CAT 10, AP-5

BROWN & ROOT, INC. CPSES	NUMBER	REVISION	ISSUE DATE	PAGE
JOB 35-1195	CP-CPM-6.9G	2	1/19/81	1 of 17

TITLE:

CP-CPM 6.9 (APPENDIX G) DOCUMENTATION FOR ASME WELDING, FABRICATION, AND INSTALLATION ACTIVITIES

ORIGINATOR: [signature] DATE 12-1-80

REVIEWED BY: [signature] QA/QC DATE 12-1-80

APPROVED BY: [signature] CONSTRUCTION PROJECT MANAGER DATE 12-1-80

[signature] MANAGER, Materials Engineering DATE 1-9-81

[signature] QUALITY ASSURANCE, Houston DATE 1-19-81

VOID

CPSES 35-1195 CONTROL COPY DOCUMENT CONTROL CENTER

0.i TABLE OF CONTENTS

DCN #1
DCN #2
DCN #3

- specify base metal repair
- [illegible]
- approvals
- [illegible]
+ hold points
Table 6.9G-2
- weld filler rod
-

VOID

FOIA-85-59

M326

JOB 35-1195
Comanche Peak Steam Electric Station

Sheet 1 of 3

Construction Procedure
DOCUMENT CHANGE NOTICE NUMBER 3

This notice applies to Construction Procedure No. 35-1195- CPM-6.9G Revision 2 .

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

Change the procedure as follows:

Replace the following pages with the attached:

Page 2 of 17
Page 12 of 17

Reason for change: Change in requirement, reference correction

This change approved by:

[signature] 6-4-81
Originator Date

Reviewed by:

[signature] 6/9/81
Brown & Root Quality Assurance Date

Reviewed by:

W.E. Baker 6-9-81
Sr. Project Welding Engineer Date

Reviewed by:

[signature] 6-11-81
Construction Project Manager Date

6-11-81
Effective Date

JOB 35-1195
Comanche Peak Steam Electric Station

Construction Procedure
DOCUMENT CHANGE NOTICE NUMBER 2 Sheet 1 of 8

This notice applies to Construction Procedure No. 35-1195-CPM-6.9G Revision 2.

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

Change the procedure as follows:

Replace the following pages with the attached

12 of 17
13 of 17
14 of 17
15 of 17
16 of 17
17 of 17
Table 6.9G-2

Reason for change: Clarification

This change approved by:

[signature] 6/1/81
Originator Date

Reviewed by:

James [signature] 6/1/81
Brown & Root Quality Assurance Date

Reviewed by:

W E Baker 6-1-81
Senior Project Welding Engineer Date

Reviewed by:

D.C. [signature] 6-1-81
Construction Project Manager Date

6/2/81
Effective Date

JOB 35-1195
Comanche Peak Steam Electric Station

Construction Procedure
DOCUMENT CHANGE NOTICE NUMBER 1 Sheet 1 of 13

This notice applies to Construction Procedure No. 35-1195-CPM 6.9G Revision 2.

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

Change the procedure as follows:

Replace the following sheets with the attached:

Page 1 of 17
Page 2 of 17
Page 3 of 17
Page 4 of 17
Page 5 of 17
Page 6 of 17
Page 8 of 17
Page 14 of 17
Page 16 of 17
Page 17 of 17
Table 6.9G-3 Sheet 1

Add Figure 6.9G-6A

Reason for change:
Additional Requirements

This change approved by:

[signature] 4-2-81
Originator Date

Reviewed by:

[signature] 4/2/81
Brown & Root Quality Assurance Date

N/A [initials] 4-2-81
TUGCO Quality Assurance Date

Reviewed by:

[signature] 4-2-81
Construction Project Manager Date

April 2, 1981
Effective Date

BROWN & ROOT, INC. CPSES	NUMBER	REVISION	ISSUE DATE	PAGE
JOB 35-1195	CP-CPM-6.9G	2	1/19/81	1 of 17

TITLE:	ORIGINATOR: *See DCN #1	DATE
	REVIEWED BY: #See DCN #1 QA/QC	DATE
CP-CPM 6.9 (APPENDIX G) DOCUMENTATION FOR ASME WELDING, FABRICATION, AND INSTALLATION ACTIVITIES	APPROVED BY: *See DCN #1 CONSTRUCTION PROJECT MANAGER	DATE
	*DCN #1 MANAGER, Materials Engineering	DATE
	*See DCN #1 QUALITY ASSURANCE, Houston	DATE

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0.ii LIST OF TABLES

0.ii FIGURES

0.iv SUPPLEMENTS

1.0 INTRODUCTION

This appendix to Procedure CPM 6.9 provides the documentation requirements of ASME Section III for welding, fabrication, and installation activities.

2.0- REQUIREMENTS

2.1 APPROVAL AUTHORITY

The requirements for origination, review, and approval of this appendix shall be in accordance with procedure CPM 6.1. In addition, this appendix and its' DCN's shall be approved by the Project Welding Engineer.

2.2 RESPONSIBILITIES

Documentation governed by this appendix shall be originated and primarily controlled by the Project Welding Engineer during field use. The B&R Site QA Manager is responsible for ASME Code certification, as required. The Permanent Plant Records Vault Supervisor has responsiblity for documentation storage and retrieval.

2.3 DOCUMENTATION LOGS

Responsible groups shall keep a status of such documentation sufficient to permit traceability and retrieval. Logs shall be used to list the applicable drawing numbers, weld number(s), item designations, and current status or locations of the documentation.

2.4 DOCUMENTATION STORAGE

When documentation is stored in an unattended location, such storage area shall be locked or otherwise secured.

2.5 VERIFICATION OF INSPECTIONS

Inspections shall be evidenced by signature, initials, or ink stamp that identifies the individual making the inspection. All documentation entries shall be made with a black, indelible, ink pen (not felt tip pens).

2.6 ANI REVIEW

Upon completion of documentation or any document change, the applicable documentation shall be presented to the ANI for review as noted below. If the documentation is acceptable, the ANI indicates his concurrence by initialing and dating the applicable welding documentation.

Initial Review Required: All welding documentation, e.g. WDC, MWDC, RPS, Hanger Packages, Travelers, MRS'S

NOTE 1: The following documentation changes require ANI re-review:

a. Deletions of items designated as ANI holdpoints (unless a weld is voided).

b. Additions of operational steps in sequences previously reviewed.

2.6.1 Inspection Plans

2.6.1.1 Weld Data Process Sheet/Inspection Plan

ANI review of documentation may be accomplished with a "Weld Data Process Sheet/Inspection Plan Form" (Figure 6.9G-6) in lieu of the weld documentation. The form is initiated and controlled by Welding Engineering and completed by the drawing number, code class, individual weld identification and QC holdpoints. A line entry may also be completed for a MRS or travelers.

Hold or inspection points are established on this form by indicating them in the applicable space(s). Hold/inspection points not shown, such as travelers or MRS operations, are noted in the "comments" column.

Upon completion of each review/inspection denoted above the WE, QC, or the ANI representative shall sign and date in the appropriate space at the bottom of the form.

The holdpoints as defined on the form shall be transcribed to the appropriate MRS, WDC, or traveler by Welding Engineering and in the "Reviewed by: ANI" block shall be written "WDPS/IPF" to indicate that a completed Weld Data Process Sheet/Inspection Plan is on file to document the ANI review.

A copy of the complete WDPS/IP form shall be transmitted to the ANI by Welding Engineering.

NOTE: (This note applies to the above paragraph only)

- Any ANI holdpoint that is not transferred to the weld documentation from this form constitutes a nonconformance if the ANI holdpoint is bypassed and shall be documented in accordance with QAP-16.1
- Normally, weld documentation will be made out for a a complete ISO.
- RPS's will be presented to the ANI for review.

2.6.1.2 Piping Modification Inspection Plan

In lieu of the plan discussed in Paragraph 2.6.1.1 above, a Piping Modification Inspection Plan (PMIP; Figure 6.9G-6A) may be used for the selection of ANI holdpoints. The holdpoints shall be established by Welding Engineering in accordance with written sampling plans provided by the ANI.

Blank PMIP's will be submitted to the ANI for signature. Upon signature, entries in accordance with the written sampling plans will be made by Welding Engineering. The serial number of the PMIP will then be entered in the "Reviewed by: ANI" block on the weld documentation. Copies of the form shall be submitted to the ANI and the QA Department.

2.7 ROUTING OF DOCUMENTATION (ASME)

Upon completion of the ANI review, MRS(s), Hanger Packages, WDC(s), RPS(s) shall be returned to the PWE. From this point on, the documentation listed above shall be controlled by the FWTC substations and maintained as described in Section 2.3 hereof.

At the completion of each shift, or the end of the related work, all documentation shall be returned to the FWTC substation. Upon completion of all work presented by such documentation, the affected documentation shall be reviewed for completion. If completed, it shall be transmitted to the System Release/Turnover Group.

2.8 DOCUMENTATION MODIFICATION REQUIREMENTS

2.8.1 Piping Subassemblies (Reviwions To MRS and Related WDCs) and Component Supports

When documentation revision is necessary before or during fabrication, the affected documentation shall be forwarded to:

a. Piping Documentation - revised by Welding Engineering in accordand with Appendix 6.9G.

b. Component Support Documentation - Revised by the Hanger Package Distribution Station in accordance with Appendix 6.9G, and Procedure CPM-9.10.

This process shall include surveillance, review, and modifications by the ANI as defined in Section 2.6.

2.8.2 Field Welds (Piping)

Revisions to WDCs shall be made and reviewed (Section 2.8.1 above) with the exception that documentation of the changes/revisions shall be made by WE and the changes shall be initialed and dated near the change.

NOTE: Changes that substantially revise the designated work may require that the affected weld documentation be voided and new documentation issued.

3.0 DOCUMENTATION PREPARATION AND PROCESS FLOW

3.1 WELD DATA CARDS AND MULTIPLE WELD DATA CARDS

NOTE: Documentation initiated and dated by the Welding Engineering department before July 2, 1979, may be used as prescribed in Supplement 6.9G-I.

Weld Data Cards (WDC, Figure 6.9G-1) or Multiple Weld Data Cards (MWDC, Figure 6.9G-2) shall be prepared for all welds which must meet the requirements of ASME Section III, Division 1 except as provided herein. WDCs and MWDCs shall meet additional requirements given below.

1. MWDCs for ASME welds are limited to socket welds and component support welds on the same drawing or subassembly. No more than one piping subassembly, component support, or isometric or hanger drawing (for field welds) shall be documented on a single MWDC.

2. Spaces requiring entries on WDCs and MWDCs that are not applicable shall be marked N/A by the WDCC.

3. A maximum of four (4) welding procedures may be assigned to a given WDC. WPSs may be changed by the WT in the field.

4. Corrections to an entry on a WDC, MWDC, or other documentation shall be accomplished by drawing a line through the incorrect entry, and initialing and dating the new entry.

5. Class 2 and 3 Component Support Welds do not require unique identification (weld numbering) except for the following: Attachment welds to pressure retaining members; hangers or welds utilizing multiple processes or filler materials; full penetration welds excluding flare beveling on structural tubing; and welds requiring NDE (weld numbers for welds requiring NDE may be added upon completion of work).

Class I component support welds require unique weld numbers for all welds. Heat number traceability is required for all Class I and impact tested materials and shall be recorded on an MIL.

3.2 WDC AND MWDC ORIGINATION

The following entries are required for all WDCs and MWDCs for the work to be accomplished:

1. All identification information, as applicable.

2. WPS numbers: The correct WPS revision numbers and any applicable ICNs shall be entered by the WT just before the release of the card to Construction. When a welding procedure for the automatic GTAW process is used, as a minimum, an appropriate GTAW procedure for manual tacking shall be listed in addition to and above the automatic GTAW procedure. A maximum of four WPSs may be provided.

3. Enter the "Weld Filler Metal Required."

NOTE 1: Unless specified otherwise by the PWE, if a WDC references ER308, then ER308L is acceptable; if ER316, then ER316L is acceptable. Westinghouse applications will require approval of the W representative.

4. Enter the "piece" number (PC#) and "P" number on the WDC. The MWDC piece number is noted in the MRS section on the back or as on an attached MRS. For component supports this may be accomplished on a Bill of Materials. The "P" number(s) for the material should be entered adjacent to the applicable connecting weld numbers on the top of the MWDC (front).

   In addition, verify that the WPS is acceptable for the wall thickness, material type, etc. (wall thicknesses may be found by consulting ANSI Standards B16.9, B16.11, B36.10, and B 36.19).

5. Verify that the WPS was qualified to ASME Sections III and IX and approved by G&H.

NOTE 2: An applicable WPS is shown on Table 6.9G-1 by Piping Specification Category and Code Class. If the one shown is used, this verification is unnecessary.

6. Check if PWHT is required by the WPS. If no PWHT is required, enter N/A in all applicable spaces. If PWHT is required, attach a PWHT checklist as shown on Figure 6.9-3 and complete all identification information.

7. Add sequential operations to be followed during fabrication or installation including inspection requirements. For NF Supports, hold points shall be entered in accordance with the requirements delineated in Table 6.9G-3 and, as applicable, for the hanger to be fabricated/installed from the following:

   - Support Number Ident.
   - Size, Configuration, Tolerance/Dwg.
   - Material Correct Dwg.
   - Fasteners Correct & Complete
   - Location and Elevation/Dwg.
   - Spring Can Stops Installed
   - Spherical Bearings
   - All Welds/Dwg. & WPS (V.T.)
   - P.T./M.T.

8. Entry of QC holdpoints. Make entries as noted on the "ASME Inspection Requirement Matrix" (Table 6.9G-1), as noted by ASME

Section III Code Class and Piping Category or the component Support Inspection Matrix (Table 6.9G-3). Enter weld numbers as applicable adjacent to the applicable sequence on the MWDC.

NOTE 3: For dissimilar metal shop welds, PT is required on both the root and final weld surfaces. Buttwelds shall be 100% RT'd.

NOTE 4: For branch connections, any additional NDE shall be as required by Note 4, Table 6.9G-1.

NOTE 5: Use one space for each type of NDE required.

NOTE 6: Holdpoints are denoted with a check " ✔ "; Inspection points with an "X". "WT" inspection points shall be as required by the PWE and indicated with an "X". CON. (Construction) holdpoints shall be as defined by the PS.

NOTE 7: Required holdpoint and inspection point operations shall be performed by the group defined on the WDC or RPS in the order shown from left to right (i.e., if an operational sequence requires WT and QC holdpoints, the WT inspection shall occur before QC inspection).

NOTE 8: Delta ferrite checks shall be performed as required by Appendix 6.9D.

NOTE 9: Line, drawing no., weld no.(s), and fabrication code and class entries shall be made on WDCs and MWDCs, as applicable.

NOTE 10: Upon acceptable completion of the WDC(s), the individual making the above entries shall denote "Review" immediately below the last operational sequence and sign and date in the "WE" column.

3.2.1 Pre-established Repair Sequence (Optional - In Process)

1. A pre-established repair sequence may be added at the direction of the PWE below final NDE. Signoffs for review shall be made below such sequence. Normally the pre-established sequence will contain the following operations:

    a. Excavate defect.

    b. Perform Info PT.

c. Evaluate excavation and attach a sketch to the WDC and return to Welding Engineering.

2. In the event that this pre-established repair sequence is not used, all steps may be marked N/A by the PWE in the "Inspection Results" column.

3.3 REPAIR PROCESS SHEET

Welds requiring rewelding which were rejected after final inspection, all "major" repairs, and all base metal repairs requiring welding shall be documented on the RPS, Figure 6.9G-4 (or continuation sheet). The RPS is normally reproduced on the back of the WDC. Specific requirements by classification of repairs are given in Appendix 6.9D, Section 3. Before defining each repair operation sequence, the repair type shall be defined (i.e. Base Metal Repair, In-Process Repair, Cosmetic Repair, Major Weld Repair).

The applicable repair operations shall be established and approved before proceeding with the repair work.

NOTE 1: For socket, component supports, and pipe butt welds using the MWDCs and WDCs, the first repair sequence may be defined for each weld before initial issuance of the card. Should the repair not be required, the appropriate signoff areas are marked N/A by the cognizant QC Inspector or WT and initialed and dated.

NOTE 2: The repair work and the inspection holdpoints on the RPS must be totally completed (signed) by the QC Inspector. When the repair is complete and the RPS is signed, work may continue to the next sequential step on the front of the WDC or MWDC.

1. The rejectable operation identified on the front of the WDC is marked "U" for unsatisfactory and signed and dated by the QC Inspector before continuing to the RPS operational repair sequence.

2. Each major welded repair (excluding in-process welds) shall be numbered consecutively as R-1, R-2, etc. This shall be stated next to the repair type before the first operational step. Operation designations shall be "operation number" of the rejectable operation on the front of the WDC suffixed by an A, B, C, etc. In-process welds will be sequentially number IP-1, IP-2, etc.

3. Should an operational step result in a rejectable condition that cannot be considered an in-process repair, then one shall be added to the repair number and this shall be affixed prior to the next operational sequence, i.e.:
R-1 Major Weld Repair

   7A Grind defect
   7B PT excavation
   7C Fill per WPS 88023
   7D Grind for NDE interpretation
   7E Perform final RT "U"
   7F Remove Purge Dam N/A
R-2 Major Weld Repair
   7A Grind defect
   7B PT excavation
   7C Fill per WPS 88023

4. In a given operational sequence, steps that are not to be used may be marked "N/A" in the Inspection Results section by the PWE.

5. Upon completion of a given operational sequence, work shall proceed to the next succeeding step on the front of the WDC i.e., Step 7D is the last operational step which includes signoff for required final NDE.

   On the Weld Data Card, Step 8 is the next step after signoff of the required NDE, as required by the last step on the RPS.

3.3.1 Required Approvals

→ Base metal repair - ANI, WE, G&H
Major weld repair - ANI, WE
In-process repairs - WE
Cosmetic Repairs - ANI, WE

Approval signatures and dates shall be affixed in the appropriate column of the RPS directly below the last operation step defined. On MWDC's, sequences for several welds may be defined before affixing of approval signatures at the end of the last operation defined.

<u>NOTE</u>: A repair cycle shall be defined as operations on a weld after a rejectable code-required final NDE that results in either an acceptable or rejectable additional code-required final NDE.

The repair number on applicable RPS's shall be advanced only under these circumstances unless determined otherwise by the PWE.

3.3.2 Repair Process Sheet Initiation

The Repair Process Sheet shall be completed and verified as follows for repairs to ASME items:

1. The WDC Serial No. (where applicable), drawing no., and weld no. shall be entered at the top right corner. For component support applications, both the component support drawing number and the applicable piping isometric drawing number shall be provided. For base metal defects, the spool number shall be entered.

3.3.3 Weld Metal Repairs

1. Required approvals, inspections and holdpoints shall be established as delineated in Table 6.9G-2, required examination, QC holdpoints, and approvals required for repairs to ASME Section III, Subsection NB, NC, ND. For Subsection NF, see Table 6.9G-3, Note 6, page 3 of 3.

2. The Repair Process Sheet shall describe the defects, including sketches or attachments (i.e., overlays) in order to adequately locate the defect(s) at a later date.

3. For weld repairs, if the original weld points were completed, verify that in addition to the weld repair requirements of the original weld QC hold points are as required by Table 6.9G1. If a delta ferrite check is required, verify that "Delta Ferrite Check" has been entered.

4. The repair cycle (the number of repairs to this weld) shall be noted. Requirements for more than two repairs are given in Appendix 6.9D.

5. If all items on the RPS have been acceptably completed, the originator shall denote "Final Review" on the line immediately below the last operational step entered and sign and date in the appropriate column. The applicable documentation shall then be transferred to QA for QA review/ANI review/approval, as required.

3.3.4 Major Base Metal Repairs

1. Verify that the required approvals have been made for base metal repairs by referring to Table 6.9G2. For component supports, the applicable CSTP or HP number shall be entered.

2. Enter/verify that the WPS to be used is acceptable for the material and the type of weld to be made, and that the "Weld Filler Material Required" where shown is as specified on the WPS (See also Section 3.2.4 of this Appendix.)

3. If post-weld heat treatment is subsequently required, enter/verify that the time and temperature requirements have been entered and that a "PWHT Checklist" (Figure 6.9G-3) is attached.

4. Establish the required QC holdpoints and approvals required on the RPS operation sequence, and the NDE requirements of Table 6.9G-2.

5. Establish the "Repair Cycle No.," the number of the repair to be made is entered.

6. Verify that the sketch or overlay attachment is adequate to find the repaired defect at a later date.

7. Establish that spaces for delta ferrite readings have been established where applicable for S/S materials. (See also Appendix 6.9D, Section 3.18.)

8. If all items above have been acceptably completed, the originator shall sign and date the "Weld Engr." approval column.

9. Review and modify an applicable MRS, HP, and CSTP for required items such as described in Section 2.8 of this Appendix and concurrently with the RPS operational sequence. Review and approval of the RPS operational sequence shall be as required by Sections 2.6 and 2.7 of this Appendix.

NOTE: Base metal repairs which are not associated with a field weld shall be defined on an RPS at the back of a WDC. The WDC shall be completed as to all applicable items and the "production release" section marked N/A or crossed out. The RPS shall be completed on the back defining the repair sequence and requirements.

Base metal repairs associated with a weld having a WDC (such as weld end prep repairs) may be completed as part of the repair sequence on the RPS for that weld.

3.4 THE MANUFACTURING RECORD SHEET

A MRS (Figure 6.9G-5) is a shop traveler for ASME Section III piping subassemblies and for modifications to Code-certified piping fabrications. (The MRS is not required for component supports or field welds.) A MRS shall be initiated for all piping subassemblies to be fabricated and is routed with the WDCs for any welds to be made as part of the documentation package.

For socket welds documented on the MWDC, the MRS may be affixed to the back of the card as shown in Figure 6.9G-2. (For component supports, the MRS may be used as a Bill of Materials.)

Subassemblies composed of screwed fittings also require an MRS.

The MRS shall be completed as follows:

1. Enter all applicable identification information (drawing revision, line, composite, subassemblies, or component support numbers).

2. Complete the Bill of Materials on the MRS or the back of the MWDC from the construction drawing for item, quantity/ length (random lengths are not filled in), size, schedule/ rating, material specification, and type or grade. Other items are completed in the field.

3. For a MRS where a Code-certified item is to be modified, the Bill of Materials shall be completed as above for the items to be added or deleted.

4. Every attempt should be made to install pipe exactly on location. However, when this cannot be accomplishd, Code-certified items may be shortened in the field to permit fitup and installation provided the following conditions are satisfied:

   a. No <u>shop</u> welds are altered or cut;

   b. The final working point dimensions are maintained ±2 inches for Unit 1 and Common building, and ±½ inch for Unit 2 building of the dimensions specified on the drawing (reference by CPM-6.9E, paragraph 3.12.1);

   c. The final dimension after shortening will be recorded on modification MRS which is verbally requested from and prepared by Welding Engineering.

A CMC is not required to perform such modifications. Modifications in excess of tolerances and/or those cutting shop welds, shall require CMC's and modification MRS's. The cutting of field welds will also require a CMC.

NOTE 1: Modifications to Code-certified items resulting from design changes or a change in weld numbers require a drawing revision, or CMC to permit such modifications.

NOTE 2: When final dimensional inspection for piping subassemblies was completed after July 20, 1979, cleaning and packaging was not a required QC holdpoint and need not be inspected. The QC Inspector shall note such hold points N/A and initial and date.

NOTE 3: Any marking falling within the allowed modification area shall be transferred prior to the modification.

The MRS is routed with associated weld data cards for surveillance/review as delineated in Sections 2.6 and 2.7 above.

3.5 THE COMPONENT MODIFICATION CARD

The CMCs shall be issued and controlled in accordance with applicable TUSI procedures. Upon receipt, the CMC shall be reviewed and appropriate action taken as follows:

NOTE: Except for ASME Class I applications, CMC's to add or delete materials or welds, within the original design, for welding problems, misfabrication, or misalignment, may be issued by Welding Engineering.

3.5.1 Documentation

3.5.1.1 Weld Data Card.

1. Where a shop weld on a certified piping subassembly is to be cut, issue a modification MRS with a step added to confirm joint removal. The associated WDCs may be issued concurrently. If the subassembly has not been certified, the existing MRS may be revised and reapproved as described Sections 2.6 and 2.7 above. Revisions to CSTPs shall be in accordance with procedure CPM 6.3 and with WDCs added or deleted as described in this section.

2. The congnizant welding technician will verify any required weld removals on the MRS. Where an MRS is not required, as in the case of field welds, this verification shall be made by the welding technician signing or initialing the applicable hold point on the WDC.

3. Upon final QC review, QCR personnel will enter "VOID" in bold lettering in the applicable weld blocks on the appropriate WDC.

NOTE: The PWE may stamp "VOID" on original WDCs in lieu of QCR when the documentation is available.

4. Upon issuance of associated WDCs, the CMC number shall be entered on the card.

5. If all welds on the cards are "VOID" and not presently in the Records Vault, they shall be transmitted to QA.

6. If all welds on cards are not affected the card may be used for further production use.

EXCEPTION 1: WDCs for BOP applications shall be controlled and processed as noted above with the exception that they are forwarded to the BOP Inspection Group for the documentation file.

EXCEPTION 2: CMCs affecting BOP welds listed on weld data sheets shall be filed with the appropriate drawing and all appropriate corrections made on the associated Weld Data Sheets prior to turnover.

3.5.1.2 Verification.

Concurrent with the above activity, the following verification and/or actions shall be taken/made by Welding Engineering:

1. Verify that the CMC is completed for line number, drawing number, and weld numbers and that all instructions and sketches are clear.

2. Verify that the necessary approvals have been made using a CMC.

   REQUIRED: Site Engineering

3. Where Westinghouse supplied equipment is located adjacent to the weld to be removed, approval by an authorized W representative is also necessary (the "Owner's Agent").

3.6 DOCUMENTATION ACTIVITIES DURING FABRICATIONS/INSTALLATION

1. The craftsman making the weld fit-up shall enter the heat number of the base materials to be joined on the applicable WDC. When subassemblies are to be joined, traceability shall be verified through the use of the subassembly number. When items of material on a subassembly are welded together and an MRS is used, traceability shall be through entries on the MRS. In such instances, the heat number block on the WDC may be marked "N/A". When a valve or other equipment is to be joined, the serial number of the item shall be entered in place of the heat number.

For component supports, verification of materials shall be made on the MWDC, MRS or MIL (Figure 6.9G-7).

NOTE 1: An inspector verifies that the materials used and the heat numbers entered are correct at the time of first inspection. For ASME Fabrication activities, these verifications shall be made by the QCI; for BOP, the CIT.

NOTE 2: When piping subassemblies or other code-stamped items are joined, the subassembly serial no. shall be recorded in lieu of the heat number.

NOTE 3: For Class 2 and 3 component supports and Class 1 standard items, the heat number block on the MWDC, MRS or Bill of Materials may be marked "N/A".

2. Entries shall be made on the WFML during the welding process as defined in Appendix 6.9B.

3. When welding austenitic stainless steel, the weld interpass temperature shall be checked by the craftsman after each pass has been completed around the entire pipe joint.

4. When M&TE is used to perform inspections, the QC Inspector shall enter the M&TE number and calibration due date in the space provided on the WDC or MWDC, and initial and date the entry.

5. Certain austenitic stainless steel welds shall be required to be measured for delta ferrite content. The measurements shall be accomplished by the WT who shall record the four readings in the space immediately to the right of the NDE procedure/revision designations on the WDC. If the readings are within the specified requirements, he shall sign and date the applicable operation (see Appendix 6.9D, Section 3.18).

Upon completion of all work required by the documentaion, the MRSs and WDCs, and associated documentation shall be routed to the WE. Upon receipt, the FWTC shall review as noted, weld documentation for completion. If acceptable, "Final Acceptance" shall be written on the front after the last operation step defined and the WE column shall be signed and dated and ASME documentation transmitted to the System Release/Turnover Group for review, approval, certification, and subsequent storage. For BOP WDCs, the MDS shall forward the completed cards to the BOP Inspection Group for approval and filing in the Permanent Plant Records Vault.

For component supports, upon completion of the hanger, the Craft shall return the Hanger Package to Welding Engineering for final review. After final review, the Hanger Package will be returned to the craft for final inspection by QC and subsequent transmittal by QC of the accepted Hanger Package to the Permanent Plant Records Vault.

3.7 NONDESTRUCTIVE EXAMINATION DOCUMENTATION REQUIREMENTS

1. NDE Report forms shall be completed for NDE performed on Non-ASME safety-related items, "Info" NDE, RT and UT examinations, and unsatisfactory VT, PT and MT inspections in accordance with the NDE Procedures Manual. For satisfactory VT, PT, MT and digital thickness UT, an NDE report is not required.

2. For welds that use WDCs or MWDCs, the following information shall be recorded.

   a. The NDE procedure and revision to which the examination was performed.

   b. The inspection results (i.e., "S" Satisfactory, "U" Unsatisfactory).

   c. The inspector shall verify that the fabrication code/acceptance standard was correct for the examination performed.

   d. The signature or initials and date of the inspector conducting the examination.

   e. The inspector's level of certification.

NOTE: NDE required by hold points must be certified by a Level II on the applicable report or WDC.

Upon completion of all holdpoints for welds which do not require final radiography, the WDC package shall be returned to the FWTC.

TABLE 6.9G-1
ASME INSPECTION REQUIREMENTS MATRIX

Sheet 1 of 4

Piping Specification Category	Code Class	"P" Number	Joint Design	Size	Welding Procedure Specified	Prior to Welding					After 2nd Pass			Final						Purge Dam Removal	Delta (XI) Ferrite	Comments
						Cleanliness	Fitup	Preheat	Purge	PT End Prep	VT	MT	PT	[illegible]	PWHT	VT	UT	PT	RT			
150	3	8	F	-	88032	X	X									X						
150	3	8	OB	2½"-3½"	88023	X	X									X						
150	3	1	OB	≥4"	11020	X	X								5	X	2	3				
151	2	8	F		88023	X	X									X		X				
151	2	8	OB		88023	X	X		X							X			X	9	7	
151	3	8	F		88023	X	X									X						
151	3	8	OB		88023	X	X		X							X		2		9	7	
152	2	1	F		11020	X	X									X	3	X				
152	2	1	OB		11020	X	X								5	X			X			
152	3	1	F		11020	X	X									X						
152	3	1	OB		11020	X	X								5	X	2	3				
153	3	3	OB	≥26"	55010	X	X		X							X		2				
301	2	8	F		88023	X	X									X		X				
301	2	8	OB		88011 88023	X	X		X							X			X	9	7	
301	3	8	F		88023	X	X									X						
301	3	8	OB		88011 88023	X	X		X							X		2		9	7	
301	2	8	F		88023	X	X									X		X				
301	2	8	OB		88011 88023	X	X		X							X			X	9	7	
301	3	3	F		88023	X	X									X						

TABLE 6.9G-1 Sheet 2 of 4

ASME INSPECTION REQUIREMENTS MATRIX

Piping Specification Category	Code Class	"P" Number	Joint Design [4]	Size	Welding Procedure Specified	Prior to Welding: Cleanliness	Prior to Welding: Fitup	Prior to Welding: Preheat	Prior to Welding: Purge	Prior to Welding: VT End Prep	After 2nd F Root: VT	After 2nd F Root: MT	After 2nd F Root: PT	Pre PWHT NDE	Final: PWHT	Final: VT	Final: MT	Final: PT	Final: RT	Purge Dam Removal	Delta (FN) Ferrite	Comments
601	3	8	OB		88011 88023	X	X	X	X							X		2		9	1	
602	2	1	F		11020	X	X	X								X	1					
602	2	1	OB		11020	X	X	X							5	X			X			
602	3	1	F		11020	X	X	X								X						
602	3	1	OB		11020	X	X	X							5	X	2	3				
1302	2	1	F		11020	X	X	X								X	3	X				
1302	2	1	OB		11020	X	X	X							5	X			X			
1302	3	1	F		11020	X	X	X								X						
1302	3	1	OB		11020	X	X	X							5	X	2	3				
1303	2	1	F		11020	X	X	X								X	3	X				NS-43B 1.7.3.4 (b)
1303	2	1	OB		11012	X	X	X							5	X			X			
1501	2	8	F		88023	X	X	X								X		X				
1501	2	8	OB		88011 88023	X	X	X	X							X			X	9	1	
1501	3	8	F		88023	X	X	X								X						
1501	3	8	OB		88011 88023	X	X	X	X							X		2		9	1	
2002	2	1	F		11020	X	X	X								X	3	X				
2002	2	1	OB		11010 11020	X	X	X							5	X			X			
2002	3	1	F		11020	X	X	X								X	3	6				

TABLE 6.9G-1

ASME INSPECTION REQUIREMENTS MATRIX

Sheet 3 of 4

Piping Specification Category	Code Class	"P" Number	Joint Design	Size	Welding Procedure Specified	Prior to Welding: Cleanliness	Prior to Welding: Fitup	Prior to Welding: Preheat	Prior to Welding: Purge	Prior to Welding: PT End Prep	After 2nd PT Root: VT	After 2nd PT Root: MT	After 2nd PT Root: PT	Final: Pre PWHT NDE	Final: PWHT	Final: VT	Final: MT	Final: PT	Final: RT	Purge Dam Removal	Delta Ferrite	Comments
2001	3	1	OB		11010 11020	X	X	X							5	X	2	3				
2001	2	1	F		11020	X	X	X								X	3	X				NS-430 1.3.3.4 (b)
2001	2	1	OB		11012	X	X	X							5	X			X			
2501	1	8	F		88023	X	X	X								X		X				
2501	1	8	OB		88011 88023	X	X	X	X	8						X		X	X	9	7	
2501	2	8	F		88023	X	X	X								X		X				
2501	2	8	OB		88011 88023	X	X	X	X							X			X	9	7	
2501	3	8	F		88023	X	X	X								X						
2501	3	8	OB		88011 88023	X	X	X	X							X		2		9	7	
2503	2	1	F		11010 11020	X	X	X								X	3	X				
2503	2	1	OB		11010 11020	X	X	X								X			X			
2503	3	1	F		11010 11020	X	X	X								X						
2503	3	1	OB		11010 11020	X	X	X								X	2	3				
2505	2	8	F	½"	88023	X	X	X					11			X		11 X				Inst. Tubing
2505	3	8	F	½"	88023	X	X	X					11			X		11				Inst. Tubing
2001	3	1	OB		11012	X	X	X							5	X	2	3				
						X	X	X								X						
						X	X	X								X						

TABLE 6.9G-1

ASME INSPECTION REQUIREMENTS MATRIX

NOTES:

1. For dissimilar metal shop welds the root and final weld surfaces shall be liquid penetrant examined and 100% RT is required for butt welds.

