4- GET ISO. G+H. M2-3252-02 PIPING 2823-M2-0605
FAB SI-2-RB-88 STRUCT 2323-S2-0602

5- GET INSP PROC. QI-QAP-11.1-28 FAB & INSTALL'N INSP OF SAFETY CL. COMP SUPPORTS
RECORD UNACCEPTABLE PER CP-QAP-16.1

6- GET INSTALL'N PROC. 9.10

7- SPEC- 2323-MS-46A - DES SPEC
MJ-100 - FAB. CONSTR. SPEC

ASKED TED NEELY TO CALL 2 PM 9/13

TALK TO GEO. BUNT - CRAFT - SUPPORTS (B&R)
524-259

TALK TO R. WRIGHT MAT'L CONTR
835

CONTACT DAVE RENTSCHER.

TALK TED NEELY X581 QA QC

TALK TO CALDWELL X286 QA QC 897 4856
3712

SI-207340+532R Rev 0

CMC's INVOLVED

TED NEELY
FOREMAN

NEELY PUT HEAT NUMBER H30382 &
SAYS IT IS A VENDOR'S ITEM

THEY HAD A "REQUEST TO WAREHOUSE" FOR
PART OF A HANGER THAT SAID
"BELOW TO BE FILLED OUT BY WAREHOUSE A"

THEY LISTED PART #5 & FOR A HEAT
NUMBER, IT SAYS "N/A VENDOR SUPPLY"

THERE IS CURRENTLY A HEAT NUMBER ON THE PIECE

TOM ELLIS WENT W/ WEISMAN →

THEY CAME BACK W/ A MATERIAL REQUEST
& THEY SAY:
ITEM #5 1 3/4 R 12¼ x 12¼
HEAT LOT & SER # RIR 21236

ERM MPSI SAYS IT WAS NEVER SHIPPED

→ LOOK FOR MWOC

MARK KAPLIN ~~APPROVED~~ APPROVED HEAT #A15834NF

HAVE → ISO SI-2-073-401 S32R REV 0

MATL IDENTIFICATION FORM -
MIL H 30382 WAS MARKED THROUGH

REQUISITION FOR WAREHOUSE "A"
TOM ELLIS WAS W/ ALLEG & VERIFIED THERE
WAS NO HEAT # ON PIECE 5

G/H SPEC 2323-MS-46A
TUGCO PO CP-0046A.1 NPS IND INC

ITEM 5 is A36
ITEM 6 SEEMS TO BE SOMETHING ELSE
(?)

LISTED ON DWG B/M
#5 1 PL 3/4 x 12 1/4 x 12 1/4 BEND SA36
#6 3 PL 3/4 x 10 1/4 x 10 1/4 A240/A304

ITEM 5 HEAT NUMBER 802 N55790 3/4" PL

MATERIAL TRACER -
ITEM 6 32 0 SA36 5734NF
ITEM 6 67 0 A240/A304 8391NF

MATERIAL TRACER SHOWN ON

CHECK ON TYPE OF MATERIAL #6

PAGE 36 -45

51-2-073-401-S32R Rev 0

Action

GET REST OF RECORDS FROM
ACTIVE FILE

Copy of ~~look~~ FOR RIR 21236
Copy of ~~..~~ NPS IND PO# CP-0046A.1

DOCUMENTS RELATED TO PIECE 5

1. RIR 21236
2. REQUISITION FOR HGR "R" PARTS 4/1 & 11/83
   PAGE 123 of 144
3. HANGER INSPECTION REPORT COGWELL FOR M'DONALD 8-17-83
4. MAT IDENT LOG JOHN COGWELL 8/17/83
   HEAT # 30382

   # 5734 MF
   MARK KAPLAN 8/4/82

~~5. HANGER INSPECTION~~

Allegation Summary

1. Category No.: 33 TRT Member: J. Malonson

2. Subject: Missing/Incorrect Heat Number on Plate (Traceability)

3. Summary of Allegation:

AQH-22 (Nisich) - It is alleged that there was no heat number marked on a piece of plate installed as a part of a pipe suppport.

4. Region IV's Conclusion:

No Region IV documentation was found for this category.

5. What the TRT Had Done:

The TRT reviewed all related documentation and QC records and interviewed B&R personnel.

6. TRT Conclusions:

The allegation was correct but since documented evidence and traceability is available, there is no safety significance.

7. Hearings:

The matters of this category have not been discussed in the hearings.

5

SEER WRITEUP DOCUMENT CONTROL/ROUTE SHEET

Allegation Numbers AP-24 + AP-25
Subject of Allegation UNDOCUMENTED AND UNCONSERVATIVE COMPUTER PROGRAM
TRT Group MECHANICAL / PIPING
Author: R MASTERSON

This sheet will be initialed by each reviewer. It stays with all revisions to the SSER writeup and serves as a routing and review record. It will be filed in the work package when the writeup is published.

Draft Number

Draft	1	2	3	4	5
Author	-jrm				
Group Leader	JHon				
Tech. Editor					
Wessman/Vietti					
J. Gagliardo					
T. Ippolito					

Revision Number

Final	1	2	3	4	5
Author					
Tech. Editor					
Group Leader					
J. Gagliardo					
T. Ippolito					

Administrative

Writeup integrated into SSER ______
Potential Violations to Region IV ______
Workpackage File Complete ______
Workpackage Returned to Group Leader ______

FOIA-85-59
CC-260

Draft 2 - 8/6/84

AP-24 & AP-25/CP2

SSER

1. Allegation Group: Mechanical and Piping Category No. 34 - Computer Programs Not Properly Validated

2. Allegation number: AP-24 and AP-25

3. Characterization: It is alleged that two specific computer programs, ITT ittgrinnell FUB II Rev. 2 and Corner & Lada Base Plate Program, used for evaluating support base plate and their associated bolts made erroneous assumptions and were not validated.

4. Assessment of safety significance: Due to the specificity of the two allegations, and since the documentation needed to review these allegations were located offsite at the vendor offices, the NRC Technical Review Team (TRT) performed the review ~~at the individual vendor locations, together with reviewing~~ including appropriate procedures. Rewrite

AP-24 - The allegation indicated that the Itt Grinnell (ITT-G) base plate computer program FUB II Revision 2 was never validated and specifically only checked one bolt out of four for a tension load. Previous to this review during the period February 22 to March 23, 1983, the NRC Region IV (RIV) inspection team addressed these same allegations related to computer program FUB II, Revision 2 in their report Nos. 50-445/83-12 and 50-446/83-07. These reports concluded that one concern was not substantiated. However, in the process of the inspection a related concern was verified by the program author. This concern was found to be without technical merit by the RIV inspector.

The TRT reviewed the allegations ~~with representatives of ITT-G engineering management, structure analysis~~ management and engineering ~~quality assurance. The manager of structural analysis gave~~ and a detailed history of the FUB II computer program. The traceability of the evolution of the FUB II program from Rev. 0 to Rev. 3 was well documented. The FUB II program was the first computer program issued for use by ITT-G for the Comanche Peak Project. It was confirmed by ITT-G engineering management that the earlier version of the program, FUB I, had not been issed to the Comanche Peak Project. The concern of the alleger dealing with only one bolt being checked for tension load was addressed by ITT-G two months prior to the RIV inspection. As a result of this internal audit, a series of computer analyses were investigated by ITT-G in the period September to December 1982. The documentation reviewed by the NRC TRT of this internal inspection showed that for a series of randomly chosen base plate configurations, bolts other than bolt No. 4 were chosen correctly as the bolt with the highest tension load.

During the evaluation by ITT-G, however, it was discovered that the computer program failed to perform the correct moment arm comparisons to choose the shortest moment arm, which when converted to force couples resulted in the hightest loaded bolt. The TRT reviewed the ITT-G Rev. 3 documentation for the moment arm discrepancy. Twenty five actual samples of baseplates at Comanche Peak were reanalyzed by Rev. 3 of FUB II which included the change by ITT-G to pick the largest moment arm to determine maximum bolt load. ITT-G explained that the choice of the larger moment arm rather the smaller moment arm was based upon other comparisons that resulted in very conservative results vs finite element analyses for the smallest moment arm. In effect ITT-G was incorporating two concerns in Rev. 3 to FUB II. Concern No. 1 was to revise the program to choose between the smallest moment arm(s) available, where before no choice was apparent. Concern No. 2 revised Concern No. 1 to pick the largest moment arm, since a finite element comparison yielded overly conservative results for the smallest moment arm choice. The TRT reviewed the twenty five samples of a four bolted base plate analyses and found that an average conservatism of bolt tension/shear interaction of 25% (based on shortest moment arm?) between the finite element analyses and FUB II Rev. 3 was substantiated. As additional documentation, ITT-G provided evidence of approximately fifty other base plate designs that were compared for conservatism between FUB II Rev. 3 and finite element analysis. This grouping showed similar results.

I understand this, but this is very bad logic. That doesn't justify use of wrong moment arm.

That does not make sense

AP-25 - Corner and Lada Base - Plate Program

The TRT requested the Cranston Rhode Island offices of Corner and Lada for the express purpose of reviewing their Base-Plate Program documentation. The three allegations to be investigated were 1) the program assumes rotation about the center of the attachment and 2) the program has not been validated 3) there is additional rigidity that is not being taken into consideration.

The Corner and Lada (C&L) base-plate program was written for the Comanche Peak project and approximately 2000 base plates were analyzed. The TRT reviewed the documentation for this program. The basic mathematical formulation for this base-plate analysis was presented in a 1980 (Symposium of effects of Pipe Restraints on Piping Integrity at the Pressure Vessel and Piping Century II Conference in San Francisco. This formulation takes into account the anchor bolt stiffness, base-plate flexibility, and foundation stiffness. Using that information the program then calculates a new rotation point from which the plate stress and anchor bolt loads can be determined.

The documentation for this program is very extensive including studies on a .375 inch and a .75 inch base plate. The results of the C&L Base-Plate Program were compared to the results from a C&L finite element analysis and the published results from a Teledyne Engineering Services finite element analysis. The Base Plate Programs variation on anchor bolt loads was from 3.3 to 9.5 percent less than the two finite element solutions.

There is additional rigidity that is not considered. However, this additional rigidity would only reduce the loads on the anchor bolts. Therefore, the present method of calculating anchor bolt reactions is more conservative.

In addition to the above documentation various additional base plates were reviewed. These plates had non-symetric bolt patterns, attachments not located at the plate center, and two attachments. The results of these plates when compared to their finite element solutions were that the C&L Base Plate Program was between 5 to 18 precent conservative.

I thought the concern was on ITT Grinnell FUB II Rev. 2. What not just discuss this?

5. Conclusions and Staff Positions:

These are not conclusions or positions

A review of the onsite records at Pipe Support Engineering (PSE) revealed that some baseplates had been analyzed by FUB II Rev. 0 and Rev. 1. The TRT determined that approximately 12-- hangers with baseplates were part of a backfit program to rerun the baseplate analyses to FUB II Rev. 2 or Rev. 3. These 1200 hangers were not identified by hanger number, however, the evidence of the reanalysis will be in the calculation package of each stress is 0 package. The TRT reviewed approximately 90 hanger calculation packages from 25 pipe stress isometrics. Every hanger baseplate analysis reviewed had been performed to FUB Rev 3. No evidence of FUB II Rev. 0 or Rev. 1 computer analysis could be found. In conclusion the TRT reviewed in depth the documentation and historical backup for FUB II Rev. 0 through Rev. 3, and found the conclusions reached by the RIV inspection to be substantiated. Additional verification was reviewed and found to document ITT-G's conclusions for the FUB II Rev. 3 program. No evidence was found of safety violations, impairment or design function, or generic implications.

The TRT, after reviewing the Corner & Lada base plate documents determined that the allegations have no technical merit, safety significance nor generic implications.

Why discuss Rev 3
The concern was on Rev 2.

5

6. Actions Required: None

[redacted]

8. Attachments: None

9. Reference documents:

1. Itt Grinnell FUB II Rev. 2 Base Plate Program documentation dated April 20, 1982.
2. Itt Grinnell FUB II Rev. 3 Base Plate Program documentation dated September 12, 1982.
3. Itt Grinnell FUB II Engineering Procedure
4. US NRC Region IV Inspection Report 50-445/83-12, 50-446/83-07
5. TUEC Procedures CP-EP-2.1, CP-EP-4.0
6. TUSI Engineering Guidelines Section II "General Engineering Criteria for Pipe Support Design", Section IV "Base Plates", Section V and VI "Hilti and Richmond Anchor Bolts", Section XV "Pipe Support Design Guidelines.
7. C&L Base Plate Program Documentation dated May 11, 1981.
8. Base Plate Output for Hanger No. DD-1-006-101-Y35R, CC-1-043-026-A33R, AF-1-048-045-A35R DD-X-059-020-F45R, SW-1-011-022-F-33R CC-1-132-008-543R

9. C&L letter dated February 18, 1983 to John Finneran from Francis H. Lavelle concerning Base Plate documentation.

10. PSE Small Bore Hanger Stress Isometrics H-SA-X-EC-007, H-MS-1-RB-005, H-SA-X-TB-014, H-MS-1-RB-007, H-RM-1-SB-001, H-CH-1-AB-045, H-WD-1-SB-014, H-CS-1-AB-006B, HWP-X-AB-018, H-SA-X-AB-015 with their associated hanger calculation packages (70 total).

11. PSE Large Bore Hanger Calculation Packages 00-1-067-712-553R, CT-1-021-701-S22R, CS-1-063-703-A42R, CC-1-050-701-A43S, BR-1-013-701-S43R, WP-1-049-700-S-43R, CS-1-002-700-C52S, OO-X-026-701-A33R, BR-X-001-706-A53R, BR-X-001-705-A53R, BR-X-001-707-A53R, BR-X-079-700-A53R, CC-X-909-718-E23R, BR-X-044-703-A33R, CS-X-004-703-A33R, CC-X-909-702-E23R, VA-X-006-700-A73S, VA-X-004-702-A73R, CC-X-12-700-A43R, CC-X-12-701-A43R

10. This statement prepared by: ______________________ __________

Name Date

Reviewed by: ______________________________ __________

Group Leader Date

Approved by: ______________________________ __________

Project Director Date

AP-24 -- AP28

#34 + 35
RJM

LIMITED APPEARANCE STATEMENT

OF

[redacted]

I'm [redacted]

I worked in [redacted] at Comanche Peak for [redacted] Design criteria was always changing during the time I was at Comanche Peak.

For the first part of this period we did not have a Pipe Support Engineering Manual, and the design criteria as such was from ITT Grinnell. In mid-1980 the Pipe Support Engineering Manual was published, and each engineer was given a copy for designing hangers.

About the time the manual came out, a calculator program for the TI-59 calculator came out also; and the instructions for use of this program were included in the PSE Manual.

This program (FUB-II) is confidential on magnetic cards, and no one except ITT Grinnell personnel know what equations are used in the program. The program output consists of design parameters for hanger base plates and are: plate stress, tension on one bolt and shear on four bolts.

AP-24

FOIA-85-59

CC-261

During early use of this FUB-II program, it was found that computed plate stress and bolt tension were extreme with respect to hand calculations. Those as-built FUB-II calculations had to be rerun each time FUB-II program revisions were made.

The FUB-II four-bolt plate program has never been validated that I know of to date. All of the as-built plates which have been qualified with FUB-II should be rechecked unless Bolt No. 4 was the critical bolt.

The F TENS MAX. in the output is for only Bolt No. 4, and the other three bolts are not checked for tension load, as I have determined from test check runs of this program.

This means that about 75 percent of the as-built FUB-II qualified base plates should be rerun and some of these will fail. Another theoretical program by Corner and Lada was used to qualify base plates. This program assumes rotation about the center of attachment, which is not true because of the rigidity at this point.

I do not know of any validation of the Corner and Lada program with test data. This program cannot be validated with finite element theoretical programs which have never been validated or have published accuracy information for similar problems.

AP-24

AP-25

CONCLUSIONS, FUB II PROGRAM

The development effort for this program will be considered sucessful if it can produce results $\pm$ 10% of STARDYNE results. Unconservatism in the range of 10% is assumed not to be significant for the following reasons:

1. Any plate analysis is subject to some degree of error, no matter how sophisticated the methodology.
2. Loadings on the plate are calculated by analyses using conservative assumptions.
3. Moment effects are conservatively estimated in the program.
4. Shear effects are conservatively estimated in the program.
5. A conservative approach is taken to shear-tensile interaction in bolt qualification.
6. Bolts can carry substantially higher loads than their load ratings, if allowed to slip. This phenomenon is similar to the plastic range for steel.

