TASK PACKAGE
ISSUE AND REVISION CONTROL SHEET

U.S. DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE
FLUOR Federal Petroleum Operations Company

TASK NUMBER: WH-MM-819E	**PAN NO.: 03191780**
SITE (S): West Hackberry	**ECP NO.:**
TASK TITLE: Repair Brine Tank WHT-15 (Tank Repairs)	**TASK REV. NO.: 0**

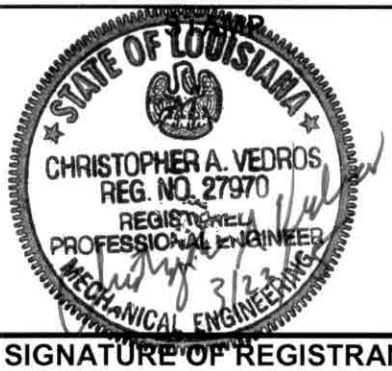
TASK REVISION NO.	APPROVED BY	APPROVED BY DATE	ERU INITIAL	ERU DATE	DESCRIPTION OF REVISION
A		3/23/15			Issued For Design Review
0		3/23/15			Approved For Construction

U.S. DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE

FLUOR Federal Petroleum Operations Company

SECTION NO.: 01010 **SECTION TITLE: Summary of Work (SOW)**	**DATE: 02/16/15** **REVISION NO.: 0**
TASK NUMBER: WH-MM-819E **SITE (S): West Hackberry** **TASK TITLE: Repair Brine Tank WHT-15 (Tank Repairs)**	**PAN NO.: 03191780** **ECP NO.:**

REGISTRATION INFORMATION



SIGNATURE OF REGISTRANT

DATE OF SIGNATURE 3/23/15

DISCIPLINE: Mechanical

APPROVED FOR CONSTRUCTION

E. N. Fraiser

DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE
SYSTEMS & PROJECTS

DATE: 3/24/2015

ISSUE AND REVIEW SUMMARY

REV NO.	DESIGNED BY	CHECKED BY	APPROVED BY	PAGES	REMARKS
A	B. Briuglio	J. Nguyen	C. Vedros	All	Issued for Design Review
0	B Briuglio 3/23/15	J Nguyen 3/23/15	C Vedros 3/23/15	All	Approved For Construction

SUMMARY OF WORK

PART 1 GENERAL

1.01 DESCRIPTION

The work covered by this Summary of Work (SOW) consists of furnishing all materials, tools, equipment, supplies, transportation, facilities, labor, supervision and services required to perform the work in connection with the repairs of Brine Tank WHT-15.

1.02 LOCATION

The work shall be performed at the West Hackberry Strategic Petroleum Reserve site near the town of Hackberry, LA, approximately 30 miles southwest of Lake Charles, LA.

1.03 WORK INCLUDED

A. TANK DESCRIPTION

1. Tank WHT-15 was manufactured by American Tank and Vessel, Inc. in 1997 in accordance with design standard API 650, 9th Edition, for use by the Government's M&O Contractor in brine service. The atmospheric open top tank is 32 feet high by 110 feet diameter, with a nominal capacity of 50,000 barrels.

2. The referenced drawings and design calculations to this document provide additional information.

B. TANK REPAIRS

1. This task includes all the repairs that are presently known. Any additional repairs added after the issuance of this task package will be done via a Change Notice (CN).

2. Use new materials for tank repairs and/or alterations per Table 2-3, Group II of API-650 (11th Edition). Submit materials for approval prior to use of materials.

3. The Subcontractor must add their locks and tags to the electrical equipment after the Government's M&O Contractor has locked out and tagged out the equipment to assure electrical isolation during the period of performance.

4. The Subcontractor will purchase a quantity of nineteen (19) new aluminum anodes, GALVOTEC GA-A-HFT-44 or equal. The Subcontractor must submit the anode manufacturer's technical data

sheets to the Government's M&O Contractor for review and approval prior to purchase. Additionally, the Subcontractor is to purchase a quantity of nineteen (19) 1" NPT plugs.

5. The aluminum anode, as shown on the catalog cut sheet in Attachment B, is mounted onto one end of a 1" schedule 80 pipe. The other end of the pipe has 1" male NPT threads. Each anode will be supplied from the manufacturer with a 1" schedule 80 half collar coupling. One end of the coupling has 1" female NPT threads and the other end is to be welded to the tank surface. Turn over any unused couplings to FFPO Site Property.

6. The Subcontractor is to remove all nineteen (19) existing anodes (nine are located on the tank bottom and ten are located on the shell interior) by unscrewing the 1" schedule 80 pipe from the 1" schedule 80 half collar coupling that is welded to the tank. Clean existing female threads in the half collar coupling by running a thread chaser through the threads. Provide and install 1" NPT plugs to protect the half collar coupling female threads during the re-coating work by others. See Attachment B.

7. If the 1" schedule 80 pipe cannot be unscrewed from the half collar coupling due to excessive corrosion then the Subcontractor will cut the existing half collar couplings no less than a 1/4" from the tank surface then grind the remaining coupling until flush with tank surface. Weld new half collar coupling (supplied with each new anode) at locations next to the previously removed half collar couplings, approximately two inches to the side. All joints are to be fully welded using 1/4 inch minimum leg fillet weld. All welding is to be performed in accordance with API 650. Provide and install 1" NPT plugs to protect the half collar coupling female threads during the re-coating work by others. See Attachment B.

8. The Subcontractor is to repair the vertical weld located on the internal shell of Course 3 in the west tank quadrant that exhibits corrosion on the lower four feet of the weld as follows: Remove the rusty corroded metal by grinding until reach sound metal. Examine the ground metal surfaces by MT or PT method to verify sound metal. Re-weld as required to complete the repair. The weld in need of repair is shown in the two photographs found on page 41 of 51 in the API 653 Out-of-Service Inspection Report in Attachment A. All welding is to be performed in accordance with API 650.

9. To provide drainage of standing water on the wind girder, the Subcontractor will install one (1) drain hole every 100 linear feet around the wind girder. The edge of the 1/2" diameter drain hole is to be located a distance of a 1/2" from the weld where the wind girder meets the tank shell. Be sure not to drill through the weld and any

structural support angles located on the underside of the wind girder. See Attachment A.