2. Final MT, PT or RT required for buttwelds greater than 4" (ND5212).

3. For P-1 materials, PT may be substituted for MT (MS-43B 1.10.2 (a). For socket welds, PT will normally be performed.

4. Full penetration butt and corner welded branch and piping connections shall require final NDE as follows:

   a. Class one weldments greater than 4" require RT and MT or PT.
   b. Class one weldments equal to or less than 4" require MT or PT.
   c. Class two weldments greater than 4" require RT.
   d. Class two equal to or less than 4" require MT or PT.

   NOTE: MT or PT is required externally, and when accessible, internally. (NB 5242, 5243, NC 5242.)

5. PWHT required for P-1 materials as required by ASME Section III. If PWHT is required, use WPS 11012 (MS-100 4.33.5 (a)).

6. Required for work falling within the scope of MS-100 only, and in accordance with other notes (MS-100 2.1.2).

7. The delta ferrite check shall be accomplished by a welding technician and surveillance over such operations shall be performed as follows by the establishment of a QC hold point for delta ferrite: Class 1 weldments 100% QC hold point. Class 2 & 3 weldments 10% random QC hold point.

   Selection of inspection (WT) and QC hold points and their disposition shall be in accordance with MS-100, Paragraph 4.34.6.

8. All Code Class 1 & 2 weld end preparation surfaces 2" or more in thickness shall be examined by the magnetic particle or liquid penetrant method (NB5130, NC5130).

9. Purge Dam Removal required for field welds where purging is required by the applicable WPS.

10. For Class 1 welds defined in ASME Section III, NB4360 (Specially Designed Welded Seals) perform MT or PT on the final weldment surface (NB5271) and other NDE as for a fillet weld to PSC 2501, Class One. (NOTE: CRDM Welding)

    NOTE: WT and QC hold points may be on a surveillance or other system other than the WDCs at the option of the PWE or Site QA Manager.

11. The final pass of all pressure boundary welds and finished machined surfaces of all hardfaced areas shall be PT examined (MS-625).

12. In addition to mandatory hold points, Welding Engineering may add additional QC holdpoints where deemed necessary.

TABLE 6.9G-2 Sheet 1 of 2

Required Examination, QC Hold Points and Approvals Required for Repairs

Repairs	Defect Removal	Repair Cavity				Completed Repair					Required Approvals					Manufacturer
Base Metal Defects		PT	MT	UT	VT/Mech Meas	PT	MT	RT	VT	UT	PME	TUSI	PWE	ANI	G&H	
(1) Not exceeding 10% of wall thickness or 3/8"		8 X	8 1	2	X											
(2) 10% of wall thickness or greater than 3/8"		X	1	2	X	4	4 1	4	4		9	9	X	X	6	
(3) Exceeding min. wall thickness		X	1			X	1	X	X		9	9	X	X	6	
Weld Repairs																
(1) Minor repairs not requiring welding		X	1	2	X											
(2) Minor repairs requiring welding		X	1			4	4	4	X				X	X	6	
(3) Major repairs		X	1			4	4	4	X				X	X	6	
Code Stamped Parts Appurtenances											X	X		X	X	3

TABLE 6.9G-2

Required Examination, QC Hold Points and Approvals
Required for Repairs

REPAIR CHART NOTES:

1. MT may be substituted for PT where applicable.

2. When it is not possible or practical to examine a possible minimum wall violation through mechanical measurement, UT measurement of wall thickness may be substituted.

3. For code stamped or certified items, the repair or modification of items which fall within the scope of Brown & Root certificate of authorization or manufacturer's approval is not required. For items which fall outside such scope, repair shall be with the approval to the specifications of, or by the manufacturer.

4. The examination of repairs shall be repeated as required for the original item except that repair of defects originally detected by MT or PT methods when the repair cavities do not exceed the lesser of 3/8" or 10% of the nominal thickness need only be re-examined by an MT or PT method. If the repair cavity exceeds the above, RT is required.

5. Any base metal defects which are a result of the manufacturing process or weld repairs to stainless steel which require more than two repairs, shall result in a disposition in accordance with QAP 16.1.

6. Arc strikes on items other than piping in the field violating minmum wall thickness shall require a Gibbs & Hill engineering evaluation and reccmmendation.

7. If a weldment is rejectable to the point that removal of the weld is necessary, a Component Modification Card (CMC) and a new Weld Data Card will be issued.

8. For Class III applications, the cavity need only receive a visual examination as a minimum. All cavities resulting from arc strike removal on Class III items in the shop shall be PT inspected.

9. As required by MS-100.

10. Repair situations which fall outside the scope of this matrix shall be analyzed as per job specification and code requirements and dispositioned accordingly.

11. In-process defects shall be documented as required in the space provided on the back of the applicable WDC or on continuation sheets.

12. NDE reports for VT, PT or MT, UT/DT examination shall only be required as per the Documentation section of this procedure.

Table 6.9G-3

INSPECTION REQUIREMENTS FOR COMPONENT SUPPORTS

Table 6.9G-3

Sheet 1 of 3

INSPECTION REQUIREMENTS FOR COMPONENT SUPPORTS

CLASS	TYPE	FIT-UP CLEANLINESS	PREHEAT	VT	PT/MT	RT	UT	PWHT
1 NF5211 Plate & Shell	Full Penetration Butt	X	X	X	X (3)	X (2)		(4)
	Full Penetration	X	X	X	X (3)	X (2)		(4)
	Double Fillet Welded Lap			X	X (3)	X (2)		(5)
	Full Fillet Welded Tee			X	X (3)	X (2)		(5)
1 NF5212 Linear Type	Full Penetration	X	X	X	X (3)	X (2)		(4)
	Full Penetration Tee & Corner	X	X	X	X (3)	X (2)		(4)
	Full Fillet Welds			X	X (3)	X (2)		(5)
	All Other Welds			X	X			(5)
1 NF5213 Component Standard Support	Full Penetration Butt	X	X	X		X		(4)
	Fillet Welds w/Throat Dim 1"		X	X	X			(5)
	All Other Welds			X				(5)
II NF5221 Plate & Shell	Full Penetration Butt	X	X	X	X			(4)
	Full Penetration Groove	X	X	X	X			(4)
	Double Fillet Welded Lap				X			(5)
	Full Fillet Welded Tee Joint				X			(5)
	Other Welds in Primary Members				X			(5)
	All Other Welds			X				(5)
II & MC NF5222 III NF5232	Full Penetration Butt	X		X				(4)
	Full Penetration Tee Welds	X		X				(4)
	All Fillet Welds			X				(5)
	All Other Welds			X				(5)
II & MC NF5223 Class III NF5233	Full Penetration Butt	X		X				(4)
	Fillet Welds			X				(5)
	All Other Welds			X				(5)
III NF5231 Plate & Shell	Full Penetration Butt Welds Exceeding 1 1/2" in Thickness	X			X			(4)
	All Other Welds			X				

NOTE: Refer to Page 3 (Notes) for those numbers that are in parenthesis.

Table 6.9G-3

INSPECTION REQUIREMENTS FOR COMPONENT SUPPORT ATTACHMENT WELDS TO PIPING

TABLE 6.9G-3

INSPECTION REQUIREMENTS FOR COMPONENT SUPPORT

ATTACHMENT WELDS TO PIPING

CODE CLASS	P1 PIPE	Fit-up Clean	Purge	Preheat	VT	MT PT	P8 PIPE	Fit-up Clean	Purge	Preheat	VT	MT PT	RT
1	Fillet						Fillet	X	X (1)	X	X	X	
							Groove	X	X (1)	X	X	X	
2	Fillet	X			X	X	Fillet	X	X (1)		X	X	
	Groove	X			X	X	Groove	X	X (1)		X	X	
3	Fillet	X			X		Fillet	X	X (1)		X		
	Groove	X			X		Groove	X	X (1)		X		

TABLE 6.9G-3

NOTES

1. Purge is not required if wall thickness of pressure piping exceeds 1/4" thickness. Wher purge is required, a hold point for purge dam removal is also required.

2. When the results of Radiography are not meaningful, ultrasonic examination shall be performed. In addition, the adjacent base material for at least 1/2 inch on each side of the joint shall be examined by either MT or PT.

3. When the requirements of note 2 can not be met, the welds including the adjacent base material for at least 1/2 inch on each side of the weld shall be examined by either MT or PT.

4. Full penetration welds in P1 material over 1-1/2" requires Post Weld Heat Treatment.

5. Fillet and partial penetration welds in P1 material over 1-1/2" with a throat thickness or groove dimension over 3/4" require Post Weld Heat Treatment.

6. Inspection Requirements for Repairs to Component Supports

   A. Repairs that require welding will be reinspected with the original NDE method that detected the defect. The cavity does not require inspection.

   B. Elimination of surface defects by grinding, that do not require welding, will be examined by MT or PT after blending.

   C. Base metal repairs will be examined in accordance with the material specification for the material affected.

FIGURE 6.9G-1 WELD DATA CARD (FRONT)

BROWN & ROOT, INC.
CPSES JOB # 35-1195

WDC Serial No.__________
Drawing No.__________
Weld No.__________

WELD DATA CARD

LINE #.		WPS #	REV#/ICN#	FABRICATION CODE & CLASS/ACC. STD. ASME III
			/	
			/	
			/	

BASE MATERIAL	POSTWELD HEAT TREATMENT
HT #______ to HT #______	TIME______ Hrs., TEMP.______ °F
PC.#______ to PC #______	HEATING RATE______ °/Hr.______
P #______ to P #	

NGEP/REV	VT/200	PT/200	MT.400	RT/101	UT		

					WELD FILLER MATERIAL REQUIRED
MR#(S) ______	[illegible]	[illegible] DUE DATE	QC		ROOT CLASS
______					FILL CLASS
QC VERIF. ______					CLASS
DATE: ______					CLASS

NOTES: (1) Applicable QC/ANI hold points shall be indicated by checkmark ✓.
(2) ANI inspection points indicated by (X).
(3) [illegible] Satisfactory inspections [illegible] "S"; Unsatisfactory inspections by a "U".

PRODUCTION RELEASE

OPER. NO.	OPERATION	HOLD POINTS			COD	SAT. OR UNSAT.	INSPECTION RESULTS [illegible]		
		[illegible]	[illegible]	ANI			QC OF [illegible]	[illegible] LEVEL	ANI
	[illegible]			[illegible]			[illegible]		

Approval signatures shall be affixed on the line immediately below the last [illegible] in each [illegible].

BROWN & ROOT, INC. CPSES JOB 35-1195	NUMBER	REVISION	ISSUE DATE	PAGE
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FIGURE 6.9G-2

MULTIPLE WELD DATA CARD (FRONT)

WDC Serial #________________

Drawing #________________

MULTIPLE WELD DATA CARD

ITEM NO.	WPS NO.	REV.	ICN	WELD FILLER MATERIAL	WELD HCS.	P.NO.	FABRICATION CODE & CLASS/ACC STD. ASME III -

NOTES: 1) Applicable [illegible] 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		
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

PRODUCTION RELEASE

WELD NO.	OPER-ATION	HOLD POINTS WE	QC	ANI	CONST.	SAT./UNSAT.	QC OP #	[illegible]	ANI	REV.	[illegible] CALIB. DUE DATE

WE QC ANI

Approval signatures shall be affixed on the line immediately below the last item in each sequence.

FIGURE 6.9G-2

MULTIPLE WELD DATA CARD (BACK)

PRODUCTION RELEASE

WELD NO.	OPERATION	HOLD POINTS WT	QC	ANI	CONST.	SAT. OR UNSAT.	INSPECTION RESULTS STAMP & DATE QC or WT	NDE CERT. LEVEL	ANI	[illegible]/ REV.	[illegible] #/ CALIB. DUE DATE

[illegible] QC AST

MANUFACTURING RECORD SHEET

BILL OF MATERIALS - SPOOL NO. ______________

ITEM	QUANTITY/ LENGTH	SIZE	SCHEDULE/ RATING	MATERIAL SPEC.	TYPE/ GRADE	HEAT/ CODE NUMBER		END PREP	INSPECTOR INITIALS AND DATE

[illegible]	OPERATION	[illegible]	ANI	[illegible] INITIALS	DATE	[illegible] INITIALS	DATE
	[illegible]						
[illegible]	[illegible] SURFACE COMP. IDENTIFICATION REV. ____						

ACCEPTANCE

[illegible] SIG. DATE — ANI SIG. DATE

FIGURE 6.9G-3
POST-WELD HEAT TREATMENT CHECKLIST

~~POST-WELD HEAT TREATMENT CHECKLIST~~

Drawing #____________________

Weld #____________________

	Results	Initials
1. Joint Preparation		
a. Pre-PWHT Visual examination completed (If acceptable, sign WDC hold point)	______	______
b. Cleanliness (all paint, dirt, grease, oil, and other foreign matter removed from heated areas)	______	______
c. Adequate insulation (required type, thermal insulation min. of four pipe diameters each side of weld joint)	______	______
d. Protection against internal drafts (open ended pipe capped, etc.)	______	______
e. Thermocouple placement (minimum of six, placement as per procedure)	______	______
Thermocouple I.D. ______, ______, ______, ______, ______		
f. Temperature recording instrumentation Inst # ______ Calibration Date ______ Inst # ______ Calibration Date ______	______	______
g. Valve preparation (valve in proper position, dissambled if necessary)	______	______

QC/Inspector Signature ____________________ Date ____________

	Results	Initials
2. Heating and Cooling Rates, Holding Time and Temperature		
(Verify acceptability by examining the PWHT Chart)		
a. Heating Rate	______	______
b. Cooling Rate	______	______
c. Temperature variation ______ °F Max. (between thermocouples not exceeding 100°F)	______	______
d. Holding time ______ hours ______ minutes	______	______
e. Holding temperature ______ °F min. (d and e as required by applicable Weld Data Card)	______	______
f. Has the PWHT chart been signed and dated by the operator?	______	______
g. Is the PWHT chart traceable to the applicable Weld Data Card by drawing and weld numbers?	______	______

QC/Inspector Signature ____________________ Date ____________

	Results	Initials
3. Thermocouple Removal and Final Visual Examination		
a. Thermocouple removal (check for damage due to removal)	______	______
b. Final visual examination	______	______
c. Is the PWHT chart attached to the applicable Weld Data Card	______	______
d. MT or PT of removal area	______	______

QC/Inspector Signature ____________________ Date ____________

NOTE: All results will be answered Sat (/), Unsat (X), not applicable (N/A) unless otherwise noted. Unsat answers will require a close out in the "Comments" section.

Comments: ____

____

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FIGURE 6.9G-4
REPAIR PROCESS SHEET

NDC Serial No.____________

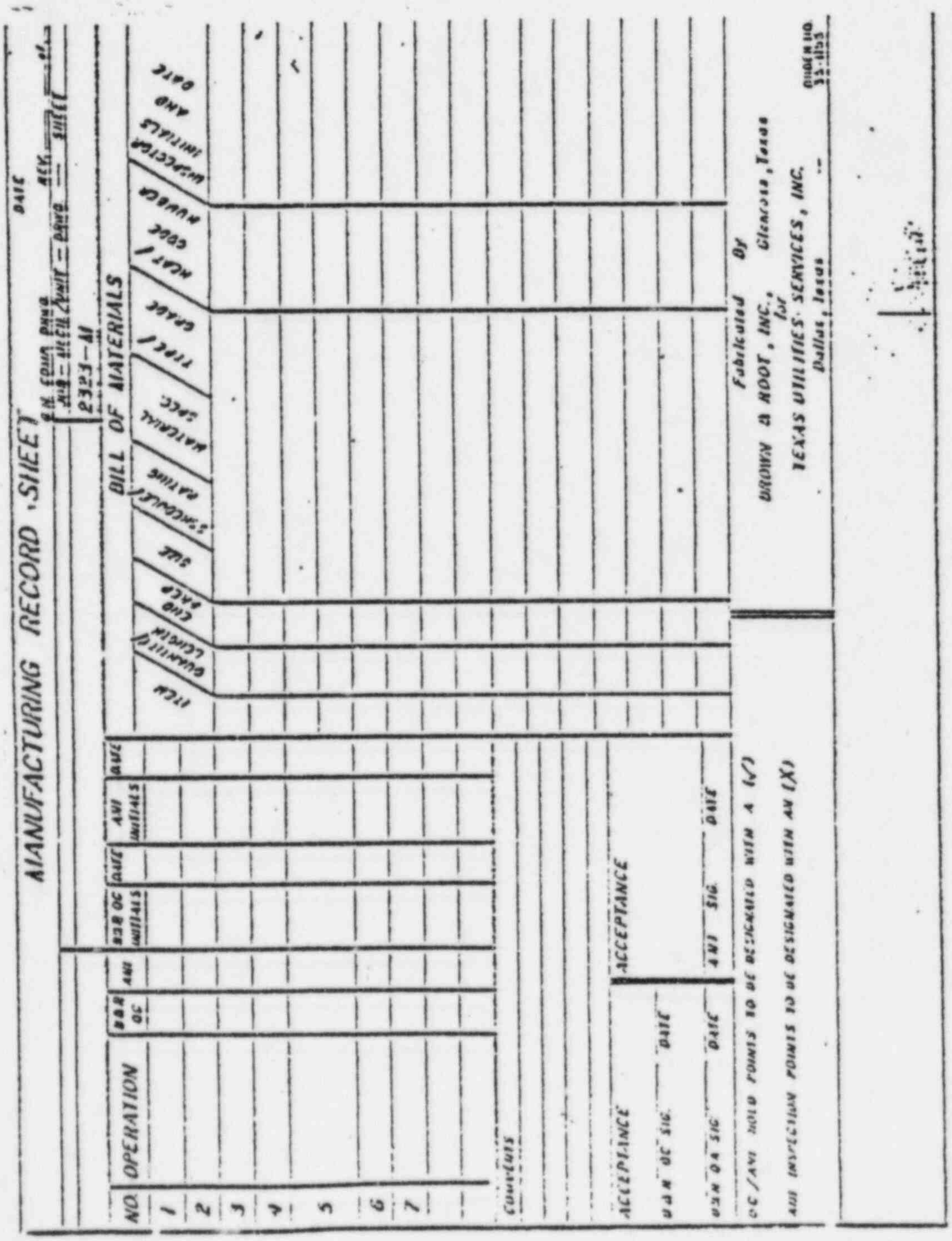
Drawing No.____________

Weld No.____________

DESCRIPTION OF DEFECT (SKETCH)

OPER. NO.	OPERATION	HOLD POINTS [illegible]	QC	ANI	CQN	"S" OF [illegible]	INSPECTION RESULTS [illegible]	[illegible] LEVEL	[illegible]

FIGURE 6.9G-5
MANUFACTURING RECORD SHEET (Typical)


MANUFACTURING RECORD SHEET
DATE
B.R. COMP. DWG
SUB-ASSEM. UNIT - DWG
REV.
SHEET
2323-MI
BILL OF MATERIALS
ITEM
QUANTITY/LENGTH
END PREP
SIZE
SCHEDULE/RATING
MATERIAL SPEC.
TYPE/GRADE
HEAT/CODE NUMBER
INSPECTOR INITIALS AND DATE
NO.
OPERATION
B&R QC
ANI
B&R QC INITIALS
DATE
ANI INITIALS
DATE
1
2
3
4
5
6
7
COMMENTS
ACCEPTANCE
B&R QC SIG. DATE
B&R QA SIG. DATE
ANI SIG. DATE
QC/ANI HOLD POINTS TO BE DESIGNATED WITH A (✓)
ANI INSPECTION POINTS TO BE DESIGNATED WITH AN (X)
Fabricated By
BROWN & ROOT, INC., Glen Rose, Texas
for
TEXAS UTILITIES SERVICES, INC.
Dallas, Texas
ORDER NO.
35-1195

BROWN & ROOT, INC. CPSES JOB 35-1195	NUMBER	REVISION	ISSUE DATE	PAGE
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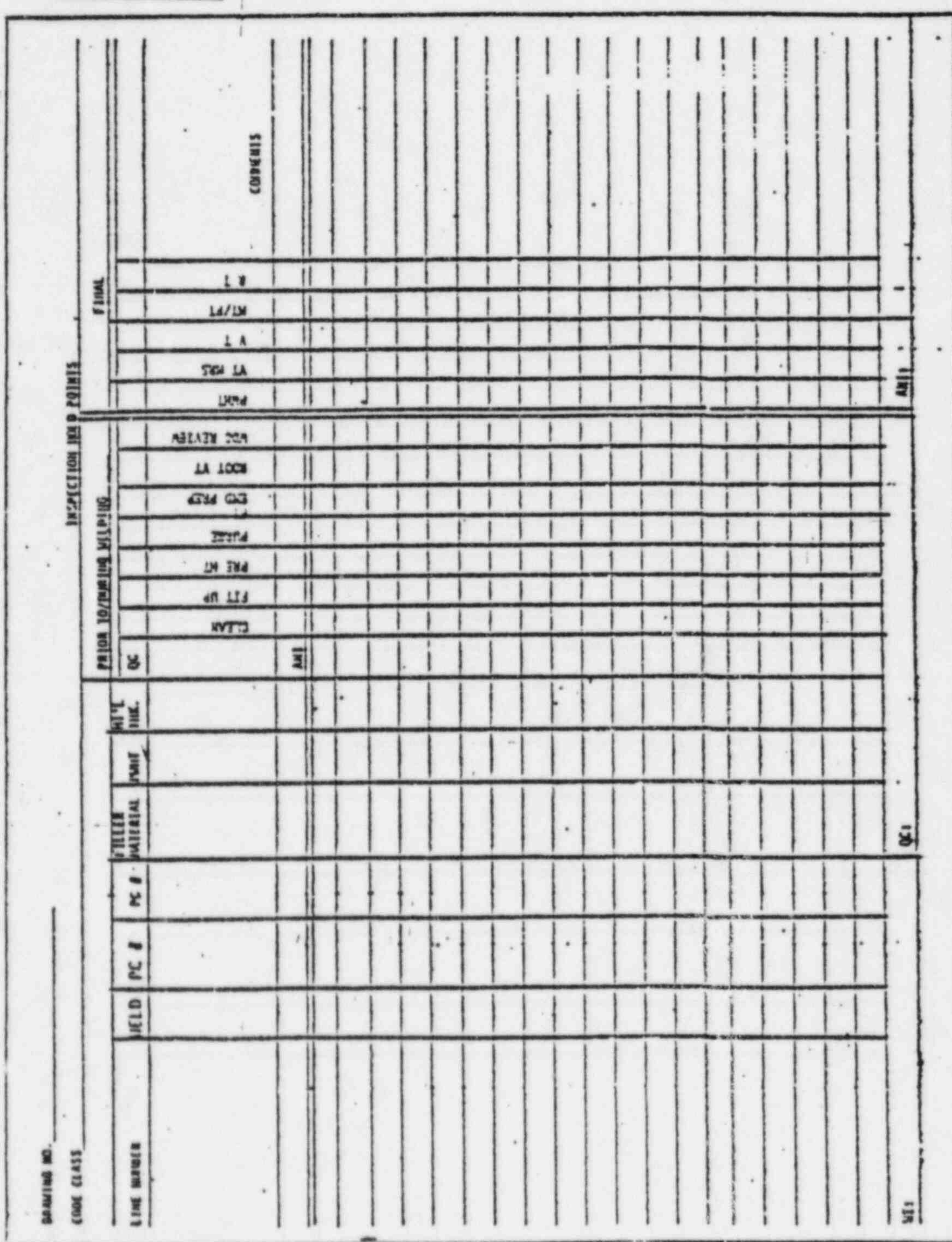
FIGURE 6.9G-6 WELD DATA PROCESS SHEET/INSPECTION PLAN FORM (TYPICAL)



PIPING MODIFICATION INSPECTION PLAN

SERIAL NUMBER______________

DRAWING NUMBER	CMC NUMBER	WELD NUMBER	HOLDPOINT ASSIGNED	SAMPLING PLAN NUMBER	DRAWING NUMBER	CMC NUMBER	WELD NUMBER	HOLDPOINT ASSIGNED	SAMPLING PLAN NUMBER

DATE ______________

BROWN & ROOT, INC. CPSES JOB 35-1195	NUMBER	REVISION	ISSUE DATE	PAGE
PIPING MODIFICATION INSPECTION PLANT FIGURE 6.9G-6A	CP-CPM-6.9G	2	1/19/81	1 of 1

FIGURE 6.9G-7
MATERIAL IDENTIFICATION LOG

MATERIAL IDENTIFICATION LOG

HANGER NUMBER ____________

Mat'l Spec	Material Description	Quantity	Heat/ID Number	Salvaged Hanger Number (where applicable)	QC Verification	Date

Category 9, item 7

SPEC TUGCO(2)

COMANCHE PEAK STEAM ELECTRIC STATION
DESIGN CHANGE AUTHORIZATION

~~(WILL)~~ (WILL NOT) BE INCORPORATED IN DESIGN DOCUMENT DCA NO. 15,295 Rev. 1

1. SAFETY RELATED DOCUMENT: XX YES ____ NO
2. ORIGINATOR: CPPE XX ORIGINAL DESIGNER ____
3. DESCRIPTION:
   A. APPLICABLE SPEC/DWG/DOCUMENT 2323-MS-94 - Pipe Whip Restraints REV. 4
   B. DETAILS THIS REVISION VOIDS AND SUPERSEDES DCA 15,295 Rev. 0.

Add to paragraph 2.6.2.3.a:

E8018C1 is an approved weld filler material to use in conjunction with ASTM-A-533, Type B, Class 2 — 90,000 psi UTS

FOR OFFICE AND ENGINEERING USE ONLY

RECEIVED JUL 10 1984

35-1195
RECEIVED
JUL 12 1984
DOCUMENT CONTROL

4. SUPPORTING DOCUMENTATION:

5. APPROVAL SIGNATURES: WHC/bb 6-28-84
   A. ORIGINATOR: W N H Crowe DATE 7-10-84
   B. DESIGN REPRESENTATIVE: CRHooton DATE 7-10-84
   C. DESIGN REVIEW PRIOR TO ISSUE: [signature] DATE 7-11-84

FOIA-85-59

6. STANDARD DISTRIBUTION:

ARMS (ORIGINAL) (1)
QUALITY ENGINEERING (1)
DCTG FOR ORIG. DESIGN (1)

Mark Welch-QA (1)
Civil Engineering (1)
Design Review (1)
Westinghouse (1)
Site DG (1)

DCA FORM 3-84

M305

Category 9, item 9

Annex 3

Conversation Record

Allegation Number AW 58, AQW 24 Time 10:00 - 10:45 am Date 8/2/84

Type ____ Visit ✓ Conference ____ Telephone

____ Incoming

____ Outgoing

Name of Person(s) Contacted or in Contact With You	Organization	Telephone Number
Bill Baker	B&R, Project Welding Engr	X 275
Ted Blixt	B&R, QE Group Supv.	X 459
Donny Doyle	B&R, QA	X 286

SUBJECT:

Weld filler metal control

SUMMARY: Subject was reviewed in question and answer session. Particular area of concern explored was the misuse for unauthorized welds of left-over weld rod issued to perform an authorized weld.

Bill Baker stated a welder found making an unauthorized weld is terminated.

Name of Person Documenting Conversation E G Thompson

Signature E G Thompson Date 8/2/84

Name(s) of Other Persons Who Were Present During Conversation

Hoa NRC-TRT

I have reviewed the summary of the conversation with the individual(s) named below and agree that it accurately represents the conversation.

Signature of Person Providing Information ____________________

File: Allegation Work Package

cc: Project Director
Group Leader

Additional pages may be attached as needed. Additional pages should be identified, signed, and dated.

FOIA-85-59 M304

Category 9 item 11

Susie Deal x432
Harold Porter

9/17/84 Reviewed Surveillance Records for Rod Shacks & WQTC. Skimmed from 4/27/81 through 8/31/84 the MDS Surveillance Checklist, Obtained blank copies of Surveilance Checklists for WQTC & MDS (Rod shacks). Discussed MDS Checklist with Walter Bailey, Welding Engineering & made comments on blank copy as to how he performs his function

Rod House #2 - skimmed surveillance records from 2/21/80 thru 8/31/84. On 12/10/82, one stationary rod oven was 352F. Temp. control was adjusted & checked at 335F before leaving. On 12/22/82 it was noted that two welders had excess shortages.

Rod House #4 - skimmed surveillance records from 2/22/80 thru 8/31/84. On 2/22/80, John Ware noted that some Q containers were not clearly marked (item 2)

FOIA-85-59

m307

Category 9 item 11

Susie Deal x432
Harold Porter

9/17/84 Reviewed Surveillance Records for Rod Shacks & WQTC. Skimmed from 4/27/81 through 8/31/84 the MDS Surveillance Checklist. Obtained blank copies of Surveilance Checklists for WQTC & MDS (Rod shacks). Discussed MDS Checklist with Walter Bailey, Welding Engineering & made comments on blank copy as to how he performs his function

Rod House #2 - skimmed surveillance records from 2/21/80 thru 8/31/84. On 12/10/82, one stationary rod oven was 352F. Temp. control was adjusted & checked at 335F before leaving. On 12/22/82 it was noted that two welders had excess shortages.

Rod House #4 - skimmed surveillance records from 2/22/80 thru 8/31/84. On 2/22/80, John Ware noted that some Q containers were not clearly marked (item 2)

FOIA-85-59

m 307

Welder Documentation Surveillance Checklist

Spot checked documents for H. Cobb (ABF) from 11/28/77 to 7/23/84. Initial form was entitled "Production Monitoring of Weld Parameter Log & item was just checked off if monitored. Later entered actual data. On 5/8/83, out of parameter noted for current - This is checked with a tong meter, since machines have only dial settings. Dial was adjusted to give current within range req'd.

Project: CPSES

Job No. 35-1195

Welder's Symbol ____________

Name ____________

Brown & Root, Inc.