Using runs A - S as examples, FUB II has been benchmarked against STARDYNE. Appendix III is a tabulation of these tests, and percentage of error is shown to be within acceptable limits.

SUPPLEMENTARY OBSERVATIONS

Prying Effects

This study indicates that prying may be a more substantial effect than it was first thought to be. However, evidence exists that in well designed plates, prying is not a severe problem.

Well designed can be construed to mean that unstiffened lenghts to bolts are kept at a minimum. It would seem a good rule of thumb that the overall plate dimensions should be kept

CC-262

COMPARISON OF FUB II TO STARDYNE

MOST HEAVILY LOADED BOLT ONLY

RUN NO.	STARDYNE RESULT	FUB II R2 RESULT	FUB II R2 / STARDYNE	% ERROR
ND-I-1	2195LB	2155LB	0.98	(2)
ND-I-2	2228LB	2238LB	1.00	0
ND-I-3	2272LB	2324LB	1.02	2
ND-I-4	2325LB	2468LB	1.06	6
ND-II-1	3245LB	3162LB	0.97	(3)
ND-II-2	1547LB	1531LB	0.99	(1)
ND-II-3	1195LB	1230LB	1.03	3
ND-III-1	1605LB	1925LB	1.20	20
ND-III-2	1419LB	1442LB	1.02	2
ND-IV-1	1612LB	1739LB	1.08	8
ND-V-1	2303LB	2243LB	0.97	(3)
ND-V-2	2460LB	2909LB	1.18	18
ND-V-3	3086LB	3017LB	0.98	(2)
C	787LB	847LB	1.08	8
D	799LB	847LB	1.06	6
E	925LB	941LB	1.02	2
F	1031LB	1349LB	1.31	31
G	1157LB	1127LB	0.97	(3)
H	1044LB	1174LB	1.12	12
I	1016LB	987LB	0.97	(3)
J	1436LB	1465LB	1.02	2
K	960LB	941LB	0.98	(2)
M	940LB	959LB	1.02	2
N	1446LB	1334LB	0.92	(8)
P	741LB	962LB	1.30	30
Q	1134LB	1074LB	0.95	(5)
R	836LB	847LB	1.01	1
U	673LB	783LB	1.16	16
V	599LB	677LB	1.13	13

ITT Grinnell Corporation — PIPE HANGER ENGINEERING DIVISION

BY ACD DATE 3/29/80 SUBJECT Unsymmetric Bolt Pattern Program SHEET NO. .... OF ......

CHKD. BY CMI DATE 4/27/80 CUSTOMER TUSI SYSTEM ....

PROJECT Comanche Peak PROJECT NO. SA-793

DATA FROM STARDYNE RUNS, ALPHABETIC SERIES

	Lower Left Bolt		Lower Right Bolt		Upper Left Bolt		Upper Right Bolt	
Run No.	Node No.	Tensile Force	Node No.	Tensile Force	Node No.	Tensile Force	Node No	Tensile Force
C	25	787 LB	31	787 LB	91	787 LB	97	787 LB
D	25	799 LB	31	799 LB	91	799 LB	97	799 LB
E	29	925 LB	37	925 LB	133	925 LB	141	925 LB
F	25	799 LB	31	591 LB	91	591 LB	97	1031 LB
G	33	1157 LB	43	1157 LB	183	1157 LB	193	1157 LB
H	25	1044 LB	31	1044 LB	91	1044 LB	97	1044 LB
I	31	1016 LB	40	1016 LB	157	1016 LB	166	1016 LB
J	33	1436 LB	43	1436 LB	183	1436 LB	193	1436 LB
K	33	960 LB	43	960 LB	123	960 LB	193	960 LB
M	33	940 LB	43	940 LB	183	940 LB	193	940 LB
N	33	1446 LB	43	1446 LB	183	1446 LB	193	1446 LB
P	29	741 LB	37	741 LB	133	741 LB	141	741 LB
Q	29	1134 LB	37	1134 LB	133	1134 LB	141	1134 LB
R	25	836 LB	31	836 LB	91	836 LB	97	836 LB
U	33	673 LB	43	673 LB	183	673 LB	193	673 LB
V	25	599 LB	31	599 LB	91	599 LB	97	599 LB

to a maximum of double the attachment dimensions for respective axes. If this was done, the flexibility of the plate would be minimum, while still accomodating reasonable bolt spacing.

In the event that this is impossible (a condition attributable to large moment concentrations) it is recommended that stiffener plates be added, in an orientation which places them from the corner of the attachment to the bolt. In so doing, plate flexibility is controlled to the extent that rigid body analysis is feasible.

Plate Stress

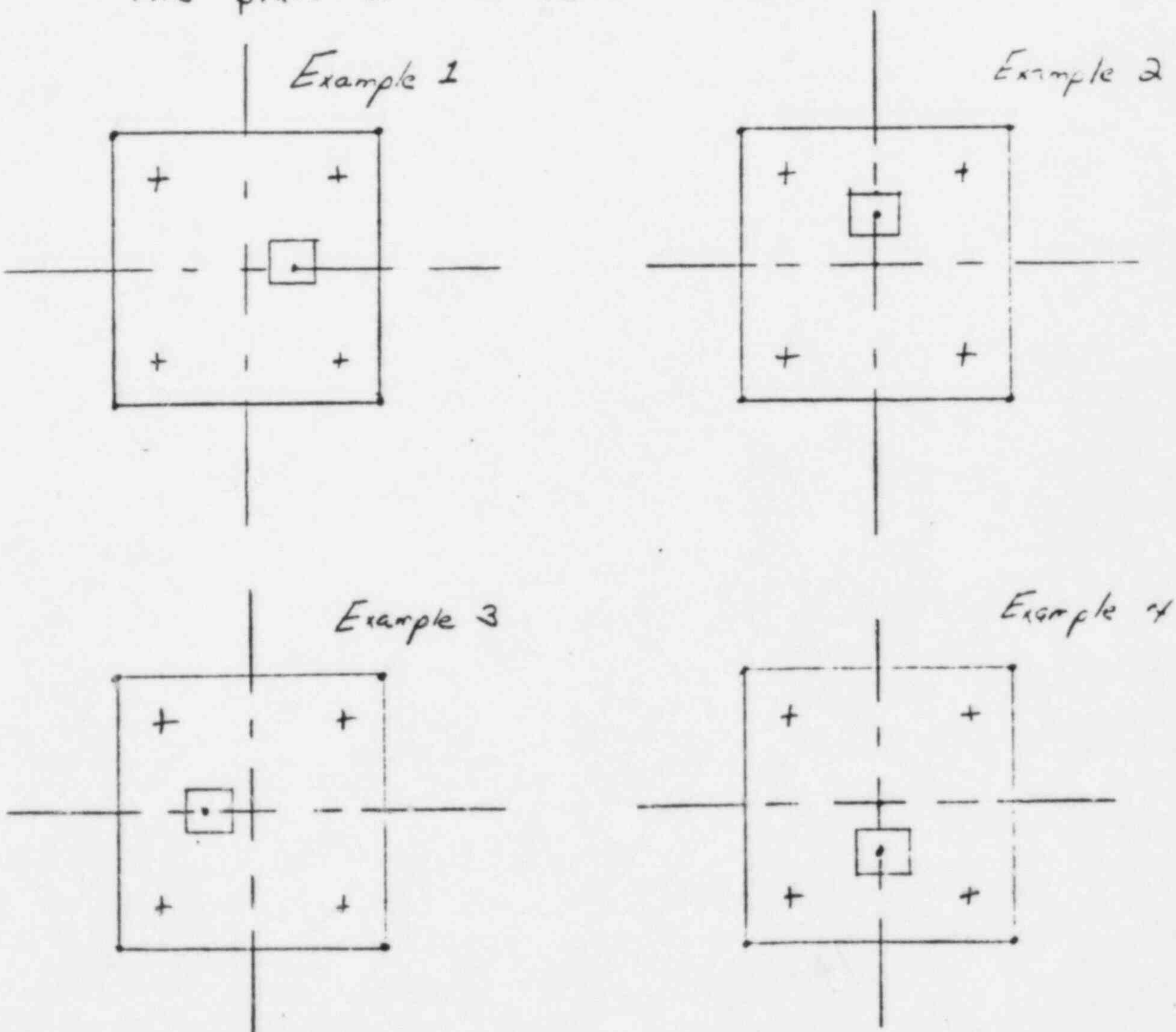
It is apparent that plate stresses are overestimated by our ES-14 procedure. It is recommended that use of this procedure be maintained for design purposes. The benefits to this are evident. First, oversizing on the basis of stress allows increased rigidity, negating potential prying effects as discussed above. Second, the conservatism in known overstatement of stress provides economic benefit when loadings are increased due to the design changes which inevitably occur in construction.

It must be realized, however, that the ES-14 approach is not a reason for rejection of a plate under recheck conditions. Moment effects in particular seem to cause very low stresses comparing ES-14 to STARDYNE. It is, therefore, recommended that judgement be used in rejection of installed plates when hand analytical methods are used for verification.

Having derived the formulation, the program was written. Appendix V contains a flowchart of program logic. Appendix VI is a listing of the final program. Appendix VII contains the major equations programmed into the procedure.

of Y_3 and Y_4. If $Y_1 + Y_2$ is less than $Y_3 + Y_4$, the eccentricity will be negative and when this is multiplied by F_Z, a negative number will result. This will occur when the attachment centroid is above the plate centroid.

The following example will illustrate the problem. A plate will be analyzed using FUB II. The configuration will be analyzed four times; each time the plate will be rotated 90°.



CC-263

Example 1

0.	00
0.	01
0.	02
0.	03
0. Fx	04
4000. Fy	05
0. Fz	06
0. Mx	07
0. My	08
0. Mz	09
6.8 Z1	10
1.2 Z2	11
6.8 Z3	12
1.2 Z4	13
4. Y1	14
4. Y2	15
4. Y3	16
4. Y4	17
0.	18
0.	19
0.	20
1. A.R.	21
0.5 a	22
0.5 b	23
0.	24
0.5 t	25
1. Factor	26
0.	27
0.	28
0.	29

NS MAX
0.00

R
0.00

R
505.03
505.03
505.03
505.03

Example 2

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
4000.	06
0.	07
0.	08
0.	09
4.	10
4.	11
4.	12
4.	13
1.2	14
1.2	15
6.8	16
6.8	17
0.	1
0.	1
0.	2
1.	2
0.5	2
0.5	2
0.	2
0.5	2
1.	2
0.	2
0	28
0.	29

F TENS MAX
0.00

P STR
0.00

SHEAR
505.03
505.03
505.03
505.03

REF. PAGE

Example 3

0.	00
0.	01
0.	02
0.	03
0.	04
4000.	05
0.	06
0.	07
0.	08
0.	09
1.2	10
6.8	11
1.2	1
6.8	1
4.	1
4.	
4.	
4.	
0.	
0.	
0.	
1.	
0.5	
0.5	
0.	
0.5	
1.	
0.	27
0.	28
0.	29

F TENS MAX
0.00

P STR
0.00

SHEAR
1494.97
1494.97
1494.97
1494.97

Example 4

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
4000.	06
0.	07
0.	08
0.	09
4.	10
4.	1
4.	1
4.	1
6.[illegible]	1
6.8	1
1.2	1
1.2	1
0.	1
0.	1
0.	2
1.	2
0.5	2
0.5	2
0.	2
0.5	2
1.	2
0.	27
0.	28
0.	29

F TENS MAX
0.00

P STR
0.00

SHEAR
1494.97
1494.97
1494.97
1494.97

This problem was fixed by adding steps to the program which take the absolute values of the products of the eccentricity and the shear force in each direction. The original form of this calculation can be found on lines 435 to 510 of Appendix II of the SF-773 report. The new form can be found on lines 425 to 504 of the listing contained in Appendix I of this report. The four example problems have been rerun under the new revision of FUB II (R3 and the problem has been corrected. (See output strips on the following two pages.)

The effects of this error on previous work will be discussed later in this report. (See Section 5.)

Example 1

0.	00
0.	01
0.	02
0.	03
0.	04
4000.	05
0.	06
0.	07
0.	08
0.	09
6.8	10
1.2	
6.8	
1.2	
4.	
4.	
4.	
4.	
0.	
0.	
0.	
1.	
0.5	
0.5	
0.	
0.5	
1.	26
0.	27
0.	28
0.	29

F MAX
0.00

P STR
0.00

SHEAR
1494.97
1494.97
1494.97
1494.97

Example 2

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
4000.	06
0.	07
0.	08
0.	09
4.	[illegible]
4.	
4.	
4.	
1.2	
1.2	
6.8	
6.8	
0.	[illegible]
0.	[illegible]
0.	2[illegible]
1.	2[illegible]
0.5	2[illegible]
0.5	2[illegible]
0.	2[illegible]
0.5	25
1.	26
0.	27
0.	28
0.	29

F MAX
0.00

P STR
0.00

SHEAR
1494.97
1494.97
[illegible].97
1494.97

Example 3

0.	00
0.	01
0.	02
0.	03
0.	04
4000.	05
0.	06
0.	07
0.	08
0.	09
1.2	10
6.8	11
1.2	
6.8	
4.	
4.	
4.	
4.	
0.	
0.	
0.	
1.	
0.5	
0.5	
0.	
0.5	
1.	
0.	27
0.	28
0.	29

F MAX
0.00

P STR
0.00

SHEAR
1494.97
1494.97
1494.97
1494.97

Example 4

0.	02
0.	03
0.	04
0.	05
4000.	06
0.	07
0.	08
0.	
4.	
4.	
4.	
4.	
6.8	
6.8	
1.2	
1.2	
0.	
0.	
0.	
1.	
0.5	
0.5	23
0.	24
0.5	25
1.	26
0.	27
0.	28
0.	29

F MAX
0.00

P STR
0.00

SHEAR
1494.97
1494.97
1494.97
1494.97

2.2 Moment Loads

Another error was also found in FUB II R2. The problem concerns the calculation of bolt pullout due to bending moments.

In FUB II the equations developed to convert bending moments to equivalent pull-out force couples are

$$Q_{m_y} = \frac{M_y}{2a + z_{mean}} \quad \text{(for } M_y \text{ moment)}$$

$$Q_{m_z} = \frac{M_z}{2b + y_{mean}} \quad \text{(for } M_z \text{ moment)}$$

where

Q_{m_y}, Q_{m_z} – Magnitudes of the force couples from M_y, M_z loads respectively

a, b – Attachment half dimensions in z and y directions respectively

z_{mean} – The smaller of $(z_1 + z_3)$ or $(z_2 + z_4)$

y_{mean} – The smaller of $(y_1 + y_2)$ or $(y_3 + y_4)$

REF.

Due to a programming error, the program always used $z_2 + z_4$ as z_{mean} and $y_3 + y_4$ as y_{mean}. The previous example will be run with bending moments to illustrate this problem.

Example 1

0.	03
0.	04
0.	05
0.	06
0.	07
4000.	08
0.	09
6.8	10
1.2	11
6.8	12
1.2	
4.	
4.	
4.	
4.	
0.	
0.	
0.	
1.	
0.5	2
0.5	2
0.	2
0.5	2
1.	2
0.	27
0.	28
0.	29

F TENS MAX
2644.57

P STR
20429.39

SHEAR
0.00
0.00
0.00

Example 2

0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
0.	08
4000.	09
4.	10
4.	11
4.	12
4.	13
1.2	14
1.2	15
6.8	1
6.8	1
0.	1
0.	1
0.	2
1.	2
0.5	2
0.5	2
0.	2
0.5	
1.	
0.	
0.	
0.	29

F TENS MAX
615.86

P STR
20429.39

SHEAR
0.00
0.00
0.00

Example 3

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
4000.	08
0.	09
1.2	10
6.8	11
1.2	
6.8	
4.	
4.	
4.	
4.	
0.	
0.	
0.	
1.	
0.5	
0.5	
0.	24
0.5	25
1.	26
0.	27
0.	28
0.	29

F TENS MAX
615.86

P STR
20429.39

SHEAR
0.00
0.00
0.00
0.00

Example 4

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
0.	08
4000.	09
4.	10
4.	11
4.	1
4.	1
6.8	1
6.8	1
1.2	1
1.2	1
0.	1
0.	1
0.	2
1.	2
0.5	2
0.5	2
0.	2
0.5	2
1.	26
0.	27
0.	28
0.	29

F TENS MAX
2644.57

P STR
20429.39

SHEAR
0.00
0.00
0.00
0.00

REF. PAC

After evaluating the conservatism with respect to finite element results of the FUE II bending formulation using the short and long moment arms, it was decided to revise the program so that the conservatism of the bending formulation is reduced. This was achieved by using the long moment arm for moment load evaluations. Consequently the following definitions of Zmean and ymean would apply

z_{mean} - The larger of $(z_1 + z_3)$ or $(z_2 + z_4)$ values

y_{mean} - The larger of $(y_1 + y_2)$ or $(y_3 + y_4)$ values

The four examples discussed earlier have been rerun with the moment arm modification.