10. Deleted

11. Replace Nozzle N and the reinforcement plate as identified in the photograph on page 45 of the Out-of-Service Inspection Report in Attachment A. The Subcontractor will provide and replace the nozzle and the reinforcement plate in accordance with dimensions and specifications shown on the original vendor tank drawing numbers 4-7 and 1-2 located in Attachment C and also API 653 Sections 9.7, 9.8 and 9.9 located in Attachment F. The welds shall be examined and tested in accordance with API 653 Section 12.1.2 located in Attachment F. The reinforcing plate will be tested by the Subcontractor in accordance with API 650 Section 7.3.4 located in Appendix E, by applying up to 15 lbf/in² gauge pneumatic pressure between the tank shell and the reinforcement plate using the telltale hole. While the space is subjected to such pressure, a soap film, linseed oil, or another material suitable for the detection of leaks shall be applied to all attachment welding around the reinforcement, both inside and outside the tank. The telltale hole is to remain unplugged and open to the atmosphere in accordance with API 650 Sections 5.7.5.1 and 5.7.2.10 located in Attachment E. The plug is to be turned over to Site Property. Provide and install gasket, blind flange and bolting hardware onto Nozzle N per the following bill of material:

    - Qty. 1 each BLIND FLANGE 3" DIA. 150# RF 125-250 RMS Material Spec A105
    - Qty. 1 each SPIRAL WOUND ASME B16.20 GASKET for 3" DIA. 150 # FLG with 304 SS Winding, Inner Ring, Outer Ring & Grafoil Filler
    - Qty. 4 each 5/8" DIA. x 3" LG. HVY HEX HD BOLT Material Spec A193 B8M TEFLON COATED
    - Qty. 4 each 5/8" Dia. HVY HEX HD NUT Material Spec A194 8M TEFLON COATED

12. Deleted

13. The Subcontractor will remove the plug from the telltale hole located in the Nozzle M reinforcement plate as shown in the photograph on page 45 of the Out-of-Service Inspection Report in Attachment A. The reinforcing plate will be tested by the Subcontractor in accordance with API 650 Section 7.3.4 located in Appendix E, by applying up to 15 lbf/in² gauge pneumatic pressure between the tank shell and the reinforcement plate using the telltale hole. While the space is

subjected to such pressure, a soap film, linseed oil, or another material suitable for the detection of leaks shall be applied to all attachment welding around the reinforcement, both inside and outside the tank. The telltale hole is to remain unplugged and open to the atmosphere in accordance with API 650 Sections 5.7.5.1 and 5.7.2.10. The plug is to be turned over to Site Property.

C. WELDING

1. Perform all welding in accordance with qualified Welding Procedure Specifications using qualified welders.

2. If any welding repairs are required on the tank shell or bottom, the welding must be in compliance with API Standard 650. Submit, for approval, the welding procedures in accordance with API 650.

3. If any welding repairs are required on piping, the welding must be in compliance with section 15051. Submit, for approval, the welding procedures in accordance with section 15051.

D. WELDING INSPECTION

1. Provide a Welding Inspector, certified per AWS QC-1, for the examination of all welding.

2. Submit for approval NDE Procedures. If additional NDE procedures are required for other repairs, such as on piping, provide these NDE procedures in accordance with section 01420.

1.04 WORK NOT INCLUDED

A. The tank will be cleaned by others before being turned over to the Subcontractor for repairs.

B. The Government's M&O Contractor will disconnect or blind all process piping prior to the Subcontractor starting repair work. Upon completion of the repair work the process piping will remain disconnected / blinded for the re-coat task by others.

C. The nineteen (19) aluminum anodes are to be turned over to FFPO Site Property.

D. Deleted

E. The Government's M&O Contractor will drain rainwater accumulated outside the tank and inside the tank dike area. The Subcontractor is responsible for rainwater that does not drain naturally due to Subcontractor placement of equipment and/or materials.

F. The Government's M&O Contractor will supply the tank with the cleanout door open. Upon completion of the tank repairs, the Subcontractor will NOT be required to install the cleanout door. The cleanout door is to remain open to accommodate the future re-coating task.

G. The tank interior coating task will be done in a separate contract.

1.05 MATERIALS AND SERVICES FURNISHED BY THE GOVERNMENT

A. The Government's M&O Contractor will lock out/tag out any electrical/mechanical equipment necessary to complete the task.

B. The Government's M&O Contractor will have firewater available for fire protection and/or cleaning if necessary.

C. The Government's M&O Contractor will disconnect or blind all process piping prior to the Subcontractor starting repair work.

D. The Government's M&O Contractor will turn off and lock out the cathodic rectifier prior to any repair work being performed.

1.06 CONDITIONS AFFECTING THE WORK

A. Access to the site for the Subcontractor is through the Southeast Gate.

B. The Government's M&O Contractor will control access to job location by a work permit system. Obtaining work permits on a daily basis from the Government's M&O Contractor representative prior to commencing work is the responsibility of the Subcontractor.

C. Dispose all of construction debris at an off-site disposal facility approved by the Government's M&O Contractor. Conduct clean-up operations of waste materials continuously throughout the duration of the project.

1.07 DISPOSITION OF EXCESS MATERIAL

Any excess material will be given to FFPO Site Property.

PART 2 QUALITY ASSURANCE

2.01 MANUFACTURER'S QUALIFICATIONS

N/A

2.02 SUBCONTRACTOR QUALIFICATIONS

N/A

2.03 SOURCE QUALITY CONTROL

Source inspection does not constitute acceptance of work.

2.04 FIELD QUALITY CONTROL

FFPO retains the right to inspect/witness any or all work performed by the Subcontractor. Such inspection, or lack thereof, does not constitute acceptance of work.

2.05 MINIMUM REQUIREMENTS

The Subcontractor also will adhere to minimum quality requirements as outlined elsewhere in the contract documents.