Welding Engineering Department

Welder Documentation Surveillance Checklist

Welder Surveillance	1	2	3	4
Iso. or Drawing No.				
Weld Identification No.				
Applicable WPS/Rev.				
WFM Class				
WFM Size				
Ampmeter M&TE No.				
Voltmeter M&TE No.				
Pyrometer M&TE No.				
Base Metal Thickness (in.)				
Weld Progression				
Preheat Temperature				
Interpass Temperature				
Shielding Gas Type & Flow (cfh)				
Purge Gas Type & Flow (cfh)				
Welding Process/Indicated Pass				
Current and Polarity				
Amperage				
Voltage				
Bead Width (in.)				
Travel Speed (ipm)				
Rod Oven Operational (Sat/Unsat)				
Welding Parameters (Sat/Unsat)				
Inspector Initial/Date of Insp.				
Welder's Initial				

Comments (Discrepancy and Corrective Action):

____

Technician's Signature

Welding Engrg
Walter Bailer
Reviews 82-83

WELDING ENGINEERING
MATERIAL DISTRIBUTION STATION
SURVEILLANCE CHECKLIST

Project: CPSES

Organization:	Location:	Date:
PIPE DEPT. MDS		

Code	Surveillance Performed By:
S = Satisfactory U = Unsatisfactory	

No.	Characteristic & Description	Code	Remarks
1.	Temperature of the Level "B" Storage facility shall not be below 40°F.		Rod ovens keep temp well up. No Thermometer
2.	"Q" weld filler material in original containers are clearly marked with weld filler material classification, size, and the heat/lot number.		Survey of containers for proper tags. Individual wire with no tags are tagged by personnel
3.	All associated warehouse requisitions for weld materials shall be maintained at the MDS until the material is used or removed from the MDS.		This is a requisition only for matl from central warehouse "A"
4.	When "Q" weld filler material is removed from its containers, handling and storing is being accomplished in a manner which prevents contamination.		No coated rods left out of rod oven if open container. Bare wire in containers with lids
5.	Adequate protective covering is to be provided for weld filler material remaining in the orig. container after opening.		Opened boxes taped up to protect remaining wire. "Bad" cans of coated rods are identified for scrap
6.	Only "Q" weld filler material is being issued from the MDS.		Only Q matl is in rod shack. Non Q matl in red containers
7.	Weld filler material being issued in approved containers (except consumable inserts). a. Straight length bare wire-leather pouch identified with a serial number b. Spooled bare wire-properly marked container c. Covered electrodes-limited to capacity of issuing container (low hydrogen electrode issued in heated ovens only)		Observe MDS attendants. Big spools had a label with ID. 50 lb containers - heated oven. ≈ 25 lb containers - heated rod oven. Rod hot boxes are plugged in a battery of 50 sockets

Hot boxes may be cold but rods are out of ovens.

WELDING ENGINEERING
MATERIAL DISTRIBUTION STATION
SURVEILLANCE CHECKLIST

Project: CPSES

Organization:	Location:	Date:
PIPE DEPT. MDS		
Code S = Satisfactory U = Unsatisfactory	Surveillance Performed By:	

No.	Characteristic & Description	Code	Remarks
8.	MDS attendant verifies WFML, has Issuance Approval been given by person (check for list of signatures to approve issuance of filler material) and the WFML been completed for the WPS, material size and class, welder's symbol, date, and for the MWDC the weld number as applicable.		welder matrix - welder certified for job - checked by rod shack list of authorized signatures Foreman fills in first 5 columns, Rod shack attendant enters heat # & amount issued (no of rods). Amt retd is no of rods
9.	Verify log for repeated shortages by a welder or shortages over 5 stubs a day.		Checks the log to see if it is kept up. Only enter welders who are short.
10.	Storage of Non-Conforming Weld Filler Material (NCWFM) 1. NCWFM shall be stored in a facility or container that is secure by locking devices sufficient to prevent immediate and casual entry. 2. NCWFM containers shall be marked red in color and tagged to indicate the actual or suspected classification and size of the material during storage and transit. 3. All NCWFM containers shall be maintained in one area within the MDS. The NCWFM area shall be clearly identified as "Non-Conforming Weld Filler Material, Do Not Issue".		Have [illegible], locked container check for red Only have a single container (drum). NCWFM [illegible] always marked as [illegible]
11.	Verification of Stationary and Portable Rod Ovens 1. Verify Stationary Rod Oven temperature is between 250°F-350°F. 2. Verify calibration due date on stationary rod oven thermometer.		Checks thermometer on each rod oven & calibration date

WELDING ENGINEERING
MATERIAL DISTRIBUTION STATION
SURVEILLANCE CHECKLIST

Project: CPSES

Organization: PIPE DEPT. MDS	Location:	Date:
Code S = Satisfactory U = Unsatisfactory		Surveillance Performed By:

No.	Characteristic & Description	Code	Remarks
11. cont.	3. Verify operational log for stationary and portable rod oven temperatures and maintenance. 4. Verify that portable heated rod containers are checked for operation before being issued to craft personnel.		Check logs for proper documentation.

[redacted]

WPS #

WDC Serial No. ELE-84-CTH-

Drawing No. ______________

WELD FILLER MATERIAL LOG

Weld No. ______________

WELD NO.	DATE	SIZE/CLASS	WELDER SYMBOL	WPS/ICN #	HEAT/LOT # or CODE #	AMT. ISS.	AMT. RT'D.	ISSUANCE APPROVAL

WELDING ENGINEERING
MATERIAL DISTRIBUTION STATION
SURVEILLANCE CHECKLIST

Project: CPSES

Organization:	Location:	Date:
WELDING ENGINEERING	WQTC	

Code

S= Satisfactory U = Unsatisfactory

Surveillance Performed By:

No.	Characteristic & Description	Code	Remarks
1.	Temperature of the Level "B" Storage facility shall not be below 40°F.		
2.	Weld filler material in original containers are clearly marked with weld filler material classification, size, and the heat/lot number.		
3.	All associated warehouse requisitions for weld materials shall be maintained at the MDS until the material is used or removed from the MDS.		
4.	When weld filler material is removed from its containers, handling and storing is being accomplished in a manner which prevents contamination.		
5.	Adequate protective covering is to be provided for weld filler material remaining in the orig. container after opening.		
6.	Spooled bare wire issued in proper container.		
7.	Verification of Stationary and Portable Rod Ovens 1. Verify Stationary Rod Oven temperature is between 250°F-350°F 2. Verify calibration due date on stationary rod oven thermometer. 3. Verify operational log for stationary and portable rod oven temperatures and maintenance. 4. Verify that portable heated rod containers are checked for operation before being issued to craft personnel.		

MATERIAL DISTRIBUTION STATION
SURVEILLANCE CHECKLIST

PROJECT: CPSES

Organization: WELDING ENGINEERING	Location: WQTC	Date:
Code S= Satisfactory U= Unsatisfactory		Surveillance Performed By:

No.	Characteristic & Description	Code	Remarks
8.	MDS attendant verifies WFML to insure that issuance approval has been given (check list of authorized signatures) and that the WPS, material size and class, weldor's symbol, date and weld number (if applicable) have been entered.		
9.	All filler material used at WQTC, (except brazing and aluminum filler material) shall be considered Non-Conforming Weld Filler Material (NCWFM), and should be in containers marked red in color.		
10.	All weld and brazing filler material used at WQTC shall be accounted for on the WQTC Filler Metal Use Log, but WFML's are not required. However, material issued for use out of the WQTC shall require a WFML.		

[redacted]

Project: CPSES

Job No. 35-1195

Welder's Symbol AGP

Name HORN, KEITH

Brown & Root, Inc.

Welding Engineering Department

Welder Documentation Surveillance Checklist

Welder Surveillance	1	2	3	4
Iso. or Drawing No.	DC-X-923-706 T360	Temp	Temp	Temp
Weld Identification No.	NA	NA	NA	NA
Applicable WPS/Rev.	11032 4	10046 9	10046 9	10046 9
WFM Class	E7018	E7018	E7018	E7018
WFM Size	3/32	3/32	3/32	3/32
Ammeter M&TE No.	2764	2884	2884	2884
Voltmeter M&TE No.	2764	2884	2884	2884
Pyrometer M&TE No.	NA	NA	NA	NA
Base Metal Thickness (in.)	1/4	.250	.250	.500
Weld Progression	L-R	L-R	L-R	L-R
Preheat Temperature	260°	270°	270°	270°
Interpass Temperature	NA	NA	NA	NA
Shielding Gas Type & Flow (cfh)	NA	NA	NA	NA
Purge Gas Type & Flow (cfh)	NA	NA	NA	NA
Welding Process/Indicated Pass	SMA/Fill	SMA/Scrap	SMA/Scrap	SMA/Scrap
Current and Polarity	DCRP	DCRP	DCRP	DCRP
Amperage	95	110	90	105
Voltage	22	23	22	22
Bead Width (in.)	3/16	1/4	1/4	3/16
Travel Speed (ipm)	3.0	4.5	4.0	NA [illegible]
Rod Oven Operational (Sat/Unsat)	SAT	SAT	SAT	SAT
Welding Parameters (Sat/Unsat)	SAT	SAT	SAT	SAT
Inspector Initial/Date of Insp.	[illegible] 5-29-84	DH 6-12-84	[illegible]	[illegible] 7-10-84
Welder's Initial	[illegible]	[illegible]	[illegible]	[illegible]

Comments (Discrepancy and Corrective Action):

[illegible signature]

Technician's Signature

at Rod Shack #2

9/17/84 Between 3:10 & 3:25, I observed 18 welders turn in their hot boxes. Two or 3 of them carried two hot boxes. At no time were there more than four welders waiting to turn in their rods.

E. F. Thompson

Category 9, item 13
10/11/84

Category 9 - Weld rod Control

ASME SFA 5.1, Appendix, A1.9.2 states that under proper storage conditions (normal room temp. & 50% max. relative humidity or less), electrodes can be maintained for many months. If exposed to high moisture conditions, coverings may adsorb excessive moisture.

E 7018 one of most critical. Moisture must be less than 0.6% in covering.

R E Reed, Rod Shack # 2 Category ?, Item 2 9/18/84

Observed

4 ~~3~~ one rod can hot ~~5 8 7 8 9 12 13 14 15 16~~ 17
~~2~~ " " " warm ~~2~~ 3

Shortages noted by stub & damaged electrode count. Three welders each short one electrode. Two were E308. One was E7018.

All 20 welders were counted.

A single heat # of each coated electrodes in all 3 rod shacks.

A welder with two rod cans is carrying two different sizes.

Rods & stubs returned in. Unused rods removed & returned to oven. No of damaged & used rods indicated by welder & written on Stub box. Counted later & rods used obtained by difference

Category 9, item 3

WELDABILITY OF STEELS

ROBERT D. STOUT, Ph.D.
Dean of Graduate School, Lehigh University
Bethlehem, Pa.

W. D'ORVILLE DOTY, Ph.D.
Senior Research Consultant, Product Engineering
United States Steel Corporation
Pittsburgh, Pa.

Edited by

SAMUEL EPSTEIN
Technical Advisor, Deceased
and
ROBERT E. SOMERS
Welding Consultant
Hellertown, Pa.

THIRD EDITION

WRC

WELDING RESEARCH COUNCIL
345 East Forty-Seventh Street, New York, N. Y. 10017

1978

FOIA-85-59

M301

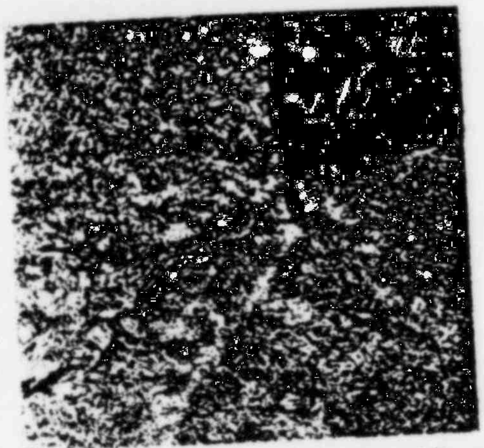


Fig. 5.20 Microcrack in Heat-Affected Zone of HY80 Steel. 65 ×.

5.20. Cracks that run roughly parallel to the fusion line are referred to as underbead cracks, while those that initiate close to the toe of the weld and propagate away from the weld because of the stress system are called toe cracks. Since cracking caused by hydrogen may occur hours or days after welding, it is also known as delayed cracking. All these types of cracking originate by the same mechanism.

There are three factors acting simultaneously in the generation of hydrogen cracks: dissolved hydrogen, tensile stresses, and a low-ductility microstructure such as martensite. The sequence of events leading to cracking have been delineated as follows:

1. Hydrogen is carried to the arc atmosphere by the shielding gas, flux, or surface contamination. This hydrogen is converted to the atomic or ionized state and readily dissolves in the weld metal.

2. As the weld metal cools it becomes supersaturated in hydrogen, which diffuses into the austenitized heat-affected zone.

3. Under rapid cooling the hydrogen is retained in the austenite instead of escaping, and the austenite persists to low temperatures at which it transforms to martensite. The atomic hydrogen is virtually insoluble in the martensite lattice.

4. The hydrogen is trapped in the martensite and thus is at a high energy level in the lattice. By diffusion it seeks rifts and discontinuities in the lattice and concentrates at these points.

5. The stresses generated by external restraint and by volume changes due to transformation act with the hydrogen to enlarge the discontinuities to crack size. The hydrogen may contribute to cracking by lowering the cohesive strength of the lattice or by adding to the localized stresses at the discontinuity.

Alloy Rods Division
CHEMETRON CORPORATION

DATE December [illegible] 1981 NO.

IT'S A FACT

Category 4, item 4

ATOM ARC 7018
MOISTURE RESISTANT LOW HYDROGEN ELECTRODES

A NEW MOISTURE RESISTANT COATING

One major concern in the welding of steel is hydrogen embrittlement. Excessive atomic hydrogen trapped in hardenable steel can exert enough pressure to cause critical defects such as underbead cracking and delayed brittle fracture.

One source of hydrogen in the arc atmosphere is moisture in the electrode coating, and for this reason Alloy Rods exercises extreme control in the production of low hydrogen elecrodes. All Atom Arc Low Hydrogen electrodes are manufactured to contain moisture levels below .02% as they are packed in hermetically sealed containers. In addition, Atom Arc 7018 electrodes are now manufactured with a flux coating that effectively resists moisture pickup for many hours after the container is opened. This improved coating provides an extra degree of reliability, especially for electrodes exposed to high temperature — high humidity working conditions.

This new moisture resistant coating is now standard for all sizes of Atom Arc 7018 electrodes. The improved coating was carefully formulated not only to resist moisture pick-up, but also to retain the fine operating characteristics and consistent dependability for which the entire Atom Arc line is so well recognized.

MOISTURE TESTING AND RESULTS

The AWS D1.1 Structural Code and the Military MIL-E-22200/1E specifications allow a maximum of .4% moisture content for E70XX low hydrogen electrodes. Testing by Alloy Rods under specific combinations of relative humidity and temperature has demonstrated that the improved Atom Arc 7018 electrode satisfies this low moisture requirement for exposure times beyond those normally allowed in field use. In fact, under certain conditions, the moisture resistant Atom Arc 7018 electrode remained below the .4% max. level even after 96 hours of exposure.

FOIA-85-59

m302

TEST METHOD

The method of moisture testing chosen by Alloy Rods is that described in **AWS A5.5-81**. The reasons for choosing this method are two-fold. First, it is the method required to satisfy AWS A5.5 and D1.1 specifications. Secondly, this test is sensitive **only** to water, and it is the most accurate and reliable method of moisture determination currently in use.

It should be noted that even though Atom Arc 7018 electrodes resist moisture pickup longer than ever before, no moisture resistant electrode will eliminate the need for storage and rebake ovens and the necessity to follow code requirements for allowable exposure times.

TYPICAL MECHANICAL PROPERTIES

	As Welded	Stress Relieved 2 hrs. @ 1150°F.
Yield Point (psi)	68,500	62,000
Tensile Strength (psi)	75,000	72,000
% Elongation (2")	31	32
% Reduction of Area	75.5	77

TYPICAL CHARPY V-NOTCH IMPACT VALUES

Temperature	As Welded	Stress Relieved 2 hrs. @1150°F.
72°F.	125 ft.-lbs.	130 ft.-lbs.
−20°F.	70 ft.-lbs.	75 ft.-lbs.

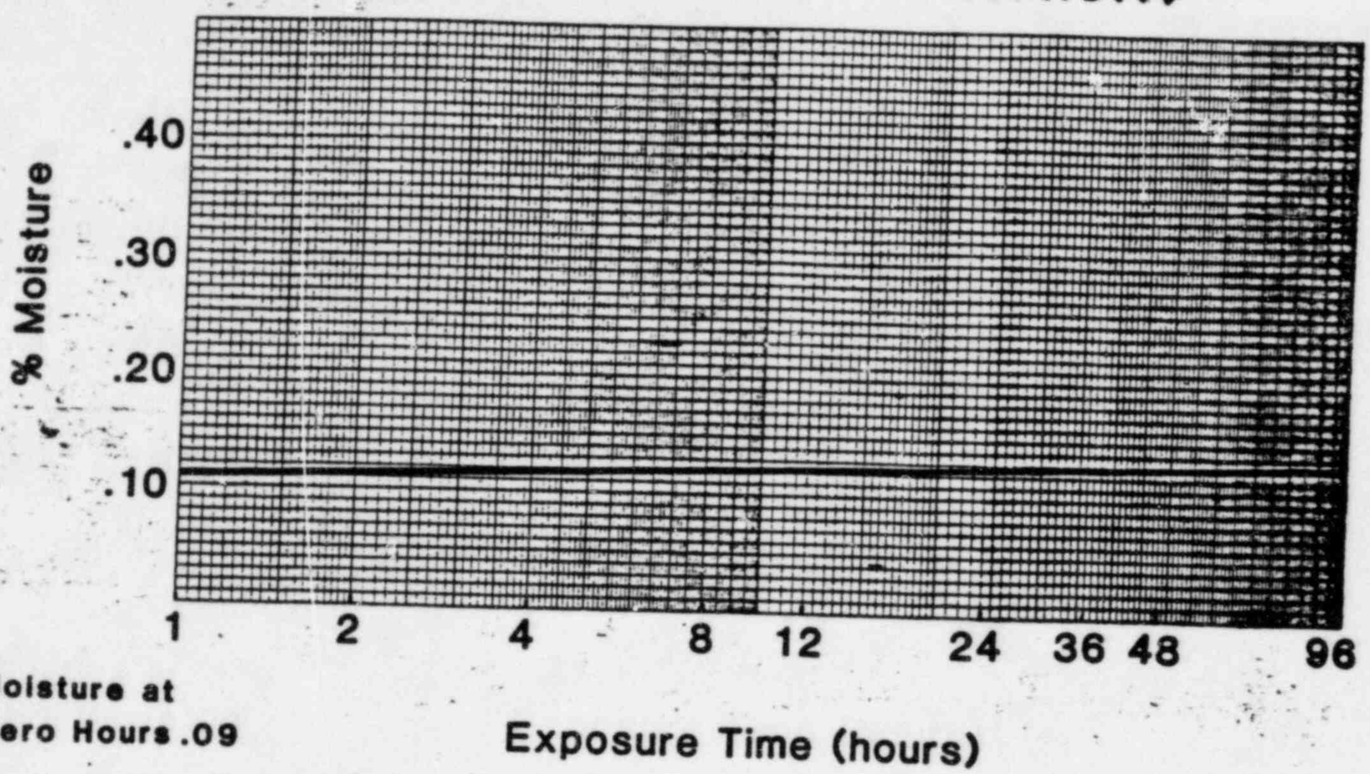
TYPICAL CHEMICAL ANALYSIS OF WELD METAL

C	Mn	Si
0.06%	1.10%	0.50%

CODE AND SPECIFICATION DATA

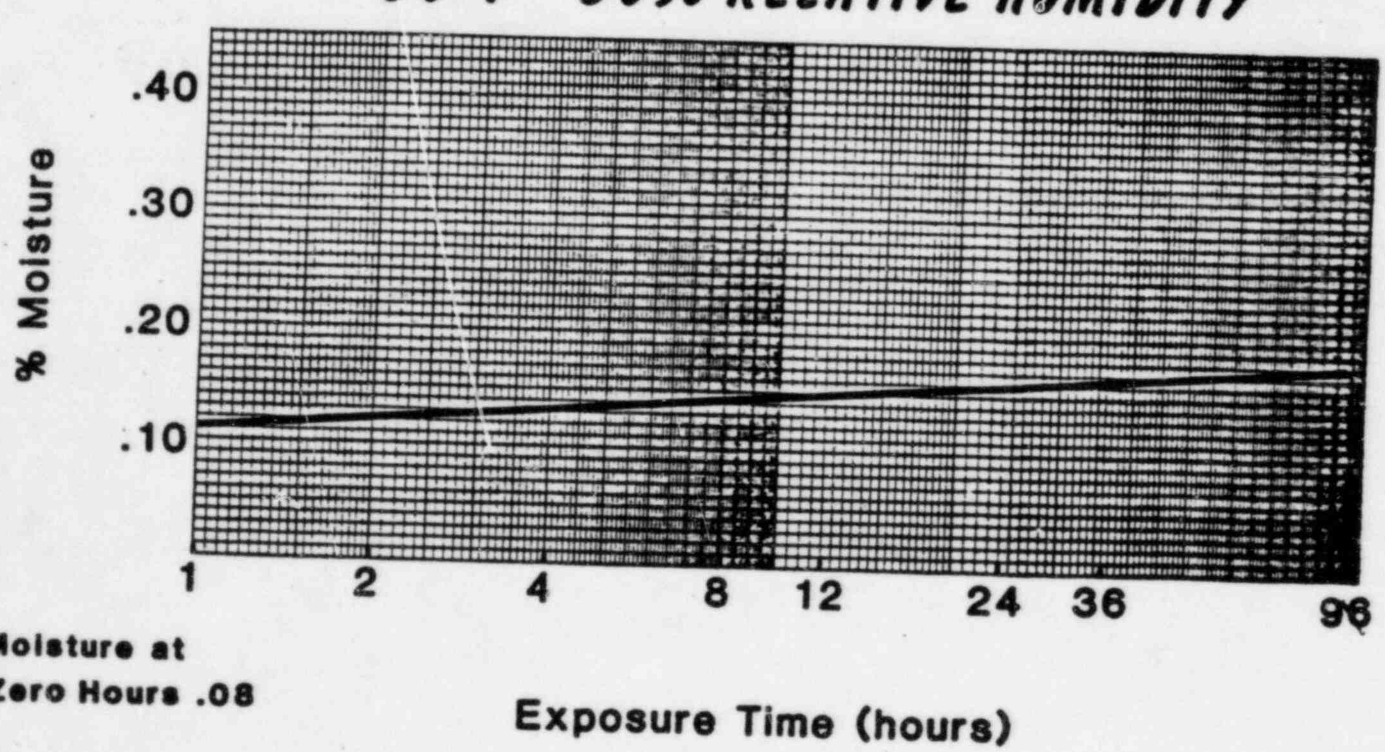
AWS: A5.1, Class E7018
ASME: SFA 5.1
Military Specification: MIL-E-22200/1E, MIL 7018
American Bureau of Shipping: 2Y
Det Norske Veritas: 3YHH
Lloyds Register of Shipping: 3H

70°F - 70% RELATIVE HUMIDITY



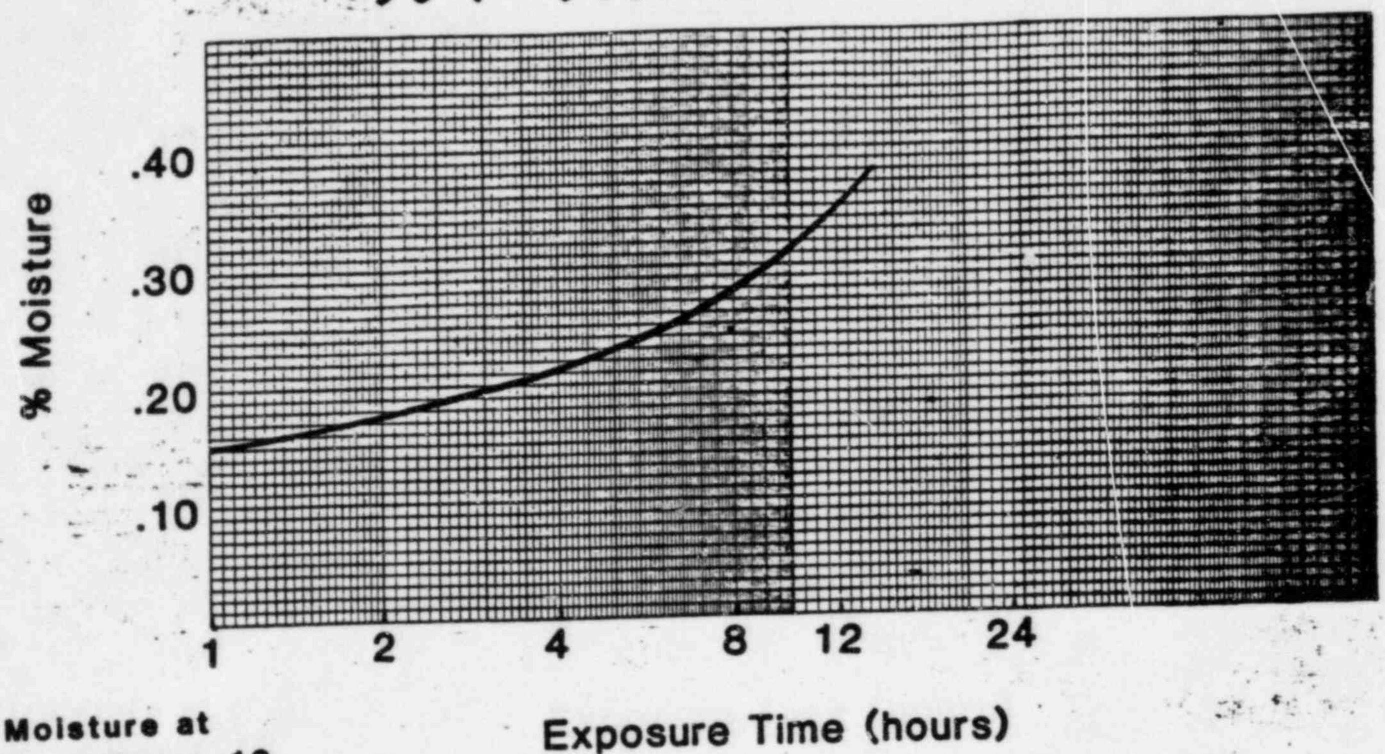
Moisture at
Zero Hours .09

80°F - 80% RELATIVE HUMIDITY



Moisture at
Zero Hours .08

90°F - 90% RELATIVE HUMIDITY



Moisture at Zero Hours .10

The data presented on the preceding pages is _TYPICAL_ and is not to be construed as guaranteed values. Tests were performed in strict accordance with AWS procedures, but individual results may differ depending on test variables.

Alloy Rods Division
CHEMETRON CORPORATION
HANOVER, PA 17331 U.S.A.

THE SPECIALIST IN WELDING METALLURGY
An Allegheny International Company

Alloy Rods Division
CHEMETRON CORPORATION
DATE [illegible] 24 1982 NO.

IT'S A FACT

Category 9, item 6

ATOM ARC 7018-1

MOISTURE RESISTANT LOW HYDROGEN ELECTRODES

SPECIFICATION DATA

AWS - A5.1, Class 7018-1
ASME - SFA 5.1
ABS - AWS A5.1

DESCRIPTION

Atom Arc 7018-1 is an all-position low hydrogen iron powder electrode that displays exceptional impacts at low temperatures in both the "as welded" and "stress relieved" conditions. It easily fulfills the AWS requirements for a minimum of 20 ft.-lbs. at -50°F. The smooth metal transfer keeps spatter to a minimum, and the complete slag coverage is designed for easy removal.

APPLICATION

The all-position Atom Arc 7018-1 electrode is intended for the wide variety of carbon and low alloy steels in the 50,000 psi minimum yield category. It is a good choice for applications that require high impact values at low temperatures.

OPERATION

Atom Arc 7018-1 electrodes operate on AC or DC reverse polarity. Do not use a whipping technique, but progress in a straight forward direction or weave only as wide as the puddle will allow. Hold a short arc at all times.

WELDING PARAMETERS

Normally, preheat is not required with the Atom Arc 7018-1 electrode. Preheat may be needed on thick sections and on highly hardenable steels to prevent brittleness in the heat affected zone. Consult the steel manufacturer's recommendations.

Alloy Rods Division

DATE

IT'S A FACT

Category 9, item 6

ATOM ARC 7018-1

MOISTURE RESISTANT LOW HYDROGEN ELECTRODES

SPECIFICATION DATA

AWS - A5.1, Class 7018-1
ASME - SFA 5.1
ABS - AWS A5.1

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WELDING PARAMETERS

Normally, preheat is not required with the Atom Arc 7018-1 electrode. Preheat may be needed on thick sections and on highly hardenable steels to prevent brittleness in the heat affected zone. Consult the steel manufacturer's recommendations.

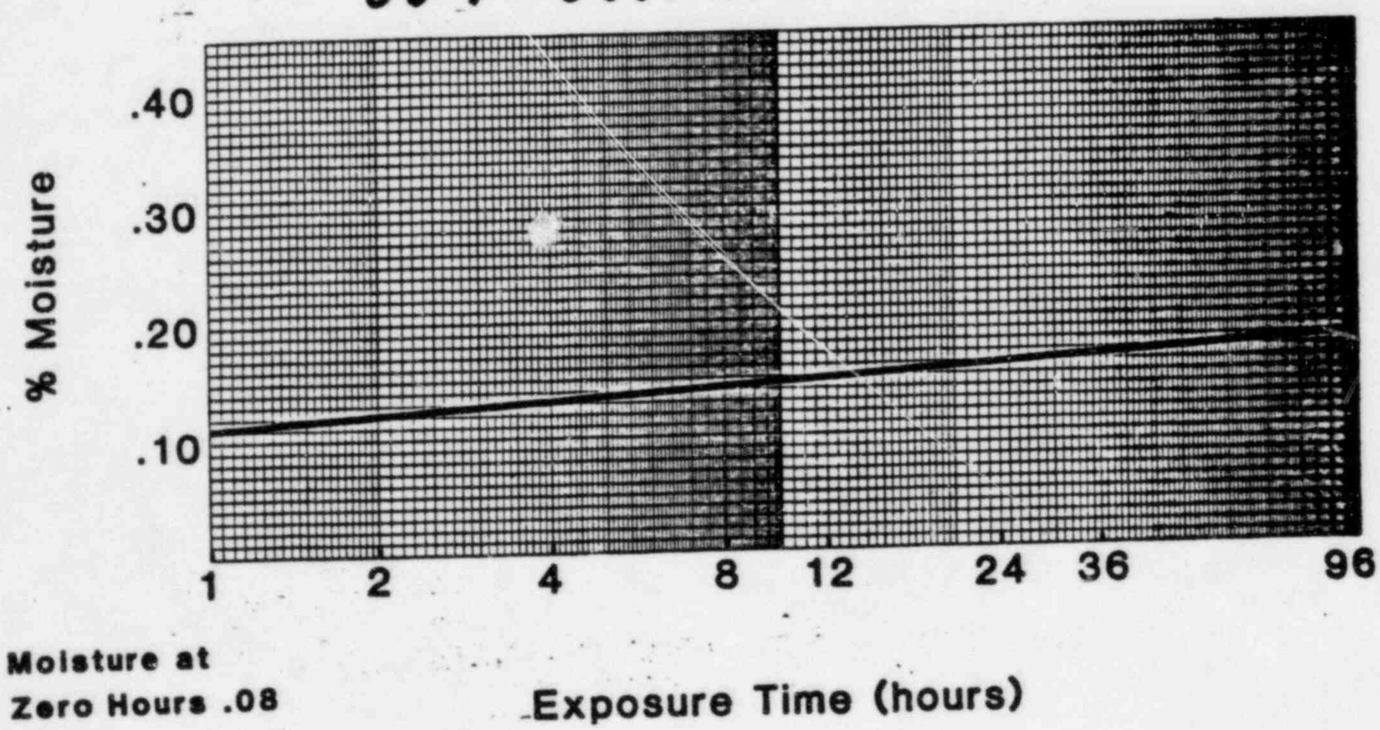
MOISTURE RESISTANT LOW HYDROGEN RELIABILITY

The new Atom Arc 7018-1 electrodes are manufactured to contain a moisture content less than **0.10%** before they are packed in hermetically sealed containers. In addition to this initial low moisture level, Atom Arc 7018-1 electrodes utilize a coating that effectively resists moisture pick-up for many hours after the container is opened. This moisture resistant coating provides that extra degree of reliability that is often necessary in high temperature - high humidity working conditions.