REF. PAGE

Example 1

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
4000.	08
0.	09
6.8	10
1.2	11
6.8	[illegible]
1.2	
4.	
4.	
4.	
4.	
0.	
0.	
0.	
1.	
0.5	
0.5	
0.	24
0.5	25
1.	26
0.	27
0.	28
0.	29

F MAX
615.86

P STR
20429.39

SHEAR
0.00
0.00
0.00
0.00

Example 2

[illegible]	
0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
0.	08
4000.	09
4.	
4.	
4.	
4.	
1.[illegible]	
1[illegible]	
6.8	
6.8	
0.	
0.	
0.	
1.	
0.5	
0.5	
0.	[illegible]
0.5	25
1.	26
0.	27
0.	28
0.	29

F MAX
615.86

P STR
20429.39

SHEAR
0.00
0.00
0.00
0.00

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BY: CML DATE: 9/21/82 SUBJECT: FUB II Verification SHEET NO. 14 OF 41

CHKD. BY: [illegible] DATE: 11/10/82 CUSTOMER: TUSI SUPPORT I.D.

PROJECT: Comanche Peak OTHER I.D. ES-21

REF. PAG.

Example 3

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
4000.	08
0.	09
1.2	10
6.8	11
1.2	[illegible]
6.8	
4.	
4.	
4.	
4.	
0.	
0.	
0.	[illegible]
1.	[illegible]
0.5	[illegible]
0.5	[illegible]
0.	[illegible]
0.5	[illegible]
1.	[illegible]
0.	[illegible]
0.	[illegible]
0.	29

F MAX
615.86

P STR
20429.39

SHEAR
0.00
0.00
0.00
0.00

Example 4

0.	00
0.	01
0.	02
0.	03
0.	04
0.	05
0.	06
0.	07
0.	08
4000.	09
4.	10
4.	
4.	[illegible]
4.	
6.8	
6.8	
1.2	
1.2	
0.	
0.	
0.	[illegible]
1.	[illegible]
0.5	[illegible]
0.5	[illegible]
0.	24
0.5	25
1.	26
0.	27
0.	28
0.	29

F MAX
615.86

P STR
20429.39

SHEAR
0.00
0.00
0.00
0.00

3.0 FUB II Revision 3

The FUB II R2 program was revised to FUB II R3 to incorporate the following changes:

(i) Correction and modification of the bending formulation as programmed in FUB II R2. This assures that the larger of the values (z_1+z_3) or (z_2+z_4) will always be used in evaluating My loads. Similarly the larger of the values (y_1+y_2) and (y_3+y_4) will always be used in Mz evaluations

(ii) Correction of the shear formulation dealing with eccentricities as detailed in Section 2.1 of this report.

(iii) Change in tensile load heading from "F TENS MAX" to "F MAX" to save programming steps

(iv) Change in program label from "FUB II R2" to "FUB II R3" to reflect new revision of program.

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PROJECT Comanche Peak OTHER I.D. ES-21

REF. PA

These changes in the program can be found by comparing the program listings for each revision. The shear calculations are located on lines 435-510 of the R2 listing and lines 425-504 of the R3 listing. The moment calculations are located on lines 75-169 of the R2 listing and lines 75-171 of the R3 listing. (The R2 listing can be found in the SA-793 Report - Appendix IV. The R3 listing is Appendix I of this report.)

4.0 <u>Baseplate Samples</u>

To illustrate the accuracy and/or consistency of FUB II R3 finite element (NUPSI, BASEPLATE II) as well as FUB II analyses were performed on selected baseplate samples. These samples were randomly picked from existing runs (NO-I to NO-IV series of baseplate runs and Special Analysis (SA) files.) To offset the limitations imposed on the random sampling method, additional baseplate samples were designed to test any critical factors / parameters not covered in the random samples, including the modification of bending formulation

All baseplate samples possesed the following characteristics:

i) The longest plate dimension (edge to edge) was less than or equal to 20"

ii) Defining the aspect ratio (AR) as

$$AR = \frac{\text{Largest Plate Dimension (Lateral)}}{\text{Smaller Plate Dimension (Lateral)}},$$

the minimum aspect ratio was 1.0 and the maximum 2.0

iii) The attachments on the baseplates varied in shape and orientation

The following is a summary of the baseplate runs used in the comparison.

ND-I-1 to ND-I-4 Samples

Refer to Appendix 3 of this report and Appendix III in the SA-793 report.

These represent the set of baseplate runs used in the FUB II QA documentation. For these samples the following represent the summary of the characteristics.

Aspect Ratio – $1.0 < AR \leq 1.5$

Plate Thickness – $0.375'' \leq t \leq 1.0''$

Loads – Applied Individually ([illegible])

Bolts – Stiffness value of 480 kips/in was used.

SA-Baseplate Samples

Refer to Appendix 4 of this report.

These are samples selected at random from Special Analysis (SA) files. Each example is identified by the SA-file number. A summary of their characteristics is as follows.

Aspect Ratio – $1 \leq AR \leq 1.377$

Plate Thickness – $0.5 \leq t \leq 1.0$

Loads – Applied in Combination

Bolts – Maximum Stiffness Value of 480 kips/in

Additional Samples

Refer to Appendix 12 of this report.

Selected by judgemental sampling methods to illustrate single load cases aspect ratios greater than 1.5. The samples also serve to verify the modification in bending formulation as well as the extreme conditions of thin plate/stiff bolt combinations. A summary of characteristics is as follows.

Plate Aspect Ratio – 1.0 < AR 2.0

Plate Thickness – t = .375

Loads – Applied Individually & In Combination

Bolts – Stiffness of 500000 lb/in

The sample problems are identified as follows:

REF. | PAC

01 – 15 x 10 x 0.375 Plate

A – With Load Combinations

B – With M_x Load Only

C – With M_y Load Only

02 – 20 x 10 x 0.375 Plate

A – With M_x Load Only

B – With M_y Load Only

C – With F_z Load Only

03 – 16.75 x 16.75 x 0.25 Plate

A – With M_x Load Only

B – With M_y Load Only

C – With Load Combinations

Load defined according to NPS Coordinate system

5.0 Results and Evaluations

5.1 FUB II / Baseplate Comparisons

In choosing to use the longer moment, the results from FUB II (with the formulation to use the longer moment) were compared against several finite element runs

Many finite element runs were made during the initial verification process of FUB II. Four of these runs (ND-I-1 to 4) were rerun with bending moments. These results were compared against those of FUB II. A summary is below.

Run No.	FUB II R3 Bolt Pullout	F.E. Bolt Pullout	FUB II R3 Plate Stress	F.E. Plate [illegible]
ND-I-1	535.21	383	5107.35	1886
ND-I-2	555.97	413	5107.35	1716
ND-I-3	577.15	450	5107.35	1637
ND-I-4	613.10	492	5107.35	1626

These runs do not vary significantly in parameters. Its results are not conclusive.

It is necessary to assess the impact of the errors found in FUB II. Twenty five baseplates from the Comanche Peak Project were examined. These baseplates were initially analyzed by FUB II R2 and were found to have failures. They were sent for special analysis and using BASEPLATE II, 24 out of 25 were found to be acceptable. FUB II R3 (with the shear corrected and the longer moment arm consistently used) was also run. The results are tabulated in the following table.

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Table of FUB II/BASEPLATE II Results

SA No.	R2 Pullout	R3 Pullout	F.E. Pullout	R2 Stress	R3 Stress	F.E. Stress	R2 Shear	R3 Shear	F.E. Shear	R2 Interaction	R3 Interaction	F.E. Interaction
SA-3435	1110	1110	956	7973	7973	3209	779	791	16	.60	.60	.304
SA-3558	2719	2719	1725	12837	12837	1590	1040	1175	955	1.29	1.33	.912
SA-3702	3358	3237	2136	8027	8027	3350	171	213	190	1.15	1.14	.76
SA-3700	3262	3262	2206	9992	9992	6044	234	253	230	1.14	1.14	.79
SA-3557	2955	2718	1968	13655	13655	4549	579	579	561	1.6	1.49	1.12
SA-3473	2672	2672	1949	17028	17028	6167	90	95	68	1.23	1.23	.9
SA-3472	2349	2349	1819	16849	16849	7207	89	91	64	1.09	1.09	.842
SA-3547	3354	3354	2741	22701	22701	17291	138	192	[illegible]	1.11	1.11	.92
SA-3489	2508	[illegible]	2176	15765	15765	13919	10	11	9	1.23	1.23	1.07
SA-35[illegible]	5606	5449	4691	20203	20203	4813	142	[illegible]	142	1.22	1.18	1.02
SA-3[illegible]	3150	[illegible]	2471	15650	15650	6004	0.0	0.0	0.0	1.4	1.4	1.1

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SA No.	R2 [illegible]	R3 [illegible]	F.E. [illegible]	R2 S[illegible]	R3 Stress	F.E. Stress	R2 Shear	R3 Shear	F.E. Shear	R2 [illegible]	R3 [illegible]	F.E. [illegible]
SA-3565	1916	1401	667	14590	14590	7470	1018	1056	1051	1.24	1.04	.73
SA-3573	4014	4014	2329	6974	6974	2083	806	856	692	1.21	1.22	.74
SA-[illegible] (worst case)	[illegible]	[illegible]	[illegible]	1862[illegible]	18659	13756	116	118	86	1.27	1.22	[illegible]
SA-3625	4568	4568	2681	12742	12742	5354	275	275	255	1.04	1.04	.64
SA-3631	5421	5192	3440	17304	17304	10104	859	859	791	1.32	1.27	.88
SA-3546	[illegible]118	[illegible]	[illegible]	24329	24329	10055	297	204	259	.86	.86	.57
SA-3436	976	973	590	8764	8764	4032	328	328	292	1.08	1.08	.71
SA-3569	6369	6331	4700	19986	19986	7551	355	452	434	1.42	1.43	1.08
SA-3560	2536	[illegible]	1306	9114	9114	4228	151	[illegible]	138	1.43	1.37	.59
SA-3465	3203	3110	2092	14729	14729	5084	379	384	329	1.08	1.05	.73
SA-3610	1821	1805	1243	10105	10105	4395	314	314	257	1.15	1.15	.81

BY [illegible] DATE [illegible] SUBJECT [illegible] SHEET NO. 25 OF 41
CHKD. BY CA DATE 11/10/82 CUSTOMER [illegible] SUPPORT I.D.
PROJECT [illegible] OTHER I.D. [illegible]

REF. PAGE

SA No.	[illegible] Pullout	[illegible] Pullout	[illegible] Pullout	[illegible] Stress	R3 Stress	FE Stress	[illegible] Shear	R3 Shear	FE Shear	[illegible] Interaction	[illegible] Interaction	FE Interaction
SA [illegible]	3038	[illegible]	[illegible]	[illegible]	[illegible]	11158	237	314	235	1.2	1.17	.54
SA-[illegible] (worst case)	3511	7726	4382	13465	13465	4488	1261	1261	911	2.05	1.9[illegible]	1.10
SA-[illegible] (worst case)	11008	10763	7420	13750	13750	5771	1137	1212	846	2.56	2.52	1.7[illegible]

(in lbs)

SA No.	Allowable Tensile Load	Allowable Shear Load
SA-3435	3200	3087
SA-35[illegible]	2866	3087
SA-3[illegible]	3072	3087
SA-3[illegible]	3072	3087
SA-35[illegible]	2245	2046
SA-3[illegible]	2245	2046
SA-3[illegible]	2245	2046
SA-35[illegible]	3200	3087
SA-3[illegible]	2030	3426
SA-354[illegible]	4688	6398
SA-3666	2245	2046
SA-35[illegible]	2400	2312
SA-[illegible]	6783	5375
SA-3628	2410	2046
SA-3625	4700	3693
SA-3631	4688	5375
SA-3546	2913	2288
SA-3[illegible]	1162	1663
SA-35[illegible]	4688	5375
SA-3563	1890	1663
SA-[illegible]	3333	3426
SA-3[illegible]	1876	1663
SA-3[illegible]	2635	3426
SA-3[illegible]	4688	5375
SA 3[illegible]	4688	5375

AP-24 -- AP-28

THIS DOCUMENT DOES NOT PERTAIN TO AH-5 OR AH-8

In Reply Refer To:
Dockets: 50-445/83-12 ✓
50-446/83-07

MAY 13 1983

Texas Utilities Generating Company
ATTN: R. J. Gary, Executive Vice
President & General Manager
2001 Bryan Tower
Dallas, Texas 75201

Gentlemen:

This refers to the special inspection conducted by Mr. J. I. Tapia of our staff and Dr. W. P. Chen of the Department of Energy's Energy Technology Engineering Center (ETEC) during the periods of February 22-March 8 and March 22-23, 1983, of activities authorized by NRC Construction Permits CPPR-126 and CPPR-127 for the Comanche Peak Steam Electric Station, Units 1 and 2.

Areas examined during the inspection and our findings are discussed in the enclosed inspection report. Within these areas, the inspection consisted of selective examination of procedures and representative records, interviews with personnel, and observations by the inspectors.

Within the scope of the inspection, no violations or deviations were identified.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in the NRC Public Document Room unless you notify this office, by telephone, within 10 days of the date of this letter and submit written application to withhold information contained therein within 30 days of the date of this letter. Such application must be consistent with the requirements of 2.790(b)(1).

Should you have any questions concerning this letter, we will be pleased to discuss them with you.

Sincerely,

"Original Signed by:
W. A. CROSSMAN"

G. L. Madsen, Chief
Reactor Project Branch 1

FOIA-85-59

ES	ES	RPSA	RPB1	DRRP&EP	ES
JITapia/jkh	DMHunnicutt	TFWesterman	GLMadsen	JEGagliardo	EJohnson
4/27/83	4/27/83	5/2/83	/3/83	5/5/83	5/6/83

RPB2
WCSeidle
5/3/83

CC-264

Enclosure:
Appendix - NRC Inspection Report: 50-445/83-12
50-446/83-07

cc w/encl:
Texas Utilities Generating Company
ATTN: H. C. Schmidt, Project Manager
2001 Bryan Tower
Dallas, Texas 75201

bcc to DMB (IE01)

bcc distrib. by RIV:

RPB1 (Debbie)	D. Kelley, SRI-Ops
RPB2	R. Taylor, SRI-Cons
TPB	Section Chief (RPS-A)

RA
C. Wisner
M. Rothschild, ELD
MIS SYSTEM
RIV File
RIV Reading File
Br. Reading File
TEXAS STATE DEPT. OF HEALTH
Juanita Ellis
David Preister

ITT

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Pipe Hanger Division

July 24, 1984

EAS, Incorporated
P.O. Box 657
East Greenwich, RI 02818

Attn: B. Masterson

Subject: Review of FUB II Documentation-
Independent Review on behalf of
NRC Technical Review Team for
Comanche Peak

Dear Sir:

Per your request, attached are copies of the following pages from FUB II Documentation Reports.

REPORT	PAGES
1. SA-793 (FUB II backup up to Rev. 2)	37 - 39
2. FUB II Rev. 3 Documentation Report	3 - 25

If you have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

ITT GRINNELL CORP.

Vipin Kumar

VIPIN KUMAR

VK/ng
Encls.

cc: P. Stanish
P. Salcone - w/encls.
D. Powers - w/encls.