PART 3 REFERENCE STANDARDS

A. API-650 (2007), Welded Steel Tanks for Oil Storage (11^{th} Edition, Errata 2011)
B. API-653 (2009), Tank Inspection, Repair, Alterations and Reconstruction (4^{th} Edition, 2010)
C. API-2015 (2001), Requirements for Safe Entry and Cleaning of Petroleum Tank (6^{th} Edition, 2006)
D. ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
E. 29 CFR 1910, OSHA General Industry Standards
F. 29 CFR 1926, OSHA Construction Standards
D. CFR 40 – Protection of Environment
E. NACE, American Society of Corrosion Engineers
F. SSPC (Latest Revisions), Steel Structural Painting Manuals Volumes I and II by Structural Painting Council

PART 4 DRAWINGS AND SPECIFICATIONS

All work shall be done in accordance with the following drawings and specifications unless specifically stated to the contrary in this Summary of Work.

A. Drawings

Number	Revision	Title
WH-M-103-133	8	Piping and Instrument Diagram Brine Disposal System Brine Tanks
WH-M-103-134	4	Piping and Instrument Diagram Brine Disposal System Brine Pumps
WH-M-105-239	2	Area Piping Plan Brine Disposal Tanks WHT-14 and WHT-15
WH-E-315-006	0	Brine Tanks WHT-14 & WHT-15
WH-S-221-823 Sheet 1 of 2	1 AB	Brine Tank Maintenance Walkways WHT-14 Plan Handrail Post Locations
WH-S-221-824 Sheet 2 of 2	1 AB	Brine Tank Maintenance Walkways WHT-14 Handrail Sections and Details
1-1	1	General Arrangement 110' Dia. X 32' Open Top Tanks WHT-14
1-2	1	Orientation 110' Dia. X 32' Open Top Tanks WHT-14
1-3	1	Nameplate 110' Dia. X 32' Open Top Tanks WHT-14
2-1	1	Bottom 110' Dia. X 32' Open Top Tanks WHT-14
2-2	1	Bottom Sketch Plates 110' Dia. X 32' Open Top Tanks WHT-14
4-1	3	24" Dia. Shell Nozzle 110' Dia. X 32' Open Top Tanks WHT-14
4-2	1	3" Dia. Shell Nozzle 110' Dia. X 32' Open Top Tanks WHT-14
4-3	1	6" Dia. Shell Nozzle 110' Dia. X 32' Open Top Tanks WHT-14
4-4	1	20" Dia. Shell Nozzle 110' Dia. X 32' Open Top Tanks WHT-14
4-5	1	10" X 2" Dia. Level/St Well Nozzle 110' Dia. X 32' Open Top Tanks WHT-14
4-6	1	3" Dia. Shell Nozzle 110' Dia. X 32' Open Top Tanks

		WHT-14
4-7	1	3" Dia. Shell Nozzle 110' Dia. X 32' Open Top Tanks WHT-14
7-1	1	Spiral Stairwell 110' Dia. X 32' Open Top Tanks WHT-14
7-2	1	Outside Stringer 110' Dia. X 32' Open Top Tanks WHT-14
7-3	1	Inside Stringer 110' Dia. X 32' Open Top Tanks WHT-14
7-4	1	Stairway Supports 110' Dia. X 32' Open Top Tanks WHT-14
7-5	1	Windgirder Handrail 110' Dia. X 32' Open Top Tanks WHT-14
7-6	1	Spiral Stairway 110' Dia. X 32' Open Top Tanks WHT-14
7-7	1	Outside Stringer 110' Dia. X 32' Open Top Tanks WHT-14
7-8	1	Inside Stringer 110' Dia. X 32' Open Top Tanks WHT-14
7-9	1	Stairway Supports 110' Dia. X 32' Open Top Tanks WHT-14
7-10	1	Windgirder Handrail 110' Dia. X 32' Open Top Tanks WHT-14
9-1	1	36" X 48" Flush Type Cleanout Door 110' Dia. X 32' Open Top Tanks WHT-14
9-2	1	36" X 48" Flush Type Cleanout Door 110' Dia. X 32' Open Top Tanks WHT-14
10-1	1	Windgirder Details 110' Dia. X 32' Open Top Tanks WHT-14
10-2	1	Windgirder Details 110' Dia. X 32' Open Top Tanks WHT-14
10-3	1	Windgirder Details 110' Dia. X 32' Open Top Tanks WHT-14
10-4	1	Walk Thru Windgirder Details 110' Dia. X 32' Open Top Tanks

		WHT-14
10-5	1	Walk Thru Windgirder Details 110' Dia. X 32' Open Top Tanks WHT-14
10-6	1	Windgirder Walk Thru Stiffening 110' Dia. X 32' Open Top Tanks WHT-14
11-1	1	External Piping & Supports 110' Dia. X 32' Open Top Tanks WHT-14
11-2	1	Pipe Guides for 20" Dia. Inlet Pipe 110' Dia. X 32' Open Top Tanks WHT-14
11-3	1	Pipe Guides for 4" Dia. Inlet Pipe 110' Dia. X 32' Open Top Tanks WHT-14
11-4	1	Pipe Guides for 6" Dia. Inlet Pipe 110' Dia. X 32' Open Top Tanks WHT-14
11-5	1	Grounding Clips 110' Dia. X 32' Open Top Tanks WHT-14

B. Specifications

Section	Revision	Description
01420	0	Nondestructive Examination of Vessels and Piping
15051	0	Welding

PART 5 SUBMITTALS

The minimum Subcontractor submittals are specified in the attached Construction Submittal Register.