MOISTURE TEST

Alloy Rods' moisture testing followed the method prescribed in Section 25 of the AWS A5.5 specification. This method not only satisfies AWS requirements, but since it is sensitive only to water, it also is the most accurate and reliable method of moisture determination currently in use.

80°F - 80% RELATIVE HUMIDITY



It should be noted that even though Atom Arc 7018-1 electrodes resist moisture pick-up for long periods of exposure, no moisture resistant electrode will eliminate the need for storage and rebake ovens or the necessity to follow code requirements for allowable exposure times.

	AMPERAGE DCRP	
DIAMETER	RANGE	OPTIMUM
3/32"	70-110	100
1/8"	90-160	140
5/32"	130-220	170
3/16"	200-300	250
7/32"	250-350	300
1/4"	300-400	350

TYPICAL MECHANICAL PROPERTIES

	As Welded	Stress Relieved 8 hrs. @1150ºF.
Yield Strength (psi)	70,800	60,800
Tensile Strength (psi)	82,500	75,900
% Elongation (2")	31	32
% Reduction of Area	72	72

TYPICAL UNDILUTED WELD METAL ANALYSIS

C	Mn	P	S	Si
0.070	1.49	0.012	0.017	0.37

TYPICAL CHARPY V-NOTCH IMPACT PROPERTIES

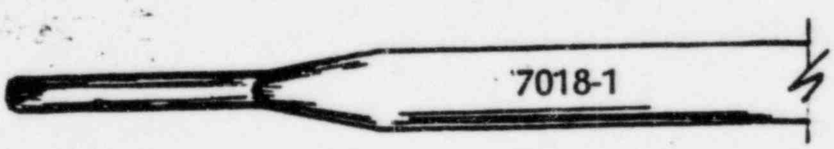
Temperature °F.	As Welded	Stress Relieved 8 hrs. @1150°F.
-50	74 ft.-lbs.	52 ft.-lbs.

PACKAGING

Diameters 3/32" thru 1/4" are available in 50# or 10# hermetically sealed cans.

ELECTRODE IDENTIFICATION

Each electrode is marked with 7018-1 as shown.



The data presented on the preceding pages is *TYPICAL* and is not to be construed as guaranteed values. Tests were performed in strict accordance with AWS procedures, but individual results may differ depending on test variables.

Alloy Rods Division
CHEMETRON CORPORATION
HANOVER, PA 17331 U.S.A.

THE SPECIALIST IN WELDING METALLURGY
An Allegheny International Company

ANSI/AWS D1.1-84
An American National Standard

1984

Structural Welding Code

Steel

FOIA-85-59

m 308

Table 4.1.4
Filler metal requirements for exposed bare applications of ASTM A242 and A588 steel

Welding processes			
Shielded metal arc	Submerged arc	Gas metal arc	Flux cored arc
A5.5.81	A5.23-83[1,4]	A5.28-70[4]	A5.29-80
			E71T8-Ni1 E71T8-Ni2 E7XTX-K2
E7018-W E8018-W	F7AX-EXXX-W		E80T1-W
E8016-C3 or E8018-C3 E8016-C1 or E8018-C1 E8016-C2 or E8018-C2	F7AX-EXXX-Ni1[2] F7AX-EXXX-Ni4[2]	ER80S-Ni1	E8XTX-Ni1
E7016-C1L or E8018-C1L E7016-C2L or E8018-C2L E8018-B2L[1]	F7AX-EXXX-Ni2[2] F7AX-EXXX-Ni3[2]	ER80S-Ni2 ER80S-Ni3 ER80S-B2L[1] ER80S-G[1,3]	E8XTX-Ni2 E80T5-Ni3 E80T5-B2L[1]

1. Deposited weld metal shall have a minimum impact strength of Charpy V-notch 20 ft-lb (27.1 J) at 0° F (-18° C) (only applied to bridges).
2. The use of the same type of filler metal having next higher tensile strength as listed in AWS specification is permitted.
3. Deposited weld metal shall have a chemical composition the same as that for any one of the weld metals in this table.
4. Composite (metal cored) electrodes are designated as follows:
SAW: Insert letter "C" between the letters "E" and "X"; e.g., F7AX-ECXXX-Ni1.
GMAW: Replace the letter "S" with the letter "C," and omit the letter "R;" e.g., E80C-Ni1.

Table 4.4.2
Minimum holding time

1/4 in. (6.4 mm) or less	Over 1/4 in. (6.4 mm) through 2 in. (51 mm)	Over 2 in. (51 mm)
15 min	1 hr/in.	2 hrs plus 15 min for each additional in. over 2 in. (51 mm)

Preheat and interpass temperatures must be sufficient to prevent crack formation, and temperatures above the specified minimum may be required for highly restrained welds. In joints involving combinations of base metals, preheat shall be as specified for the higher strength steel being welded.

4.3 Heat Input Control for Quenched and Tempered Steel

When quenched and tempered steels are welded, the heat input shall be restricted in conjunction with the maximum preheat and interpass temperatures required (because of base metal thicknesses). The above limitations shall be in strict accordance with the steel producer's recommendations. The use of stringer beads to avoid overheating is strongly recommended. Oxygen gouging of quenched and tempered steels is not permitted.

Table 4.4.3
Alternate stress-relief heat treatment

Decrease in temperature below minimum specified temperature, Δ °F	Δ °C	Minimum holding time at decreased temperature, hours per inch of thickness
50	28	2
100	56	3
150	84	5
200	112	10

4.4 Stress Relief Heat Treatment[8]

4.4.1 Where required by the contract drawings or specifications, welded assemblies shall be stress-relieved by heat treating. Finish machining shall preferably be done after stress relieving.

8. Stress relieving of weldments of A514, A517, and A709 Grades 100 and 100W steels is not generally recommended. Stress relieving may be necessary for those applications where weldments must retain dimensional stability during machining or where stress corrosion may be involved, neither condition being unique to weldments involving A514, A517, and A709 Grades 100 and 100W steels. However, the results of notch toughness tests have shown that postweld heat treatment may actually impair weld metal and heat-affected zone toughness, and intergranular cracking may sometimes occur in the grain-coarsened region of the weld heat-affected zone.

4.4.2 The stress relief treatment shall conform to the following requirements:

(1) The temperature of the furnace shall not exceed 600° F (315° C) at the time the welded assembly is placed in it.

(2) Above 600° F (315° C), the rate of heating[9] shall not be more than 400° F (220° C) per hour divided by the maximum metal thickness of the thicker part in inches, but in no case more than 400° F per hour. During the heating period, variation in temperature throughout the portion of the part being heated shall be no greater than 250° F (140° C) within any 15 ft (4.6 m) interval of length.

(3) After a maximum temperature of 1100° F (590° C) is reached on quenched and tempered steels, or a mean temperature range between 1100 and 1200° F (650° C) is reached on other steels, the temperature of the assembly shall be held within the specified limits for a time not less than specified in Table 4.4.2, based on weld thickness. When the specified stress relief is for dimensional stability, the holding time shall be not less than specified in Table 4.4.2, based on the thickness of the thicker part. During the holding period there shall be no difference greater than 150° F (83° C) between the highest and lowest temperature throughout the portion of the assembly being heated.

(4) Above 600° F (315° C), cooling shall be done in a closed furnace or cooling chamber at a rate[9] no greater than 500° F (260° C) per hour divided by the maximum metal thickness of the thicker part in inches, but in no case more than 500° F per hour. From 600° F (315° C), the assembly may be cooled in still air.

4.4.3 Alternatively, when it is impractical to postweld heat treat to the temperature limitations stated in 4.4.2, welded assemblies may be stress-relieved at lower temperatures for longer periods of time, as given in Table 4.4.3.

Part B
Shielded Metal Arc Welding

4.5 Electrodes for Shielded Metal Arc Welding

4.5.1 Electrodes for shielded metal arc welding shall conform to the requirements of the latest edition of AWS A5.1, Specification for Mild Steel Covered Arc Welding Electrodes, or to the requirements of AWS A5.5, Specification for Low Alloy Steel Covered Arc Welding Electrodes.

4.5.2 Low Hydrogen Electrode Storage Conditions. All electrodes having low hydrogen coverings conforming to AWS A5.1 shall be purchased in hermetically sealed containers or shall be dried for at least two hours between 450° F (230° C) and 500° F (260° C) before they are used. Electrodes having a low hydrogen covering conforming to AWS A5.5 shall be purchased in hermetically sealed containers or shall be dried at least one hour at temperatures between 700° F (370° C) and 800° F (430° C) before being used. Electrodes shall be dried prior to use if the hermetically sealed container shows evidence of damage. Immediately after opening of the hermetically sealed container or removal of the electrodes from drying ovens, electrodes shall be stored in ovens held at a temperature of at least 250° F (120° C). After the opening of hermetically sealed containers or removal from drying or storage ovens, electrode exposure to the atmosphere shall not exceed the requirements of either 4.5.2.1 or 4.5.2.2.

4.5.2.1 Approved Atmospheric Exposure Time Periods. After hermetically sealed containers are opened or after electrodes are removed from drying or storage ovens, the electrode exposure to the atmosphere shall not exceed the values shown in Column A, Table 4.5.2, for the specific electrode classification.

4.5.2.2 Alternative Atmosphere Exposure Time Periods Established by Tests. The alternative exposure time values shown in Column B in Table 4.5.2 may be used provided testing establishes the maximum allowable time. The testing shall be performed in accordance with AWS A5.5, Section 3.10, for each electrode classification and each electrode manufacturer. Such tests shall establish that the maximum moisture content values of AWS A5.5 (Table 9) are not exceeded. Additionally, E70XX (AWS A5.1 or A5.5) low hydrogen electrode coverings shall be limited to a maximum moisture content not exceeding 0.4% by weight.

These electrodes shall not be used at relative humidity-temperature combinations that exceed either the relative humidity or moisture content in the air that prevailed during the testing program.[10]

4.5.3 Electrode Restrictions for A514 or A517 Steels. When used for Welding ASTM A514 or A517 steels, electrodes of any classification lower than E100XX shall be dried at least one hour at temperatures between 700 and 800° F (370 and 430° C) before being used, whether furnished in hermetically sealed containers or otherwise.

9. The rates of heating and cooling need not be less than 100° F (55° C) per hour. However, in all cases, consideration of closed chambers and complex structures may indicate reduced rates of heating and cooling to avoid structural damage due to excessive thermal gradients.

10. For proper application of this provision, see Appendix J for the temperature-moisture content chart and its examples. The chart shown in Appendix J, or any standard psychrometric chart, must be used in the determination of temperature-relative humidity limits.

Table 4.5.2
Permissible atmospheric exposure of low hydrogen electrodes

Electrode	Column A (hours)	Column B (hours)
A5.1		
E70XX	4 max	Over 4 to 10 max
A5.5		
E70XX	4 max	Over 4 to 10 max
E80XX	2 max	Over 2 to 10 max
E90XX	1 max	Over 1 to 5 max
E100XX	1/2 max	Over 1/2 to 4 max
E110XX	1/2 max	Over 1/2 to 4 max

Notes:
1. Column A: Electrodes exposed to atmosphere for longer periods than shown shall be redried before use.
2. Column B: Electrodes exposed to atmosphere for longer periods than those established by testing shall be redried before use.
3. Entire table: Electrodes shall be issued and held in quivers, or other small open containers. Heated containers are not mandatory.

4.5.4 Redrying Electrodes. Electrodes that conform to the provisions of 4.5.2 shall subsequently be redried no more than one time. Electrodes that have been wet shall not be used.

4.5.5 Manufacturer's Certification. When requested by the Engineer, the contractor or fabricator shall furnish an electrode manufacturer's certification that the electrode will meet the requirements of the classification.

4.6 Procedures for Shielded Metal Arc Welding

4.6.1 The work shall be positioned for flat position welding whenever practicable.

4.6.2 The classification and size of electrode, arc length, voltage, and amperage shall be suited to the thickness of the material, type of groove, welding positions, and other circumstances attending the work. Welding current shall be within the range recommended by the electrode manufacturer.

4.6.3 The maximum diameter of electrodes shall be as follows:

4.6.3.1 5/16 in. (8.0 mm) for all welds made in the flat position, except root passes.

4.6.3.2 1/4 in. (6.4 mm) for horizontal fillet welds.

4.6.3.3 1/4 in. (6.4 mm) for root passes of fillet welds made in the flat position and groove welds made in the flat position with backing and with a root opening of 1/4 in. or more.

4.6.3.4 5/32 in. (4.0 mm) for welds made with EXX14 and low hydrogen electrodes in the vertical and overhead positions.

4.6.3.5 3/16 in. (4.8 mm) for root passes of groove welds and for all other welds not included under 4.6.3.1, 4.6.3.2, 4.6.3.3, and 4.6.3.4.

4.6.4 The minimum size of a root pass shall be sufficient to prevent cracking.

4.6.5 The maximum thickness of root passes in groove welds shall be 1/4 in. (6.4 mm).

4.6.6 The maximum size of single-pass fillet welds and root passes of multiple-pass fillet welds shall be

4.6.6.1 3/8 in. (9.5 mm) in the flat position

4.6.6.2 5/16 in. (8.0 mm) in the horizontal or overhead positions

4.6.6.3 1/2 in (12.7 mm) in the vertical position

4.6.7 The maximum thickness of layers subsequent to root passes of groove and fillet welds shall be

4.6.7.1 1/8 in. (3 mm) for subsequent layers of welds made in the flat position

4.6.7.2 3/16 in. (4 mm) for subsequent layers of welds made in the vertical, overhead, or horizontal positions

4.6.8 The progression for all passes in vertical position welding shall be upward, except that undercut may be repaired vertically downwards when preheat is in accordance with Table 4.2, but not lower than 70° F (21° C). However, when tubular products are welded, the progression of vertical welding may be upwards or downwards but only in the direction or directions for which the welder is qualified.

4.6.9 Complete joint penetration groove welds made without the use of steel backing shall have the root gouged to sound metal before welding is started from the second side, except as permitted by 10.13.

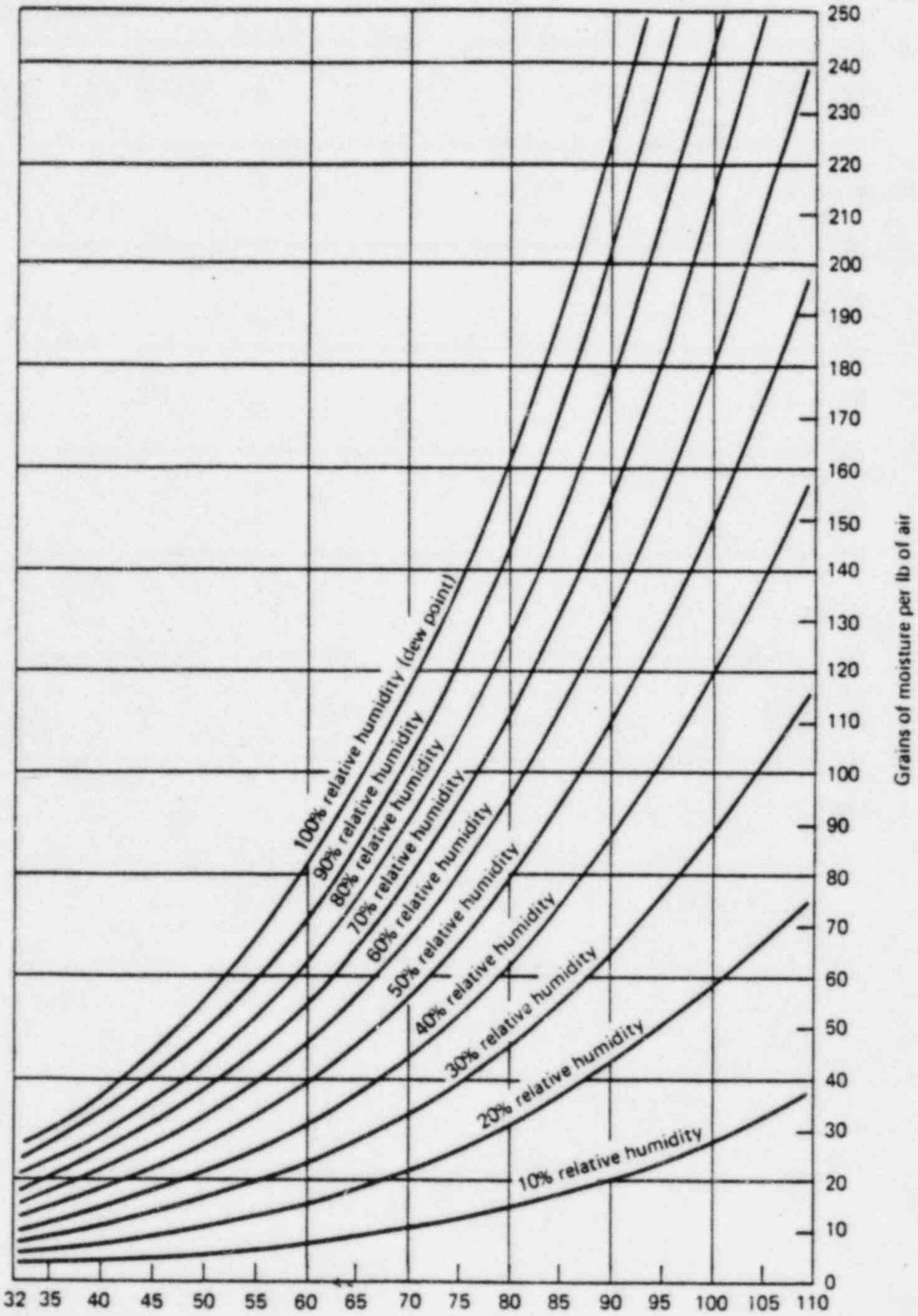
Part C
Submerged Arc Welding

4.7 General Requirements

4.7.1 Submerged arc welding may be performed with one or more single electrodes, one or more parallel electrodes,[11] or combinations of single and parallel electrodes. The spacing between arcs shall be such that the slag cover over the weld metal produced by a leading arc does not cool sufficiently to prevent the proper weld deposit of a following electrode. Submerged arc welding with multiple electrodes may be used for any groove or fillet weld pass.

11. See Appendix I.

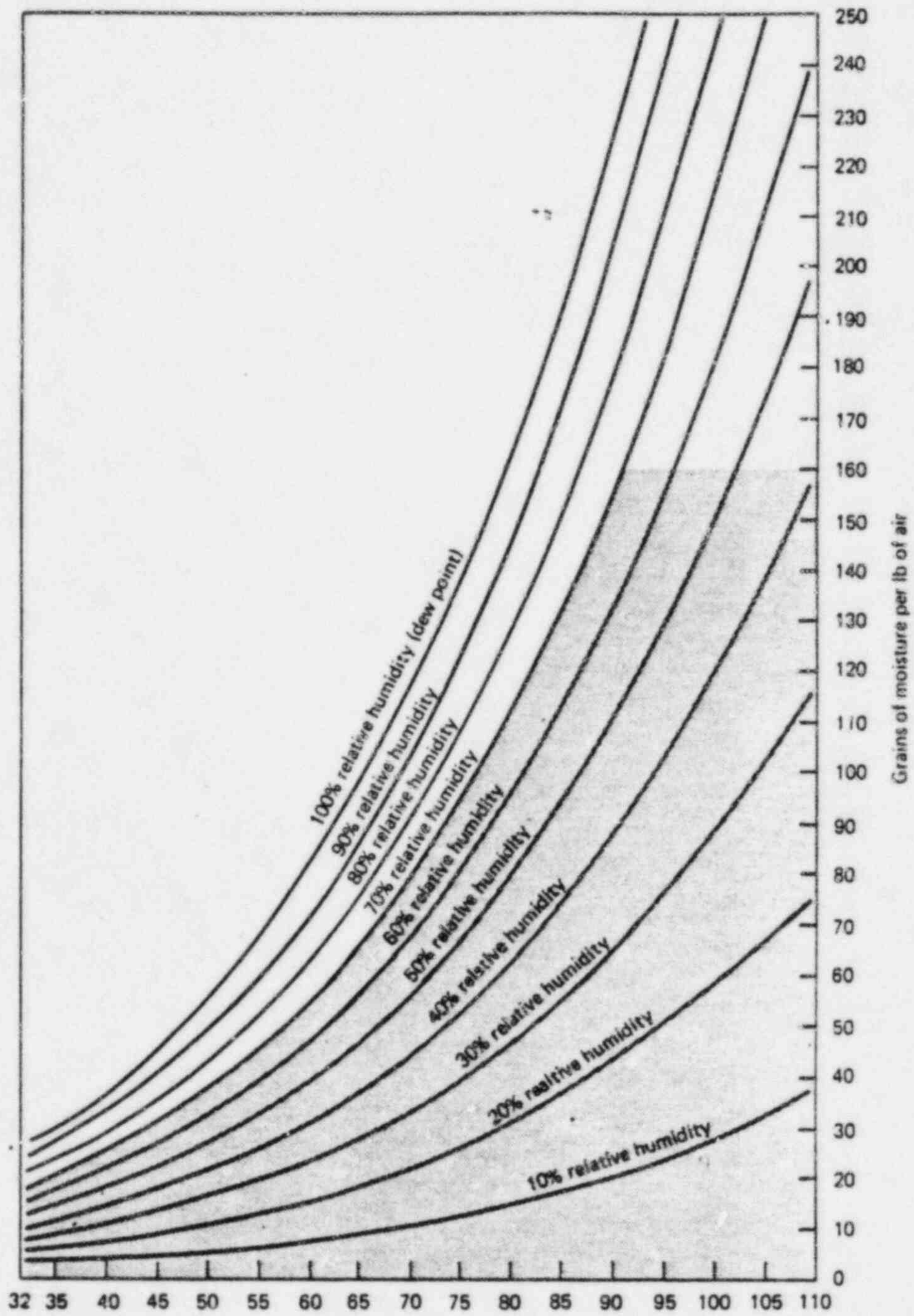
Appendix J: Temperature—Moisture Content Charts



Notes:

1. Any standard psychrometric chart may be used in lieu of this chart.
2. See Fig. J2 for an example of the application of this chart in establishing electrode exposure conditions.

Fig. J1—Temperature-moisture content chart to be used in conjunction with testing program to determine extended atmospheric exposure time of low hydrogen electrodes (see 4.5.2)



Example: An electrode tested at 90° F and 70% relative humidity (RH) may be used under the conditions shown by the shaded areas. Use under other conditions requires additional testing.

Fig. J2—Application of temperature-moisture content chart in determining atmospheric exposure time of low hydrogen electrodes

Caution should be used in preheating quenched and tempered steel, and the heat input must not exceed the steel producer's recommendation (see 4.3).

4.3 Heat Input for Quenched and Tempered Steel

The strength and toughness of the heat-affected zone of welds in quenched and tempered steels are related to the cooling rate. Contrary to principles applicable to other steels, the fairly rapid dissipation of welding heat is needed to retain adequate strength and toughness.

The cooling rate of the austenitized heat-affected zone must be sufficiently rapid to ensure the formation of the hardening constituents in the steel microstructure. Overheating of quenched and tempered steel followed by slow cooling prevents the formation of a hardened microstructure.

The deposition of many small weld beads improves the notch toughness of the weld by grain refining and the tempering action of ensuing passes. A weave bead, with its slower travel speed, increases heat input and is therefore not recommended. Because the maximum heat input for various quenched and tempered steels varies over a wide range, heat input as developed and recommended by the steel producers should be strictly observed.

4.4 Stress Relief Heat Treatment

This paragraph provides for two postweld heat treatment methods for stress relief of a welded assembly. The first method requires the assembly to be heated to 1100° F (595° C) max for quenched and tempered steels, and between 1100 and 1200° F (595 to 650° C) for other steels. The assembly is held at this temperature for the time specified in Table 4.4.2. In 4.4.3, an alternative method permits a decrease in temperature below the minimum specified in the first method, when the holding time is increased. The alternative method is used when it is impractical to postweld heat treat the welded assembly at higher temperatures. These temperatures are sufficiently below the critical temperature to preclude any change in properties.

If the purpose of the postweld heat treatment is to stress relieve the weld, the holding time is based on the weld metal thickness even though some material in the weldment is thicker than the weld. If the purpose of the postweld heat treatment is to maintain dimensional stability during subsequent machining, the holding time is based on the thickest component in the weldment. Certain quenched and tempered steels, if stress relieved as a carbon or low alloy steel, may undergo undesirable changes in microstructure, causing a deterioration of mechanical properties or cracking, or both. Such steels should only be stress relieved after consultation with the steel producer and in strict accordance with the producer's recommendations.

Precautionary Note: Consideration must be given to possible distortion due to stress relief.

Part B
Shielded Metal Arc Welding

4.5 Electrodes for Shielded Metal Arc Welding

The ability of low hydrogen electrodes to prevent underbead cracking is dependent on the moisture content in the coating. During welding, the moisture dissociates into hydrogen and oxygen; hydrogen is absorbed in the molten metal and porosity and cracks may appear in the weld after the weld metal solidifies. The provisions of the Code for handling, storage, drying, and use of low hydrogen electrodes should be strictly adhered to in order to prevent moisture absorption by the coating material.

4.5.2 For carbon steel low hydrogen electrodes, AWS A5.1, Specification for Carbon Steel Covered Arc Welding Electrodes, specifies no moisture limit for the low hydrogen coating. However, the appendix to AWS A5.1 states it should be less than 0.6%. Alloy steel low hydrogen electrodes covered in AWS A5.5, Specification for Low Alloy Steel Covered Arc Welding Electrodes, have a specified maximum moisture content. For the E70XX class electrodes, it is 0.6%; for E80XX electrodes, it is 0.4%; for E9015 and E9016 electrodes it is 0.4%; and for the remainder of the E90XX class, the E100XX, the E110XX, and E120XX class electrodes, it is 0.2%.

Experience has shown that the limits specified above for moisture contents in electrode coverings are not always sufficiently restrictive for some applications using the E90XX and lower classes. Electrodes of classifications lower than E100XX are subject to more stringent moisture level requirements when used for welding the high-strength quenched and tempered steels, ASTM A514 and A517. All such electrodes are required to be dried between 700 and 800° F (370 and 430° C) before use. Electrodes of classification below E100XX are not required by AWS A5.5 to have a moisture content less than 0.2%, and the required drying will achieve at least this moisture level. This precaution was necessary because of the sensitivity of high strength steels and weld metal to hydrogen cracking.

Tests have shown there can be a wide variation in the moisture absorption rate of various brands of electrodes representing a given AWS classification. Some electrodes absorb very little moisture during standard exposure times while others absorb moisture very rapidly. The

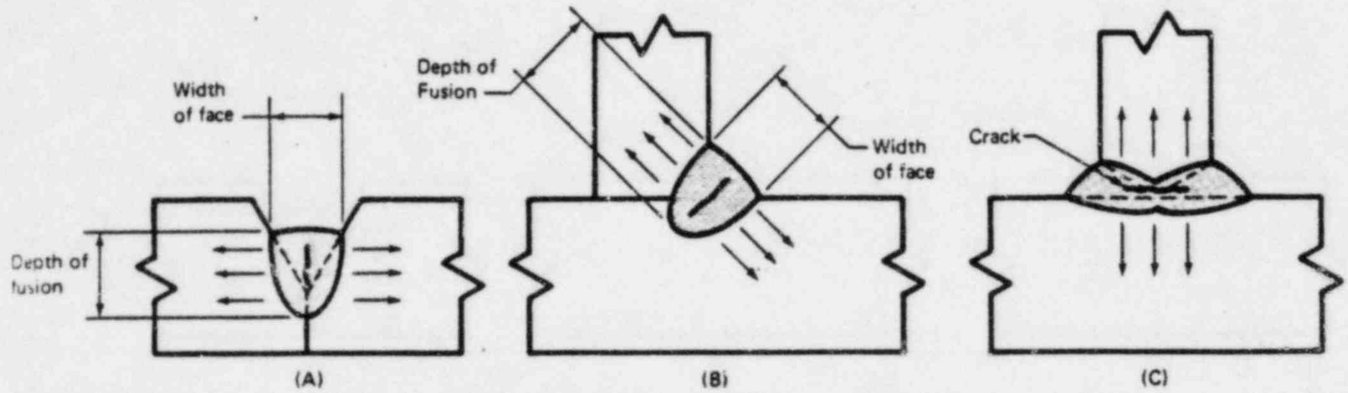


Fig. C4.7.7—Examples of centerline cracking: (A) Groove weld; (B) Fillet weld; (C) Weld in T-joint

moisture control requirements of 4.5.2 are necessarily conservative to cover this condition and ensure that sound welds can be produced.

The time restrictions on the use of electrodes after removal from a storage oven may seem overly restrictive to some users. The rate of moisture absorption in areas of low humidity is lower than that encountered in areas of high humidity. The Code covers the most restrictive situations.

4.6 Procedures for Shielded Metal Arc Welding

This section contains the prequalified welding procedure requirements for shielded metal arc welding.

Part C
Submerged Arc Welding

4.7 General Requirements

Part C contains prequalified procedure requirements for submerged arc welding. The provisions of this section apply only to prequalified welding procedures. Submerged arc welding is normally associated with high heat input, and heat input exceeding the steel producer's recommendations could reduce the toughness of the joint for quenched and tempered steels.

4.7.7 The weld nugget or bead shape is an important factor affecting weld cracking. Solidification of molten weld metal due to the quenching effect of the base metal starts along the sides of the weld metal and progresses inward until completed. The last liquid metal to solidify lies in a plane through the centerline of the weld. If the weld depth is greater than the width of the face, the weld surface may solidify prior to center solidification. When this occurs, the shrinkage forces acting on the still hot, semi-liquid center or core of the weld may cause a centerline crack to develop, as shown in Fig. C4.7.7(A) and (B). This crack may extend throughout the longitudinal length of the weld and may or may not be visible at the weld surface. This condition may also be obtained when fillet welds are made simultaneously on both sides of a joint with the arcs directly opposite each other, as shown in Fig. C4.7.7(C).

In view of the above, 4.7.7 requires that neither the depth nor the maximum width in the cross section of the weld metal deposited in each weld pass shall exceed the width at the surface of the weld pass. This is also illustrated in Fig. 4.7.7.

Weld bead dimensions may best be measured by sectioning and etching a sample weld.

4.8 Electrodes and Flux for Submerged Arc Welding

4.8.1 AWS A5.23, Specification for Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding, was published in 1976 and revised in 1980. Electrodes and fluxes conforming to the classification designation of this specification may be used as prequalified provided the provisions of 4.1.1 and Table 4.1.1 are observed. The contractor should follow the supplier's recommendations for the proper use of fluxes.

4.8.3 The requirements of this section are necessary to assure that the flux is not a medium for introduction of hydrogen into the weld because of absorbed moisture in the flux. Whenever there is a question about the suitability of the flux due to improper storage or package damage, the flux should be discarded or dried in accordance with the manufacturer's recommendations.

Category 9, item 1

A Study of Hydrogen Cracking in Underwater Steel Welds

A yield strength of 50 ksi appears to be the limit beyond which hydrogen cracking occurs frequently in underwater welding of structural steels

BY H. OZAKI, J. NAIMAN AND K. MASUBUCHI

ABSTRACT. This project was undertaken to investigate hydrogen cracking in underwater ("wet") welds. Several kinds of structural steel specimens were used, including those made of mild steel, 50 ksi (yield strength) class steels, and HY-80 steel.

The Y-slit restraint test was used because the testing conditions of this method can be related to actual fabricating conditions. Several types of electrode were used in the welding of mild steel, and the effects of the different electrode coatings examined. Low hydrogen electrodes were used in the welding of both high tensile strength steel and mild steel (E7018), and 25Cr-20Ni stainless steel electrodes (E310-16) in the welding of HY-80 steel. This enabled an examination of the effects of undermatching, and an examination of austenitic electrodes.

The same materials were also used to make air welds so that comparisons could be made between underwater and air welds.