W24

AP-24 7/24/84

1) OPENED MEETING WITH P. STANISH, V KUMAR, D. POWERS & P. SACCONE. EXPLAINED THE OVERALL CONCEPT OF THE TRT AND THAT I WAS HERE TO DO AN INDEPENDENT REVIEW OF THE RIV REPORT OF 4/27/83 # 83-07.

2) V KUMAR THEN SPENT SOME TIME EXPLAINING TO ME THE HISTORY OF THE FUB II BOLT PROGRAM. REV 2 WAS THE FIRST REV EVER USED BY ITTG AT CP OR ANY OTHER LOCATION

3) THE FUB II R-2 PROGRAM DOCUMENTATION WAS REVIEWED FOR CONTENT AND THEORY. REV 2 IS DATED 4/27/82 REV 3 IS DATED 12/15/82. ITTG DEVELOPED A CALCULATION PROGRAM FUB I TO VERIFY BOLT LOADS ON UNSYMMETRICAL PATTERNS. THEY ALSO DEVELOPED PLATE STRESSES & THE EFFECTS OF PRYING. AND PLATE FLEXIBILITY. BECAUSE THE REQUIREMENTS WERE DIFFERENT-

AP-24
AP-25

FOIA-85-59

CC-265

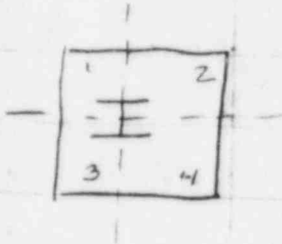
FUB II WAS DEVELOPED INDEPENDENTLY. FUB II HAD THREE EFFORTS OF DEVELOPMENT. FUB II EFFORT #1 WHEN COMPARED TO STARDYNE SHOWED THAT IT WAS TOO CONSERVATIVE FOR RIGID PLATES & UNCONSERVATIVE FOR VERY FLEXIBLE PLATES. THIS EFFORT ALSO INCLUDED A PLATE STRESS SOLUTION FROM ES-14.

4) DURING THE FUB II EFFORT #2 THE INCLUSION OF A SINGLE FACTOR TO REPRESENT PRYING WAS REPLACED WITH AN ATTEMPT TO USE A CURVE FITTING ROUTINE BASED ON ADDITIONAL COMPUTER RUNS. THIS DATA WAS INCONCLUSIVE.

5) FUB II EFFORT #3 WAS EMPLOYED TO USE DIMENSIONAL ANALYSIS TECHNIQUES. VERY EXTENSIVE APPROACH TO DIMENSIONALIZING THE PROBLEM. TYPICAL RESTRICTIONS

a) ALL BOLTS OF SAME Ø & MATERIALS &

b) ONLY ONE BOLT PER QUADRANT (X,Y)



6) RESULTS ARE CONSIDERED ACCEPTANCE IF THEY PRODUCE RESULTS WITHIN ±10% OF STANDARD. REASONS FOR ALLOWING -10% ARE GIVEN ON PAGE 37 OF 39

7) REV 3 CONSIDERS UNSYMMETRICAL BOLT PATTERN & NON-CENTRALLY LOCATED ATTACHMENT.

8) BOTH SHEAR DISCREPANCY & MOMENT ARM DISCREPANCY WERE DOCUMENTED

9) HAND CALCS WERE PRESENT TO VERIFY TI-59 PROGRAM.

10) a) WHY SMALLEST TO LARGEST ARE R3

b) WHY 30% FIGURE ON RESULTS & COMPARISON

c) HOW DO RESULTS COMPARE

a) FUB II REV 0 BASED UPON 3rd APPR.

b) THIS IS ON CONSERV SIDE ∴ OK

IT ONLY FAILS IF -10% ON UNCONS SIDE

c) TURN PAGE

10) THE REVISION ADDRESSED TWO CONCERNS ONE FROM AN PROBLEM & THE VERY CONSERVATIVE FLOW DRAIN-[illegible] RESULTS SHOWED THAT THE CHANGE IN Z_1+Z_3 OR Z_2+Z_3 WAS ALWAYS CONSERVATIVE COMPARED TO F.E. DO NOT KNOW WHY.

11) REV 2 OF FUB II WAS SENT TO J. MERRIT ON 6/18/80 AND REV 3 WAS SENT AFTER DOCUMENTATION OF REV 3 IE AFTER 12/82

[redacted]

12) TALK TO MIKE LEACH FOR FUB II REV 2 TO REV 1 BACKFIT & MIKE CHAMBERLAIN

13) REVIEWED THE FUB II REV 3 LOG BOOK WHICH VERIFIES THAT THE PROGRAM IS COMPARED AGAINST A PREVIOUS RUN EACH TIME IT IS USED. REVIEWED JAN 84, FEB 84, MAR - JUL 84. CHECKED JAN 83 WHEN FUB II REV 2 WAS USED. JAN 12 1983 WAS WHEN REV 3 WAS USED FOR THE FIRST TIME. A RANDOM CHECK OF THE

REMAINDER OF 1983 SHOWS REV 2
WAS NEVER USED AGAIN.

14) J. FINNERAN STATED THAT HE COULD REMEMBER AN EFFORT BY PSE TO BACKFIT ALL OF THE PREVIOUS FUB I ~~REV~~ WITH THE NEW FUB II REV 2. HE WILL TRY TO FIND THAT FOR ME.

15) 6/18/80 TO MERRIT SENT FUB II REV 2 AND ASKED FOR FUB II REV 1 BACK [redacted]

a) FEB 12 1980 FUB II REV 0 SENT TO SITE

b) FEB 28 1980 A "NEW" FUB II REV 0 SENT TO SITE TO REPLACE 2/12/80 ISSUE SINCE THAT HAD NOT BEEN USED (SENT BACK TO ITT ON 2/29/80)

~~c) SITE ISSUED FUB II REV 0 TO ENGINEERS 4/1/80~~

C) ON 6/2/80 FUB II REV 1 WAS SENT TO SITE (MERRIT) APPROXIMATELY (20) WERE BACKFIT REV 1 TO REV 0

FUB I NEVER SENT TO SITE PER DAVE COFFIN WITH TELECON TO DAVE POWERS

✓ ON 6/18/80 REV 2 WAS SENT DOWN

✓ ALL CALC PACK ARE DESIGN REVIEWED TO REV 2 or REV 3

- 8/1/84 REVIEWED RANDOM SAMPLES OF DES. RE.
- H-SA-X-EC-004-007-5, H-SA-X-EC-004-008-5, 009-5,
- 015-5, 017-5 } H-MS-1-RB-005-001-2, 005-2, 006-2 }
H-SA-X-TB-014-001-G, 004-G, 005 G H-SA-X-TB-014-006-G
S.B H-MS-1-RB-007-001-2, 002-2, 003-2, 005-2 }
- H-SA-X-EC-004-001-5, 002-5, 003-5, 004-5, 005-5,
006-5 } H-RM-1-SB-001-008-3, 011-3, 013-3, 001-3
002-3, 004-3, 005-3, 007-3 } H-MS-1-RB-005-009-2,
013-5, 010-2, 016-2 } H-CH-1-AB-045-001-3, 004-3, 005-3 }
59 H-WP-1-SB-014-001-2, 003-2, 004-2, 006-3, 014-2,
007-3, 008-3, 009-3, 010-3 } H-CS-1-AB-006B-002-2,
006-2, 007-2, 009-2, 011-2 } HWP-X-AB-018-001-3, 003-3,
004-3, 011-3, 012-3, 013-3, 017-3, 008-3

[redacted]

L.B
20
DU-1-067-712-S53R, CT-1-021-701-S22R
CS-1-063-703-A42R, CC 1-050-701-A43S
BR-1-013-701-S43R, WA-1-049-700-S43R
CS-1-002-700-C52S, DD-X-026-701-A33R
BR-X-001-706-A53R, BR-X-001-705-A53R
BR-X-001-707-A53R, BR-X-079-710-A53R
CC-X-709-718-E23R, BR-X-044-703-A33R
CS-X-004-703-A33R, CC-X-709-702-E23R
VA-X-006-700-A73S, VA-X-004-702-A73R
CC-X-12-700-A43R, CC-X-12-701-A43R

H-SA-X-AB-015-001-5, 002-5, 004-5, 005-5, 006-5,
007-5, 008-5, 009-5, 011-5, 014-5, 015-5, 016-5

ITT

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Pipe Hanger Division

July 24, 1984

EAS, Incorporated
P.O. Box 657
East Greenwich, RI 02818

Attn: B. Masterson

Subject: Review of FUB II Documentation-
Independent Review on behalf of
NRC Technical Review Team for
Comanche Peak

Dear Sir:

Per your request, attached are copies of the following pages from FUB II Documentation Reports.

	REPORT	PAGES
1.	SA-793 (FUB II backup up to Rev. 2)	37 - 39
2.	FUB II Rev. 3 Documentation Report	3 - 25

If you have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

ITT GRINNELL CORP.

Vipin Kumar

VIPIN KUMAR

VK/ng
Encls.

cc: P. Stanish
P. Salcone - w/encls.
D. Powers - w/encls.

CC-266

3.7N SEISMIC DESIGN

In addition to the steady state loads imposed on the system under normal operating conditions, the design of equipment and equipment supports requires that consideration also be given to abnormal loading conditions such as earthquakes. Seismic loadings are considered for earthquakes of two magnitudes: Safe Shutdown Earthquake (SSE) and Operating Basis Earthquake (OBE). The SSE is defined as the maximum vibratory ground motion at the plant site that can reasonably be predicted from geologic and seismic evidence. The OBE is that earthquake which, considering the local geology and seismology, can be reasonably expected to occur during the plant life.

For the OBE loading condition, the Nuclear Steam Supply System is designed to be capable of continued safe operation. The design for the SSE is intended to assure:

1. That the integrity of the reactor coolant pressure boundary is not compromised;

2. That the capability to shutdown the reactor and maintain it in a safe condition is not compromised; and

3. That the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of 10CFR100 is not compromised.

It is necessary to ensure that required critical structures and components do not lose their capability to perform their safety function. Not all critical components have the same functional safety requirements. For example, a safety injection pump must retain its capability to function normally during the SSE. Therefore, the deformation in the pump must be restricted to appropriate limits in order to assure its ability to function. On the other hand, many components can experience significant permanent deformation without loss of function. Piping and vessels are examples of the latter where the principal requirement is that they retain their contents and allow fluid flow.

The seismic requirements for safety-related instrumentation and electrical equipment are covered in Section 3.10. The safety class definitions, classification lists, operating condition categories and the methods used for seismic qualification of mechanical equipment are given in Section 3.2.

3.7N.1 SEISMIC INPUT

3.7N.1.1 Design Response Spectra

Refer to Section 3.7B.1.1.

3.7N.1.2 Design Time History

Refer to Section 3.7B.1.2.

3.7N.1.3 Critical Damping Values

The damping values given in Table 3.7N-1 are used for the systems analysis of Westinghouse equipment. These are consistent with the damping values recommended in Regulatory Guide 1.61 except in the case of the primary coolant loop system components and large piping (excluding reactor pressure vessel internals) for which the damping values of 2 percent and 4 percent are used as established in testing programs reported in Reference [1]. The damping values for control rod drive mechanisms (CRDM's) and the fuel assemblies of the Nuclear Steam Supply

3.7B SEISMIC DESIGN

3.7B.1 SEISMIC INPUT

3.7B.1.1 Design Response Spectra

Design response spectra for both horizontal and vertical ground motion for the SSE are shown in Figures 3.7-1 and 3.7-7, respectively. Response spectra for 2, 5, 7, 10, and 15 percent of critical damping are provided for both the horizontal and vertical motions and are scaled to the maximum ground accelerations of 0.12g and 0.08g selected for the SSE. For the OBE, a scaling factor of 0.5 is applied to the SSE design spectra.

The response spectra are based on the most recent data available concerning response of structures to earthquake motion. They are constructed on the basis of the recommendations of Newmark, Blume, and Kapur [14] and conform to the requirements of NRC Regulatory Guide 1.60, Revision 1, with the exception of the 33 Hz to 50 Hz frequency range. In that range, the vertical response spectrum of NRC Regulatory Guide 1.60, Revision 1, differs from the vertical response spectrum of Reference [14]. The effects of this deviation on the results of the analyses of structures and systems are negligible because they only affect the modes which have low amplification. Similarly, the method recommended in Reference [14] for the construction of vertical response spectra leads to a slight deviation from NRC Regulatory Guide 1.60, Revision 1 recommendations for accelerations corresponding to 3.5 Hz. The magnitudes of these differences are negligible.

The response spectra indicate the estimated response of a structure subject to significant nearby earthquake ground motion. The spectra are presented over a range of frequencies corresponding to natural frequencies of structural elements, and they represent the maximum amplitude of motion in structural elements for typical degrees of structural damping. Because the design response spectra have been developed from a large number of real records, following the procedures recommended by Newmark, the effect of strong motion duration and distance of focal depth are included [29].

There are, of course, general associations between duration of strong motion and the size of an event. Longer durations of strong motion are expected with greater-sized earthquakes. Higher frequency accelerations are attenuated with greater distance from the epicenter of the earthquake. These conditions are inherent in the strong motion records which are the source of Newmark's work. In no case are the amplification factors less than one.

3.7B.1.2 Design Time History

A set of five artificial time history records has been produced for each of the horizontal and vertical motions resulting from the SSE. These artificial records are based on the design response spectra requirements presented in Section 3.7.1.1. Each artificial record is specifically developed for each case of structural damping values considered. A set of five artificial records is developed for the five structural damping values of [illegible], 5, 7, 10, and 15 percent.

As an alternative to a site-dependent analysis, these artificial time history records are suitable for use as base excitations for the dynamic structural analysis.

The mathematical procedures used to generate these artificial time history records can be briefly summarized as follows:

1. The spectral characteristics of the selected site SSE design response spectra are extracted to construct a frequency response function with proper phase factor modification.

3.7.1.3 Critical Damping Values

The specific percentages of critical damping values used for Category I structures, systems, and components are based on the materials, stress levels, and type of connections of the particular structure or component. They are determined in accordance with the recommendations of NRC Regulatory Guide 1.61 and Reference [14].

Structure and component damping values used in the response spectrum and time history analyses are given in Table 3.7-1. Damping factors associated with foundation springs are discussed in Section 3.7.2.4. Damping values for Westinghouse equipment are shown in Section 3.7N.

3.7.1.4 Supporting Media for Seismic Category I Structures

All seismic Category I structures are founded on the firm, unweathered Glen Rose Limestone which constitutes the principal bedrock formation in the site.

Below the Glen Rose unit lies the Twin Mountains Formation, which forms a gradational contact with the Glen Rose unit and is composed principally of sandstone, limestone, and clay stone. The portion of the Glen Rose unit which provides the founding material for the Category I structures consists of argillaceous limestone with lenses and zones of calcereous clay stone. Approximately 150 to 160 ft of this formation is present beneath the lowermost foundation. The upper portion of the Glen Rose unit consists of weathered rock and a soil cover of a few feet. Prevailing soil and rock characteristics are presented in Table 3.7-2.

The soil cover and the upper 40 ft (approximately) of the Glen Rose Limestone are totally removed by foundation excavation. Thus, all of the moderately-to-severely weathered rock present at the site is removed.

With the exception of the Service Water Intake Structure, no structural backfill is used under or against Category I structures.

More detailed description of the site geology, the subsurface conditions, and the engineering properties of site materials are included in Sections 2.5, 2.6, and 2.7.

Foundation elevations, depths of embedment, total structural heights, and foundation plan dimensions for the Category I structures are presented in Table 3.7-4.

3.7B.2 SEISMIC SYSTEM ANALYSIS

3.7B.2.1 Seismic Analysis Methods

Methods of seismic analysis used for seismic Category I structures, systems, and components, as well as applicable stress and deformation criteria, and mathematical models, are described in this section.

Seismic analysis of seismic Category I structures, systems, and components is performed by the use of the response spectrum or the time history concept of analysis, or both [28], [30], [35]. The use of the response spectrum concept provides a convenient procedure for seismic analysis. Spectrum analysis uses the natural frequencies, mode shapes, and appropriate modal dampings as a fraction of critical damping, and is an approximate method for determining the seismic response of linear elastic multidegree-of-freedom systems with lumped masses and elastic properties in discrete parts.