PART 6 ATTACHMENTS

A. API 653 Out-of-Service Inspection Report November 4-6, 2014
B. GALVOTEC Aluminum Anodes GA-A-HFT-44 Catalog Sheet
C. Tank Drawings
D. Tank Design Calculations
E. API 650 Sections 5.7.2.10, 5.7.5.1, 7.3.4
F. API 653 Sections 9.7, 9.8, 9.9, 12.1.2

SPR CONSTRUCTION SUBMITTAL REGISTER

PROJECT TITLE/REFERENCE NUMBER Repair Brine Tank WHT-15 (Tank Repairs)				PAGE 1 OF 3		
SUBCONTRACTOR/VENDOR				TASK NO. WH-MM-819E		
SUB-MIT NO.	SPECIFICATION PARAGRAPH NO.	DESCRIPTION OF SUBMITTAL	(1) SUBMITTAL DEADLINE	(2) COPIES TO SMTR	COPIES TO OTHERS	REMARKS OR NOTES
	01010	**SUMMARY OF WORK**				
1	1.03.B.2	Mill Certificate	3 Weeks Before Work	3		
2	1.03.B.4	Anodes Manufacturer's Technical Data Sheets	3 Weeks Before Work	2		
3	Deleted					
4	Deleted					
5	Deleted					
6	Deleted					
7	Deleted					
8	Deleted					
9	Boilerplate	Daily Work Report (DWR) Format	3 Weeks Before Work	3		
10	Boilerplate	Daily Inspection Report (DIR) Format	3 Weeks Before Work	3		

SPR CONSTRUCTION SUBMITTAL REGISTER

PROJECT TITLE/REFERENCE NUMBER Repair Brine Tank WHT-15 (Tank Repairs)				PAGE 2 of 3		
SUBCONTRACTOR/VENDOR				TASK NO. WH-MM-819E		
SUB-MIT NO.	SPECIFICATION PARAGRAPH NO.	DESCRIPTION OF SUBMITTAL	(1) SUBMITTAL DEADLINE	(2) COPIES TO SMTR	COPIES TO OTHERS	REMARKS OR NOTES
11	1.03.D.1 & 2	NACE 2 Inspector Certification Record	2 Weeks Before Inspection			
12	Deleted					
13	Boilerplate	Subcontractor Qualifications	With Bid	2		
	01420	**NONDESTRUCTIVE EXAMINATION OF VESSEL AND PIPING**				
14	1.05.B	NDE/NDT Personnel Qualifications	2 Weeks Before Inspection	3		
15	Deleted					
16	Deleted					
17	Deleted					
18	1.05.B.3 Thru 10	NDE/NDT Test Procedures	3 Weeks Before Work	3		
19	Deleted					

SPR CONSTRUCTION SUBMITTAL REGISTER

PROJECT TITLE/REFERENCE NUMBER Repair Brine Tank WHT-15 (Tank Repairs)				PAGE 3 of 3		
SUBCONTRACTOR/VENDOR				TASK NO. WH-MM-819E		
SUB-MIT NO.	SPECIFICATION PARAGRAPH NO.	DESCRIPTION OF SUBMITTAL	(1) SUBMITTAL DEADLINE	(2) COPIES TO SMTR	COPIES TO OTHERS	REMARKS OR NOTES
	15051	**WELDING**				
20	1.04.B.1	Welding Procedure Specifications	4 Weeks Before Work	3		
21	1.04.B.2	Welding Procedure Qualification Records	2 Weeks Before Work	3		
22	1.04.B.3	Welder Qualification Records	2 Weeks Before Work	3		
23	Deleted					
24	Deleted					
25	Deleted					
26	Deleted					
27	Deleted					

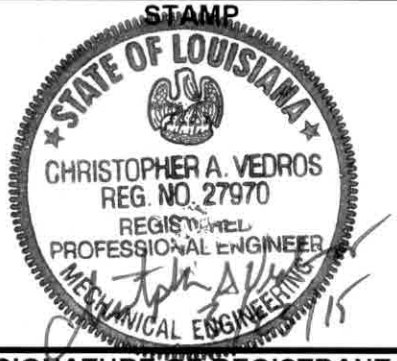
U.S. DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE

FLUOR Federal Petroleum Operations Company

SECTION NO.: 01420 **SECTION TITLE: NONDESTRUCTIVE EXAMINATION OF VESSELS AND PIPING**	**DATE: 02/16/15** **REVISION NO.: 0**
TASK NUMBER: WH-MM-819E **SITE (S): WEST HACKBERRY** **TASK TITLE: REPAIR BRINE TANK WHT-15 (Tank Repairs)**	**PAN NO.: 03191780** **ECR NO.:**

REGISTRATION INFORMATION

STAMP



SIGNATURE OF REGISTRANT

DATE OF SIGNATURE 3/23/15

DISCIPLINE:

APPROVED FOR CONSTRUCTION

E.M. Fratar

DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE
SYSTEMS & PROJECTS

DATE: 3/24/2015

ISSUE AND REVIEW SUMMARY

REV NO.	DESIGNED BY	CHECKED BY	APPROVED BY	PAGES	REMARKS
A	B.BRIUGLIO	J. NGUYEN	C. VEDROS	ALL	DESIGN REVIEW
0	B. Briuglio 3/20/15	3/23/15	3/23/15	ALL	APPROVED FOR cONSTRUCTION

NONDESTRUCTIVE EXAMINATION OF VESSELS AND PIPING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section establishes the requirements and methods for nondestructive examination (hereinafter referred to as NDE) of vessels and piping identified with line numbers on the construction drawings or otherwise specifically referred to in this Section. This specification, along with the appropriate erection/fabrication codes, defines the complete requirements for nondestructive examination.

1.02 REFERENCE STANDARDS

When more recent editions of codes, specifications, and standards are available, the Government's approval shall be obtained by the Contractor prior to using the later editions.

A. API Standard 1104, 2001, Welding of Pipelines and Related Facilities

B. ASME Boiler and Pressure Vessel Code, 2004, Section V, Nondestructive Examination.

C. ASME Boiler and Pressure Vessel Code, 2004, Section VIII, Pressure Vessels.

D. ASME B31.3, 2002, Chemical Plant and Petroleum Refinery Piping.

E. ASME B31.4, 2002, Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols.

F. SNT-TC-1A, 2001, Recommended Practice (For Qualification and Certification of Nondestructive Testing Personnel)

G. ASTM E 94, 2004, Standard Guide for Radiographic Testing

H. ASTM E 142, (Revision Date), Standard Method for Controlling Quality of Radiographic Testing

I. ASTM E 164, 2003, Standard Practice for Ultrasonic Contact Examination of Weldments

J. ASTM E165, 2002, Standard Practice for Liquid Penetrant Examination.

K. ASTM E 709, 2001, Standard Practice for Magnetic Particle Examination

L. ASTM E 797, 2001, Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method.

M. AWS QC1, (Revision Date), Standard for Qualification and Certification of Welding Inspectors

N. MIL STD 45662A, (Revision Date), Calibration Systems Requirements

O. ISO 10012-1, 1992, Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment

P. API 650, 2001, Welded Steel Tanks for Storage

Q. API 653, 2001, Tank Inspection, Repair, Alteration, and Reconstruction

1.03 METHODS

A. Only the following NDE methods shall be used in performing work under this specification:

1. Radiographic (RT)

2. Ultrasonic (UT)

3. Magnetic Particle (MT

4. Liquid Penetrant (PT)

5. Visual Testing (VT)

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Division 1, General Requirements.