The hydrogen content in underwater welds was determined using the glycerine method. The carbon-equivalent formulas and the critical cooling time (from 800 to 500 C (1472 to 932 F) to produce a fully martensitic structure) are used in the discussion of hydrogen-cracking susceptibility. It was found that, whatever the electrode-type used, no observable hydrogen cracks resulted from the underwater welding of mild steel. But hydrogen cracks did result from the underwater welding of high strength steels. The use of undermatching techniques or austenitic electrodes did not improve the weld integrity.

Introduction

The increasing use of offshore structures such as platforms, storage tanks and pipelines has created a demand for the development of underwater welding techniques that can be used in their construction and repair.

In order to obtain high quality underwater welds and to develop more reliable processes, the weldability of various structural steels must be investigated.

Because of the high quenching rate caused by the water environment and because large quantities of hydrogen are present, hydrogen cracking is one of the most severe problems in the underwater welding of steel. A number of reports on this subject are available, but the results tend to be inconsistent.

Grubbs and Seth[1] contend that the hydrogen cracking problem in carbon steel welds is minor unless the carbon equivalent exceeds 0.4. Also, extensive cracking was not found in tee and lap joints of HY-80 steel, a material known to be crack-sensitive in air welding.[2] However, England's Welding Institute has reported that extensive hydrogen cracking does occur in underwater welds made in normal carbon steels with 0.3 to 0.42 carbon equivalent.[3] In addition, it has been reported that due to the martensitic structure, the maximum hardness in the heat-affected zone of underwater welds in mild steel (carbon equivalent: 0.33) was about 600 Hv.[4] Both the hardness measurement and the microscopic observation indicate that even in mild steel hydrogen cracking can occur.

The objective of this study is to systematically obtain experimental data on the hydrogen-cracking susceptibility of underwater welds in various structural steels.

The presence of hydrogen, the presence of a susceptible microstructure and the presence of tensile stress or strain are the causative factors in the hydrogen cracking of steel welds. All three factors can be represented by three engineering indexes: the diffusible hydrogen content, the carbon equivalent and the intensity of restraint.[5] In the present study, the underwater hydrogen potential of various types of electrode was determined using the glycerine method. The cracking tests were carried out using a Y-slit restraint test such that the intensity of restraint could be related to actual fabricating conditions.

Austenitic electrodes have a large hydrogen solubility and tend to keep hydrogen away from the crack-sensitive base metal. Because of this, they reduce hydrogen cracking in underwater steel welds when the carbon equivalent exceeds 0.40.[1] Recently, it was reported that several different types of austenitic electrode have been observed to produce underwater welds containing martensitic structures along the fusion boundaries; this

Paper presented at the 58th AWS Annual Meeting held in Philadelphia, Pennsylvania, during April 25-29, 1977.

H. OZAKI is a Research Associate and K. MASUBUCHI is Professor, Massachusetts Institute of Technology, Cambridge, Mass.; J. NAIMAN is with NAVSEC, Hyattsville, Maryland.

Table 1—Chemical Composition of Materials Used, Wt-%

	C	Si	Mn	P	S	Ni	Cr	Mo	V	Nb	C.E.[a]	P_{cm}[b]
Mild steel	0.20	0.02	0.53	0.03	0.04						0.29	0.23
ST52	0.19	0.34	1.14	0.02	0.03						0.38	0.26
A537A	0.16	0.30	1.20	0.02	0.03	0.20	0.20	0.06	0.06	0.02	0.45	0.26
HY-80	0.18	0.20	0.32	0.02	0.03	2.99	1.68	0.41			0.85	0.36

(a) Carbon Equivalent $= C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$

(b) $P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + \frac{Cu}{20} + 5B$

is due to the high base metal dilution and the high quenching rate caused by the water environment which in turn results in weld metal hydrogen cracking.[6]

It has been demonstrated that the use of undermatched electrodes (the weld metal strength being lower than that of the base metal) effectively reduces hydrogen cracking.[7]

This study examines how the use of an austenitic electrode and an undermatched electrode affects the welding of HY-80 steel.

Experimental Procedure

Materials

Several commercially available steels including mild steel (ABS grade A), 50 ksi (yield strength) class steels (A537A and ST 52), and HY-80 steel were used in the evaluation of the hydrogen cracking susceptibility of underwater welds—Table 1. The specimens were 1/2 in. (12.5 mm) thick. In Table 1, the carbon equivalent values (C.E.) and the P_{cm}[5] values of these steels are shown. The following equations were used to calculate these values:

$$C.E. = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \text{ (Current spec.)}$$

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B \text{ (Ito and Bessyo}^{5}\text{)}$$

For the experiment on mild steel, three types of electrodes—including titania-iron powder type (E7014), iron powder-iron oxide type (E6027) and low hydrogen type (E7018)—were used.

The titania-iron powder type reportedly has good running characteristics. The iron powder-iron oxide type has been demonstrated to reduce the hydrogen-cracking susceptibility of underwater welds.[6]

Low hydrogen electrodes (E8018) were used for A537A steel and ST52 steel. For HY-80 steel, three types of electrode including low hydrogen electrodes with different strength (E11018 and E7018) and austenitic electrodes [E310-16 (25Cr-20Ni)] were used. E7018 electrodes and E310-16 electrodes were used to determine exactly how an undermatched electrode and an austenitic electrode affect the hydrogen-cracking susceptibility of underwater welds in HY-80 steel. All of these electrodes were 5/32 in. (4 mm) in diameter.

Hydrogen Cracking Tests

Hydrogen-cracking susceptibility was evaluated using a Y-slit self-restrained cracking test—Fig. 1. The measure of the hydrogen-cracking susceptibility of a steel is the cracking ratio—Fig. 2. This is a ratio of the height from the root to the tip of the crack versus the height from the root to the surface of the weld metal.

The restraint intensity involved in this test corresponds to the upper limits of the restraint intensity of an actual welded joint. Because of this

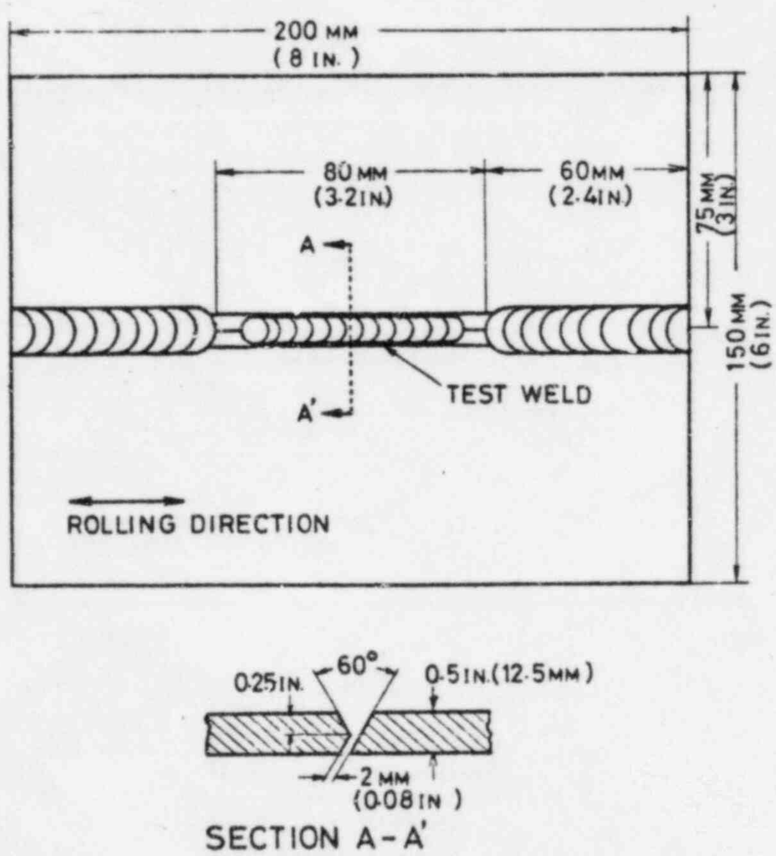
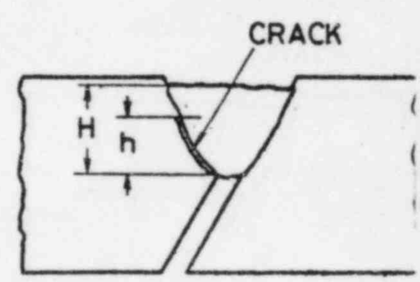


Fig. 1—The Y-slit type test specimen



CRACKING RATIO

$$= \frac{\Sigma h}{\Sigma H} \times 100$$

Fig. 2—Determination of a cracking ratio

the test results are a reasonably accurate indicator of hydrogen-cracking susceptibility.

Testing Procedure

The Y-slit specimens were cut from the plates in such a way that their longitudinal dimension was parallel to the rolling direction of the plates. The restraint welds were made in the usual manner.

The specimens were put in a tank 10 × 16 × 12 in. (250 × 400 × 300 mm) deep. Water was pumped in up to a level 1.2 in. (30 mm) above the top of the plate. The electrodes, which had been kept dry, were taken from the holding oven and waterproofed with an enamel spray prior to welding. The welding was done using 200 A, 25 V DCRP and an average welding speed of 8 ipm (20 cm/min), resulting in an average heat input of 38 kJ/in. (1500 kJ/m).

The welded specimens were submerged in a container of water at 70 F (21.5 C) for 48 hours and then sectioned to expose the cracking.

The cracking ratio of each plate-electrode combination was determined by averaging the cracking ratio values observed in four different sectionings.

Air welds were made using the same welding conditions as the underwater welds.

Metallographic Examination and Hardness

Measurement

In the metallographic examination, the specimens were polished and etched using 1% nital or aqueous picric acid and observed microscopically.

The hardness was measured using a Knoop hardness testing machine set at a 500 g load. The results were converted to the DPH (10 kg) scale. The hardness measurements were taken 1 mm (0.04 in.) above the root level in each case.

Measurement of Diffusible Hydrogen Content

Diffusible hydrogen content evolved from underwater welds was measured using the glycerine method (the procedure proposed by the Japan Industrial Standard was employed).[9]

These results can be related to those obtained by the IIW method using the following equation:[10]

$$H_{IIW} = 1.27 H_G + 2.2$$

where H_{IIW} = hydrogen content by IIW method; H_G = hydrogen content by glycerine method.

How the type of waterproof medium and the length of time the electrode is in the water before it is used affects the diffusible hydrogen content was also investigated. The waterproof mediums investigated were paraffin wax, epoxy resin, and enamel.

Table 2—Summary of the Cracking Tests

Steel	Electrode	Cracking ratio, % Air	Cracking ratio, % Underwater
Mild steel	E7014	0	0
	E7018	0	0
	E6024	0	0
ST52	E8018	2	30
A537A	E8018	21	26
HY-80	E11018	95	100
	E7018	18	100
	E310-16	1	80

Experimental Results

Cracking Tests

Table 2 summarizes the results of the cracking tests. No cracks were found in the mild steel specimens either in the underwater welds or in the air welds. Figure 3 shows the cross-section of an underwater weld made with an E7018 electrode. Figure 4 shows the microstructure of the weld; the bottom left side of Fig. 4 is the weld metal and the balance is the HAZ where the Widmanstätten structure can be seen.

Unlike mild steel, the high strength steels are likely to crack. The cracking ratio of A537A steel was 26% and the microstructure of the HAZ was bainitic—Fig 5.

The cracking ratio of ST52 steel was 30%, close to that of A537 steel. The real differences in the cracking ratios are evident in the air welds: 2% for ST52 steel and 21% for A537 steel. Although A537A steel is more susceptible than ST52 steel in air welding, both steels have approximately the same underwater hydrogen-cracking susceptibility.

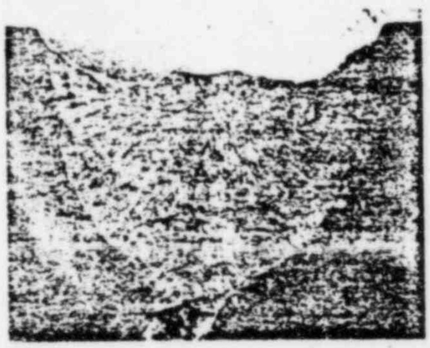


Fig. 3—An underwater weld made with E7018 electrode in mild steel. Nital etch, ×10 (reduced 59% on reproduction)

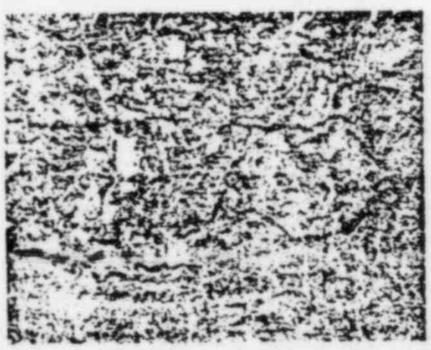


Fig. 5—Cracks in the underwater weld made with E8018 electrode in A637A steel. Nital etch, ×128 (reduced 50% on reproduction)

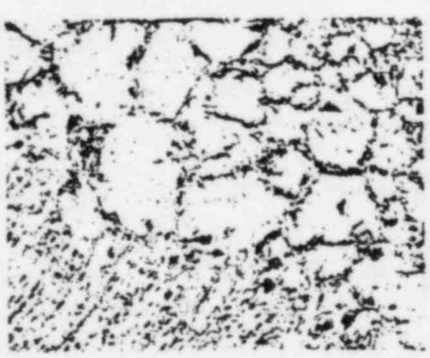


Fig. 4—Microstructure of an underwater weld made with E7014 electrode in mild steel. Aqueous picric acid, ×128 (reduced 50% on reproduction)

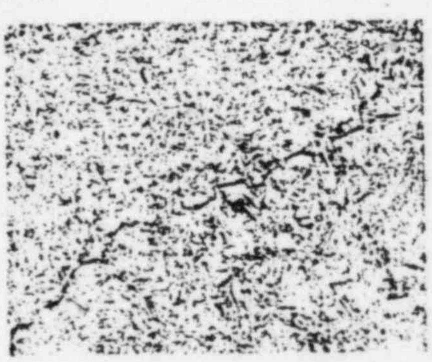


Fig. 6—The microstructure of an underwater weld made with E7018 electrode in ST52 steel; cracks can be seen in the coarse grained region in the HAZ. Nital etch, ×128 (reduced 40% on reproduction)

Fig. 7—An underwater weld made with E11018 electrode in HY-80 steel. Nital etch, ×12.5 (reduced 57% on reproduction)

Fig. 8—Cracks in an underwater weld made with E11018 electrode in HY-80 steel. Nital etch, ×128 (reduced 35% on reproduction)

Figure 6 shows the underwater ST52 steel weld microstructure, with cracks in the HAZ where the martensitic structure is present.

In the HY-80 steel welds, extensive cracks are evident in both the underwater welds and the air welds, except in the case of those made using E310-16 electrodes.

The cracking ratios of underwater welds made with E11018 and E7018 electrodes are as high as 100%. The cracking ratios of the air welds are 95% for E11018 and 18% for E7018. Note that the undermatched E7018 electrodes reduced the cracking ratio of the air welds, but not of the underwater welds.

Figure 7 shows the cross-section of an underwater HY-80 steel weld made with an E11018 electrode. Figure 7 shows that the crack initiated at the root and mostly followed the fusion line to the surface, penetrating 100% of the height.

The crack shown in Fig. 8 propagated along the prior austenite grain-boundaries in the HAZ, where the martensitic structure was present.

Table 3—Summary of Diffusible Hydrogen Content of Underwater Welds

Type of electrode	Amount of diffusible hydrogen, cc/100 g
E7014	49 (53.5)[a]
E7018	31
E6027	(24)[a]
E8018	31
E11018	32
E310-16	38
E312-15	(40)[a]

[a] Data from Stalker, Hart and Salter.*

The cracking ratio of the HY-80 steel welds made with E310-16 electrodes was 21% for underwater and 1% for air. These numbers are considerably smaller than those associated with the other types of electrode in both underwater and air welds.

It can be said that the use of an austenitic electrode can reduce the hydrogen cracking susceptibility of underwater welds. Further investigation, however, has shown that the use of an austenitic electrode cannot reduce the cracking problem in underwater welds. This is discussed in more detail further in the paper.

Diffusible Hydrogen Content of Underwater Welds

Table 3 summarizes the diffusible hydrogen content of the underwater welds; data provided by The Welding Institute are included. As mentioned under Experimental Procedure, the data in this experiment were obtained using the glycerine method and converted to the IIW scale. On the other hand, the data of The Welding Institute were actually obtained using the IIW method.

Fairly good agreement can be seen between the two bodies of data as they relate to E7014 electrodes. Among the electrodes, E6027 appears to give the lowest diffusible hydrogen content (24 cc/100 g) and E7014 appears to give the highest (49–53.5 cc/100 g). The amount of diffusible hydrogen with the low hydrogen type electrodes—including E7018, E8018 and E11018—is approximately 31 cc/100 g and is the value that falls in between those associated with E7014 and E6027 electrodes.

Because austenite has a high hydrogen-solubility, the amounts of diffusible hydrogen present in the welds made with austenite electrodes are fairly high (38 cc/100 g for E310-16 and 40 cc/100 g for E312-15).

Figure 9 shows how the amount of time the electrodes are in the water (with and without three different waterproof mediums) affects the diffusible hydrogen content in underwater welds. An E7014 electrode was

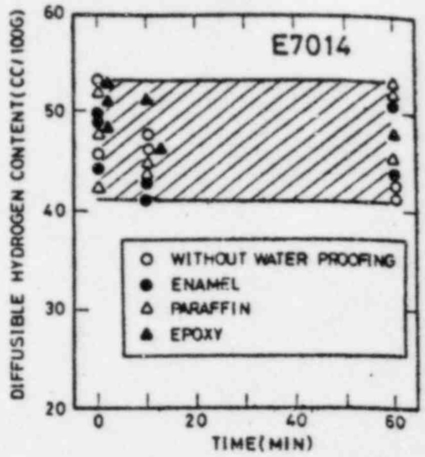


Fig. 9—Effect of immersing time of electrodes in water on the diffusible hydrogen content of underwater welds

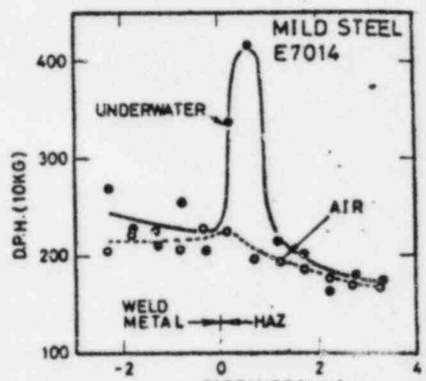


Fig. 10—Hardness distribution within the welds made with E7014 electrode in mild steel

used. The experimental data fall between 41 and 53 cc/100 g and are independent of the immersion time and the waterproof medium.

The results indicate that neither waterproofing nor immersion time before welding affects the diffusible hydrogen content of underwater welds. It can therefore be stated that, unlike air welding, the absorption of water by the coating flux does not affect the diffusible hydrogen content.

Hardness Distribution within Underwater Welds

Figures 10 and 11 illustrate the hardness distribution within underwater welds on mild steel and HY-80 steel respectively. Electrodes used were E7014 for mild steel and E11018 for HY-80 steel. Table 4 tabulates the maximum hardness in the HAZ and the hardness of the weld metal.

The maximum hardness for an underwater weld in mild steel (400 DPH) is much harder than that for an air weld made in the same materia

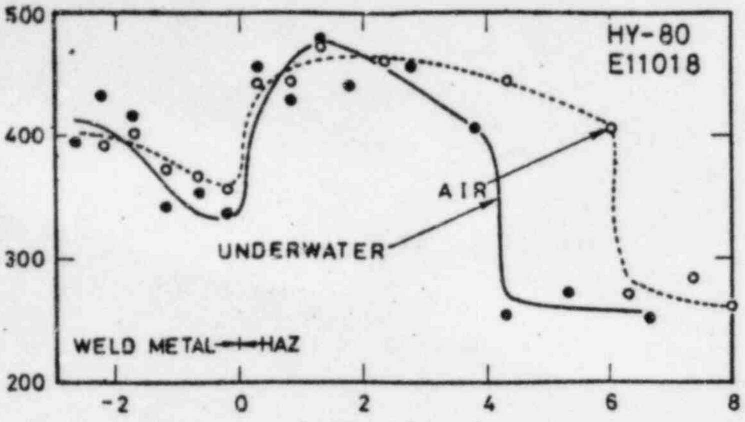


Fig. 11—Hardness distribution within the welds made with E11018 electrode in HY-80 steel

Table 4—Summary of the Hardness Measurement

Steel	Electrode	Maximum hardness in HAZ		Maximum hardness in weld metal	
		Underwater	Air	Underwater	Air
Mild steel	E7014	420	235	240	215
	E7018	400	220	210	220
	E6027	410	220	200	175
A537A	E8018	380	200	210	160
ST52	E8018	430	245	230	200
HY-80	E11018	470	470	400	400
	E7018	460	440	350	290
	E310-16	425	400	190	200

(235 DPH), indicating that the structure is susceptible to hydrogen cracking. Despite these hardness results on mild steel, no hydrogen cracking was observed—Table 3. The type of electrode used did not seem to have a significant effect on the maximum hardness. These results do not agree with those of Hasui and Suga which indicated that the use of an iron oxide type electrode could reduce the maximum hardness.[11]

When A537A steel was welded underwater, the maximum hardness was less than 400 DPH, lower than that of mild steel by 20 to 40 DPH. Despite this, hydrogen cracking occurred—Table 3.

On ST52 steel, the maximum hardness was about 430 DPH, higher than that of mild steel.

The maximum hardness in the underwater welds on HY-80 steel varied from 425 to 470 DPH and was affected by the electrode type. The E11018 produced the hardest HAZ and the E310-16 the softest. Coating type affected the hardness; the underwater weld metal hardness was 400 DPH for E11018, 350 DPH for E7018, and 190 DPH for E310-16.

Unlike mild steel in which there is a large difference between the maximum hardnesses of underwater and air welds, the maximum hardnesses of underwater and air welds in HY-80 steel are nearly the same; also, the air weld hardness is almost as high as the underwater weld hardness.

Discussion: Hydrogen-Cracking Susceptibility in Underwater Welds

According to Grubbs and Seth,[1] under restrained conditions and when underbead cracking was present the carbon equivalent was 0.445; when underbead cracking was not present, it was 0.392. They concluded that steels with a carbon equivalent of up to 0.40% could be welded underwater without hydrogen cracking.

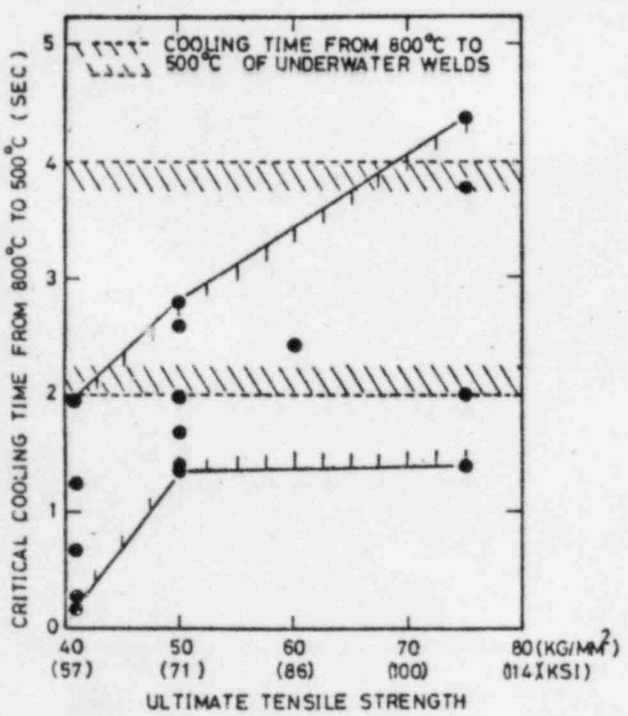


Fig. 12—Relationship between the critical cooling time from 800 to 500 C and the ultimate tensile strength of various structural steels

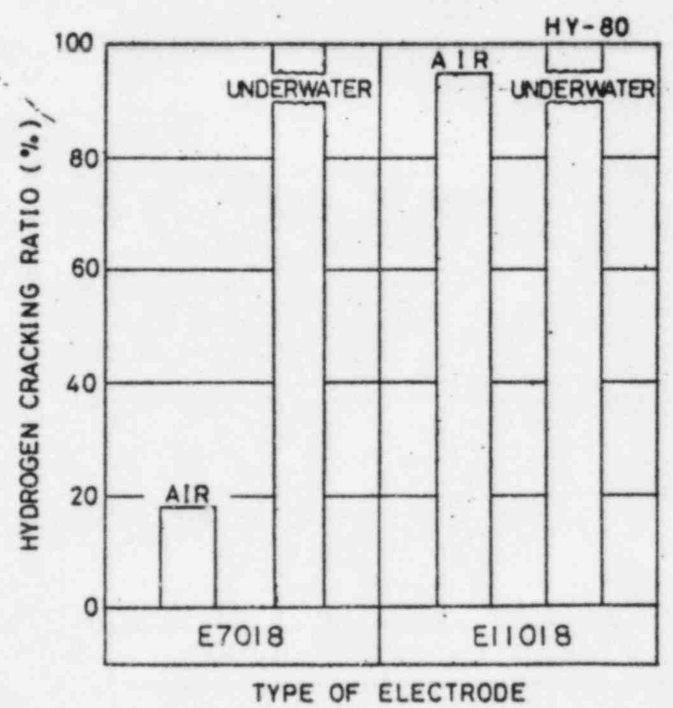


Fig. 13—Effect of an undermatched electrode on the hydrogen cracking susceptibility of HY-80 welds

Table 5—Effect of the Use of Austenitic Electrode on Cracking in Underwater Welds of HY-80 Steel

Type of electrode	Atmosphere	Hydrogen cracking ratio, %	Total cracking ratio, %
E11018	Air	95	100
	Underwater	100	100
E310-16 (25Cr-20Ni)	Air	1	10
	Underwater	21	100

Bouwman and Haverhals[12] carried out controlled thermal severity (CTS) tests on ST37, ST41, and ST52 steels. Among these steels, only ST52 steel cracked spasmodically. The present experimental results indicate that steels having a yield strength of more than 50 ksi (345 MPa) frequently experience hydrogen cracking when they are welded underwater.

As mentioned above, the 50 ksi yield strength class in steels is a critical one in which hydrogen cracking frequently occurs; the critical carbon equivalent (C.E.) is approximately 0.35 and the critical P_{cm} approximately 0.25 (see Table 1). This critical carbon equivalent value is lower than that proposed by Grubbs and Seth.

The critical cooling time (the cooling time necessary to produce a fully martensitic structure in steel welds) is another index useful in the prediction of cracking. Figure 12 illustrates the relationship between the critical cooling time (from 800 to 500°C or 1472 to 932 F) and the strength of various steels. The critical cooling time values were obtained from steels available commercially. In Fig. 12 the typical cooling time from 800 to 500 C of underwater welds is superimposed to be in the range of 2 to 4 seconds.[6,12,13]

In underwater welding, steels with a yield strength of more than 50 ksi (345 MPa) are likely to produce a fully martensitic structure. Only mild steel can be welded underwater without forming a martensitic structure. The tendency of this data agrees with that of cracking susceptibility.

Effect of Undermatched Electrodes

Satoh and Toyoda[7] demonstrated that the use of undermatched welding techniques effectively reduces the hydrogen-cracking susceptibility of air welds. The lower strength weld metal can absorb more strain than the higher strength weld metal, allowing the strain needed to cause cracking to be attenuated.

In addition, since the rapid quenching that takes place in underwater welding hardens the weld metal, it is not always necessary to use overmatched electrodes. Figure 13 shows how undermatched electrodes affect the hydrogen-cracking susceptibility of both air welds and underwater welds in HY-80 steel.

In the air welds, the cracking ratio of the weld metal made with E11018 is considerably higher than that with E7018. The effect of undermatched electrodes can be clearly seen. According to hardness measurements (Table 4) the hardness of the weld metal is approximately 400 DPH with E11018 and 350 DPH with E7018. This hardness difference may be responsible for the cracking ratio difference.

Since the underwater cracking ratio of both E11018 and E7018 is 100%, the use of E7018 is not effective, even though its hardness value is 50 DPH less than that of E11018.

Undermatched electrodes do not significantly affect underwater weld quality, even though they do affect air weld quality.

Effect of Austenitic Electrodes

The Welding Institute studied how austenitic electrodes affect the hydrogen cracking susceptibility of underwater welds.[6] They found that the use of austenitic electrodes reduced the susceptibility. Also, they found that many electrodes that produced austenitic weld metal in air welds produced martensitic weld metal in underwater welds due to the base metal dilution and the high quenching rate caused by the water environment, and hydrogen cracking was the result. It was also observed that all austenitic welds contained bands of hard martensite along the fusion boundaries.

Table 5 compares the hydrogen cracking ratio with the total cracking ratio of the welds made with E11018 and E310-16 electrodes.

The use of austenitic electrodes is apparently effective in reducing hydrogen cracking in both underwater and air welding. For instance, the underwater cracking ratio of E310-16 electrodes is 21%, much lower than that of E11018 electrodes (100%); in air welds the reduction of the cracking ratio is even more significant (from 95% to 1%). But the total cracking ratio value for both electrodes is 100%; the total cracking ratio cannot be reduced using either electrode.

Figure 14 shows a cross-section of a weld made using an austenitic elec trode; hot cracking is evident. The use of an austenitic electrode, therefore does not always minimize the crackin problem in underwater welds.

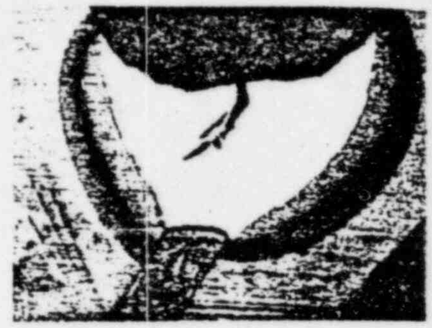


Fig. 14—Underwater weld made with E310-16 electrode in HY-80 Steel. Nital etch, ×8 (reduced 48% on reproduction)

Conclusions

1. No observable hydrogen crack were found in either underwater or ai welds in mild steel. The coating typ did not noticeably affect the wel integrity.

2. Underwater welds in hig strength steels cracked.

3. 50 ksi (yield strength) class stee was the border line case as far a hydrogen cracking was concerned.

4. Underwater welds in HY-80 stee cracked extensively.

5. The use of undermatchin techniques did not prevent cracking i HY-80 steel.

6. The use of an austenitic electrod (25Cr-20Ni stainless steel) reduce hydrogen cracking but increased h cracking.

Acknowledgments

The study on which this paper i based was partially supported by research contract entitled "Develop ment of New, Improved Techniques c Underwater Welding" for the Nationa Sea Grant Office of the Nationa Oceanic and Atmospheric Administra tion, Department of Commerce Matching funds were provided by group of Japanese companies.

The authors wish to thank Kawasa Heavy Industries, Ltd., especially D Toshio Yoshida, Executive Managin Director, and Dr. Kiyohide Terai, Ma ager of the Welding Research Labor tory, for their encouragement for th study. The authors would also like t thank Mr. Daniel Conley for his assi tance and General Dynamics Corpor tion Quincy Shipyard for providin materials.

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Special purchase of rod for a job in turbine building. Was not ASME, got into rod shack, has since been cleared up

Category 9, item 10

8/2/84 10 am
Bill ~~Baker~~ Project Welding Engr
Ted Blixt QE Grp Supv
Don Doyle QA
} Mtg with Hoa & Thompson

Foreman determines amount of rods drawn for a job.

Limited access can require much more rod because little is used.

~~Such~~ Undocumented welds [illegible] none ASME insofar as known - Baker

Baker Automatic termination of welder for unauthorized use of filler rod. [illegible]

Temporary hanger work also includes weld data card & records to withdraw & use filler metal

Tape on Welder training, perf, proc qual, etc.

Welder Orientation, includes 6,9 training & weld filler control education

Control stations issued rod from main storage area. These stations are under Piping Mech General Supt. monitored by WE (formal & documented).

Rods are bundled 25 or 50 to a bundle & normally issued in this manner.