In a time history analysis, there are two basic ways of using the time history for linear elastic systems, namely, by a modal analysis time history, which uses the same free vibration characteristics and damping factors as the spectrum analysis, or by solving a system of coupled differential equations of motion by direct numerical integration. In the latter case, the numerical integration using a suitable technique must be performed simultaneously for all of the coupled equations. This procedure is cumbersome, requiring a large amount of computations, and is susceptible to computational difficulties. For example, it is difficult to know how small the time intervals should be to avoid mathematical instability. Furthermore, there is no really satisfactory way to determine all of the damping coefficients in these coupled differential equations of motion. Because of these difficulties, the modal method of analysis is used. Only in the case of nonlinear behavior when structures, systems, and components cannot be regarded as linear elastic, such as springs with nonlinear restoring-force functions and nonlinear elastic properties of materials, is the method of direct numerical integration of coupled differential equations of motion used.

Where the aforementioned methods do not provide reliable results, or where analysis appears impractical, dynamic testing of equipment is performed to ensure functional integrity.

The methods used for seismic analysis of particular seismic Category I structures, systems, and components are summarized in Table 3.7B-2.

It should be noted that the modal analysis time history method is used to generate responses at selected locations, such as the ones required for the development of instructure response spectra. Responses at selected locations resulting from both response spectrum concept and time history are compared. Static loads resulting from a dynamic analysis are used in the design of some structural components such as foundation mats, floors, and shear walls [34].

3.7B.2.1.1 Idealization of Seismic Category I Structures, Systems, and Components

A most important part of seismic analysis is devising a mathematical model that satisfactorily represents the dynamic behavior of a seismic Category I structure, system, or component. The modeling technique used results in mathematical models composed of a network of lumped masses and elastic properties in discrete parts. Normally, characteristic points or nodes are selected so that they coincide with concentrations of mass, e.g., at floors, changes of cross sectional area, or at locations which are important for stiffness. The characteristic points for lumping of the masses of an axisymmetric shell-type structure are selected at the centroids of horizontal cross-sections through individual components of the structure. These centroids lie on the vertical centerline of the structure. Each mass has six degrees of freedom, namely, three translations in the three principal orthogonal directions and three rotations about the three principal orthogonal axes. In general, responses associated with all of these degrees of freedom can be coupled and excited by each direction of seismic motion. Bending and shearing effects are considered in determining the discrete rigidities between the lumped masses.

For all seismic Category I structures, finite element techniques that simulate floor slabs and shear wall assemblies are used to generate the reduced stiffness matrix associated with the number of dynamic degrees of freedom required for the dynamic analysis. The mathematical model for which this reduced matrix is generated consists of lumped masses, viscous dashpots, and elastic properties in discrete parts. The mathematical models representing the seismic Category I structures and the method chosen for the selection of the number of masses are described in Subsection 3.7B.2.1.6.

For ease of computation, the mathematical model is reduced to contain as few dynamic degrees of freedom as feasible so that it can be analyzed successfully by means of algorithms adopted for today's high-speed digital computers.

Foundation structure interaction is represented by decoupled springs, dashpots, and effective masses generally associated with the six degrees of freedom in a global orthogonal system. The methods used to determine the foundation parameters related to torsion, rocking, and translation are described in Subsection 3.7B.2.4.

3.7B.2.1.2 Analytical Approach

In order to analyze the response of a linear elastic lumped mass system, the natural frequencies and corresponding mode shapes are first determined. This determination is accomplished by extracting the eigenvalues and associated eigenvectors from a homogeneous system of equations which result from undamped free vibration and are comprised of stiffness or flexibility and mass matrices developed from the mathematical model. These free vibration characteristics are calculated by using any one of the suitable algorithms coded into the computer programs, such as the diagonalization method originated by Jacobi, Householder's tridiagonalization method combined with the Sturm sequence method, and methods such as those used in computer programs presented in Section 3.7B(A). After establishing the free vibration characteristics, such as natural frequencies and associated mode shapes, the next step consists of response computations obtained by using the response spectrum approach or time history analysis or both [28], [30], [31], [35], [38].

1. Response Spectrum Analysis

The response spectrum analysis is performed using various computer programs consisting of different subroutines developed by Gibbs & Hill, Inc., IBM, and others as described in Section 3.7B(A).

The analysis of the structures founded on bedrock uses spectral values from the free-field horizontal and vertical ground response spectra developed for this site. Spectral values associated with modal dampings and natural frequencies are obtained for each mode. Then the maximum absolute accelerations, inertia forces, shears, moments, and relative displacements are obtained in each mode. The maximum modal responses of all the modes are combined by the square root of the sum of the squares (SRSS), by absolute sum, and by combinations thereof, as discussed in Subsection 3.7B.2.7. 2 Q130.8

A separate analysis is made on the model representing the structure founded on bedrock for each of the three orthogonal principal directions of input ground excitations.

Vertical and two horizontal ground excitations are assumed to act simultaneously. Hence, the combined effects of earthquakes on structures, components, or elements are computed by taking the SRSS of the particular effects at any particular point, caused by each of the three components of earthquake motion (two horizontal motions at right angles and one vertical motion).

In the case of shell structures when shell theory is used, maximum stress resultants (membrane shears, moments, and forces), as well as unit stresses and displacements, are obtained. This is accomplished by applying distributed inertia forces and using a suitable computer program.

The total overturning moment at the base of a structure is obtained. The maximum dynamic foundation pressure is evaluated to ensure that it is within permissible limits.

The analysis is performed for both the SSE and OBE unless it is apparent that one of these controls the design.

2. Time History Analysis and Instructure Response Spectra

After the mathematical models of structures are analyzed for their characteristics of free vibration, the time history responses at selected mass points are obtained using the artificial time history ground motion [30], [31], [38]. Derivation of the appropriate time history ground motion is discussed in Subsection 3.7B.1.2. Once the time history response of a selected mass point is generated, the next step is to subject a single-degree-of-freedom system, with the natural

6. Results and conclusions

7. Attestation

3.7B.2.1.4 Differential Seismic Movement of Interconnected Components

The seismic analysis of seismic Category I subsystems and equipment subjected to differential support motion is performed in three parts using lumped mass mathematical models as follows:

1. Modal response spectrum analysis is performed for all three principal orthogonal directions of support motion for each direction of ground excitation using appropriate instructure response spectra constructed on the basis of superimposing the spectra for all support points and enveloping them as stated in Subsection 3.7B.2.5. The analysis of these subsystems or components follows the same considerations as those described in Subsection 3.7B.2.1 for seismic Category I structures. The vertical analysis is combined with both horizontals, according to the statement in Subsection 3.7B.2.1.2, to produce basic dynamic loading conditions.

2. The same multimass lumped parameter model is subjected to a stress analysis due to differential displacements of the support points. The displacements used are consistent with the directions of structural excitation being considered in the spectrum analysis. This results in basic differential displacement loading conditions.

3. The results obtained from the spectrum analysis and differential displacement analysis are then combined directly. The effects of these loading conditions on the components and the supporting structures are determined.

3.7B.2.1.5 Stress and Deformation Criteria

The maximum horizontal ground accelerations are 6 and 12 percent of gravity for OBE and SSE, respectively. The maximum vertical ground accelerations are equal to two-thirds of the horizontal. Horizontal and vertical ground motions are assumed to act simultaneously. Horizontal ground response spectra for the SSE are shown on Figure 3.7B-1.

Primary steady-state stresses including the effects of the normal operating loads plus the OBE loads are maintained well within the elastic limit of the material affected.

For systems and equipment, self-limiting secondary stresses may exceed allowable primary stress to the extent permitted by the appropriate codes. For the OBE, the equipment function is performed without permanent deformation.

Primary steady-state stresses, including the effects of the normal operating loads plus the SSE loads, are limited to prevent loss of function of the equipment. For the purpose of calculation, the no-loss-of-function stresses are limited to 90 percent of the yield strength of the material, except when valid plastic analysis demonstrates structural integrity. Local, self-limiting, secondary stresses may exceed yield stress levels to the extent set forth in the appropriate design standards and codes.

Deformations resulting from the combined influence of normal operating loads and the loads from the SSE are investigated to verify that they do not impair the functional performance required for a safe and orderly shutdown of the plant.

For fatigue analysis required by some codes, the number of expected earthquakes, the duration of strong motion vibration, and the number of rectangular base resting on an elastic half space [1], [2], [23], [37]. Torsional foundation spring constants, damping ratios, and effective masses and rotary inertias for foundation below the vibrating mat associated with the foundation springs are determined on the basis of the equivalent radius for the rectangular base of dimensions 2c by 2d using the theory of the elastic half space for a circular footing according to Subsection 3.7B.2.4 [1], [2], [23], [32], [37]. The effects of the embedment of the structures are evaluated and taken into consideration in the analysis. Best estimate values, upper bound values, and lower bound values of foundation spring constants used in the parametric analyses described in Subsection 3.7B.2.4 are presented in Tables 3.7B-25 through 3.7B-29.

The stiffness matrices of the buildings are generated using suitable computer programs based on finite element techniques. For unsymmetric structures the stiffness matrices include the effects of torsional rigidities of shear wall assemblies between floors. The stiffness matrices obtained for finite element models are reduced to conform to the number of degrees-of-freedom of the dynamic models which are used in the dynamic analysis [3], [23], [30], [38].

3.7B.2.2 Natural Frequencies and Response Loads

The natural frequencies and modal participation factors for all modes resulting from the parametric analyses of all the seismic Category I structures are presented in Tables 3.7B-30 through 3.7B-45. Response loads for these structures obtained by the square root of the sum of the squares method (SRSS) are summarized in Tables 3.7B-46 through 3.7B-50 in the form of modal accelerations.

For comparison, envelope values of time history analysis results for the Electrical and Auxiliary Buildings and for the Fuel Building are presented in Tables 3.7B-51 and 3.7B-52.

Seismic loads used for the design of seismic Category I structures are obtained by multiplying the response accelerations with the appropriate masses.

Response spectra at all floors are developed for all seismic Category I structures as indicated in Subection 3.7B.2.5.

3.7B.2.3 Procedure Used for Modeling

The structures and their contents possess mass which contributes to the inertia loading of the structure. The complexity of the spatial distribution makes it necessary to concentrate the mass at characteristic points or nodes. These points are selected so that they coincide with concentrations of mass, e.g., at the floors, or with locations which are important for stiffness. In some instances, the nodes are selected at intermediate points of structures and equipment that can be regarded as being of uniform construction. This discretization into characteristic points permits a more accurate prediction of the dynamic behavior of actual structures and equipment.

At each node, the structure or system is given six degrees of freedom (three translation components and three rotation components).

No simplifications aimed at reducing the total number of degrees-of-freedom considered in the analysis are made. All six degrees-of-freedom of each node are treated as generalized displacements for all seismic Category I structures.

The idealization of the mass is performed on the basis of relative displacements. If the horizontal cross-section of the structural component, for example, does not deform significantly, and the contents undergo essentially the same displacement as the structure, all mass in a given place can be represented by a point mass placed at the centroid.

It is not feasible to formulate a mathematical model which would include, in addition to the primary structure, all of the equipment, piping systems, and other lightweight structures. These subsystems are therefore uncoupled from the primary structures and are analyzed by the response spectrum approach procedure. In order to use the spectrum analysis for secondary systems, floor response spectra are developed as described in Subsection 3.7B.2.5.

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The criteria employed for system/subsystem decoupling are consistent with the provisions of USNRC Standard Review Plan, Subsection 3.7.2, June 1975. They are based on the mass ratio, R_m of the supported subsystem mass to the corresponding support mass, and the frequency ratio, R_f of the supported subsystem fundamental frequency to the corresponding supporting system dominant frequency such that:

1. If $R_m < 0.01$, decoupling can be done for any R_f

2. If $0.01 < R_m < 0.1$, decoupling can be done if $R_f < 0.8$ or $R_f > 1.25$

3. If $R_m > 0.1$, an approximate model of the subsystem should be included in the primary system model.

where:

$$R_m = \frac{\text{Total mass of supported subsystem}}{\text{Mass of support}}$$

$$R_f = \frac{\text{Fundamental frequency of the supported system}}{\text{Frequency of the dominant support motion}}$$

The floor response spectra are generated using the mathematical models which consist of the lumped masses computed from tributary structure dead loads, a portion of live loads, and fixed equipment loads. In some cases, the uncoupled mathematical models, with lumped masses representing the equipment, include the effective masses and flexibility of the supporting structure.

3.7B.2.4 Soil-Structure Interaction

The mathematical model for performing the dynamic analysis of seismic Category I structures supported on the ground is comprised of lumped masses and elastic properties in discrete parts. Because these structures are founded on sound bedrock (Glen Rose Limestone) with shear wave velocities of 5500 to 6000 ft/sec, the foundation-structure interaction is evaluated using the conventional elastic half-space theory in accordance with References [1], [2], [23], [32], and [37]. The justification for the use of this theory is based on the fact that sound bedrock is much closer to being a truly elastic material than any other common foundation material. Using the half-space theory, foundation spring constants with associated effective masses of the rock and damping ratios caused by radiation damping are determined.

This value is much larger than the value of rocking rigidity constant obtained for the effect of embedment. Therefore, in this case, the effect of the embedment on rocking rigidity is neglected.

In reality, the rocking rigidity constant for embedment is higher in value than the one obtained here. Perhaps a more realistic value can be obtained by assuming that the vertical contact surface of the embedment with the depth h has a mirror image surface with the depth of 2h. Then half of the value for rocking rigidity constant based on the elastic half space theory seems to be more appropriate when the ratio of the actual depth of embedment to the length of embedment is less than unity. For example, using this approach, the following value for rocking rigidity constant for embedment is obtained:

$$k_{\psi} = \frac{G}{1-\nu} \; 0 \cdot 4 \times 8 \times 100 \times 20^2 \times \frac{1}{2} = 64{,}000 \; \frac{G}{1-\nu}$$

Incidentally, this value and the values obtained for the ratios of the depth to the length of embedment less than one are in close agreement with the values obtained on the basis of the approach to the problem for cohesive soils as presented in References [39] and [40]. These values also compare well for practical purposes with the ones obtained using formulation presented in Reference [7].

For the dynamic analysis of seismic Category I structures which have relatively shallow depths of embedment (such as the Safeguards, Electrical and Auxiliary, and Fuel buildings), the effect of embedment on rotational foundation rigidities (torsion and rocking) is negligible; also, because a wide range of foundation rigidities is considered by parametric studies (Subsection 3.7B.2.9), this effect is neglected. The Service Water Intake Structure, which has a greater depth of embedment, is analyzed by including the effects of embedment in both translational and rotational foundation rigidities on the basis of the pressure distribution for a perfectly rigid base on an elastic half-space.

3.7B.2.5 Development of Floor Response Spectra

The methods of seismic analysis are covered in Subsection 3.7B.2.1. The response spectrum method for the development of instructure response spectra is not used.

Instructure response spectra at selected locations of interest are developed on the basis of computed responses to an artificial time history input of ground motion. The time history of the simulated earthquake ground motion is developed to be compatible to the given ground response spectra. Having established the time history of the ground motion, the lumped mass mathematical models of seismic Category I structures are analyzed and time histories at desired masses lumped at floor levels or any other location of interest are generated. Once the time history of the floor motion is obtained, the next step consists of subjecting a single degree-of-freedom system with the natural frequency range of interest and various damping ratios to the floor time history motion. The maximum acceleration responses obtained are then plotted as ordinates and the corresponding natural periods of the single oscillators are plotted as abscissa. The envelope of maximum peaks is used for the construction of instructure response spectra.

In constructing instructure response spectra, uncertainties inherent to the analysis, such as the material properties of the foundation material and the structures, damping values, soil structure interaction, approximations in the modeling techniques, and computation of structure natural frequencies, are accounted for by parametric variations incorporated into the analysis and by broadening of the peaks of the resulting envelope response spectra as described in Subsection 3.7B.2.9.

The procedure of parametric variations consists of evaluating and using in the dynamic analysis lower bound, best estimate, and upper bound values for the foundation spring constants in the case of all seismic Category I structures with the exception of the Fuel Building and the Service Water Intake Structure where only lower bound and upper bound values are used. In addition, the analysis of the Containment Building is performed for each set of foundation spring constants by considering a cracked and an uncracked Containment wall.