B. Section 15051, Welding-Unlined Pipe.

C. Section 01424, NDE-Cement Lined Pipe.

1.05 SUBMITTALS

A. The Contractor shall submit all items in accordance with the requirements of Section 01300 "Submittals". The Contract Submittal Requirements Listing (CSRL) in Section 01300 is a summary of all contract submittals and contains the items listed below. The list in this section takes precedence over the CSRL.

B. NDE Procedure and Qualifications

The Contractor shall submit, but not be limited to, the following procedures and records. These items shall be submitted to the Government for approval prior to beginning fabrication or construction. (Only those procedures and records that are applicable to the Contract scope of work are required.)

1. Procedure for the Qualification and Certification of NDE Personnel (including subcontractors).

2. NDE Personnel Qualification and Certification Documents (including subcontractors) in accordance with Paragraph 1.08.

3. Detailed Radiographic Procedure for Radiography in accordance with Paragraph 3.01.A.

4. Radiation Safety Procedure, Licenses, and Registrations in accordance with Paragraph 3.01.B.

5. Material Safety Data Sheets in accordance with Paragraph 3.01.F when film is processed at any SPR site.

6. Ultrasonic Test Procedure in accordance with Paragraph 3.02.

7. Magnetic Particle Test Procedure in accordance with Paragraph 3.03.

8. Liquid Penetrant Test Procedure in accordance with Paragraph 3.04.

9. Name of Radiographic Subcontractor, if used (and subcontractor's applicable NDE Procedures).

10. All procedures shall include examples of records and reporting forms to be used for documentation of relevant procedure activities.

The above procedures shall be submitted for the Contractor's NDE Subcontractor if applicable. Subcontractor's procedures must be approved by the Contractor first. The Government, at it's discretion, may disqualify any NDE Subcontractor.

C. The Contractor shall submit all NDE records, charts and radiographs to the Government in accordance with this section.

1.06 PROCEDURES

A. Each NDE method shall be applied as specified in a qualified approved written NDE procedure in accordance with the appropriate parts of this specification and references therein.

B. The Contractor shall control NDE activities in accordance with Government approved NDE procedures.

1.07 PROCEDURE QUALIFICATION

A. Each proposed NDE procedure shall be qualified by demonstrating the procedure's ability to detect known indications or, in the case of radiography, the procedure's ability to demonstrate acceptable radiographic sensitivity. Qualification shall be witnessed by the Government.

B. Procedure Qualification, including costs, shall be the Contractor's responsibility.

1.08 PERSONNEL QUALIFICATION

A. The Contractor shall meet the following requirements:

1. The qualification and certification of NDE personnel shall be in accordance with the guidelines of SNT-TC-1A or AWS QC1 (for visual weld inspection), and Contractor's written practice.

2. Before the notice to proceed can be given for NDE work, the Contractor shall submit NDE personnel qualifications and certification records including current eye exam for each of the initial group of proposed NDE individuals to the Government.

3. One copy of NDE personnel qualification, current eye examination, and certification records, shall be retained by the Contractor at the job site for reference.

B. The Contractor shall review and approve Subcontractor NDE personnel certification procedures and personnel qualifications prior to submittal to the Government.

C. The Contractor shall furnish all labor required for project NDE activities including necessary transportation, safety equipment, materials, consumables and facilities.

1.09 ABBREVIATIONS

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
MIL	Military Specification

PART 2 PRODUCT

2.01 EQUIPMENT

A. The Contractor shall furnish all NDE equipment necessary for the following:

1. Qualifying NDE procedures.

2 Qualifying and certifying NDE personnel.

3. Performance, interpretation, and documentation of production NDE in accordance with this specification and all applicable references.

B. Transportation, storage, set-up, maintenance and calibration of NDE equipment shall be the Contractor's responsibility.

C. All NDE equipment, including Test Facilities, to be employed by the Contractor shall meet the requirements of this specification and applicable referenced documents and shall be approved by the Government before use.

D. Equipment and consumables proposed shall be described in sufficient detail in the Contractor's submitted procedures to allow meaningful evaluation of their suitability for their intended use by the Government during review.

E. When applicable, describe the methods used to demonstrate that the Contractor's calibration program complies with MIL STD 45662A.

2.02 MATERIALS

A. The Contractor shall furnish all materials necessary for the following:

1. Qualifying NDE procedures.

2. Qualifying and certifying NDE personnel.

3. Performance, interpretation, and documentation of production NDE in accordance with this section and all applicable references.

B. Transportation, storage, and replenishment of materials shall be the Contractor's responsibility.

C. All NDE materials proposed by the Contractor shall meet the requirements of this specification and applicable references. No NDE materials shall be used until the Government has had adequate time to review Contractor's submittal describing the material. NDE materials may also be approved by the Government during the practical demonstration of procedures. NDE material substitution shall not be permitted without Government approval.

D. Proposed NDE materials shall be described in sufficient detail in the Contractor's submitted procedures to allow meaningful or adequate evaluation to determine suitability for purpose by the Government during review.

E. The Contractor shall maintain Material Safety Data Sheets on site for all chemicals brought on SPR sites and submit this documentation as required including film processing chemicals. Contractor shall establish a Public Right to Know workstation for MSDS in the immediate workplace.