Bill Baker to provide reference or copy of

Above notes taken during a conference on the subject of weld rod control

Category 9, AW-56, AQW-24

FOIA-85-59

Note Bill Wright later said not in writing to automatically terminate welder

310

M3[illegible]

Category 9, item 8

AW-56 (1)

Task # AW-56

7/13/84

1. Obtained a copy of CP-CPM 6.9B, Revision 1, 10/17/80, Weld Filler Metal Control. Para. 3.2.2 covers Rod Ovens. Stationary and portable rod ovens are temperature checked in accordance with certain requirements and a log is maintained. Temperature range is 250F - 350F. Low-hydrogen electrodes are segregated to maintain traceability by the classification, size, and heat/lot number when placed in a heated stationary or portable oven.

Para 3.3.2, Weld Filler Metal - Production Requirements restricts exposure of low-hydrogen electrodes to ambient conditions. E70xx, the most commonly used, has a maximum exposure time of 4 hours.

2. Telecon with Bill Wright on 7/13/84. Requirements for control of welding rods are specified in CP-CPM 6.9B Rev 1. New welders are given an indoctrination course which includes handling of low-hydrogen electrodes. Welding Technicians are required to overcheck each welder's operation at least once every 14 days and document results. Except for such overchecks, adhering to the maximum exposure time limits for low-hydrogen electrodes is largely dependent on the welder. *

* Was this the practice at time of allegation?

Ans. Present Practice

Category 9, Item 16

Comanche Peak Open Issue Action Plan

Task: Weld Rod Control

Ref. Nos.: AW-56, AQW-24, CPSES Issues

Characterization:

AW-56 alleged that welders were not keeping their rod cans plugged in. AQW-24 alleged that unauthorized weld filler metal was used to repair tube steel on a diesel generator. The CPSES issues, in summary, alleged that lax enforcement of weld rod control procedures resulted in a supply of uncontrolled electrodes with excessive exposure to ambient conditions.

Initial Assessment of Significance:

There appears to be sufficient specificity to warrant followup of these allegations. The safety significance is difficult to evaluate with the available information.

Source: Mechanical and Piping Allegations, Category 9

Approach to Resolution:

1. Review Gibbs & Hill Specifications for applicable codes, materials, welding requirements, etc.
2. Review weld filler material requirements of ASME B&PV Code and AWS D1.1 Structural Welding Code.
3. Review Brown & Root weld filler metal control procedure.
4. Review NRC Region IV reports.
5. Review ASME and ASTM material specifications.
6. Review ASLB testimony for additional information on allegations.
7. Spotcheck field welding activities and "rod shacks."
8. Obtain and review reports related to excessive exposure of coated electrodes to ambient conditions or high humidities.
9. Examine hardware involved, if possible.
10. Identify and review NCRs, inspection reports, and other documentation related to allegations.
11. Evaluate allegations for generic/safety implications.
12. Report on results of review/evaluation of allegations.

<u>Related Open Issues</u>:

1. Using system code from the tracking system open items, list and identify any open items.

2. Review activities necessary to close or partially close related items.

3. While performing physical inspections, examine surrounding system, components, and structures for any apparent defect or indicator of faulty workmanship.

4. Complete portion of IE module on welding if it relates to effort made on allegations.

Category 9, item 18

W77

Table 1—Electrode Classification

AWS Classification	Type of Covering	Capable of Producing Satisfactory Welds in Positions Shown[a]	Type of Current[c]
E70 Series—Minimum Tensile Strength of Deposited Metal, 70 000 psi			
E7010-X[b]	High cellulose sodium	F, V, OH, H	dc, reverse polarity
E7011-X	High cellulose potassium	F, V, OH, H	ac or dc, reverse polarity
E7015-X	Low hydrogen sodium	F, V, OH, H	dc, reverse polarity
E7016-X	Low hydrogen potassium	F, V, OH, H	ac or dc, reverse polarity
E7018-X	Iron powder, low hydrogen	F, V, OH, H	ac or dc, reverse polarity
E7020-X	High iron oxide	H-Fillets	ac or dc, straight polarity
		F	ac or dc, either polarity
E7027-X	Iron powder, iron oxide	H-Fillets	ac or dc, straight polarity
		F	ac or dc, either polarity
E80 Series—Minimum Tensile Strength of Deposited Metal, 80 000 psi			
E8010-X[b]	High cellulose sodium	F, V, OH, H	dc, reverse polarity
E8011-X	High cellulose potassium	F, V, OH, H	ac or dc, reverse polarity
E8013-X	High titania potassium	F, V, OH, H	ac or dc, either polarity
E8015-X	Low hydrogen sodium	F, V, OH, H	dc, reverse polarity
E8016-X	Low hydrogen potassium	F, V, OH, H	ac or dc, reverse polarity
E8018-X	Iron powder, low hydrogen	F, V, OH, H	ac or dc, reverse polarity
E90 Series—Minimum Tensile Strength of Deposited Metal, 90 000 psi			
E9010-X[b]	High cellulose sodium	F, V, OH, H	dc, reverse polarity
E9011-X	High cellulose potassium	F, V, OH, H	ac or dc, reverse polarity
E9013-X	High titania potassium	F, V, OH, H	ac or dc, either polarity
E9015-X	Low hydrogen sodium	F, V, OH, H	dc, reverse polarity
E9016-X	Low hydrogen potassium	F, V, OH, H	ac or dc, reverse polarity
E9018-X	Iron powder, low hydrogen	F, V, OH, H	ac or dc, reverse polarity
E100 Series—Minimum Tensile Strength of Deposited Metal, 100 000 psi			
E10010-X[b]	High cellulose sodium	F, V, OH, H	dc, reverse polarity
E10011-X	High cellulose potassium	F, V, OH, H	ac or dc, reverse polarity
E10013-X	High titania potassium	F, V, OH, H	ac or dc, either polarity
E10015-X	Low hydrogen sodium	F, V, OH, H	dc, reverse polarity
E10016-X	Low hydrogen potassium	F, V, OH, H	ac or dc, reverse polarity
E10018-X	Iron powder, low hydrogen	F, V, OH, H	ac or dc, reverse polarity
E110 Series—Minimum Tensile Strength of Deposited Metal, 110 000 psi			
E11015-X[b]	Low hydrogen sodium	F, V, OH, H	dc, reverse polarity
E11016-X	Low hydrogen potassium	F, V, OH, H	ac or dc, reverse polarity
E11018-X	Iron powder, low hydrogen	F, V, OH, H	ac or dc, reverse polarity
E120 Series—Minimum Tensile Strength of Deposited Metal, 120 000 psi			
E12015-X[b]	Low hydrogen sodium	F, V, OH, H	dc, reverse polarity
E12016-X	Low hydrogen potassium	F, V, OH, H	ac or dc, reverse polarity
E12018-X	Iron powder, low hydrogen	F, V, OH, H	ac or dc, reverse polarity

[a] The abbreviations F, V, OH, H, and H-Fillets indicate welding positions (Figs. 1 and 2) as follows:
F = Flat
H = Horizontal
H-Fillets = Horizontal Fillets
V = Vertical
OH = Overhead
} For electrodes 3/16 in. and under, except 5/32 in. and under, for Classifications EXX15-X, EXX16-X, and EXX18-X.

[b] The letter suffix "-X" as used in this table stands for the suffixes A1, B1, B2, etc. (see Table 2) and designates the chemical composition of the deposited weld metal.

[c] Reverse polarity means electrode is positive, straight polarity means electrode is negative.

FOIA-85-59 M312

Table 2—Chemical Requirements

AWS Classification[a]	Chemical Composition, per cent[d]							
	Carbon	Manganese	Phosphorus	Sulfur	Silicon	Nickel	Chromium	Molybdenum	Vanadium
CARBON-MOLYBDENUM STEEL ELECTRODES									
E7010-A1		0.60			0.40				
E7011-A1		0.60			0.40				
E7015-A1		0.90			0.60				
E7016-A1	0.12	0.90	0.03	0.04	0.60	...	...	0.40 to 0.65	...
E7018-A1		0.90			0.80				
E7020-A1		0.60			0.40				
E7027-A1		1.00			0.40				
CHROMIUM-MOLYBDENUM STEEL ELECTRODES									
E8016-B1	0.12	0.90	0.03	0.04	0.60	...	0.40 to 0.65	0.40 to 0.65	...
E8018-B1					0.80				
E8015-B2L	0.05	0.90	0.03	0.04	1.00	...	1.00 to 1.50	0.40 to 0.65	...
E8016-B2	0.12	0.90	0.03	0.04	0.60	...	1.00 to 1.50	0.40 to 0.65	...
E8018-B2					0.80				
E8018-B2L	0.05	0.90	0.03	0.04	0.80	...	1.00 to 1.50	0.40 to 0.65	...
E9015-B3L	0.05	0.90	0.03	0.04	1.00	...	2.00 to 2.50	0.90 to 1.20	...
E9015-B3					0.60				
E9016-B3	0.12	0.90	0.03	0.04	0.60	...	2.00 to 2.50	0.90 to 1.20	...
E9018-B3					0.80				
E9018-B3L	0.05	0.90	0.03	0.04	0.80	...	2.00 to 2.50	0.90 to 1.20	...
E8015-B4L	0.05	0.90	0.03	0.04	1.00	...	1.75 to 2.25	0.40 to 0.65	...
E8016-B5	0.07 to 0.15	0.40 to 0.70	0.03	0.04	0.30 to 0.60	...	0.40 to 0.60	1.00 to 1.25	0.05
NICKEL STEEL ELECTRODES									
E8016-C1	0.12	1.20	0.03	0.04	0.60	2.00 to 2.75	...	...	...
E8018-C1					0.80				
E8016-C2	0.12	1.20	0.03	0.04	0.60	3.00 to 3.75	...	...	...
E8018-C2					0.80				
E8016-C3[b]	0.12	0.40 to 1.25	0.030	0.030	0.80	0.80 to 1.10	0.15	0.35	0.05
E8018-C3[b]									
MANGANESE-MOLYBDENUM STEEL ELECTRODES									
E9015-D1	0.12	1.25 to 1.75	0.03	0.04	0.60	...	...	0.25 to 0.45	...
E9018-D1					0.80				
E10015-D2					0.60				
E10016-D2	0.15	1.65 to 2.00	0.03	0.04	0.60	...	...	0.25 to 0.45	...
E10018-D2					0.80				
ALL OTHER LOW-ALLOY STEEL ELECTRODES[e]									
EXX10-G									
EXX11-G									
EXX13-G									
EXX15-G	...	1.00 min[c]	...	...	0.80 min[c]	0.50 min[c]	0.30 min[c]	0.20 min[c]	0.10 min[c]
EXX16-G									
EXX18-G									
E7020-G									
E9018-M[b]	0.10	0.60 to 1.25	0.030	0.030	0.80	1.40 to 1.80	0.15	0.35	0.05
E10018-M[b]	0.10	0.75 to 1.70	0.030	0.030	0.60	1.40 to 2.10	0.35	0.25 to 0.50	0.05
E11018-M[b]	0.10	1.30 to 1.80	0.030	0.030	0.60	1.25 to 2.50	0.40	0.25 to 0.50	0.05
E12018-M[b]	0.10	1.30 to 2.25	0.030	0.030	0.60	1.75 to 2.50	0.30 to 1.50	0.30 to 0.55	0.05

NOTE—Single values shown are maximum percentages, except where otherwise specified.

[a] The suffixes A1, B3, C2, etc. designate the chemical composition of the electrode classification.

[b] These classifications are intended to conform to classifications covered by the military specifications for similar compositions. See Note under A1.5.1.3 in Appendix A1.

[c] In order to meet the alloy requirements of the G group, the weld deposit need have the minimum, as specified in the table, of only one of the elements listed.

[d] For determining the chemical composition, dc, straight polarity only, may be used where dc, both polarities, is specified.

[e] The letters "XX" used in the classification designations in this table stand for the various strength levels (70, 80, 90, 100, 110, and 120) of electrodes.

Category 9, item 19
Thompson

undated

REPORT ON

OVER EXPOSED E7018 ELECTRODE

FOIA-85-59 313

Welding at CPSES is performed to the requirements of several fabrication codes, i.e., AWS D1.1, ANSI B31.1, ASME Section III, Subsections NB, NC, ND, and NF, all of which may differ in the requirements for the purchase, storage, control, and documentation of weld filler material.

An effective filler material program must be formulated in such a manner as to assure that the filler material issued for a particular application meets all of the requirements of the governing code and design specification for that application. Consideration must also be given to the human element involved and realization that regardless of the rules, checks, and verifications put forth, mistakes can and will be made. Therefore, the program must have procedures, with specific methods and verifications, which minimize the chance for undetected errors. It must also contain the conservativeness that takes into account an undetected error and the worst case results of such an error as it pertains to the weldment.

The filler material program at CPSES was formulated and is implemented in this manner. In order to minimize the chance of error as it pertains to the issuance of correct filler material for the governing fabrication code all filler material is purchased, stored, and issued in the same manner, regardless of the fabrication code governing the intended use. This is permitted by the practice of adopting the most stringent requirement contained in any of the referenced codes for a specific item or type of filler material. This assures that upon issuance the material has the required testing and certification to meet the requirements of any of the fabrication codes being utilized for the type of material issued. The chances of error are further reduced by the fact that only one type of electrode (E7018) is issued for the welding of low carbon and mild steels using the shielded metal arc process. The use of this electrode which far exceeds the mechanical properties required for the welding of most of the structural steel used at CPSES is an important item in explaining the conservativeness of the program, and a detailed description of the benefits of this practice will be included in another section of this report.

Weld Filler Metal Control at CPSES is governed by Construction Procedure CPM 6.9B. Each new welder is given an orientation as to the requirements of this procedure by Welding Engineering after successful completion of qualification testing and prior to being released for production welding. The importance of filler material control at a Nuclear Facility is explained to the welder and they are informed that any willful violation of the procedure would result in immediate termination. The orientation is documented and signed by the welder.

The nucleus for filler metal issuance is the Weld Filler Material Log (WFML). No filler material is issued to anyone until they present a properly filled out WFML to the material distribution attendent. The WFML contains the type of material requested, amount requested, the welding procedure with which it will be used, the welders identification symbol, and the intended use of the material. Issuance approval is signed by the responsible foreman. Upon receiving the WFML, the distribution station attendant enters on the WFML the amount of material issued and the heat number of the material. The attendant also checks the welders symbol against the Welder Qualification Matrix to assure that the welder is qualified for the Welding Procedure listed and verifies that the material requested is the correct type for use with the procedure.

All filler material is issued in a numbered container. Bare wire in a leather pouch, covered electrode in a portable rod oven. Each time material is issued, the number of the container, the welders symbol, and time of issuance is entered in a log which is maintained for this purpose.

When the containers are returned the amount of unused filler material is counted and entered on the WFML. Rod stubs are also counted.

The degree to which filler material can be traced to a specific item through the WFML varies in accordance with the documentation requirements of the item. For all piping welds with the exception of 2" and under field run pipe, the filler material is issued against the individual weld by number. The same is true of class one pipe supports. On all other supports, the material is traceable to the support by number. For miscellaneous steel applications not requiring documentation, the filler material is issued against the drawing which may contain several items.

It should be pointed out that of all the Fabrication Codes used at CPSES, ASME is the only one which requires traceability of filler material. The use of the WFML for issuance of filler material for other than ASME applications is strictly to control the issuance and return of unused material.

Adherence to the control procedure is verified during various scheduled inspections and reviews, as indicated below.

	Fit-up Insp.	Final Insp.	Random Monitering	Scheduled Surveillance	Doc. Review
ASME NB,NC,ND	QC	QC	WE/QC	WE	WE/QE/ANI
ASME NF	*	QC	WE/QC	WE	WE/QE/ANI
BOP Pipe Non RWMS	WE	WE	WE	WE	WE/BOP Records
Seismic Supports	*	QC	QC/WE	WE	QE/WE
Seismic Misc. Steel	*	QC	QC/WE	WE	QE/WE
Non-seismic Misc. Steel			WE	WE	WE/BOP Records

* <u>QC IF BUTT WELDS</u>

The program as described contains the necessary procedures, training, and instruction to adequately control the use of weld filler material and the verifications to assure that the procedures are being followed.

Although violations of the procedure can and occasionally do occur, the frequency is minimal and we are confident that these violations are identified either through field verifications by QC and Welding Engineering or subsequent document reviews. Once identified each violation is thoroughly investigated and appropriate corrective action taken.

Consideration has also been given to the possibility of an undetected violation. Due to specification requirements that all welds on low alloy materials, including Non-Q applications, be documented on Weld Data Cards or Operational Travelers with inspection hold points, the probability of such an occurance is reduced to the welding of low carbon or mild steel.

All low carbon & mild steels (P-1) welded at CPSES utilizing the shielded metal arc process (SMA) in accordance with Brown & Root Welding Procedures are welded with E7018 electrode. These steels have a specified minimum tensile strength requirement ranging from 45 KSI to 70 KSI. The bulk of the structural steel used for pipe supports and miscellaneous steel fabrication have a minimum tensile strength of 58-60 KSI while the piping materials require 70 KSI.

E7018 Electrode has a specified minimum tensile strength requirement of 70 KSI. In actual test on this material performed for certification the average actual tensile strength of the filler material is 83 KSI.

This filler material which is classified as a "low hydrogen" type of electrode has coatings low in hydrogen content. They were developed for the welding of hardenable steels in which electrodes, other than low hydrogen type, produce a phenomenon known as "underbead cracking" and is caused by the hydrogen absorbed from the arc atmosphere. This cracking does not occur in low carbon and mild steel.

The reasons for the selection of this type of electrode for the welding of carbon steels are that they meet or exceed the tensile requirements of any of the carbon or mild steels being used, has excellent impact properties for those critical systems requiring impact values, has a high deposit rate, excellent appearance with very little spatter, easy slag removal, and produces excellent X-ray quality welds.

The exposure limits set forth in the Brown & Root filler metal control procedure for E7018 electrode is four (4) hours. This is the maximum time by procedure that the electrode may be left out of a heated container. The electrode manufacture for the electrode used at CPSES has published reports based on controlled testing that this electrode can be exposed for 72 hours or more at 90°F and 70% humidity and stay below 0.4% moisture content. The ASME specification for E7018 specifies a moisture content of 0.6 or less.

The effects of moisture in excess of that specified for welds in low carbon and mild steels are as follows:

1) A small amount of moisture may cause internal porosity. Detection of this condition requires X-ray inspection or destructive testing.
   Internal porosity is detrimental only to the extent that it reduces the area of the cross section of the weld. The code allowances for stress calculations for welds not requiring volumetric inspection are formulated with the conservatism to provide for this type of undetected discontinuity.

2) A relatively high amount of moisture causes visable external porosity in addition to internal porosity.
   Porosity open to the surface which is excessive in size and amounts to that allowed by codes may reduce the fatique strength of welds subject to cyclic loadings. As all welds at CPSES receive a surface examination as a minimum, this type of porosity would be identified and reduced to acceptable limits.

3) Severe moisture pickup can cause weld cracks in addition to severe porosity, poor appearance and slag problems.
   Again these types of defects are detectable by visual means and would be removed and corrected.

Although it was deemed necessary to this report to describe the effects of moisture in a low hydrogen electrode it is also fitting to put this into the proper prospective by conducting tests utilizing electrode that had been exposed to the atmosphere for long periods of time. To do this, we selected E7018 electrode that had been forwarded to the Welding Qualification & Training Center from the Material Distribution Center due to over exposure. This electrode had been stored in the WQTC for seven months in an open container and open to the atmosphere of an unheated or cooled shop.

Test specimens were prepared by welding a one inch thick plate of material type SA-36 utilizing a full penetration butt weld. Prior to machining specimens for destructive testing, the entire weld was radiographed. The following results were obtained:

Radiographs	- Clear - No Visable Defects
Bend Tests	- Specimen #1 - No Visable Defects/Acceptable
	- Specimen #2 - No Visable Defects/Acceptable
	- Specimen #3 - 1/32" Indication/Acceptable
	- Specimen #4 - 2-1/32" Indication/Acceptable
Tensile Tests	- Specimen #1 - 73 KSI Failure in Base Metal
	- Specimen #2 - 74.5 KSI Failure in Base Metal

In summary, the fabrication codes would permit the entire mild steel structural fabrication of CPSES to be made with non low hydrogen electrodes not subject to the storage and issuance restrictions of low hydrogen type electrodes. This fact, substantiated by the referenced testing, conclude that the use of E7018 electrode for this appplication is ultra conservative and even that which has exceeded the specified exposure limits for long periods of time will produce welds with a significantly higher strength level than the base material.

In conclusion the facts presented here establish evidence that the necessary checks and balances are present within the filler material program at CPSES to assure to the highest degree that the controls as set forth in the procedure are being adhered to and violations identified. It has also been demonstrated that on a worse case basis, should a violation remain undetected, the program includes the conservativeness to prevent a resulting weld failure.

Brown & Root, Inc.

RF-103.20-08

MATERIALS ENGINEERING LABORATORY

TENSILE TESTING LOG Tested in accordance with ASME Section II SA370 1974

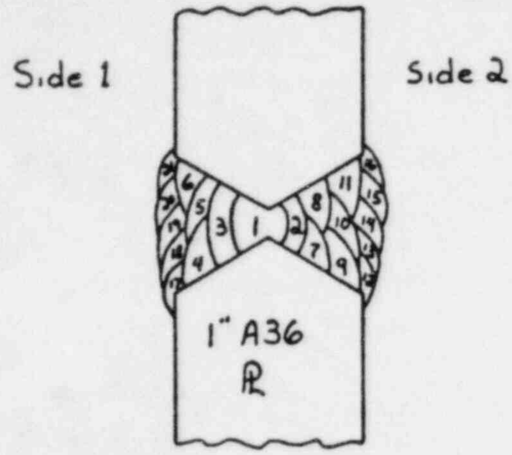
LABORATORY TEST NO. CP 10-11-83

WORK ORDER NUMBER N/A

TEST TECHNICIAN H. Porter [signature] 10/11/83

DATE October 11, 1983

SPECIMEN NO	SIZE	AREA	YIELD LOAD	ULTIMATE LOAD	YIELD STRENGTH (PSI)	TENSILE STRENGTH (PSI)	% EL.	R.A. DIA.	% R.A.	FRACTURE LOCATION
#1	1.519	1.369	N/A	99940	N/A	73000	N/A	N/A	N/A	Base Metal
	.901									
#2	1.497	1.332	N/A	99240	N/A	74500	N/A	N/A	N/A	Base Metal
	.890									



Tension Test
Filler Material: 1/8" E7018
Ht. no.: 53122
Lot no.: 026B226
Lab Report: CP 10-11-83
Specimen no.: 1 & 2

Welded in accordance with WPS 11032 Rev. 11.

Approximate bead sequence SPECIMEN # 1

PASS	ROD SIZE	AMPS	VOLTS	TRAVEL	BEAD WIDTH	MAX INTERPASS TEMP	COMMENTS
1	1/8	140	23	2.6	3/8"	Preheat 70°F	
2	1/8	150	23	6.0	3/8"	200°	
3	1/8	150	23	5.0	1/2"	220°	
4	1/8	150	23	6.5	3/8"	350°	
5	1/8	150	23	6.5	3/8"	340°	
6	1/8	150	23	4.5	1/2"	350°	
7	1/8	150	23	7.0	3/8"	360°	
8	1/8	150	23	3.0	1/2"	400°	
9	1/8	150	23	7.0	5/16"	340°	
10	1/8	150	23	7.0	3/8"	380°	
11	1/8	150	23	5.5	1/2"	410°	
12	1/8	150	23	7.0	3/8"	120°	
13	1/8	150	23	7.0	3/8"	180°	
14	1/8	150	23	7.0	3/8"	220°	
15	1/8	150	23	7.0	3/8"	250°	
16	1/8	145	22	7.0	3/8"	290°	
17	1/8	150	23	7.0	3/8"	240°	
18	1/8	150	23	7.0	3/8"	275°	

SPECIMEN # 1

PASS	ROD SIZE	AMPS	VOLTS	TRAVEL	BEAD WIDTH	MAX INTERPASS TEMP	COMMENTS
19	1/8	150	23	7.0	3/8"	335°	
20	1/8	150	23	6.5	3/8"	350°	
21	1/8	140	22	7.0	3/8"	380°	

Brown & Root, Inc. HOUSTON, TEXAS

WELDING PROCEDURE QUALIFICATION TESTS PERFORMED AND RESULTS

~~Lab Report~~ No. Ht.# 53122 ~~Coupon 1+2~~ TEST #1 10/11/83
Date

	ACCEPT	REJECT
1. Tensile: Figure No. QW-462.1 (a) No. CP-10-11-83 Report - UTS, % Elongation	✓	
2. Bend: Figure No. QW-462.2 (a) SB(✓) FB/RB( ) Report - Results	✓	
3. CVN: Figure No. N/A Size ______ Test Temperature ______ °F Report ______ Base Metal		
Ft-lbs / MLE / % Shear ______ HAZ		
______ Weld Metal		
4. Macro Section: a. Inspection at N/A b. Hardness Traverse		
5. Microfissure Check: a. Inspection at N/A of bend Specimens.		
6. Sensitization Test: a. Test Method N/A Number of Specimens ______		
7. NDE. Type RT Code ASME IX - QW-191	✓	
Type ______ Code ______		
8. Other Tests		

9. Comments

Jimmy White — 10/12/83
Welding Engineer — Date

W.P. Baker — 10/13/83
Project Welding Engr. — Date

BROWN & ROOT, INC.

QUALITY ASSURANCE DEPARTMENT

WELDER QUALIFICATION NDE RADIOGRAPHIC REPORT

SERIAL NUMBER WQRT — 7575

PROJECT COMANCHE PEAK JOB NO 35-1195 UNIT N/A PAGE 1 OF 1

WELDER NAME	SOCIAL SECURITY NO.	SYMBOL
Fred Nichols	463-74-9587	ANO

WELD PROCEDURE SPECIFICATION: Weld Metal test specimen Heat # 53122 Lot # 0768226 POSITION: 2G

MTL. TYPE	MTL. THICK.	DIA./LENGTH	(PIPE) DIA.	(PLATE - LONG SEAM) LENGTH
ASTM A36	1.00"	12"		

STAGE OF MFG.: ☐ REPAIR ROOT ☐ INTERMEDIATE ☐ FINAL ☑

JOINT DESIGN: Double Welded — BRN. BKS. ☐ OPEN BUTT ☐

X-RAY

MAKE: N/A (struck through) KVP. M.A. FOCAL SPOT SIZE

FILM MFG. EKC ASTM CLASS 1☑ 2☐

FFD. 29"

ISOTOPE

IRIDIUM 192 ☑ COBALT 60 ☐

SIZE DIA. 1/10 LENGTH 1/10

CURIES 55

LOADED 1☐ 2☑ OTHER ☐

EXPOSURE TIME MIN. 18 SEC. 0

LEAD SCREENS

FRONT	CENTER	BACK
.005 ☐		☐ .005
.010 ☑	NA	☑ .010

TECHNIQUE T 1A (if not standard, attach sketch)

UNSHARPNESS

$Ug = \frac{Ft}{d}$

F = ___" t = ___" d = ___" Ug = ✓

PENETRAMETER SIZE 20 MTL. SS ASTM ☑ ASME ☐

PENETRAMETER SOURCE SIDE ☑ FILM SIDE ☐

SHIM MTL. SS THICK .090

NDE PROCEDURE CP-QI-QAP-10.2-3 Rev. 4

RADIOGRAPHER	CERTIFICATION LEVEL	RT COMPANY
Pendergrass, Lunsford	II, II	B+R

VIEWING SINGLE ☑ COMPOSITE ☐ RT DATE 10/7/83 ACCEPTANCE STANDARD CP-QI-QAP-10.2-3 Rev. 4

LOCATION MARKERS	SENSITIVITY	DENSITY WELD	DENSITY PENETRAMETER	ACCEPT	REJECT	CRACK	ROOT CONCAVITY	ROOT CONVEXITY	ROOT CREASE	MELT THROUGH	CRATER PIT/CRACK	ROOT UNDERCUT	POROSITY	SLAG INCL	TUNGSTEN	INCOMPLETE PENET.	INCOMPLETE FUSION	UNDERCUT	BURN-THRU	SURFACE DEFEATS	UNCOM. INSERT	REMARKS
0-2	2T	260	248	✓																		Porosity at end and start OK

B&R INTERPRETER	CERTIFICATION LEVEL
D R Dodson	III

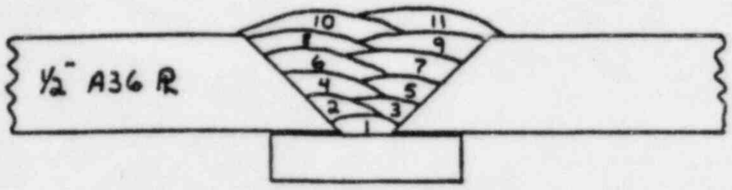
FILM EVALUATION DATE 10/8/83 COMMENTS

SUPERVISOR WELD TRAINING CENTER REVIEW DATE / /

CP-QA-504-0

All Weld Metal Tension Test
Filler Material: 1/8" E7018
Ht. no.: 53122
Lot no.: 026B226
Lab Report: CP 11-3-83
Specimen no.: 5

Welded in accordance with WPS 11032 Rev. 11 and SFA 5.1.



Approximate bead sequence

SPECIMEN # 1G

PAGE 1 OF 1

PASS	ROD SIZE	AMPS	VOLTS	TRAVEL	BEAD WIDTH	MAX INTERPASS TEMP	COMMENTS
1	1/8	145	22	5"	3/8"	Preheat 70°	
2	1/8	145	23	6 1/2"	3/8"	200°	
3	1/8	145	22	6"	3/8"	270°	
4	1/8	145	22	4 1/2"	1/2"	325°	
5	1/8	140	22	5 1/2"	1/2"	300°	
6	1/8	145	22	4"	5/8"	310°	
7	1/8	145	22	4"	5/8"	325°	
8	1/8	145	22	3 1/2"	3/4"	320°	
9	1/8	150	23	5 1/2"	5/8"	325°	
10	1/8	150	22	4 1/2"	3/4"	300°	
11	1/8	150	22	4 1/2"	3/4"	300°	

Brown & Root, Inc.