The instructure response spectra obtained on the basis of the parametric variations are enveloped and the resonance peaks of the resulting curves are broadened by at least ±10 percent.

As necessitated by their intended use, three groups (types) of floor response spectra are developed as follows:

1. Interpolation Instructure Response Spectra

   For general use, instructure response spectra are developed for the top and bottom node translational accelerations in the directions of three orthogonal principal axes and rotational accelerations about these axes. A set of these response spectra is developed for each seismic Category I structure for both SSE and OBE intensities and for different values of equipment damping.

   This type of response spectra is developed for the Containment Building and internal structure, the Safeguards Building, the Electrical and Auxiliary Buildings, and the Service Water Intake Structure.

   Typical instructure response spectra for the Containment Building are presented on Figures 3.7B-41 through 3.7B-49. These nine figures represent a complete set of instructure response spectra for one specific value of equipment damping due to SSE excitations in three orthogonal directions. The first three figures represent the response spectra at the top nodal point of the building due to nodal translations, while the next three are for the translations of the bottom nodal point of the building. The last three figures represent the response spectra for the effects of nodal torsion or rocking; the spectral values of these last three figures are for a point 100 ft away from the vertical axis passing through the top and bottom nodal points of the building. The response spectra for one specific value of equipment damping at any point within the building can be evaluated from the set of response spectra corresponding to the same equipment damping. They are obtained by the linear interpolation or extrapolation of the response spectra for the nodal translations plus the additional contribution from the torsional or rocking effects using rigid body transformation. For example, given a point P (X , Y , Z , all in ft) located within the building, the response spectra at this point corresponding to the SSE in X direction and two percent equipment damping is computed as follows:

where:

a. $(Ax)_u$, $(Ay)_u$, and $(Az)_u$ are the spectral values for the upper nodal point (X, Y_u, Z) obtained from Figure 3.7B-41.

b. $(Ax)_j$, $(Ay)_j$, and $(Az)_j$ are the spectral values for the lower nodal point (X, Y_j , Z) obtained from Figure 3.7B-44.

c. A_1, A_2, and A_3 are the spectral values caused by the effect of rocking or torsion about the X, Y, and Z axes, respectively, and obtainable from Figure 3.7B-47.

The spectral values at P are obtained by using the following linear interpolation procedures:

$$(Ax)_p = (Ax)_1 + \frac{Y_p - Y_1}{Y_u - Y_1}\left[(Ax)_u - (Ax)_1\right] + \left|\frac{(Z_p - Z)A_2}{100}\right| \quad (3.7B\text{-}16)$$

$$(Ay)_p = (Ay)_1 + \frac{Y_p - Y_1}{Y_u - Y_1}\left[(Ay)_u - (Ay)_1\right] + \left|\frac{(Z_p - Z)A_1}{100}\right| + \frac{(X_p - X)A_3}{100} \quad (3.7B\text{-}17)$$

$$(Az)_p = (Az)_1 + \frac{Y_p - Y_1}{Y_u - Y_1}\left[(Az)_u - (Az)_1\right] + \left|\frac{(X_p - X)A_2}{100}\right| \quad (3.7B\text{-}18)$$

2. Floor-by-Floor Response Spectra

Supports and seismic restraints of uncoupled subsystems, such as seismic Category I equipment and components, are generally situated away from the centers of gravity of the floors on which they are located. The design and testing of such equipment, components, and supports calls for the determination of maximum spectral accelerations at these locations in three orthogonal directions for the combined effect of horizontal and vertical earthquake excitations.

In order to eliminate the necessity for the supplier to perform linear interpolations, rigid body transformations, and combinations of results from horizontal and vertical earthquakes response spectra are developed at the critical locations of each floor of all seismic Category I buildings. These spectra are directly applicable to equipment at any location on the floors considered.

Typical response spectra at critical locations for floor elevation 852.5 ft. of the Safeguards Building and corresponding to 2-percent equipment damping and SSE intensity are shown on Figure 3.7B-50. Curves Ax, Ay, and Az represent the spectra in the X, Y, and Z directions for the combined effect of the three simultaneous earthquakes. The coupling effects of the nonsymmetric structure are included. The procedure for developing these response spectra is as follows:

a. Response spectra for each earthquake excitation (X, Y, Z) are obtained at intermediate nodes by interpolating between the spectral values of top and bottom nodes.

b. Spectral accelerations are derived at points of greatest eccentricity from the centers of gravity of the floors (critical locations) by rigid body transformation. The values obtained can be designated as follows:

   Axx, Ayx, Azx for spectral accelerations in X, Y, and Z directions due to X earthquake

   Axy, Ayy, Azy, for spectral accelerations in X, Y, and Z directions due to Y earthquake

   Axz, Ayz, Azz for spectral accelerations in X, Y, and Z directions due to Z earthquake

c. For X + Y + Z earthquake combination the values for total acceleration in X, Y, and Z directions are obtained as follows:

$$Ax = \sqrt{A^2xx + A^2xy + A^2xz} \qquad (3.7B\text{-}19)$$

$$Ay = \sqrt{A^2yx + A^2yy + A^2yz} \qquad (3.7B\text{-}20)$$

$$Az = \sqrt{A^2zx + A^2zy + A^2zz} \qquad (3.7B\text{-}21)$$

In addition to the above Instructure Floor Response Spectra, refined floor-by-floor response spectra have also been issued primarily for As-Built Piping Analysis. These response spectra are similar to the floor-by-floor response spectra, except that extra conservatism due to hand smoothing has been eliminated by use of computer and curves are plotted in terms of acceleration versus frequency. The response spectra have been generated for 1% and 2% damping for 1/2 SSE and 2% and 3% damping for SSE. The use of refined response spectra for a purpose other than As-Built Piping Analysis requires prior approval from the engineer. 44

Typical refined response spectra at critical locations for floor elevation 852.5 ft. of the Safeguards Building and corresponding to 2-percent equipment damping and SSE intensity are shown on Figure 3.7B-50A. Curves Ax, Ay, and Az represent the spectra in the X, Y, and Z directions for the combined effect of the three simultaneous earthquakes. The coupling effects of the nonsymmetric structure are included.

3. Response Spectra at Selected Locations

For certain special subsystems such as the RCL subsystem, response spectra at the exact locations of the subsystems considered (e.g., at the steam generator support or the reactor nozzle) are developed as follows: Floor time histories for the three translational and three rotational degrees-of-freedom and for each earthquake excitation (SSE and OBE) are derived at the nodes corresponding to the floors which contain the selected locations. Response spectra are developed at these nodes by subjecting a single-degree-of-freedom system with the natural frequency range of interest and various damping ratios to the floor time history motions obtained. The response spectra at the selected points are then developed by rigid body transformations.

Figures 3.7B-51, 3.7B-52, and 3.7B-53 represent the response spectra of translational accelerations in three orthogonal directions at the location of the outermost support of the steam generator for two percent equipment damping and for SSE excitations in X, Y, and Z directions, respectively.

3.7B.2.6 Three Components of Earthquake Motion

The three orthogonal components of the design earthquake motion are assumed to act simultaneously. The combined responses (shears, moments, deflections, and so forth) of structures, components, and elements to the simultaneous application of the two horizontal and one vertical ground excitations are obtained by means of the SRSS method because it is considered unlikely that the peak values of the responses from ground excitations in different directions can coincide. This procedure is in conformance with the recommendations of NRC Regulatory Guide 1.92.

3.7B.2.7 Combination of Modal Responses

When the response spectrum concept of analysis is used, only the maximum modal responses are known and the phasing of modes cannot be determined as in the time history analysis. Therefore, the total response at a point in the multi-degree-of-freedom system can only be approximated. The maximum modal responses are normally combined by SRSS, by absolute sum, or by combinations thereof.

The method of combining maximum modal responses is not straightforward. When frequencies of the modes are closely spaced (differences of ± 10 percent in frequency), the absolute sum procedure of combining the responses in these modes is used.

When the absolute sum procedure for combining some of the modal responses is used, the total maximum response is obtained by treating the responses resulting from the absolute sum as pseudomodal responses and combining them with all other modal responses in an SRSS manner. This procedure conforms to the recommendations of NRC Regulatory Guide 1.92. When additional conservatism is desired, the total maximum

Mathematical models representing subsystems are subjected to their support motions, which reflect the seismic environment of the free-field and structural amplifications. Therefore, when these support motions are used as input to the dynamic system, each mode responds according to the amplification which has been predetermined in the time history analysis of the supporting structure.

Elimination of resonance condition is considered good practice in the design of subsystems. The resonance peaks are readily identified from the appropriate response spectra. Elimination of resonance is the principal aim of the design. To eliminate this resonance condition, some modification of the dominant natural frequencies can be achieved by providing stiffer or more flexible supports and smaller or bigger mass characteristics of the subsystem. When this becomes impossible or impractical, the subsystem is analyzed and designed for the resonance condition.

3.7B.3.5 Use of Equivalent Static Load Method of Analysis

Where a subsystem can be adequately and realistically represented as a one-degree-of-freedom system, and no determination of natural frequency is made, the response of the subsystem is assumed to be the peak acceleration of the appropriate floor response spectra curves at the appropriate value of damping. 20

For a subsystem which can be adequately and realistically represented as a simple model, similar to the guidelines of NRC Regulatory Guide 1.100, Rev. 1, and produce conservative analysis results, and no determination of natural frequencies is made, the response of the subsystem is assumed to be the peak of the appropriate floor response spectra at the appropriate value of damping multiplied by a factor of 1.5. A factor less than 1.5, but not less than 1.0 may be used, provided conservative results are obtained and proper justification provided.

Equipment having a minimum natural frequency equal to or greater than 33 Hz is also sometimes designed by the equivalent static load method, in which case the applied seismic loads correspond to accelerations
20 equal to at least the zero-period accelerations of the appropriate floor response spectra.

3.7B.3.6 Three Components of Earthquake Motion

The combined effect of the three components of earthquake motion on seismic Category I subsystems is determined by the SRSS method as described in Subsection 3.7B.2.6.

3.7B.3.7 Combination of Modal Responses

When the response spectrum concept of analysis is used, only the maximum modal responses are known, and the phasing of modes cannot be
20 determined. Therefore, the total response at a point in the multi-degree-of freedom system can only be approximated. The maximum modal responses are combined by the methods of NRC Regulatory Guide 1.92, Revision 1. For equipment and subsystem analyses, the methods presented in the Regulatory Guide paragraphs 1.1, 1.2.1, 1.2.2, or 1.2.3 are acceptable methods for vendor qualification.

3.7B.3.8 Analytical Procedures for Piping

3.7B.3.8.1 Design Criteria

Piping design criteria for Code Class 1 piping are in accordance with NB-3000 of the ASME B&PV Code, Section III. For Code Class 2 and Code Class 3 piping, see Section 3.9B.2.2.

Piping is anchored so that the total movements caused by relative building motion plus thermal growth do not overstress the system.

Critical areas of valve and piping inside the Containment are affected by relative motion between the Containment Building and the internal structure. Similar criteria are followed in these areas, especially at elevations where relative movements between Containment wall and internal structure are greater.

Piping is analyzed as an elastic system subject to thermal loadings and given displacements at anchor points.

Two analyses are made to determine the following:

1. Stresses imposed by thermal movements between equipment and anchors and by slow movements between structures

2. Dynamic stresses imposed by seismic loading as a result of relative motion of buildings

Each piping system is idealized as a mathematical model consisting of lumped masses connected by elastic members. In order to adequately represent the dynamic and elastic characteristics of the piping system, lumped masses are located at carefully selected points. Sufficient mass points are located to ensure that all modes with frequencies less than 33 Hz are considered in the analysis. The number of degrees of freedom is verified to be equal to or greater than twice the number of 20
modes with frequencies less than 33 Hz. In the modeling of the piping system, valves, reducers, tee and branch connections attached to the pipe are included. The location, type and stiffness of supports provided are reviewed and included in the analysis.

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Anchors with all six degrees restrained have thermal movement included in the analysis (i.e., anchors at equipment nozzles, containment penetrations, or embedded pipes).

There are three (3) categories of displacement for each direction of earthquake. Two of these categories represent rigid body motion of the structure, motions that are common to all points on the structure. The third category represents deformation of the structure, that is relative displacements of points on the structure.

20

When all of the points of fixity are located on a single structure, the rigid body motions of the structure, translation and rotation, do not result in relative motion of the points of fixity. Since the third category of displacement, deformation of the structure, represents a small portion of the total displacement profile, the effects of this displacement on the points of fixity are neglected.

For piping passing between buildings or equipment mounted on individual structures or foundations (such as big tanks), the relative displacement of support points located in different structures is considered in piping stress analysis.

Maximum relative displacements in two horizontal and the vertical direction between piping supports and anchor points between buildings are used as equivalent static displacement boundary conditions in order to calculate the secondary stresses of the piping system. Relative seismic displacements used are obtained from a dynamic analysis of the structures, and are always considered to be out-of-phase between different buildings and the equipment if applicable to obtain the most conservative piping responses.

20 3.7B.3.8.1.1 Simplified Design Method

Class 2 and 3 piping systems, whose nominal diameter is 4-inches or
38 less and whose temperature is less than 200F, may be analyzed by this
Simplified Design Method.

This method considers all loading resulting from pressure, deadweight, seismic, thermal expansion and anchor movements for all piping within the scope of this procedure. Each loading or combination of loads is evaluated for the stress requirements specified for the plant operating conditions as defined in the ASME Code Section III for Class 2 and 3 piping systems and Table 3.9B-1B.

The Simplified Design Method uses a conservative static seismic analysis based on the stress criteria as outlined below in order to establish the span between seismic support and to determine seismic loads on piping supports, anchors, and equipment nozzles. It provides spacing between deadweight supports and the corresponding loads acting on them.

The Simplified Design Method presents also a method of evaluating thermal flexibility of the piping systems and determination of thermal loads.

The basic steps included in the simplified design method are as follows: 20

1. Seismic support spacing is calculated based on the stress criteria. The individual stress contributions in the eg. 9 of the ASME Code, Section III, Subsection NC are as follows: the stress due to dead weight is equal to $0.1S_h$, the stress due to pressure is equal to $0.5S_h$ and the stress due to seismic loading is equal to $0.6S_h$.

   In order to evaluate the seismic stress level in the piping, the value of seismic acceleration is obtained by the SRSS method from three applicable response spectra, one vertical and two horizontal. The response spectras of the building and/or structure are selected for the highest elevation of the anlayzed piping.

   Reducing factors are used to obtain the seismic support span for piping with concentrated masses such as valves and for piping with bends, reducers, tees, etc. The reduction of the seismic span assures compliance with allowable stress limits of the ASME Section III code.

2. Thermal expansion of piping system and thermal and seismic anchor movements are used in order to select the type of seismic supports. The piping system is sub-divided into simple configurations such as a guided cantilever, expansion loop, etc. The thermal expansion is evaluated for each piping configuration and the type of pipe support (rigid or snubber) is established in order to meet the allowable secondary stress level S_A.

3. A simplified conservative method is used to obtain the thermal and seismic loads acting on pipe supports and anchors.

20 High Energy Fluid Piping Systems, as defined by NRC BTP APSCP 3-1 are not covered by this method unless break locations are postulated at every fitting, valve and welded attachment.

Piping systems that are subject to the occasional loads such as water hammer and the dynamic effects of LOCA are not covered by simplified method.

Normal and Upset Operating Conditions

The effects of pressure, weight and other sustained mechanical loads must meet the following:

$$(8) \quad S_{SL} = \frac{PD_o}{4t_n} + \frac{.75i\,M_A}{Z} = S_h$$

where:

P = internal design pressure, psi

D_o = outside diameter of pipe, in.

t_n = nominal wall thickness, in.

M_A = resultant moment loading on cross section due to weight and other sustained loads, in-lbs.

i = stress intensification factor ($0.75i \geq 1$)

Z = section modulus of pipe, in^3.

S_h = basic material allowable stress at design temperature, psi

Occasional Loads

During the upset conditions the effects of pressure, deadweight, other sustained and occasional loads, as defined in the design specification for upset conditions must meet the following requirements: 20

$$(9) \quad S_{OL} = \frac{P_{max.}D_o}{4t_n} + \frac{0.75i\,(M_A + M_B)}{Z} \leq 1.25\,S_h$$

Terms same as (8) except:

P_{max} = peak pressure, psi

M_B = resultant moment due to occasional loads, such as earthquake (use half range only). Effects of anchor displacements due to earthquake are included in Equation (10).