PART 3 EXECUTION

3.01 RADIOGRAPHIC TEST METHOD

A. Radiographic Procedure and Personnel

1. Radiographic procedures shall be in accordance with API Standard 1104, for radiography of welds where the acceptance criteria is API Standard 1104 or ASME B31.4.

2. Radiographic procedures shall be in accordance with ASME BPVC Section V where the acceptance criteria is ASME B31.3, or ASME BPVC Section VIII.

3. Radiography of cement lined pipe is addressed in specification Section 01424.

4. Radiographic Procedures submitted by the Contractor shall include specific information to address the requirements of the appropriate fabrication/erection codes, and this specification.

5. Contractor's Radiographic Procedures shall be qualified by practical demonstration prior to the start of production radiography. Practical demonstration shall require the Contractor's demonstration performance of each radiographic procedure technique for the Government's witness.

6. One copy of each accepted and qualified radiographic procedure and the qualification radiographs shall be retained at the job site for reference. One copy of the qualified radiographic procedure shall also be maintained in each mobile laboratory used on the job.

7. Personnel performing radiography and/or interpreting radiographs shall be qualified and certified either R.T. Level II or Level III in accordance with Paragraph 1.08 of this specification section.

B. Radiation Safety

1. The Contractor shall submit his radiation safety procedures, licenses, and registrations for proposed radiation producing devices to the Government for review prior to performing radiography. All procedures must be accepted prior to performance of production radiography.

2. Each application using x-ray equipment or radioactive materials shall have a radiation survey made during the initial set-up and for each subsequent radiographic exposure, to assure adequate personnel protection.

3. The Contractor shall remove radiation producing devices from the project property at the end of each work day or night, as the case may be.

4. Each person using x-ray equipment and radiation sources shall wear a radiation film badge and a pocket dosimeter. Personnel radiation exposure shall not exceed the limits called for in statutory regulations. "Audible Alarm" dosimeters shall be worn when required by state or NRC Regulations.

5. The Contractor shall provide lockable storage for x-ray equipment when not in use and locked, shielded storage for radioactive materials when not in use.

6. The Contractor shall supply two operable, calibrated radiation survey instruments at each radiographic exposure set-up.

7. Radiation producing devices shall not be left unattended when removed from locked storage.

8. The Contractor is required to comply with all site safety regulations during the performance of radiography.

C. Sources Of Radiation (Gamma Ray)

1. Gamma ray sources may be proposed for use where allowed by the referenced codes or Standards.

2. Specific use of gamma ray sources is limited to Iridium 192. The use of gamma radiation requires prior Government approval.

3. Gamma projectors for Iridium 192 shall be of the portable type with depleted uranium shielding. The drive cables and source tubes are considered a part of the projector and shall allow for proper positioning of the source.

4. The Contractor shall use 8 half value layer collimator where technique allows.

5. Each Iridium 192 source used shall be accompanied by a source decay chart showing the capsule number, the dated decay curve, and the physical dimensions of the source material.

D. X-ray Equipment

1. X-ray machines of the portable type may be used and shall have minimum operating characteristics of 150 kV and 3 mA, with a focal spot not to exceed 5mm x 5mm. The tube head may be positioned by use of a portable dolly, tube stand, or other suitable fixture. Maximum practical shielding shall be employed on the x-ray machine.

2. For routine pipeline radiography, in accordance with API Standard 1104, an x-ray machine mounted on a self-propelled internal crawler may be used. The use of an internal crawler requires Government acceptance of operational demonstrations as follows:

a. The accuracy of crawler stopping and positioning for exposure must be within 5 degrees of perpendicular with respect to the weld and the film (90° ± 5°).

b. The Contractor must demonstrate crawler operational performance and accuracy. This demonstration shall be such that the Government can accept the use of the crawler. The crawler must not damage the pipe.

c. Any type of crawler accepted by the Government may later be disapproved by the Government for reasons of unreliability or poor performance, including but not limited to the following:

1) Inaccurate stopping positions for correct exposure causing excessive radiation beam angle and distortion of the weld image.

2) Inaccurate exposure causing excessive or inadequate radiographic film density.

3) Excessive mechanical breakdowns or unreliability causing delays to production of weld radiographs.

4) Excessive vibration or movement during exposure causing blurred radiographic images.

5) Damage to the pipe.

d. In the event of the Government's disapproval of any previously approved crawler, the Contractor shall immediately replace the disapproved crawler with a crawler acceptable to the Government or use other techniques. Any radiographs that fail to meet the quality requirements of this specification shall be reproduced at Contractor's expense.

3. The Contractor shall provide sufficient numbers and types of x-ray and/or gamma ray equipment on site at all times, capable of a production rate commensurate with that of construction.

4. The Contractor shall provide electrical generation equipment in sufficient capacities and quantities to allow uninterrupted operation of x-ray equipment and support equipment at multiple work site locations. Contractor shall provide any required spare batteries, battery charging equipment or portable electrical generators necessary for the operation of radiography equipment. Equipment must meet standards for Class I Division II Areas when work is performed in these areas.

5. The Contractor shall supply all tools, equipment, personnel and transportation necessary for the assembly, operation, repair, and routine maintenance of his NDE equipment. Contractor shall also supply all support equipment necessary to install or remove equipment from the pipe.

E. Radiographic Support Equipment

1. The Contractor shall provide all mobile radiographic support equipment.

2. All support equipment shall be suitable for the terrain and climatic conditions to be encountered.

3. Radiographic darkroom configurations shall include the following as minimum standard equipment:

a. Covered film processing tanks or vats with latchable lids for securing during transit.

b. Adequate light proofing to provide an acceptable environment for processing radiographic film.

c. A suitable air conditioner/heater in good operating condition.

d. Miscellaneous darkroom hardware necessary for processing radiographs; hangers, reels, timers, thermometers, safe lights, etc.

e. Film drying equipment of sufficient capability to maintain required production of dried, ready-to-read radiographs. Film dryers shall be vented to the darkroom exterior.

f. Radiographic film viewer, intensifier control, and suitable masks.

g. A suitable densitometer, approved by the Government, with a certified calibration strip. (Ref. MIL-STD-45662A)

4. Support equipment shall be self-sufficient with an independent electrical power source of adequate capacity to simultaneously operate all support system components; i.e., film dryers, air conditioner, and radiographic film viewer.