MATERIALS ENGINEERING LABORATORY
TENSILE TESTING LOG   Tested in accordance with ASME Section II SA370 1974

RF-103.20-08

LABORATORY TEST NO. CP 11-3-83   WORK ORDER NUMBER N/A

TEST TECHNICIAN H. Porter *[signature] 11/3/83*   DATE November 3, 1983

SPECIMEN NO.	SIZE	AREA	YIELD LOAD	ULTIMATE LOAD	YIELD STRENGTH (PSI)	TENSILE STRENGTH (PSI)	% EL.	R.A. DIA.	% R.A.	FRACTURE LOCATION
#1	1.497	.4031	18400	24140	45646	59885	N/A	N/A	N/A	N/A
	.343									
#2	1.494	.4437	20340	30120	45841	67883	N/A	N/A	N/A	Weld Metal
	.297									
#3	1.497	.4431	20100	30930	45362	69803	N/A	N/A	N/A	Base Metal
	.296									
#4	1.497	.4566	21000	30700	45992	67236	N/A	N/A	N/A	N/A
	.305									
#5	.250 Dia.	.04909	N/A	3555	N/A	72418	N/A	N/A	N/A	N/A

CONTROLLED COPY

COMANCHE PEAK NUCLEAR POWER PLANT
ALLEGATIONS AND/OR INVESTIGATIONS SUMMARY

TASK NO.	ALLEGATION OR CONCERN	ACTION/STATUS	SOURCE ANON	SOURCE CONFID	BN/DATE	CROSS REF./OR TRACKING SYSTEM NO.	COMPLETION CATEGORY 1-7 LEAD	SCHEDULE OPEN	SCHEDULE COMPLETE	ALLEGER-DATE RECEIVED SOURCE DOCUMENT PAGE
AQW-24	Weld rod control					HW-1	1 ART			84-006 3/7/84 A-4, P. 12 ✓
AQW-25	Weld Data Card Lost						1 ART			84-006 3/7/84 A-21 Testimony, P. 13, 15, 16
AQW-26	Unauthorized welding on rebar						1 ART			84-006; 3/7/84; A-4, Testimony, P. 70-71
AQW-27	Liquid pentrant materials improperly certified	Initial disposition IR 82-18, 82-09 IR 82-11 IR 83-10, 83-01 As discussed in IR 83-24					1 ART			CASE ltr 3/18/83 to ASLB
AQW-28	Craft would satisfy a CMC on an inadequate weld by welding over it instead of following the procedure of cutting it out then welding	Ltr to Applicant 4/24/84 Response due 5/25/84		X			1 ART			A-3 Statement
AQW-29	Undocumented weld repairs Modifications were made to material, such as a hanger, after QC had approved it.	Ltr to Applicant 4/24/84 Response due 5/25/84		X			1 ART			A-3 Statement

FOIA-85-59

Category 9, item 21

M 314

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CONTROLLED COPY

COMANCHE PEAK NUCLEAR POWER PLANT
ALLEGATIONS AND/OR INVESTIGATIONS SUMMARY

TASK NO.	ALLEGATION OR CONCERN	ACTION/STATUS	SOURCE ANON	SOURCE CONFID	BN/DATE	CROSS REF./OR TRACKING SYSTEM NO.	COMPLETION CATEGORY 1-7 LEAD	SCHEDULE OPEN	SCHEDULE COMPLETE	ALLEGER-DATE RECEIVED SOURCE DOCUMENT PAGE
AW-55	Holes are drilled in various types of pipe supports, cable tray supports, and plates, and when they are found to have been drilled in the incorrect location the holes are filled, utilizing illegal plug welds	Initial disposition IR-81-12					1 ART			8/7/81 IR-81-12 P. 3, #2
AW-56	Welders are not keeping their rod cans plugged in during the work day	Initial disposition IR-81-12					1 ART			8/7/81 IR-81-12 P. 3, #6
AW-57	Concern regarding quality of welding of NPS Industries (NPSI) Pipe Whip Restraints	IR 82-14					1 ART			A-45, 7/30/82 Testimony, IR 82-14 P. 2,#2
AW-58	3 pipe support fillet welds were fit-up and welded with excessive gap	Initial disposition IR 83-07					1 ART			Unknown IR 83-07 P.3, #2

CONTROLLED COPY

COMANCHE PEAK NUCLEAR POWER PLANT
ALLEGATIONS AND/OR INVESTIGATIONS SUMMARY

TASK NO.	ALLEGATION OR CONCERN	ACTION/STATUS	SOURCE ANON	SOURCE CONFID	BN/DATE	CROSS REF./OR TRACKING SYSTEM NO.	COMPLETION CATEGORY 1-7 LEAD	SCHEDULE OPEN	SCHEDULE COMPLETE	ALLEGER-DATE RECEIVED SOURCE DOCUMENT PAGE
AQW-24	Weld rod control					IW-1	1 ART			84-006 3/7/84 ✓ A-4, P. 12
AQW-25	Weld Data Card Lost						1 ART			84-006 3/7/84 A-21 Testimony, P. 13, 15, 16
AQW-26	Unauthorized welding on rebar						1 ART			84-006; 3/7/84; A-4, Testimony, P. 70-71
AQW-27	Liquid pentrant materials improperly certified	Initial disposition IR 82-18, 82-09 IR 82-11 IR 83-10, 83-01 As discussed in IR 83-24					1 ART			CASE ltr 3/18/83 to ASLB
AQW-28	Craft would satisfy a CMC on an inadequate weld by welding over it instead of following the procedure of cutting it out then welding	Ltr to Applicant 4/24/84 Response due 5/25/84		X			1 ART			A-3 Statement
AQW-29	Undocumented weld repairs Modifications were made to material, such as a hanger, after QC had approved it.	Ltr to Applicant 4/24/84 Response due 5/25/84		X			1 ART			A-3 Statement

FOIA-85-59

Category 9, item 21

M 314

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Category 10, APS item 3 — Thompson

BROWN & ROOT, INC. CPSES	INSTRUCTION NUMBER	REVISION	ISSUE DATE	PAGE
	QI-QAP-11.1-26	0	1-3-80	1 of 40
ASME PIPING & WELDING INSPECTIONS	APPROVED BY: [signature]		1/3/80 DATE	

Note: N/A

1.0 REFERENCES

1-A QA Personnel Training Manual
1-B WES-16, "Schedule of Standard Test Welder Qualification Matrix and Welder Performed Qualification Log"
1-C QI-QAP-11.1-22, "Cleanliness Control"
1-D VT-NDEP, "Visual Examiniation"
1-E G&H Specification, MS-100, "Piping Erection Specification"
1-F G&H Specification, MS-43B, "Piping Nuclear (Shop Fabrication)"
1-G CP-NDEP-000, "Marking Requirements for NDE"

2.0 PURPOSE

To outline QC inspection activities for welding during site fabrication and installation of ASME piping.

3.0 INSTRUCTIONS

3.1 VERIFICATION PRIOR TO FABRICATION/INSTALLATION

INFORMATION COPY

The QC Inspector shall verify that the documentation to be used in fabrication or installation corresponds to the revision of the construction drawings that are part of the documentation package.

Welder qualification shall be verified on a random basis by consulting the "Welder Qualification Matrix" at Weld Filler Material Log entries. This shall be performed at fit-up.

3.2 DOCUMENTING WELD INSPECTIONS

Upon verification, witnessing, or monitoring that an operation or the results of an inspection are acceptable, the QC Inspector shall initial, or sign and date the applicable documentation in the space provided. Work may not proceed beyond an established QC or ANI hold point until it is witnessed, monitored, or verified, or where permitted for an ANI inspection point, waived. ANI inspection points will be waived by the ANI in writing.

The NDE Procedure and revision date shall be entered on the applicable Weld Data Card by the QC Inspector. For RT and UT, the NDE report number should also be entered in the blank block to the right of the UT-NDEP space.

FOIA-85-59

M323

Fillet welds used for attaching slip-on flanges shall have a minimum leg size of 1.4 times the nominal thickness of the pipe wall, but not less than 1/8 inch.

Fitting to fitting socket welds sizes (i.e. reducing insert to socket welded "T") shall be approximately equal to the socket lip dimension unless directed otherwise by the PWE.

Undercuts shall not exceed 1/32 inch and shall not encroach on the required section thickness.

3.18 FINAL NONDESTRUCTIVE EXAMINATION

When final NDE is required other than visual examination, it shall be performed subsequent to any required PWHT.

When NDE is required other than visual, the craft foremen will complete a "Request for NDE" form for welds requiring radiography and/or ultrasonic examination and forward it to the NDE supervisor. NDE is to be performed by the B&R QC Department in accordance with their procedures.

3.19 PIPING SUBASSEMBLY FINAL SURFACE AND DIMENSIONAL EXAMINATION

The Pipe Fabrication Shop QC Inspector shall make a final examination of the entire surface of the piping subassembly. This shall include verification of marking (correct, legible and traceable to the corresponding documentation) and final dimensions and configuration of the items at the time such measurements are taken by the craft personnel.

When required by the Manufacturing Record Sheet, QC Inspector shall verify that the subassembly is clean to the extent that no contamination is visible to a person with normal visual acuity. All external and internal surfaces shall be free of purge dams, mill scale, organic coatings, grease, oil and debris.

3.20 REPAIRING OF WELD AND BASE METAL DEFECTS

Welds and base metal defects shall be repaired as dispositioned by the Project Welding Engineer, who will generate the required documentation for all repairs.

After performing base metal repairs, the repaired area shall be [redacted] as required by Attachment 11 as supplemented by the PWE.

Any RT's after weld prep repairs exceeding the lesser of 3/8" or 10% of the section thickness may be accomplished after the completion of the joint when final RT is required by applicable specifications.

If a major repair is performed on an item (using a Repair Process Sheet, Attachment 12) that has been previously pressure tested, then a re-test, in accordance with applicable codes and specifications, of the repaired area is necessary.

The QC NDE Inspector will mark the repaired area, when practical with a "Nissen Ink Marker" showing a circle around the area and and the repair number after the visual examination is complete. In addition, major base metal repairs on the inside surface of an item shall be located and marked on the outside surface. The marking is to facilitate inspection during the pressure test. For any additional marking requirements, see Reference 1-G.

3.21 POST WELD HEAT TREATMENT

All PWHT to ASME Section III and ANSI B31.1 requirements is the responsibility of the Pipe Superintendent.

The cognizant QC Inspector shall verify acceptable completion of PWHT within the parameters of this Procedure and document such in the "Post Weld Heat Treatment Checklist" (Attachment ::).

Upon acceptable completion of PWHT to the requirements of this section, the applicable WDC and the "Final Approval" stamp on the PWHT chart may be accepted.

3.21.1 HEATING METHOD

The method of heating and cooling for PWHT shall be accomplished by resistance, furnance or induction heating for all pipe diameter greater than 2" nominal.

3.21.2 TIME AND TEMPERATURE REQUIREMENTS

The holding times and temperatures shall be in accordance with the Table I, unless specified otherwise by Welding Engineering.

The metal temperature shall be maintained within the temperature ranges specified for the minimum holding times (Reference: Applicable WPS).

INFORMATION COPY PPRV

ATTACHMENT 11

Required Examination, QC Hold Points and Approvals Required for Repairs

Repairs / Base Metal Defects	Defect Removal	Repair Cavity PT	Repair Cavity MT	Repair Cavity UT	VT/Mech Meas	Completed Repair PT	Completed Repair MT	Completed Repair RT	Completed Repair VT	Completed Repair UT	Required Approvals PME	TUSI	PWE	ANI	G&H	Manufacturer
(1) Not exceeding 10% of wall thickness or 3/8"		8 X	8 1	2	X											
(2) 10% of wall thickness or greater than 3/8"		X	1	2	X	4	4 1	4	4		9	9	X	X	6	
(3) Exceeding min. wall thickness		X	1			X	1	X	X		9	9	X	X	6	
Weld Repairs		✓				✓		✓	✓		x	x	✓	✓	x	
(1) Minor repairs not requiring welding		X	1	2	X											
(2) Minor repairs requiring welding		X	1			4	4	4	X				X	X	6	
(3) Major repairs		X	1			4	4	4	X				X	X	6	
Code Stamped Parts Appurtenances											X	X		X	X	3

ATTACHMENT 11-1

Required Examination, QC Hold Points and Approvals Required for Repairs (page 2)

REPAIR CHART NOTES:

1. MT may be substituted for PT where applicable.

2. When it is not possible or practical to examine a possible minimum wall violation through mechanical measurement, UT measurement of wall thickness may be substituted.

3. For doce stamped or certified items, the repair or modification of items which fall within the scope of Brown & Root certificate of authorization or interim letter, manufacturer's approval is not required. For items which fall outside such scope, repair shall be with the approval to the specifications of, or by the manufacturer.

4. The examination of repairs shall be repeated as required for the original item except that repair of defects originally detected by MT or PT methods when the repair cavities do not exceed the lesser of 3/8" or 10% of the nominal thickness need only be re-examined by an MT or PT method. If the repair cavity exceeds the above, RT is require.

5. Any base metal defects which are a result of the manufacturing process or weld repairs to stainless steel which require more than two repairs, shall result in a disposition in accordance with Reference Q.

6. Arc strikes on items other than piping in the field violating minimum wall thickness shall require a Gibbs & Hill engineering evaluation and recommendation.

7. If a weldment is rejectable to the point that removal of the weld is necessary, a weld addition removal card (WARC) and a new Weld Data Card will be issued.

8. For Class III applications, the cavity need only receive a visual examination as a minimum. All cavities resulting from arc strike removal on Class III items in the shop shall be PT inspected.

9. As required by Reference A.

...7 Required Examination, QC Hold Points and Approvals Required for Repairs (page 3)

11. Repair situations which fall outside the scope of this matrix shall be analyzed as per job specification and code requirements and dispositioned accordingly.

12. In-process defects shall be documented as required in the space provided on the back of the applicable WDC or on continuation sheets.

13. NDE reports for VT, PT or MT examinations shall only be required as per the Documentation section of this procedure.

ATTACHMENT 12

Repair Process Sheet

REPAIR PROCESS SHEET

WCC Serial No.__________

Drawing No.__________

Weld No.__________

DESCRIPTION OF DEFECT (SKETCH)

OPER. NO.	OPERATION	HOLD POINTS WT	QC	ANI	COM	"S" or "U"	INSPECTION RESULTS QC or WT	NDE CERT LEVEL	SIGN AND DATE ANI

WE [illegible]

[illegible fine print]

Category 10, APS item 2
Thompson

BROWN & ROOT, INC. CPSES	PROCEDURE NUMBER	REVISION	ISSUE DATE	PAGE
JOB 35-1195	CP-CPM 6.9D	0	2-6-80	1 of 46

TITLE:		
CP-CPM 6.9D (APPENDIX D) WELDING AND RELATED PROCESSES	ORIGINATOR: [signature]	1/30/80 DATE
	REVIEWED BY: [signature] QA/QC	2-5-80 DATE
	APPROVED BY: [signature] CONSTRUCTION PROJECT MANAGEMENT	2/5/80 DATE
	[signature] MANAGER, Materials Engineering	1-31-80 DATE
	[signature] QUALITY ASSURANCE, Houston	2-5-80 DATE

note: N/A

0.1 TABLE OF CONTENTS

DCN#1
DCN#2
DCN#3
DCN#4
DCN#5

Q,BT To minimize sensitization of SS material, each defect shall be limited to two repairs. If the defect has not been eliminated in two attempts the procedure shall be submitted to the Owner for approval defining methods for further repair and sensitization control. When a weld is completely removed for any reason, the weld prep configuration may be restored and the weld replaced in accordance with an approved WPS. If any weld defects are evident in the replacement weld, a procedure shall be submitted to the owner for repair and sensitization control to remove all such defects. In no case shall a weld be completely removed and replaced more than twice without specific owner approval. This paragraph applies to field welds only.

3.19.3 Cosmetic Repair
Q

A cosmetic repair shall be considered the removal of ID or OD surface conditions which interfere with the interpretation of NDE after the final visual examination has been completed. This provides a secondary signoff for visual examination and other NDE.

A pre-established sequence may be used for cosmetic repairs.

If the final visual examination on the WDC or MRS has not been signed an operational sequence to allow reinspection is not necessary.

If visual examination has been completed, initiate a RPS operational sequence. If an item covered by an MRS, "Final Dimension/Surface Condition" holdpoint has not been completed by the ANI, ANI review shall be noted as "N/A". If signed, ANI, review is required.

NOTE: For fabrication, ANI review shall be documented on the MRS.

Require visual examination where accessible. Require UT examination, or where possible, mechanical measurement to verify wall thickness. Where VT is impossible, RT may be substituted.

3.19.4 Base Metal Repairs

3.19.4.1 Major Defects.
Q,NF,BOP

Base metal defects that must be repaired by welding are major repairs.

3.19.4.2 Minor Defects.
Q,NF,BOP

Base metal defects removed by grinding are minor repairs; however, if grinding violates minimum wall thickness, the repair must be completed as a major repair.

3.19.4.3 Additional Requirements.

BOP,NF,Q

Welding Engineering approval is required prior to a major repair. The approval is attained via approval of an NCR and/or RPS. If the repair is to be performed on a code stamped item B&R, QA shall assure that our "N" stamp authorizations are of the appropriate type (i.e., the repair of code stamped valves and equipment requires manufacturer's authorization prior to repair).

BOP,Q Surface defects (other than arc strikes) no deeper than 1/16 inch need not be repaired if the defect does not encroach on the minimum wall thickness.

Minor base metal repairs do not require an RPS.

QCI The QC NDE Inspector will mark the repaired area, when practical, with a "Nissen Ink Marker" showing a circle around the area and the repair number after the visual examination is complete.

Major base metal repairs on the inside surface of an item shall be located and marked on the outside surface to facilitate inspection during the pressure test.

QCI After performing base metal repairs the repaired area shall be inspected as required by Appendix 6.9G and as supplemented by the PWE.

QCI Westinghouse will evaluate and provide resolution on any major or minor repairs on Westinghouse supplied items (this shall include all arc strike repairs).

Modification of any Westinghouse-supplied items must have Westinghouse approval prior to the modification.

All arc strikes shall be removed from base metal surfaces.

NOTE: Defect repair cavities shall be sufficiently wide to permit complete fusion and allow free manipulation of the electrodes during repair welding.

3.19.5 Documentation and Evaluation of Minimum Wall Violations

1. QC shall place a hold tag on the item and note the rejectable NDE report number on the hold tag.
2. Submit the NDE report to Welding Engineering.

3. If the minimum wall violation can be repaired in accordance with the requirements of Specifications MS-100 or MS-43B or MS-44B, then Welding Engineering will issue a RPS (for completed or partially completed welds) or additional operations on the WDC (for joints where welding is not initiated).

4. If the minimum wall violation cannot be repaired in accordance with the requirements of Specifications MS-100 or MS-43B or MS-44B, then Welding Engineering shall generate an NCR for site Mechanical engineering for dispositioning.

5. The hold tag will be removed by QC prior to start of work only after the RPS has been issued or the NCR dispositioned "use as-is" by engineering.

3.19.6 Weld End Prep Repairs

BOP Weld end preps shall not be repaired by welding without the written resolution of the PWE, Construction and the Owner/ Engineer, except as noted below.

Q,BOP Maximum depth of repair without site engineering approval is 3/8 inch deep (a RPS is required for this repair). On Westinghouse supplied items W concurrence is required for all repairs.

Q MT or PT of weld end preparations in material less than 2 inch in thickness is not required after grinding or the addition of filler metal. Radiography of the completed weld is considered adequate.

Q,NF Any RT's after weld prep repairs exceeding the lesser of 3/8 inch or 10% of the section thickness may be accomplished after the joint when final RT is required by applicable specifications.

NF Surfacing of weld end preps for fit-up purposes shall be accomplished by one or more stringer beads being deposited on an unbroken surface.

NF The surface shall be free of irregularities exceeding 1/32 inch in depth.

NF Surfacing required for fit-up to "T" fillet weld joints shall be accomplished by stringer beads deposited on the larger surface of the two joining members.

3.19.7 Base Metal Repairs to Bulk Material

For bulk piping materials in storage, the repaired item shall be banded to identify the nonconformance report number or other documentation by which it was repaired. The band may be removed after the item is inserted into a piping system. The repair documentation shall be filed with the documentation for piping subassemblies.

CAT 10, AP-5
ITEM 4

QUALITY ASSURANCE DEPARTMENT
NDE REPORT

NDER-A № 289

PROJECT: COMANCHE PEAK JOB NO. 35-1195 UNIT 1 PAGE 1 OF 1

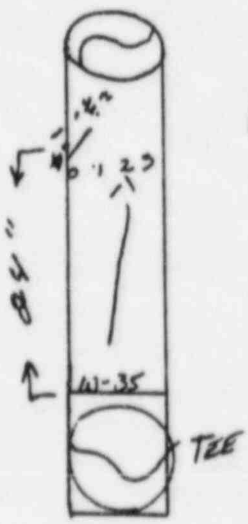
DRAWING	SYSTEM	CLASS
CC-1-SB-038	CS-110A	1☐ 2☐ 3☑ OTHER
WELD/ITEM NUMBER	LOCATION	
N/A	NORTH PUMP ROOM 773	

MTL. TYPE	MTL. THICK	DIA/LENGTH
P1	S/40	2"

STAGE OF MFG. ~~☐ REPAIR ☐ ROOT ☐ INTERMEDIATE ☐ FINAL~~ JOINT DESIGN ☐ BRN ☐ BKS ☐ INS ☐ OPEN BUTT ☑ OTHER

SKETCH AND REMARK (S)

MISHANDLING MARKS ON 2" PIPE. MARK MEASURES 1¼" LONG x ¼" WIDE x ⅛" DEEP ON WEST SIDE OF PIPE. 2' UPSTREAM FROM W-35. ELEV. 780'. 4' NORTH OF 7S. 5½' WEST OF C-S. MISHANDLING MARK MADE BY GRINDER.



FOR INFORMATION ONLY

HOLD TAG APPLIED

FOIA-85-59

ACCEPTANCE STD		DATE
ASME SECTION III	ACCEPT ☐ REJECT ☑	7/10/81

INSPECTOR	
[signature]	M325
NDE PROCEDURE	CERTIFICATION LEVEL
QI-QAP 10.2-7	II

QA 60

2" SCH. 40 tmin = 0.135" per CP-QAP-16.1 Attachment 8

2" SCH 40 tave = 0.154"

B&R Proc CP-CPM 6.9D Welding and Related Processes
B&R Inst. QI-QAP-11.1-26 ASME Piping & Welding Inspections

CAT I0, AP-5
ITEM S

REPAIR PROCESS SHEET

[illegible] Serial No. MSCR-A2899
Drawing No. CC-1-SB-38-[illegible]
Weld No. 703

T/O 1102

DESCRIPTION OF DEFECT (SKETCH)	
R1 Mechanical Marks [illegible] MSCR-A2899	Area which was ground is affected 1 1/4" long X 1/2" wide X 3/32" deep. JCB 8/24/81
* Weld in "Limited Access" Visual aid required JCB 8/24/81 # [illegible] dimensions	

OPER. NO.	OPERATION	HOLD POINTS WT	QC	ANI	COM	"S" or "U"	INSPECTION RESULTS (SIG. AND DATE) QC or WT	NDE CERT LEVEL	ANI
R1	Base Metal Repair								
a	Layout	X	NA	[illegible]		S	JCB 8/24/81		
b	[illegible]	X	NA	[illegible]		S	JCB 8/24/81		QI-QAP-10.2-1 R0
c	MT/PT	NA	✓	[illegible]		S	[illegible] 8/24/81	II	
d	Evaluate *	X	NA	[illegible]		S	JCB 8/24/81		
e	Clean	NA	✓	[illegible]		SAT	[illegible] 8-24-81	II	
f	Preheat	NA	✓	[illegible]		SAT	[illegible] 8-24-81	II	
g	Weld [illegible] R-5/0	NA	NA	[illegible]					
h	Final VT	NA	✓	[illegible]		SAT	[illegible] 8-24-81	II	
i	Final (PT)/MT	NA	✓	[illegible]		SAT	[illegible] 8-24-81	II	
j	Final UT	NA	✓	[illegible]		SAT	[illegible] 8-24-81	II [illegible]	
k	Final RT	NA	✓	(✓)		S	RW 8-26-81	II	[illegible] 9-3-81
	Rep: [illegible]								
	[illegible]: [illegible] 7-13-81								[illegible] 7/13/81
[illegible]	[illegible] 9/9/81								

FOR INFORMATION ONLY

WE	[illegible] QC QI-QAP-10.2-1 R-1 / QI-QAP-[illegible] / QI-QAP-10.2-1 R-0	ANI [illegible] 9/20/82	G&H

Approval signatures shall be affixed on line immediately below the last step to apply repair sequence.
Base Metal Repair - WE, QC, G&H, ANI
Weld Metal Repair - WE, QC, ANI
NCR 1585 [illegible] 8-24-81
[illegible]

QI-QAP-10.2-3 R1
RT-22248

CAT. 10, AP-5, ITEM 6

WPS #
11020

WDC Serial No. ___________

Drawing No. CC-1-SB-38

WELD FILLER MATERIAL LOG

Weld No. 703

WELD NO.	DATE	SIZE/CLASS	WELDER SYMBOL	WPS/ICN #	HEAT/LOT # or CODE #	AMT. ISS.	AMT. RT'D.	ISSUANCE APPROVAL
703	8/24/81	3/32 E-7018-2	ATZ	11020 5/0	87401	3	1	Jerry Emerson Rusty

FOR INFORMATION ONLY

CAT. 10, AP-5 ITEM 7

QUALITY ASSURANCE DEPARTMENT
NDE RADIOGRAPHIC REPORT

RT № 22248

PROJECT COMANCHE PEAK JOB NO 35-1195 UNIT 1 PAGE 1 OF 1

DRAWING BRP-CC-1-SB-38-8	SYSTEM 7100	CLASS 1 ☐ 2 ☐ 3 ☑ OTHER
WELD/ITEM NUMBER 9 BS @ FN 35	LOCATION 777 SG#1	

NDER # A2899

MTL. TYPE C-S	MTL. THICK. .189	DIA./LENGTH (PIPE) DIA. 2"	(PLATE - LONG SEAM) LENGTH N/A
STAGE OF MFG. ☐ REPAIR ROOT ☐ INTERMEDIATE ☐ FINAL ☑	JOINT DESIGN BRN. BKS. ☐	OPEN BUTT NA ☑	

X-RAY	ISOTOPE	LEAD SCREENS
MAKE N/A	IRIDIUM 192 ☑ COBALT 60 ☐	FRONT .005 ☐ .010 ☑ / CENTER NA / BACK ☐ .005 ☑ .010
KVP. M.A.	SIZE DIA. 1/10 LENGTH 1/10	
FOCAL SPOT SIZE	CURIES 78	
FILM MFG. EKC ASTM CLASS 1 ☑ 2 ☐	LOADED 1 ☐ 2 ☑ OTHER ☐	TECHNIQUE T IA (if not standard, attach sketch)
FFD. 17"	EXPOSURE TIME MIN. 1 SEC. 50	UNSHARPNESS
PENETRAMETER SIZE 10P MTL. SS ASTM ☑ ASME ☐		Ug = Ft/d; F =; t =; d =
PENETRAMETER SOURCE SIDE ☑	FILM SIDE ☐	Ug = ✓
SHIM MTL. SS THICK .060	NDE PROCEDURE CP-QI-QAP-10.2-3 Rev. 1	

RADIOGRAPHER	CERTIFICATION LEVEL	RT COMPANY
F. Przydzbki, R. Pendergrass	II, II	B+R

VIEWING	RT DATE	ACCEPTANCE STANDARD
SINGLE ☑ COMPOSITE ☐	8/25/81	CP-QI-QAP 10.2-3 Rev 1

LOCATION MARKERS	SENSITIVITY	DENSITY WELD	DENSITY PENETRAMETER	ACCEPT	REJECT	CRACK	ROOT CONCAVITY	ROOT CONVEXITY	ROOT CREASE	MELT THROUGH	CRATER PIT/CRACK	ROOT UNDERCUT	POROSITY	SLAG INCL.	TUNGSTEN	INCOMPLETE PENET.	INCOMPLETE FUSION	UNDERCUT	BURN-THRU	SURFACE DEFECTS	UNCONL INSERT	REMARKS
0	4T	2.54	2.35	✓																		NDER Area

FOR INFORMATION ONLY

ACCEPTED

B&R INTERPRETER R.E. Walters		CERTIFICATION LEVEL II
FILM EVALUATION DATE 8/26/81	COMMENTS	
IF APPLICABLE CLIENT REP DATE / /	IF APPLICABLE A.I. Joe C. Hair	DATE 9/3/81

CP-QA-601-0

13 MS-100

SPEC,FILE,ARMS,HAH,TUGCO

COMANCHE PEAK STEAM ELECTRIC STATION
DESIGN CHANGE AUTHORIZATION

(WILL) ~~XXXXXXX~~ BE INCORPORATED IN DESIGN DOCUMENTS

AUTHORIZATION NO. 5551, REV. 2

SAFETY RELATED DOCUMENT XX YES ___ NO

1. DESCRIPTION:

   A. APPLICABLE SPEC/~~XXXXXXXXX~~ 2323-MS-100 REV. 5
   *THIS DOCUMENT VOIDS AND SUPERSEDES DCA #5551, REV. 1.

   B. DETAILS 1) Revise paragraphs 2.8.1, 4.11.3, 4.11.5, and 4.11.6 as per the attached sheet.

   2) Add paragraph 4.11.7 as per the attached sheet.

   3) Delete the tables presently in appendix 7 and replace them with the attached table.

2. SUPPORTING DOCUMENTATION

3. SIGNATURES: MWS:wet 10-17-79

   A. APPROVED BY: F. L. McAllister 10-19-79
   G&H Representative Date

   B. APPROVED BY: Mark W. Smith 10/18/79
   Originating Engineer Date

4. STANDARD DISTRIBUTION:

B&R Field (Original) (1)
[illegible] (1)
[illegible] (1)
TUGCO [illegible] (1)
[illegible] (1)

JOB NO. 35-1195
RECEIVED
OCT 19 1979
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FOIA-85-59

m322

Page 2-8, Revise paragraph 2.8.1 to read as follows:

"Steel piping material with defects in excess of those allowed under paragraph 4.11.3 shall not be used without prior approval in writing from the site engineering staff ..."

Page 4-16, Revise paragraph 4.11.3 to read as follows:

"Repair may proceed without the approval of the site engineering staff providing the defect does not violate minimum wall as defined by paragraph 4.11.6. The site engineering staff's written approval is required prior to any repair of a defect which violates minimum wall except as permitted by paragraph 4.11.6.

Page 4-17, Delete paragraph 4.11.5.

Page 4-18, Revise paragraph 4.11.6 to read as follows:

"The minimum wall thickness for seamless or welded without filler metal pipe ordered to nominal wall in the Engineer's Piping Specification Sheets shall not be more than 12.5 percent under the specified nominal wall thickness according to the following formula:

Tn x 0.875 = Tm (Note 1)
Where Tn is the nominal pipe wall thickness
Tm is the minimum wall thickness

For pipe ordered to minimum wall Tm is as specified in the Engineer's Piping Specification Sheets.

Note 1

If pipe is ordered to the minimum wall, field counterboring shall not reduce the wall thickness to less than the Tm value.

Page 4-18, Revise paragraph 4.11.6 to read as follows:

When the minimum wall thickness requirements as defined above have not been maintained and a "use-as-is" desposition is desired, the Contractor shall document and submit the wall thickness to site Engineering for evaluation and resolution.

When the minimum wall violation can be repaired in accordance with paragraphs a, b, and c below, the Contractor may accomplish the repair without additional Engineering evaluation. When the minimum wall violation cannot be repaired in accordance with paragraphs a, b, and c below, the Contractor shall document and submit the wall thickness to site Engineering for evaluation and resolution.

Any required repairs shall be made in accordance with the following requirements:

a. Weld build-up of the outside diameter of piping shall consist of sufficient material to enable the pipe wall thickness to meet the minimum wall thickness criteria recommended by ASME SA 530 for nuclear piping or ASTM A 530 for non-nuclear piping (Attachment 7).

b. Weld build-up, after finish, on the OD shall not exceed the OD of the pipe as specified in the applicable material specification plus the maximum permissable variation, as expressed in specifications A or SA 530.

Nominal Pipe Size In.	Permissable Variation Over Pipe OD (In).
1/8 to 1½ Incl.	1/64 (0.015)
Over 1½ to 4 incl.	1/32 (0.031)
Over 4 to 8 incl.	1/16 (0.062)
Over 8 to 18 incl.	3/32 (0.093)
Over 18 to 26 incl.	1/8 (0.125)
Over 26 to 34 incl.	5/32 (0.156)
Over 34 to 48 incl.	3/16 (0.187)

c. The welding end transition must be within the limitations specified in ASME Section III, Figure NB, NC, or ND-4250-1, or ANSI B31.1, section 127.3 as applicable. When the allowable build-up is accomplished prior to making up the joint, the "C" dimension must be rechecked and rebored if required. The "C" dimension check is not required when the build-up is done as a part of the joint weld-out. Whether or not the "C" dimension is checked, the wall thickness shall be checked to ensure that 87½% of the nominal wall thickness (as specified by the applicable code) has been maintained at all locations.

Page 4-18, Add the following paragraph 4.11.7 to read as follows:

Actual wall thickness measurements of welds performed under DCA - 1593 shall be submitted to Engineering for evaluation of acceptability. Since these welds were made in accordance with DCA - 1593, they shall not be considered nonconforming until evaluated as such by Engineering. These nonconforming welds shall be identified to the Contractor for action. 2

TABLE XI Table of Minimum Wall Thicknesses on Inspection for Nominal (Average) Pipe Wall Thicknesses

NOTE 1—The following equation, upon which this table is based, may be applied to calculate minimum wall thickness from nominal (average) wall thickness:

$$t_n \times 0.875 = t_m$$

where:

t_n = nominal (average) wall thickness, in. (mm), and
t_m = minimum wall thickness, in. (mm).

The wall thickness is expressed to three decimal places, the fourth decimal place being carried forward or dropped, in accordance with the ASTM Recommended Practice E 29, for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values.*

NOTE 2—This table is a master table covering wall thicknesses available in the purchase of different classifications of pipe, but it is not meant to imply that all of the walls listed therein are obtainable under this specification.