Thermal Expansion

The requirements of either equation (10) or equation (11) of section NC-3652.2 must be met.

(a) The effects of thermal expansion must meet the requirements of equation (10)

$$(10) \quad S_E = \frac{i\,M_c}{Z} \leq S_A$$

Terms the same as in equation (8) except:

Mc = range of resultant moments due to thermal expansion. Also inluded moment effects of anchor displacements due to earthquake.

S_A = allowable stress range for thermal expansion.

The effects of pressure, weight, other sustained loads and
20 thermal expansion shall meet the requirements of equation (11).

$$(11) \quad S_{TE} = \frac{PD_o}{4t_n} + \frac{0.75i\ (M_A)}{Z} + \frac{i\ Mc}{Z} \leq (S_h + S_A)$$

Emergency Conditions

During emergency conditions the sum of the stresses due to internal pressure, deadweight, other sustained loads and occasional loads as defined in Table 3.9B-1B for emergency conditions must meet the requirements of equation (9) with an allowable stress of 1.8 S_h .

$$(9) \quad S_{OL} = \frac{P_{max.}D_o}{4t_n} + \frac{0.75i\ (M_A + M_B)}{Z} \leq 1.8\ S_h$$

3.7B.3.8.2 Basis for Computing Combined Responses

For the seismic design of piping, the horizontal and vertical loadings are obtained from the instructure response spectra that have been generated for the appropriate structures and elevations as outlined in Subsection 3.7B.2.1.2, and References [30], [31], and [36]. These loadings are combined on the basis of occurrence in the vertical and two horizontal directions at the same time.

20 Restraints are designed for loadings that are obtained from the piping analysis.

3.7B.3.8.3 Amplified Seismic Responses

For the seismic design of piping, input loading is obtained from the vertical and two horizontal modal response spectra curves for the appropriate damping of the building and/or structure.

Where a piping system is subjected to more than one amplified response spectrum, such as support points located in different structures or different elevations of the same structure, the envelope of all the amplified response spectra is applied to the system. 20

3.7B.3.9 Multiple Supported Equipment Components with Distinct Inputs

The seismic analysis of multiply supported seismic Category I subsystems and equipment subjected to differential support motion within a building or between two buildings is performed in three parts, using lumped mass mathematical models, as follows:

1. Modal response spectrum analysis is performed for all three principal orthogonal directions of support motion for each direction of ground excitation using appropriate instructure response spectra, constructed on the basis of superimposing the spectra for all support points and enveloping them as stated in Subsection 3.7B.2.5. The vertical analysis is combined with both horizontals as described in Subsection 3.7B.2.1.2, Item 1.

2. The same multimass lumped parameter model is subjected to a static analysis for the differential displacements of the support points. The displacements used are consistent with the directions

of structural excitation considered in the spectrum analysis. This results in basic differential displacement loading conditions.

3. The results obtained from the spectrum analysis and differential displacement analysis are then combined directly. The effects of these loading conditions on the components and the supporting structures are determined.

3.7B.3.10 Use of Constant Vertical Static Factors

Constant static factors are used in some cases for the design of seismic Category I subsystems and equipment. The criteria for using this method are presented in Subsection 3.7B.3.5.

3.7B.3.11 Torsional Effects of Eccentric Masses

The criteria used to account for the torsional effects of valves and other eccentric masses (e.g., valve operators) in the seismic piping analyses are as follows:

1. When valves and other eccentric masses are considered rigid, the entire mass simulating the eccentric component is lumped at its center of gravity, and all six degrees-of-freedom are taken into account.

2. When valves and other eccentric masses are not considered rigid, they are simulated by lumped masses and elastic properties in discrete parts.

3.7B.3.12 Buried Seismic Category I Piping Systems and Tunnels

For seismic Category I piping systems outside the Containment structure, including those placed in underground concrete conduits but excluding those directly buried underground, the same design criteria and analytical procedures described in Subsection 3.7B.3.8 are used to ascertain that allowable piping and structural stresses are not exceeded at Containment penetrations and at entry points into other structures.

Some seismic Category I piping systems are comprised of segments which are completely buried underground and which interface with the Auxiliary Building or the Service Water Intake Structure, or with other seismic Category I structures. Other seismic Category I piping segments are enclosed in concrete conduits which are buried underground and are connected to the conduit walls by appropriate restraints and supports.

All seismic Category I buried piping and concrete conduits are encased in a lean concrete fill or located in compacted backfill with a density sufficient to ensure that the backfill does not lose its integrity as a result of liquefaction during an SSE. If required, the effects of small settlements of structures on adjacent piping are reduced by providing flexible joints, split sleeves, and similar devices. Consolidation of the backfill is expected to be negligible under the pipe and conduit weights. Shearing distortions assumed for the design of the piping and conduits are based on consideration of the elastic properties of the compacted backfill or concrete fill, as well as those of the surrounding natural ground.

The following procedures are considered in the design of seismic Category I buried piping and concrete conduits.

3.7B.3.12.2 Stresses Caused by Differential Displacements Between Soil and Structure

As a result of soil-structure interaction, differential displacements during seismic disturbance are usually experienced between the structure and the soil at the entry points of buried pipes. The maximum horizontal and vertical differential displacements are obtained by performing the seismic spectrum analysis of each seismic Category I structure. These displacements are used in obtaining additional stresses in buried pipes. For pipes extending from one structure to another, an out-of-phase assumption is made to account for the possible phase differences of the seismic ground waves.

1. Bending and shearing stresses caused by differential displacements perpendicular to the pipe axis are obtained from the studies concerning elastic pile theory involving coefficients of subgrade reaction [4], [5], [6], [23]. When the soil surrounding the pipe can be assumed to be a homogeneous isotropic medium, solutions for beams on an elastic foundation such as the ones presented in Reference [24] are used.

2. The maximum axial stresses resulting from differential displacement along the pipe or conduit axis are computed from the consideration of load transfer from the pipe or conduit to the surrounding soil by friction to accommodate axial differential displacement at the location where the pipe is entering a structure, as well as from the elastic deformation of the soil at the other end of the pipe or conduit. However, a conservative estimate of this maximum axial stress can be obtained as the product of the axial displacement, the coefficient of horizontal subgrade reaction, and the ratio of the moduli of elasticity of the pipe or conduit material and the soil. The procedure is based on the assumption that the strain in the pipe or conduit is the same as that of the surrounding soil.

If the computed combined stresses, which include stresses resulting from earthquake, internal pressure, thermal expansion, and other operating loads, exceed the allowable limits at the penetrations, one or more of the following devices are used to relieve the stresses caused by the differential displacements:

1. The portions of the pipe at the entry points are protected from soil pressure by providing a concentric split sleeve.

2. The stresses resulting from differential displacements are reduced by replacing the compacted backfill soil or concrete fill around the pipe near the penetrations by another softer soil material.

3.7B.3.13 Interaction of Other Piping with Seismic Category I Piping

20 3.7B.3.13.1 Seismic Category I Piping with Connecting Non-Category I Piping

Interaction of seismic Category I piping with non-Category I piping connected to it is considered in the following two respects:

1. The loads transmitted under seismic excitation between the two systems locally at the point of their connection

2. The effect of the non-Category I system on the dynamic characteristics and the seismic response of the seismic Category I system

Consideration of both effects is achieved by incorporating into the analysis of the seismic Category I system a length of pipe that represents the actual dynamic behavior of the complete run of the non-Category I system. The length considered extends, but is not

limited to, the first anchor point beyond the point of change from
seismic Category I to non-Category I. Whenever possible, an anchor is
located at the intersection of the seismic Category I piping with the
non-Category I piping. In cases where location of the anchor or
restraint is not possible at the category change, it is placed on the 2
non-Category pipe, and that portion of the line up to the anchor or Q130.14
restraint is analyzed according to seismic Category I criteria. In
either case, the non-Category I piping is always isolated from the
Category I piping by anchors or seismic restraints.

3.7B.3.13.2 Seismic Category I Piping with Adjacent Non-Category I Piping

Non-Category I piping systems whose failure is not acceptable, adjacent
to seismic Category I piping, are analyzed by the nomograph method or 44
other simplified structural integrity and prevent any unacceptable
physical interaction with adjacent seismic Category I piping and
components. The nomograph method provides seismic restraint spacing
based on the natural frequency of the supported piping.

This support spacing assures that the first natural frequency of the
non-Category I piping is beyond that value which is twice the resonant 20
frequency.

3.7B.3.14 Seismic Analyses for Reactor Internals

Seismic analyses for the reactor internals are presented in
Section 3.7N.

3.7B.3.15 Analysis Procedure for Damping

Damping values expressed as percents of critical damping are determined for the type of material and fabrication of subsystems in accordance with the recommendations of NRC Regulatory Guide 1.61. Typical damping values are presented in Table 3.7B-1. For the analysis of multidegree-of-freedom systems, equivalent modal dampings are determined according to the concept of weighted modal damping as described in Subsection 3.7B.2.15 and in Reference [13].

3.7B.4 SEISMIC INSTRUMENTATION

Seismic instrumentation is provided within the plant so that in case of an earthquake, sufficient data is generated to permit verification of the dynamic analysis of the plant and evaluation of the safety of continued operation.

3.7B.4.1 Comparison with Regulatory Guide 1.12

The seismic instrumentation provided is specified in accordance with ANSI N18.5-1974, Earthquake Instrumentation Criteria for Nuclear Power Plants, as recommended by NRC Regulatory Guide 1.12, Revision 1, Instrumentation for Earthquakes, and comprises the following instruments:

1. A triaxial time history accelerograph, which consists of triaxial acceleration sensors, a seismic trigger, a magnetic tape recorder and controls, and a magnetic playback unit. The function of the triaxial time history accelerograph is to measure and permanently record absolute acceleration as a function of time during an earthquake.

4

Nomograph for Simplified Seismic Analysis Based on Allowable Stress Limit

by

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The Nomograph provided by this paper has the scope to establish the span between seismic restraints for small size piping, with low pressure and temperature during all mode of operations, in nuclear safety related systems, ASME Code Section III, Class 2 and 3.
The equation used to develop the nomograph gives the maximum span between seismic supports:

$$L = (0.4\ Sh.\ Z/GW)^{\frac{1}{4}} = (C/G)^{\frac{1}{4}} \qquad (1)$$

where L, span length between seismic supports (ft);

Sh, basic material allowable stress at design temperature, psi;

Z, elastic section modulus of pipe (in^3);

W, unit weight of the pipe (lbs/ft);

G, the effective seismic coefficient expressed in gravities;

The value of C for a straight pipe depends on the size, schedule, material of the pipe, weight of fluid and insulation. These values are tabulated per nominal size of pipe for convenience.
The eq. (1) for the maximum span length between seismic restraints was established for a straight run. For actual piping systems with multiple changes in directions, branches, concentrated weights, the maximum allowed span between restraints has to be reduced. To calculate the reduced C_b value, a reducing factor K was determined for each case and multiplied with the C value for a straight pipe.
For piping with a bend or an elbow the K value is given in a chart, depending on the stress intensification factor, the angle between the two legs connected, and the ratio of the two legs. For concentrated weights, the factor K is also tabulated. The seismic coefficient G has the value of the SRSS of the G_i values on each of the directions of a three orthogonal coordinate system. The G values are tabulated for a standard plant for convenience. The Nomograph can be used also to evaluate the first mode frequency of the piping system. Design guides are given on how to locate restraints on a piping system and how to calculate the seismic reaction loads. A simplified seismic analysis was developed based on the Nomographic method and is currently used for design of Class 2 and 3 piping systems.

1. Introduction

The Nomograph provided by this paper has the scope to establish the span between seismic restraints for small size piping, with low pressure and temperature during all mode of operations, in nuclear safety related systems, under the rules of ASME Code Section III, Class 2 and 3.

The equation to calculate the maximum span between seismic restraints based on the stress criteria was first established by J.D. Stevenson [1] assuming a maximum seismic allowable stress of 0.6 Sh. If we consider for a continuous piping over several intermediate supports, a conservative maximum bending moment of $M = 0.125\ WL^2$, the equation which gives the maximum span between seismic restraints on a straight pipe, written also in a form easy to develop a nomograph, becomes:

$$L = (0.4\ Sh\ Z/GW)^{\frac{1}{2}} = (C/G)^{\frac{1}{2}} \qquad (1)$$

Where L, span length between seismic restraints (ft);

Sh, basic material allowable stress at design temperature, psi;

Z, elastic section modulus of pipe, in^3;

W, unit weight of the pipe, lbs/ft;

G, the effective seismic coefficient expressed in gravities;

$C = 0.4\ Sh\ Z/W$;

2. Degree of Conservatism

Using a simplified seismic analysis instead of a rigorous dynamic analysis, the time required to perform the analysis will decrease substantially and subsequently the cost will decrease. It is a matter of concern to make sure that the simplified seismic analysis provides an adequate degree of conservatism.

The statistical results of different attempts to establish a multiplication factor of the peak of the reponse spectra applied, which will give an adequate conservatism, have shown that a large value yields very conservative results, and this will increase the number of seismic restraints and by that will increase the cost and the time required to built the plant. This paper attempts to contribute to find a reasonable solution to that problem and to assure an adequate degree of conservatism. An evaluation study was performed for several typical beams and support arrangements. The fixed end/multiple support beams selected are shown in Fig. No. 1. The lengths of the span were calculated by equation (1). For the beam shown in Fig. 1a, the computer analyses performed and the results are presented in Table I. The peak stress in the static analysis is at the support No. 13. The moment distribution in the Dynamic Analyses is different, and the peak stress is at anchor point No. 1. The peak stresses in both Dynamic Analysis are lower than the peak stress in the Static Analysis. The first mode frequency of the beam is almost at the peak frequency of the floor response spectra, in the resonance region.

For the beam shown in Fig. 1b, the analyses and the results are presented in Table II. The peak dynamic stress are lower than the peak static stress. The natural frequency of the beam is situated in the flexible region of the spectra, as defined by R.K. Abdel Sayed [4].

For the beams shown in Fig. No. 1c and 1d three orthogonal earthquake components were considered acting simultaneously. The span was established by equation (1), taking for G_s the SRSS of the peak acceleration spectra in the three direction:

$$G_s = \sqrt{G_x^2 + G_y^2 + G_z^2} \quad (2)$$

The seismic static analysis was performed three times for each G value separately in X, Y, Z, and the responses were combined by SRSS.

A rigorous dynamic analysis was performed with three direction response spectra simultaneously. The grouping method for 10% closely spaced modes, as required by Regulatory Guide 1.92, was used in all dynamic analyses, and a cutoff frequency of 34 Hz. The results for the beam shown in Fig. 1c are presented in Table III. The peak dynamic stress is lower than the peak static stress. The first mode frequency of the beam is higher than the peak frequencies of the response spectra but still in the resonance region. Equation (1) for the maximum span length between seismic restraints based on stress criteria is proven to be conservative for a straight run. A similar analysis was performed for the beam shown in Fig. No. 1d. The peak dynamic stress is still lower than the peak static stress, but the effect of 90° elbow is significant. The results given in Table IV, show a change in moment distribution, increased dynamic stresses, a lower first mode frequency. For actual piping systems with changes in directions, concentrated weights (valves, flanges, forged fittings), tees, etc., the maximum allowed span between restraints has to be reduced in order to meet the stress criteria.

The equation which gives the reduced span becomes

$$L = \sqrt{(C_b)/(G_s)} \quad (3)$$

Where $C_b = (K) \times (C\ )$

K, span reducing factor ≤ 1.

The values of K, for various piping components and different piping configurations are being established in Section 4. For any piping system, if equation (3) will be used to locate at the maximum allowed seismic span two mutual perpendicular restraints lateral to the pipe axis, using for G equation (2), and for unanchored pipe runs an axial seismic restraint, the results will be conservative, being based on the maximum allowable stress.