5. All support equipment shall be mobile or be part of an overall transport system which is mobile. Vehicles shall be suitable for the terrain and climatic conditions to be encountered.

F. Radiographic Supplies and Consumables

1. The Contractor shall provide all radiographic supplies and consumables.

2. Film used for radiographs shall only be fine grain, medium speed, high contrast radiographic film, free from inherent flaws that could interfere with the interpretation of the radiograph. Routine weld radiography shall use film of Class (type) 2. Class 2 film shall be Eastman Kodak, type "AA" or a Government approved equivalent. Special exposure radiography may require the use of Class (type) 1 film to produce acceptable radiographic sensitivity. The Government may require Type 1 film for any radiograph up to 1 percent of the total radiographic exposures on the project and on any weld under 6-inch diameter with less than 0.375-inch wall thickness. The use of Type 1 film shall be at the Contractor's expense. Class (type) 1 file shall be Eastman Kodak type "M" or a Government approved equivalent.

3. Lead foil screens of appropriate thickness shall be used front and back for x-ray radiography above 125 kV; for radiography using Iridium 192 radioactive sources, the minimum screen thickness, front and back, shall be 0.005 inch.

4. Fluorescent or fluorometallic intensifying screens shall not be used.

5. Film cassettes shall be sturdy, light-proof, water repellent, and designed for loading and unloading film with minimum possibility of damage to film or the screens. Cassette support devices shall not produce images on film or create excessive pressure that could result in film artifacts.

6. Heat shields for use in radiography of hot welds shall be constructed of solid, compressed gasket material or other suitable material which does not produce weave patterns or images on the radiograph that may interfere with interpretation. Heat shields which place a sheet or layer of metal between the pipe and film are prohibited. The thinnest heat shield practical shall be used. Film side penetrameters shall be positioned between the heat shield and pipe. The use of heat shields requires separate procedure qualification and approval by the Government.

7. Processing chemicals shall be those recommended by the film manufacturer. No substitutes shall be allowed. Material Safety Data Sheets for processing chemicals shall be transmitted to the Government by the Contractor before use on the project.

G. Radiographic Examination (API Standard 1104)

1. Exposure geometry shall be in accordance with API Standard 1104, Section 8.0, "Radiographic Procedure."

2. Each cassette or film holder shall be placed on the surface to be radiographed in a secure manner so that there is no gap between the surface of the pipe or component and the cassette. Where cassettes are overlapped, the maximum gap between any surface and the cassette shall be 5mm (0.2 inch). Placement of the cassette or film holder shall be straight in relation to the weld.

   Radiographs shall not be acceptable if any portion of the weld is obscured or does not show on the finished radiograph.

3. Image Quality Indicator (Penetrameter) Design (API Standard 1104)

   Penetrameters shall conform to the requirements of ASTM E-142.
   Image Quality Indicator (Penetrameter) Selection (API Standard 1104)

4. The maximum penetrameter thickness to be used shall be based on pipe wall or weld thickness. Pipe wall or weld thickness and the penetrameter identifying number are shown in API Standard 1104, Table 5, "Pipe Versus ASTM E-142 Penetrameter Thickness."

5. Radiographic Sensitivity (API Standard 1104)

a. All radiography shall be performed with a technique that clearly shows the images of the I.Q.I. (penetrameter) outline, identifying numbers, and essential hole on the finished radiograph.

b. The essential holes for ASTM penetrameters based on thicknesses are shown in API Standard 1104, Table 5, "Pipe Versus ASTM E-142 Penetrameter Thickness."

I.Q.I. (penetrameters) selected based on weld thickness shall be shimmed to account for weld thicknesses greater than the base metal. Shims shall be made from a material that is radiographically similar to the material being radiographed. The shim dimensions shall be at least 0.125 inch greater than the I.Q.I. (penetrameters) dimensions in length and width on all sides. The shim thickness shall be such that the I.Q.I. (penetrameter) rests on a total thickness equal to the average weld thickness.

6. I.Q.I. (Penetrameter) Placement (API Standard 1104)

a. Film side I.Q.I. (penetrameters) shall be used for all techniques and exposures during production radiography with the exception of the DWE/DWV technique. Prior to production radiography, all radiographic procedures to be used shall be qualified using film side I.Q.I. (penetrameters) with the exception of DWE/DWV Techniques which require source side placement.

b. Source side I.Q.I. (penetrameters) shall be identified with the lead letter "S" and film side I.Q.I. (penetrameters) shall be identified with lead letter "F". Circumferential and/or linear location of I.Q.I. (penetrameters) shall be in accordance with API Standard 1104, Section 8.0.

H. Radiographic Examination (ASME)

1. Radiographic examination techniques shall be in accordance with ASME BPV Code, Section V, Article 2 when the acceptance criteria is ASME BPV Code, Section VIII or ASME B31.3.

2. Penetrameter selection and application shall be in accordance with ASME BPV Code, Section V, Article 2 when the acceptance Criteria is ASME BPV Code Section VIII or ASME B31.3.

I. Weld Numbering And Identification Of Radiographs

1. Weld numbers shall be assigned and applied externally by the Contractor in accordance with his Government approved weld numbering and weld location procedure.

2. Weld numbers shall be painted or marked in a location and at a distance from the weld that will ensure the numbers will not be covered or obscured by other operations. These markings shall be painted or marked in figures. The Contractor shall maintain a log identifying weld numbers and weld locations or weld map. The Contractor shall use a permanent type marker to apply weld numbers to the pipe or component.

3. NDE identification shall use the same weld number identification marked on the pipe or component. Finished radiographs shall be clearly identified by the images of lead number and/or letters representing the following: (See Note)

a. DOE/SPR.

b. Contractor's Name (initials).

c. NDT Contractor's Name (initials) and Procedure Number.

d. Contract Number/Task No.

e. Weld Identification Number.

f. Date of Examination.

g. Line Number, Spool Number, or Component Number.

h. O.D. and Wall Thickness.

i. Welder Identification Number.