Nominal (Average) Thickness (t_n)		Minimum Thickness on Inspection (t_m)		Nominal (Average) Thickness (t_n)		Minimum Thickness on Inspection (t_m)		Nominal (Average) Thickness (t_n)		Minimum Thickness on Inspection (t_m)	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
0.068	1.73	0.060	1.52	0.294	7.47	0.257	6.53	0.750	19.05	0.656	16.62
0.088	2.24	0.077	1.96	0.300	7.62	0.262	6.65	0.812	20.62	0.710	18.03
0.091	2.31	0.080	2.03	0.307	7.80	0.269	6.83	0.843	21.41	0.738	18.75
0.095	2.41	0.083	2.11	0.308	7.82	0.270	6.86	0.864	21.95	0.756	19.20
0.113	2.87	0.099	2.51	0.312	7.92	0.273	6.93	0.875	22.22	0.766	19.46
0.119	3.02	0.104	2.64	0.318	8.08	0.278	7.06	0.906	23.01	0.793	20.14
0.125	3.18	0.109	2.77	0.322	8.18	0.282	7.17	0.937	23.80	0.820	20.83
0.126	3.20	0.110	2.79	0.330	8.38	0.289	7.34	0.968	24.59	0.847	21.51
0.133	3.38	0.116	2.95	0.337	8.56	0.295	7.49	1.000	25.40	0.875	22.22
0.140	3.56	0.122	3.10	0.343	8.71	0.300	7.62	1.031	26.19	0.902	22.91
0.145	3.68	0.127	3.23	0.344	8.74	0.301	7.65	1.062	26.97	0.929	23.60
0.147	3.73	0.129	3.28	0.358	9.09	0.313	7.95	1.093	27.76	0.956	24.28
0.154	3.91	0.135	3.43	0.365	9.27	0.319	8.10	1.125	28.57	0.984	24.99
0.156	3.96	0.136	3.45	0.375	9.52	0.328	8.33	1.156	29.36	1.012	25.70
0.179	4.55	0.157	3.99	0.382	9.70	0.334	8.48	1.218	30.94	1.066	27.08
0.187	4.75	0.164	4.17	0.400	10.16	0.350	8.89	1.250	31.75	1.094	27.77
0.188	4.78	0.164	4.17	0.406	10.31	0.355	9.02	1.281	32.54	1.121	28.47
0.191	4.85	0.167	4.24	0.432	10.97	0.378	9.60	1.312	33.32	1.148	29.16
0.200	5.08	0.175	4.44	0.436	11.07	0.382	9.70	1.343	34.11	1.175	29.84
0.203	5.16	0.178	4.52	0.437	11.10	0.382	9.70	1.375	34.92	1.203	30.56
0.216	5.49	0.189	4.80	0.438	11.13	0.383	9.73	1.406	35.71	1.230	31.24
0.218	5.54	0.191	4.85	0.500	12.70	0.438	11.13	1.438	36.52	1.258	31.95
0.219	5.56	0.192	4.88	0.531	13.49	0.465	11.81	1.500	38.10	1.312	33.32
0.226	5.74	0.198	5.03	0.552	14.02	0.483	12.27	1.531	38.89	1.340	34.04
0.237	6.03	0.207	5.23	0.562	14.27	0.492	12.50	1.562	39.67	1.367	34.72
0.250	6.35	0.219	5.56	0.593	15.06	0.519	13.18	1.593	40.46	1.394	35.40
0.258	6.55	0.226	5.74	0.600	15.24	0.525	13.34	1.750	44.45	1.531	38.89
0.276	7.01	0.242	6.15	0.625	15.88	0.547	13.89	1.781	45.24	1.558	39.57
0.277	7.04	0.242	6.15	0.656	16.62	0.573	14.55	1.812	46.02	1.586	40.28
0.279	7.09	0.244	6.20	0.674	17.12	0.590	14.99	1.968	49.99	1.722	43.74
0.280	7.11	0.245	6.22	0.687	17.45	0.601	15.27	2.062	52.38	1.804	45.82
0.281	7.14	0.246	6.25	0.719	18.26	0.629	15.98	2.343	59.51	2.050	52.07

SPEC, FILE, ARMS, HAH, TUCCO

MS-438 / - ... 4

ARMS INDEXED

DATE:

COMANCHE PEAK STEAM ELECTRIC STATION
DESIGN CHANGE AUTHORIZATION

(WILL) (XXXXXXXX) BE INCORPORATED IN DESIGN DOCUMENTS

AUTHORIZATION NO. 5503 Rev.1

SAFETY RELATED DOCUMENT X YES ___ NO

1. DESCRIPTION:

A. APPLICABLE SPEC/XXXXXXXXXXXX 2323-MS-43B REV. 3

B. DETAILS Revise paragraphs 1.7.3.7a, 1.7.3.8a and 1.7.3.8b per the attached sheets.

"This revision voids and supersedes DCA 5503 Rev.0."

2. SUPPORTING DOCUMENTATION

GTN-38948

3. SIGNATURES: LKH/bs

A. APPROVED BY: Gerhard Suhle — G&H Representative — 10/1/79 Date

B. APPROVED BY: [signature] — Originating Engineer — 9-28-79 Date

JOB NO. 35-1195

RECEIVED OCT 02 1979 RECEIVED

4. STANDARD DISTRIBUTION:

- B&R Field (Original) (1)
- G&H New York (1)
- G&H Dallas (1)
- TUGCO Site QA (1)
- FSUG Site (1)

FOIA-85-59

M321

Page 33, revise paragraph 1.7.3.7a to read as follows:

"The minimum wall thickness for seamless or welded without filler metal pipe ordered to nominal wall in the Engineer's Piping Specification Sheets shall not be more than 12.5 percent under the specified nominal wall thickness according to the following formula:

Tn x 0.875 = Tm (Note 1)
Where Tn is the nominal pipe wall thickness
Tm is the minimum wall thickness

For pipe ordered to minimum wall Tm is as specified in the Engineer's Piping Specification Sheets.

Note 1

If pipe is ordered to the minimum wall, field counterboring shall not reduce the wall thickness to less than the Tm value.

When the minimum wall thickness requirements as defined above have not been maintained and a "use-as-is" desposition is desired, the Contractor shall document and submit the wall thickness to site Engineering for evaluation and resolution.

Page 34, revise paragraph 1.7.3.8a to read as follows:

"Steel piping material with defects in excess of those allowed under paragraph 1.7.3.7a shall not be used without prior approval in writing from the site Engineering Staff, except as delineated in paragraph 1.13.2.a.3 of this specification or repaired per paragraph 1.7.3.8b.

Page 34, revise paragraph 1.7.3.8b to read as follows:

When the minimum wall violation can be repaired in accordance with paragraphs 1,2, and 3 below, the Contractor may accomplish the repair without additional Engineering evaluation. When the minimum wall violation cannot be repaired in accordance with paragraphs 1, 2, and 3 below, the Contractor shall document and submit the wall thickness to site Engineering for evaluation and resolution.

Any required repairs shall be made in accordance with the following requirements:

1. Weld build-up of the outside diameter of piping shall consist of sufficient material to enable the pipe wall thickness to meet the minimum wall thickness criteria recommended by ASME SA 530 for nuclear piping or ASTM A 530 for non-nuclear piping (Attachment 7).

2. Weld build-up, after finish, on the OD shall not exceed the OD of the pipe as specified in the applicable material specification plus the maximum permissable variation, as expressed in specifications A or SA 530.

Nominal Pipe Size In.	Permissable Variation Over Pipe OD (In).
1/8 to 1½ Incl.	1/64 (0.015)
Over 1½ to 4 incl.	1/32 (0.031)
Over 4 to 8 incl.	1/16 (0.062)
Over 8 to 18 incl.	3/32 (0.093)
Over 18 to 26 incl.	1/8 (0.125)
Over 26 to 34 incl.	5/32 (0.156)
Over 34 to 48 incl.	3/16 (0.187)

3. The welding end transition must be within the limitations specified in ASME Section III, Figure NB, NC, or ND-4250-1, or ANSI B31.1, section 127.3 as applicable. When the allowable build-up is accomplished prior to making up the joint, the "C" dimension must be rechecked and rebored if required. The "C" dimension check is not required when the build-up is done as a part of the joint weld-out. Whether or not the "C" dimension is checked, the wall thickness shall be checked to ensure that 87½% of the nominal wall thickness (as specified by the applicable code) has been maintained at all locations.

TABLE XI Table of Minimum Wall Thicknesses on Inspection for Nominal (Average) Pipe Wall Thicknesses

NOTE 1—The following equation, upon which this table is based, may be applied to calculate minimum wall thickness from nominal (average) wall thickness:

$$t_n \times 0.875 = t_m$$

where:

t_n = nominal (average) wall thickness, in. (mm), and
t_m = minimum wall thickness, in. (mm).

The wall thickness is expressed to three decimal places, the fourth decimal place being carried forward or dropped, in accordance with the ASTM Recommended Practice E 29, for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values.[4]

NOTE 2—This table is a master table covering wall thicknesses available in the purchase of different classifications of pipe, but it is not meant to imply that all of the walls listed therein are obtainable under this specification.

Nominal (Average) Thickness (t_n)		Minimum Thickness on Inspection (t_m)		Nominal (Average) Thickness (t_n)		Minimum Thickness on Inspection (t_m)		Nominal (Average) Thickness (t_n)		Minimum Thickness on Inspection (t_m)	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
0.068	1.73	0.060	1.52	0.294	7.47	0.257	6.53	0.750	19.05	0.656	16.62
0.088	2.24	0.077	1.96	0.300	7.62	0.262	6.65	0.812	20.62	0.710	18.03
0.091	2.31	0.080	2.03	0.307	7.80	0.269	6.83	0.843	21.41	0.738	18.75
0.095	2.41	0.083	2.11	0.308	7.82	0.270	6.86	0.864	21.95	0.756	19.20
0.113	2.87	0.099	2.51	0.312	7.92	0.273	6.93	0.875	22.22	0.766	19.46
0.119	3.02	0.104	2.64	0.318	8.08	0.278	7.06	0.906	23.01	0.793	20.14
0.125	3.18	0.109	2.77	0.322	8.18	0.282	7.17	0.937	23.80	0.820	20.83
0.126	3.20	0.110	2.79	0.330	8.38	0.289	7.34	0.968	24.59	0.847	21.51
0.133	3.38	0.116	2.95	0.337	8.56	0.295	7.49	1.000	25.40	0.875	22.22
0.140	3.56	0.122	3.10	0.343	8.71	0.300	7.62	1.031	26.19	0.902	22.91
0.145	3.68	0.127	3.23	0.344	8.74	0.301	7.65	1.062	26.97	0.929	23.60
0.147	3.73	0.129	3.28	0.358	9.09	0.313	7.95	1.093	27.76	0.956	24.28
0.154	3.91	0.135	3.43	0.365	9.27	0.319	8.10	1.125	28.57	0.984	24.99
0.156	3.96	0.136	3.45	0.375	9.52	0.328	8.33	1.156	29.36	1.012	25.70
0.179	4.55	0.157	3.99	0.382	9.70	0.334	8.48	1.218	30.94	1.066	27.08
0.187	4.75	0.164	4.17	0.400	10.16	0.350	8.89	1.250	31.75	1.094	27.77
0.188	4.78	0.164	4.17	0.406	10.31	0.355	9.02	1.281	32.54	1.121	28.47
0.191	4.85	0.167	4.24	0.432	10.97	0.378	9.60	1.312	33.32	1.148	29.16
0.200	5.08	0.175	4.44	0.436	11.07	0.382	9.70	1.343	34.11	1.175	29.84
0.203	5.16	0.178	4.52	0.437	11.10	0.382	9.70	1.375	34.92	1.203	30.56
0.216	5.49	0.189	4.80	0.438	11.13	0.383	9.73	1.406	35.71	1.230	31.24
0.218	5.54	0.191	4.85	0.500	12.70	0.438	11.13	1.438	36.52	1.258	31.95
0.219	5.56	0.192	4.88	0.531	13.49	0.465	11.81	1.500	38.10	1.312	33.32
0.226	5.74	0.198	5.03	0.552	14.02	0.483	12.27	1.531	38.89	1.340	34.04
0.237	6.03	0.207	5.23	0.562	14.27	0.492	12.50	1.562	39.67	1.367	34.72
0.250	6.35	0.219	5.56	0.593	15.06	0.519	13.18	1.593	40.46	1.394	35.40
0.258	6.55	0.226	5.74	0.600	15.24	0.525	13.34	1.750	44.45	1.531	38.89
0.276	7.01	0.242	6.15	0.625	15.88	0.547	13.89	1.781	45.24	1.558	39.57
0.277	7.04	0.242	6.15	0.656	16.62	0.573	14.55	1.812	46.02	1.586	40.28
0.279	7.09	0.244	6.20	0.674	17.12	0.590	14.99	1.968	49.99	1.722	43.74
0.280	7.11	0.245	6.22	0.687	17.45	0.601	15.27	2.062	52.38	1.804	45.82
0.281	7.14	0.246	6.25	0.719	18.26	0.629	15.98	2.343	59.51	2.050	52.07

FOIA-85-59

316 - 514

* SPEC,HAH,TUGCO

FIGURE 1. MS-100

COMANCHE PEAK STEAM ELECTRIC STATION
DESIGN CHANGE AUTHORIZATION

(WILL) (XXXXXXXX) BE INCORPORATED IN DESIGN DOCUMENTS DCA NO. 9716

1. SAFETY RELATED DOCUMENT: XX YES ______ NO

2. ORIGINATOR: CPPE XX ORIGINAL DESIGNER ______

3. DESCRIPTION:

A. APPLICABLE SPEC/XXXX/XXXXXXXX 2323-MS-100 REV. 5

B. DETAILS Revise Paragraph 2.11.4 to read:

"Arc strikes on plant equipment or material metal surfaces other than arc strikes necessary for welding starts are expressly forbidden. In cases where they occur and when occuring to a surface of an ASME code item item other than pipe or pipe supports, the contractor shall follow the Paragraph 2.8.2 repair procedure. Such repairs shall have prior approval of the owner".

4. SUPPORTING DOCUMENTATION:

5. APPROVAL SIGNATURES: RCB:jb February 26, 1981

A. ORIGINATOR: [signature] DATE 2-26-81

B. DESIGN REPRESENTATIVE: [signature] DATE 2-26-81

6. VENDOR TRANSMITTAL REQUIRED: YES ______ NO XX

7. STANDARD DISTRIBUTION: DCA FORM 11-80

ARMS (Original)	(1)
Quality Engineering	(1)
TS for Orig. Design.	(1)

JOB NO. 35-1195
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FEB 27 1981
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FOIA-85-59

CAT. 10
AP-5

CPP-4614

TO: W. E. Baker | DATE: February 26, 1981
FROM: R. C. Barber | JOB NO:
SUBJECT: Base & Weld Metal Defect Repair | REF. NO: 1. DCA-5503,R.1
2. DCA-5551,R.2
3. DCA-9716 *arc strikes*

References 1, 2, & 3 above provide specific requirements concerning the repair of Base Metal defects and the Owner/Engineer approval required for such repair.

Whenever the repair to defects exceeding minimum wall requirements can be made in accordance with the requirements of the applicable specification as modified by references 1 & 2, Site Engineering approval is not required on a case by case basis prior to making the repair.

If the requirements of reference 1 & 2 cannot be met, Brown & Root will document the conditions of the minimum wall violation and submit these with a repair procedure to Site Engineering for evaluation and approval prior to making any repairs.

Arc Strikes or other defects on piping and pipe supports may be removed without Owner/Engineer approval provided the requirements of the applicable specifications as modified by the above references are met.

Arc Strikes or other surface defects occuring on all Plant Equipment or Code Items other than piping and pipe supports will require Site Engineering evaluation and approval prior to making any repairs.

Prior approval by Site Engineering will still be required in the case of more than 2 repairs being made in any one area on stainless steel pipe weldments and whenever a Thru-root repair exceeding 3" is required in carbon steel or stainless steel pipe weldments.

I am requesting Brown & Root to revise the current procedures to reflect the above requirements.

If you have any questions or require any additional information, please advise.

R. C. Barber
Senior Project Weld. Engr.

RCB:kss
cc: J. T. Merritt
M. R. McBay
R. E. Holloway
M. W. Smith
Hawkins

F-168 8-78

CAT 10, AP-5

BROWN & ROOT, INC. CPSES	PROCEDURE NUMBER	REVISION	ISSUE DATE	PAGE
JOB 35-1195 (Supplement 6.9D-II)	QI-QAP 11.1-26	5	APR 29 1981	1 of 7

TITLE: QI-QAP-11.1-26 (SUPPLEMENT 6.9D-II) ASME PIPING WELD INSPECTIONS	
ORIGINATOR: [signature]	4/28/81 DATE
REVIEWED BY: [signature]	4/28/81 DATE
APPROVED BY: [signature] Site QA Manager	4/28/81 DATE

3.4.7 → 6.9D 3.19 → 3.19.4 → 3.19.4.3
6.9G. 3.3

3.4.6.1 Surface and Dimensional Examination

The QC Inspector shall make a final installation inspection of all piping subassemblies after completion of welding and installation activities to validate acceptance of final dimensions and surface conditions. This shall include verification that marking was accomplished within the parameters of Appendix 6.9E, Section 3.15.

Post-NDE requirements, i.e., Radiography, that may necessitate repair of a weld will not invalidate the above inspections.

When required by the MRS, the QC Inspector shall verify that the subassembly is clean to the extent that no contamination is visible to a person with normal visual acuity. All external and internal surfaces shall be free from purge dams, mill scale, organic coatings, grease, oil, and debris. Packaging of piping subassemblies shall be verified to be in accordance with Appendix 6.9H, Section 3.5.

3.4.7 Repairs

Weld and base metal repairs shall be inspected as required by Appendix 6.9D, Section 3.19. Documentation for repairs shall be as required by Appendix 6.9G, Section 3.3.

NOTE: For Base Metal Repairs, prior to final VT, the area of the repair shall be diagrammed by QC on the original NDER, and stated on NDER as final repaired area. Hold-points on the RPS for this operation signed and dated. The inspection report shall be included in the documentation package.

3.4.8 PWHT/QC Inspections (QCI-M)

The Cognizant QC Inspector shall verify acceptable completion of Post-Weld Heat Treatment to the requirements of Appendix 6.9D, Section 3.21 and shall document same on the PWHT Checklist (Figure 6.9G-3).

Brown & Root, Inc.

QUALITY ASSURANCE DEPARTMENT

QA LIBRARY

PROJECT: CPSES - Glen Rose JOB NO.: 35-1195 UNIT 1 & 2 PAGE 1 OF 1

January 15, 1982

TO: Pat Clarke

FROM: Jeannine Hewett

SUBJECT: Deletion of Quality Instructions used as Supplements to Construction Procedure CP-CPM-6.9

This is to inform you that, subsequent to our verbal instructions, the following Quality Assurance Instructions, presently incorporated as supplements to your above referenced procedure, have been deleted from use by the Site QA Manager:

DOCUMENT NO.	TITLE	SUPPLEMENT
QI-QAP-11.1-23	QC Instructions for Pipe Fabrication and Installation	6.9E-I
QI-QAP-11.1-24	Inspection of Pressure Testing	6.9I-I
QI-QAP-11.1-25	QA Review of ASME III Documentation	6.9G-II
QI-QAP-11.1-27	Insp. of Instal. of Piping	6.9E-II

Additionally, our Instruction QI-QAP-11.1-26, presently incorporated in CP-CPM-6.9 as Supplement 6.9D-II has been reissued as Revision 6 with a new title, "ASME Pipe Fabrication and Installation Inspection."

Please make appropriate changes to your procedure to reflect the above.

Jeannine Hewett
Jeannine Hewett
QA Librarian

cc: G. Purdy
B. Darrin

INFORMATION
COPY
PPRV

CAT 10, AP-5

BROWN & ROOT, INC. CPSES JOB 35-1195	PROCEDURE NUMBER	REVISION	EFFECTIVE DATE	PAGE
	CP-CPM-6.9D	2	6/12/81	1 of 48

TITLE:		
CP-CPM-6.9D (APPENDIX D) WELDING AND RELATED PROCESSES	ORIGINATOR: [signature]	6-9-81 DATE
	REVIEWED BY: [signature] QA/QC	6-10-81 DATE
	REVIEWED BY: W E Baker SR. PROJECT WELDING ENGINEER	6-10-81 DATE
	APPROVED BY: [signature] CONSTRUCTION PROJECT MANAGER	6-11-81 DATE

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M329

1.0 INTRODUCTION

This appendix to procedure CPM 6.9 has been prepared to delineate and control welding and related processes for piping and ASME III component supports at Comanche Peak Steam Electric Station (CPSES).

2.0 GENERAL

2.1 APPROVAL AUTHORITY

The requirements for origination, review and approval of this appendix shall be in accordance with procedure CPM 6.1. In addition, this appendix and its' DCN's shall be approved by the Project Welding Engineer.

3.18.5 Inspection Procedure

Calibrated delta ferrite measurement devices shall be issued as required to WTs by the calibrated tool room. These devices shall be returned to the tool room at the end of each work day.

When a weld requires delta ferrite testing, it shall be noted on the WDC.

The results of the examination shall be documented on the WDC by the WT.

Two Delta Ferrite Logs (DFL) shall be maintained by FWTC for each applicable piping system.

1. One DFL shall list all delta ferrite checks on welds with thickness one (1) inch or less.
2. The other DFL shall list all delta ferrite checks on welds with thickness over one (1) inch.

The DFL is shown as Figure 6.9 D-12.

A copy of the DFL shall be turned over the Owner/Engineer on a monthly basis.

The original DFL shall become part of the documentation for each system and shall be filed in the Permanent Plant Records vault.

3.19 FWTC WELD AND BASE METAL REPAIRS

3.19.1 Q,NF In Process Weld Repairs

In process repairs shall be defined as those discovered prior to final code required NDE.

All major weld defects discovered before final inspection shall be evaluated by the PWE who may generate an RPS operational sequence at his discretion.

NOTE: Through wall repairs or those where 1/8 inch or less metal remains shall require an RPS.

The removal of starts and stops and slag, etc. may be routinely ground out during the welding process. No documentation is required.

When weld defects are discovered before final inspection (In process), and operational steps are not defined by the PWE, the following operational steps may be used to affect reworking:

- Grind as required to remove defects within the guidelines of this procedure.
- Perform information PT or MT
- Reweld utilizing original welding procedure
- Grind and fair deposited area into the surrounding metal surface
- Reinspect utilizing the original NDE method and acceptance criteria for information unless defined otherwise by the PWE.

3.19.2 Weld Metal Repairs

3.19.2.1 Major Defects.
BOP,Q

The following defects discovered during or after final code required NDE shall be classified as "Major Repairs":

1. All cracks and/or linear defects identified during the final inspection of a weld joint.

2. Cracks, that are repaired and then reappear after the repair.

3. Minor repair excavations that result in a repair cavity that reduces the thickness of the weld to approximately 1/8" or less.

4. Any defect which is identified during final PWHT or hydrostatic testing.

5. All defects which penetrate the root of the weld, such as grind-throughs or burn-throughs.

The resolution shall be by the PWE using a RPS and shall contain as a minimum, the following:

6. An explanation of the method to be used to locate and excavate the defect (mechanical means or thermal gouging).

7. Method of inspection to be used to ensure the defect has been removed.

8. The method such as the Welding Procedure Specification and any special technique that may be required to be used to repair the excavation open butt procedure.

9. The method to be used to reinspect the repaired area and the acceptance criteria for the reinspection.

10. The proper approvals of the other groups involved with the repair.

NOTE: This may include the component manufacturer, QC and/or Construction, and the Owner/Engineer. (Westinghouse as applicable.)

3.19.2.2 Minor Defects
Q,BOP

The following types of defects discovered during or after final code required NDE shall be classified as "Minor Repairs":

1. All code rejectable defects not included under the Major Repair classification.

2. All defects resulting from fitup, cleanliness, and other welding parameters which are violations of the WPS or this appendix.

The applicable operations shall be as follows:

3. Locate the defect and mark the area to be excavated.

4. Excavate (remove) the defects by grinding or air-carbon-arc gouging. If air-carbon-arc gouging is used, the gouged surface shall be ground back to clean bright metal; SS piping shall be protected from contamination.

5. When it is felt the defect has been removed, inspect the excavated area with MT or PT.

6. After rewelding the excavation, the repaired area shall be ground and faired into the surrounding metal surface.

7. The repaired area shall be reinspected using the original NDE method(s) and acceptance criteria.

8. Westinghouse will evaluate and provide resolution on any minor repair to Westinghouse supplied items.

3.19.2.3 Q,BOP <u>Additional Requirements.</u>

When a weld is made utilizing a consumable insert and is rejected after NDE, use of the open buttwelding technique to make repairs is permitted when the repair does not exceed 3 inches. Repairs to areas greater than 3 inches will be handled on a case-by-case basis and will require Owner/Engineer approval.

Q,BT To minimize sensitization of SS material, each defect shall be limited to two repairs. If the defect has not been eliminated in two attempts the procedure shall be submitted to the Owner for approval defining methods for further repair and sensitization control. When a weld is completely removed for any reason, the weld prep configuration may be restored and the weld replaced in accordance with an approved WPS. If any weld defects are evident in the replacement weld, a procedure shall be submitted to the owner for repair and sensitization control to remove all such defects. In no case shall a weld be completely removed and replaced more than twice without specific owner approval. This paragraph applies to field welds only.

<u>NOTE</u>: When stainless steel items which have been welded previously are reused, the new weld number shall be the next sequential number of the item with the highest alpha numeric weld number.

3.19.3 Q Cosmetic Repair

A cosmetic repair shall be considered the removal of ID or OD surface conditions which interfere with the interpretation of NDE after the final visual examination has been completed. This provides a secondary signoff for visual examination and other NDE.

A pre-established sequence may be used for cosmetic repairs.

If the final visual examination on the WDC or MRS has not been signed an operational sequence to allow reinspection is not necessary.

If visual examination has been completed, initiate a RPS operational sequence. If an item covered by an MRS, "Final Dimension/Surface Condition" holdpoint has not been completed by the ANI, ANI review shall be noted as "N/A". If signed, ANI, review is required.

<u>NOTE</u>: For fabrication, ANI review shall be documented on the MRS.

Require visual examination where accessible. Require UT examination, or where possible, mechanical measurement to verify wall thickness. Where VT is impossible, RT may be substituted.

3.19.4 Base Metal Repairs

3.19.4.1 <u>Major Defects</u>.
Q,NF,BOP

Base metal defects that must be repaired by welding are major repairs.

3.19.4.2 <u>Minor Defects</u>.
Q,NF,BOP

Base metal defects removed by grinding are minor repairs; however, if grinding violates minimum wall thickness, the repair must be completed as a major repair.

3.19.4.3 <u>Additional Requirements</u>.
BOP,NF,Q

Welding Engineering approval is required prior to a major repair. The approval is attained via approval of an NCR and/or RPS. If the repair is to be performed on a code stamped item B&R, QA shall assure that our "N" stamp authorizations are of the appropriate type (i.e., the repair of code stamped valves and equipment requires manufacturer's authorization prior to repair).

BOP,Q — Surface defects (other than arc strikes) no deeper than 1/16 inch need not be repaired if the defect does not encroach on the minimum wall thickness.

Minor base metal repairs do not require an RPS.

QCI — The QC NDE Inspector will mark the repaired area, when practical, with a "Nissen Ink Marker" showing a circle around the area and the repair number after the visual examination is complete.

Major base metal repairs on the inside surface of an item shall be located and marked on the outside surface to facilitate inspection during the pressure test.

QCI — After performing base metal repairs the repaired area shall be inspected as required by Appendix 6.9G and as supplemented by the PWE.

QCI — Westinghouse will evaluate and provide resolution on any major or minor repairs on Westinghouse supplied items (this shall include all arc strike repairs).

Modification of any Westinghouse-supplied items must have Westinghouse approval prior to the modification.

All arc strikes shall be removed from base metal surfaces.

NOTE: Defect repair cavities shall be sufficiently wide to permit complete fusion and allow free manipulation of the electrodes during repair welding.

3.19.5 Documentation and Evaluation of Minimum Wall Violations

1. QC shall place a hold tag on the item and note the rejectable NDE report number on the hold tag.
2. Submit the NDE report to Welding Engineering.
3. If the minimum wall violation can be repaired in accordance with the requirements of Specifications MS-100 or MS-43B or MS-44B, then Welding Engineering will issue a RPS (for completed or partially completed welds) or additional operations on the WDC (for joints where welding is not initiated).
4. If the minimum wall violation cannot be repaired in accordance with the requirements of Specifications MS-100 or MS-43B or MS-44B, then Welding Engineering shall submit the RPS to Mechanical engineering for evaluation and resolution.
5. The hold tag will be removed by QC prior to start of work only after the RPS has been issued or the NCR dispositioned "use as-is" by engineering.

3.19.6 Weld End Prep Repairs

BOP Weld end preps shall not be repaired by welding without the written resolution of the PWE, Construction and the Owner/ Engineer, except as noted below.

Q,BOP Maximum depth of repair without site engineering approval is 3/8 inch deep (a RPS is required for this repair). On Westinghouse supplied items W concurrence is required for all repairs.

Q MT or PT of weld end preparations in material less than 2 inch in thickness is not required after grinding or the addition of filler metal. Radiography of the completed weld is considered adequate.

Q,NF Any RT's after weld prep repairs exceeding the lesser of 3/8 inch or 10% of the section thickness may be accomplished after the joint when final RT is required by applicable specifications.

NF Surfacing of weld end preps for fit-up purposes shall be accomplished by one or more stringer beads being deposited on an unbroken surface.

NF The surface shall be free of irregularities exceeding 1/32 inch in depth.

NF Surfacing required for fit-up to "T" fillet weld joints shall be accomplished by stringer beads deposited on the larger surface of the two joining members.

3.19.7 Base Metal Repairs to Bulk Material

For bulk piping materials in storage, the repaired item shall be banded to identify the nonconformance report number or other documentation by which it was repaired. The band may be removed after the item is inserted into a piping system. The repair documentation shall be filed with the documentation for piping subassemblies.

3.19.8 Repair of Arc Strikes
Q

Arc strikes found on weldments or base materials may be repaired in accordance with the following requirements:

1. For arc strike removal in stainless steel items, not requiring rewelding, perform the following:

   a. Blend grind or buff;
   b. Perform a liquid penetrant examination of the removal areas; see Note below.
   c. Verify that minimum wall thickness remains by UT or mechanical measurement;
   d. Perform a visual examination of the repair area.

2. For arc strike removal in carbon steel not requiring rewelding, perform the following;

   a. Blend grind or buff;
   b. Perform a liquid penetrant or magnetic particle examination of the removal area; See Note.
   c. Verify that minimum wall thickness remains by UT or mechanical measurement;
   d. Perform a visual examination of the repair area.

NOTE: Westinghouse approval required on Westinghouse items.

3. Documentation

a. An NDE report is not required prior to generation of a RPS or for repairing an arc strike found by Welding Engineering.

b. Westinghouse approval required for Westinghouse-supplied items.

3.20 WELDER QUALIFICATION

WQTC
PWE

Welder qualification shall be in strict compliance with Specification MES-105. All welders shall be trained in accordance with the proper codes, WPSs, BPSs and other project requirements. All welders shall be under the direct supervision of the applicable CFS. When the CFS submits a welder to the WQTC for qualification or training, a properly executed "Request for Welder/Brazer Training and/or Testing" form (Figure 6.9D-13) shall accompany the welder.

3.20.1 Qualification Worksheet

Once a welder/brazer performance qualification test is complete, all applicable data shall be tabulated on the proper worksheet (Figures 6.9D-14 and 15).

Welder/Brazer Update Status shall be as defined in MES-105.

3.20.2 Additional Requirements

All Welder/Brazer qualification shall be carried out using the requirements of the Schedule of Standard Tests (WES-16).

The Welder Qualification Matrix shall be used to assure correct welder/brazer qualification in accordance with procedure WES-16.

Welders qualified for restricted access welding shall be identified by a special designation in Schedule of Standard Tests and Welder/Brazer Qualification Log.

3.21 POST-WELD HEAT TREATMENT

QCI for
Q

GENERAL

All PWHT to ASME Section III and ANSI B31.1 requirements shall be performed as required by this document.