Since there are no code requirements to meet a frequency or a deflection criteria, the stress criteria required by code is the unique criteria used by this method. However, in order to evaluate the first mode frequency of a piping system, will consider a simply supported beam with the length of the maximum seismic span established by the stress criteria. The expression which gives the first mode frequency [5], is:

$$fo = \frac{0.743}{L^2}\sqrt{\frac{EI}{W}} \quad (4)$$

Where fo, first mode frequency, cps;

E, modulus of elasticity, lb/in^2;

I, moment of inertia, in^4;

L, length of pipe, ft;

W, unit weight of the pipe, lbs/ft;

If we substitute $D = 0.743\sqrt{\frac{EI}{W}}$ and rearrange the terms, equation (4) becomes

$$L = \sqrt{\frac{D}{fo}} \quad (5)$$

3. Development of the Nomograph

The values of C and D depend on the size, schedule, material of the pipe, weight of fluid and insulation. These values can be tabulated for convenience. Table V contains C and D values for nominal size of pipe up to 6 inch, and different schedules. For Sh, a value of 15000 psi was considered. For weight of insulation was considered unit weight of Calcium-Silicate Insulation at 200°F. The value for the modulus of elasticity, $E = 30 \times 10^6$ psi. Two set of C and D values were calculated, for empty pipe plus insulation and for pipe, water and insulation.

The seismic coefficient G has the value of the SRSS of the G_i values on each of the directions of a three orthogonal coordinate system. The G_i values are the peak floor response spectra for OBE, for different buildings at given elevation. A damping factor of 1 percent is considered. The G values for a given plant can be tabulated for convenience. Table VI contains G values for a PWR standard plant. For each G_i value, the peak frequency of the corresponding response spectra is also given. Based on equations (3) and (5) was developed a Nomograph shown in Fig. No. 5.

To find the seismic span becomes extremely simple. For a given size of pipe, schedule and fluid select C, for a building at a given elevation find G and with these two values read from the nomograph the seismic span L. With L and D, the first mode frequency fo can be also evaluated.

4. Reduced Seismic Restraint Span

To calculate the reduced seismic restraint span as per formula (3) the value K has to be determined in all cases. Many charts and tables were developed in this scope [6]. Here are given K values for elbows and concentrated weights.

4.1 Elbows

In fig. 6, the reducing factor K for elbows is given as a function of the ratio and the angle between the two legs. In fig. 7, the stress intensification factor is also considered.

4.2 Concentrated Weights

Based on stress criteria developed by Yeh [7] K_c values for different location of the concentrated weight and different ratio of the concentrated weight versus the weight of the pipe between supports are given in table VII. A stress intensification factor for valves or flanges welded to the pipe has to be also considered.

5. Guide Lines for Application

5.1 Restraints Location

The seismic restraints have to be located first close to valves or other concentrated weights, elbows, reducers, tees, etc. After that, two mutual perpendicular restraints lateral to the pipe will be located at each seismic maximum span L determinated by Nomograph. Axial seismic restraints have to be located where required.

5.2 Snubbers

The minimum span required for thermal expansion and anchor movement has to be checked and where the criteria is not met, the rigids have to be changed in snubbers.

5.3 Seismic support Loads

Seismic loads for supports and anchors can be calculated with simplified formulas and tabulated.

The reaction load on a support, assuming a beam on multiple supports: (6)

$$R = (1.5)WGL\ (lb)$$

Where W - unit weight lb/ft;

G - spectral acceleration in the direction of the support, in gravities

L - the average total lengths of the two adjacent span of the support, ft;

The 50% increase is for conservatism.

For an anchor the maximum bending moment, from Roark [8] is: (7)

$$M = 1/8\ WL^2G\ (ft\text{-}lb)$$

and the reaction force (8)

$$R = 5/8\ WLG\ (lb)$$

6. Conclusions

The Nomographic procedure described in this paper for Simplified Seismic Analysis based on allowable stress limit, is an efficient and conservative method for small size piping nuclear safety related, Class 2 and 3 ASME Code, Section III, with low pressure and temperature.

The Nomographic method is currently used for design of Class 2 and 3 piping systems. Several rigorous dynamic analysis were performed for different piping systems, with the restraints located by the Nomographic method, and the results in all cases were conservative.

The Nomographic method has been proven to be conservative and economic, reducing considerably the time required for seismic design of piping systems, with a reasonable number of restraints, in accordance with the degree of conservatism.

7. Acknowledgements

The authors wishes to thank Andrew Rutkowsky and Lou Montanaro of Gibbs & Hill, Inc., for helpful contribution and efforts for implementation of the Nomographic method in a Simplified Seismic Analysis of piping systems.

TABLE I. RESULTS FOR BEAM FIG. NO. 1A.

ANALYSIS	EARTHQUAKE COMPONENTS	EARTHQUAKE ACCEL.	PEAK STRESS (PSI)	LOCATION OF PEAK STRESS	RESPONSE PEAK FREQ. (CPS)	FIRST MODE FREQ (CPS)	MAX. DEFL. (IN)	PEAK STRESS DYN. / PEAK STRESS ST.
SSA	1	STATIC G=2.26	7397.	NODE 13	-	-	0.484	-
FDA	1	FLAT SPECTRA /2/ G=2.26	6735.	NODE 1	-	5.6	0.506	0.91
ADA	1	MODIFIED RESPONSE SPECTRA /3/ FIG NO.2	4102.	NODE 1	5.7	5.6	0.27	0.554

TABLE II. RESULTS FOR BEAM FIG. NO. 1B.

ANALYSIS	EARTHQUAKE COMPONENTS	EARTHQUAKE ACCEL.	PEAK STRESS (PSI)	LOCATION OF PEAK STRESS	RESPONSE PEAK FREQ. (CPS)	FIRST MODE FREQ (CPS)	MAX. DEFL. (IN)	PEAK STRESS DYN. / PEAK STRESS ST.
SSA	1	STATIC G=1.	7366.	NODE 13	-	-	1.105	-
FDA	1	FLAT SPECTRA G=1.	7214.	NODE 1	-	2.45	0.705	0.979
RDA	1	RESPONSE SPECTRA FIG NO.3	4891.	NODE 1	8.33	2.45	0.483	0.664

TABLE III. RESULTS FOR BEAM FIG. NO. 1C.

ANALYSIS	EARTHQUAKE COMPONENTS	EARTHQUAKE ACCEL.	PEAK STRESS (PSI)	LOCATION OF PEAK STRESS	MAX RESPONSE PEAK FREQ (CPS)	FIRST MODE FREQ (CPS)	MAX. DEFL. (IN)	PEAK STRESS DYN. / PEAK STRESS ST.
SSA	3 SRSS	G_X=1.05 G_Y=2.10 G_Z=1.20	6316.	NODE 17	-	-	0.301	-
RDA	3	RESPONSE SPECTRA FIG. NO.4	1080.	NODE 1	5.88	6.70	0.03	0.171

TABLE IV. RESULTS FOR BEAM FIG. NO. 1D.

ANALYSIS	EARTHQUAKE COMPONENTS	EARTHQUAKE ACCEL.	PEAK STRESS (PSI)	LOCATION OF PEAK STRESS	MAX RESPONSE PEAK FREQ (CPS)	FIRST MODE FREQ (CPS)	MAX. DEFL. (IN)	PEAK STRESS DYN. / PEAK STRESS ST.
SSA	3 SRSS	G_X=1.05 G_Y=2.10 G_Z=1.20	6676.	NODE 9	- -	-	0.581	-
RDA	3	RESPONSE SPECTRA FIG. NO.5	1020.	NODE 9	5.88	4.40	0.3836	0.273

SSA = SIMPLIFIED SEISMIC ANALYSIS.
FDA = FLAT DYNAMIC ANALYSIS.
ADA = AMPLIFIED DYNAMIC ANALYSIS.
RDA = RIGOROUS DYNAMIC ANALYSIS.

PIPE SIZE (IN.)	WEIGHT COMPONENT	NOMOGRAPH PARAMETER	SCHEDULE 40	SCHEDULE 80	SCHEDULE 160
3/4	PIPE + INSULATION	C	238	242	233
		D	538	591	531
	PIPE + WATER + INSULATION	C	211	221	222
		D	552	568	567
1	PIPE + INSULATION	C	332	333	320
		D	777	779	762
	PIPE + WATER + INSULATION	C	287	301	302
		D	722	740	740
1.5	PIPE + INSULATION	C	550	553	535
		D	1201	1204	1104
	PIPE + WATER + INSULATION	C	440	473	483
		D	1075	1112	1126
2	PIPE + INSULATION	C	722	728	695
		D	1538	1544	1507
	PIPE + WATER + INSULATION	C	551	600	623
		D	1343	1402	1428
2.5	PIPE + INSULATION	C	921	913	881
		D	1911	1906	1868
	PIPE + WATER + INSULATION	C	709	755	775
		D	1677	1793	1751
3	PIPE + INSULATION	C	1172	1162	1109
		D	2380	2370	2302
	PIPE + WATER + INSULATION	C	860	930	963
		D	2039	2120	2158
4	PIPE + INSULATION	C	1552	1543	1467
		D	3106	3096	3018
	PIPE + WATER + INSULATION	C	1075	1187	1253
		D	2585	2716	2794
6	PIPE + INSULATION	C	2419	2392	2254
		D	4702	4675	4530
	PIPE + WATER + INSULATION	C	1518	1791	1888
		D	3725	4045	4154

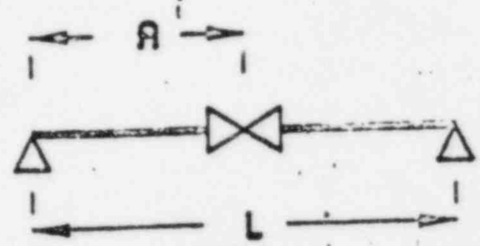
TABLE VI

SPECTRAL ACCELERATIONS G AND PEAK RESPONSE FREQUENCIES Fp, FOR STANDARD PWR PLANT

ELEV. (FT.)	G_X	F_{PX}	G_Y	F_{PY}	G_Z	F_{PZ}	G_S
CONTAINMENT BLDG							
805.50	1.12	6.66	2.07	6.06	1.27	5.	2.674
860.00	1.84	2.12	2.42	6.66	1.84	2.12	3.554
905.75	2.88	2.08	3.06	6.89	2.88	2.08	5.092
950.60	3.92	2.12	4.10	7.14	3.92	2.12	6.894
INT. STRUCTURE CONT. BUILDING							
808.00	1.06	4.76	2.08	5.71	1.21	4.76	2.629
860.00	3.28	6.06	2.49	5.26	3.53	5.71	5.424
905.75	5.27	5.98	3.0	5.98	5.95	5.0	8.406
SAFEGUARD BUILDING							
790.5	1.15	5.0	2.40	5.0	1.35	8.69	2.984
831.5	3.09	5.95	3.94	4.34	3.06	8.	5.868
873.5	4.87	5.46	4.55	14.2	4.87	6.89	8.254
AUXILIARY BUILDING							
790.5	1.00	7.69	2.60	6.06	0.81	8.33	2.901
831.5	2.22	6.06	3.07	6.06	2.34	6.67	4.453
873.5	4.10	6.45	3.44	6.45	4.75	7.14	7.156
ELECTRICAL BUILDING							
830.00	2.07	5.78	2.58	5.78	2.21	6.66	3.978
854.33	2.72	5.55	2.65	5.55	3.00	5.98	4.840
873.33	3.25	5.55	2.65	5.88	3.66	5.88	5.566

FOR CONCENTRATED WEIGHTS

K_W \ t	0.1	0.25	0.5
0.200	0.917	0.736	0.672
0.30	0.876	0.635	0.553
0.4	0.832	0.527	0.458
0.5	0.786	0.409	0.382
0.6	0.741	0.328	0.320
0.7	0.692	0.271	0.271
0.8	0.640	0.231	0.231
0.9	0.585	0.198	0.198
1.0	0.524	0.171	0.171
1.2	0.360	0.131	0.131
1.4	0.193	0.102	0.102
1.6	0.115	0.082	0.082
1.8	0.079	0.067	0.067
2.0	0.059	0.056	0.056



$\bar{K}_W = \frac{W_C}{WL_{MAX}}$; WHERE W_C CONCENTRATED WEIGHT;
WL_{MAX} . PIPE WEIGHT BETWEEN SUPPORTS :

$t = A/L_{MAX}$; WHERE A, DISTANCE OF CONCENTRATED WEIGHT TO ONE SUPPORT, WHICH IS CLOSER.

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Note: Please reduce size of figures and tables, in order to fit in the space available.

PIPE 3"-SCH 80; W=14.36 LB/FT; SH=1500.PSI; E=30.10⁶ PSI

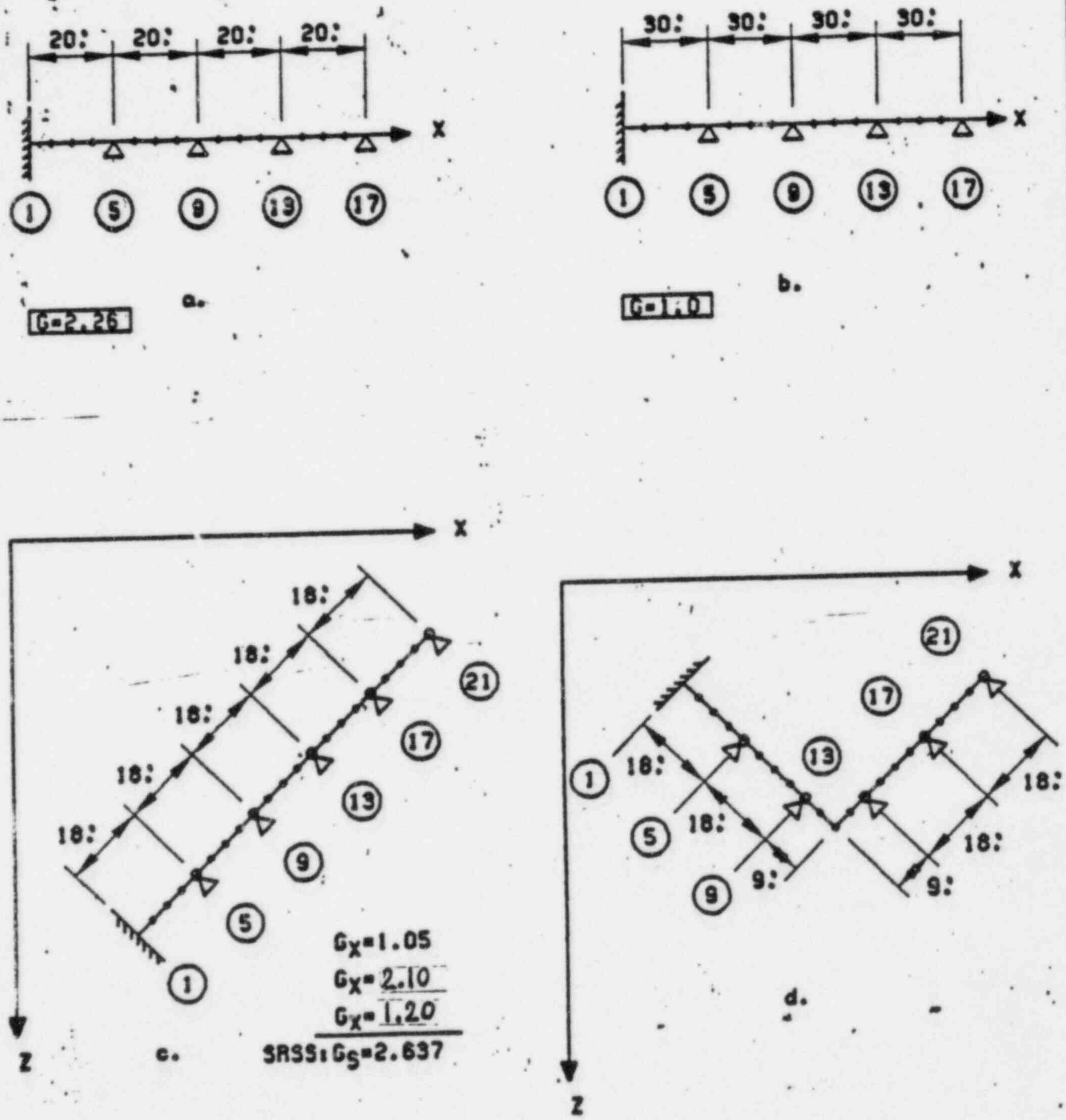

FIG. 01