Maximum size lead letter/number shall be 0.375 inch unless otherwise approved by the Government.

NOTE: Use of an I.D. imprinter (light flash) for radiograph identification requires specific Government approval and demonstration during procedure qualification radiography.

4. The Contractor's weld numbering and radiograph identification procedure shall be approved by the Government prior to the start of production radiography.

5. Radiograph location markers used to determine the circumferential location of welding defects shall be lead numbers and shall show on finished radiographs as a radiographic image. These numbers shall not be affixed to the film holder or cassette. They shall be positioned on the pipe or component surface with a zero location at the top center. When more than one film is used to radiograph a weld, the first and last location marker on each film must show on consecutive films. The use of a number belt is recommended. Maximum size lead letter/number shall be 0.375 inch unless otherwise approved by the Government. Short loads in the cassette using cut film which do not cover the film overlap are unacceptable.

6. In the event the contractor performs backwelding inside the pipe, radiographs shall be taken after the completion of all backwelding and visual inspection and acceptance of the backweld. Additional radiographs will be required anytime a weld is found to have been backwelded after final acceptance radiography.

7. The use of stripper weld passes on the pipe to correct undercut or other defects, shall also require reradiography of the weld.

J. Radiographic Film Processing

Film processing shall be in accordance with ASTM E-94 and the following:

1. All radiographs shall be processed in a manner to allow storage of the finished radiographs without discoloration or deterioration for a minimum period of five years.

2. An acid stop bath shall be used after developing following the film manufacturer's recommendation of stop bath composition and time.

3. A fixer neutralizer may be used between fixation and wash in accordance with the manufacturer's recommendation.

4. Washing shall be in accordance with the recommendations of the film manufacturer for the storage life specified.

5. A wetting agent shall be used after washing to facilitate quick, even drying.

6. Film shall be dried using circulating warm air dryers.

7. Film shall not be handled or interpreted until completely dry. To prevent delays to production of radiographs, film may be viewed wet to determine radiograph quality and the necessity for reshots only.

8. Radiographic film and processing solutions shall be disposed of by the Contractor in accordance with permits, Federal, state, and local laws, and land owner requirements as applicable. Solutions shall not be "dumped" at the work site.

9. Water supply of adequate quality and quantity shall be the responsibility of the Contractor.

K. Testing For Fixer Removal

1. The Contractor shall conduct and document random sample fixer removal tests to verify the storage life of finished radiographs meets the project requirements of five years. The rate of testing shall be once per 25 welds.

2. Testing for fixer removal shall be accomplished using "The Kodak Hypo Estimator" in conjunction with "Kodak Hypo Test Solution" (or Government

approved equivalent test), following the directions of the test material manufacturer.

3. Finished radiographs not meeting the storage life requirement shall be reprocessed at the Contractor's expense.

L. Interpretation

1. Viewing facilities provided by the Contractor shall be constructed in a manner to afford the exclusion of objectionable background lighting of an intensity that may cause reflections on the radiographic film.

2. High intensity viewing lights that can be controlled to allow the selection of optimum intensities to view the film with densities up to at least 4.0 shall be provided by the Contractor and may be used by Government Inspector. A suitable blower shall be supplied to provide cooling to such a degree that film emulsions will not be damaged while viewing the film. Fluorescent viewing lights shall be prohibited for acceptance interpretation.

3. Each radiograph shall be carefully reviewed by the Contractor for specified quality, proper placement, and accuracy of identification, including item numbers, weld numbers, number belts, I.Q.I. (penetrameters), etc., and to assure that proper coverage of the weld has been achieved before being interpreted for weld quality and submitted to the Government for final interpretation.

4. The Contractor shall check and document at least ten (10) percent of each days film for proper density by use of a densitometer to ensure that radiation exposures are of such intensity and duration to achieve an average film density in accordance with API Standard 1104 or ASME BPVC Section V, article 2 as appropriate. The average shall be based on 4 measurements in any 18 inch film length through the weld.

5. Acceptability of welds shall be determined in accordance with API Standard 1104, Section 6.0, "Standards of Acceptability - Nondestructive Testing" and the following additional requirements on weld acceptability when the acceptance criteria is API Standard 1104:

a. The maximum width of isolated slag inclusions or spherical porosity is 1/8 inch or 25 percent of the wall thickness, whichever is less.

b. Any circular indication, whether gas, slag, inclusion, or foreign material, shall not exceed 1/8 inch or 25 percent of the wall thickness, whichever is less. Circular indications have a maximum dimension/minimum dimension ratio less than 2.0.

c. Repaired burn through which shows the same root defect exists after the repair that existed before the repair, is unacceptable and must be repaired again if a repair welding procedure has been qualified for this purpose or cut from the pipe as a pipe cylinder.

6. Any discontinuity in excess of that allowed by ASME BPVC Section VIII or ASME B31.3 shall be rejected when the acceptance criteria is ASME BPVC Section VIII or ASME B31.3, whichever is appropriate.

7. The Contractor shall perform primary interpretation of radiographs for acceptance or rejection of welds. Final interpretation and concurrence or rejection of both radiograph quality and weld quality shall be made by the Government.

8. Film shall not be interpreted "wet."

9. Radiographs and corresponding interpretation reports shall be presented to the Government for interpretation at a single central location no later than 10 a.m. the next scheduled workday following radiography.

10. Radiographs shall be presented for review as a sorted, complete package for each weld radiographed. All weld repair radiograph packages shall be presented for review and shall include all previous radiographs of the weld.

11. The Government shall have the right to require replacement of the Contractor's film interpreter if more than two percent of that interpreter's film interpretations in any week are rejected by the Government.

M. Film Processing Defects

1. All films shall be free from processing or other defects which would interfere with proper interpretation of the radiograph or mask defects and which may cause deterioration or damage during storage.

2. Each radiographic film shall be examined for processing defects shortly after processing. Film processing defects are defined as any conditions which obliterate or mask a radiographic image. A film shall be rejected as uninterpretable when any one or combination of the following occur in the area of interest:

a. Light streaks;

b. Processing streaks;

c. Discoloration or excessive residual thiosulfate content due to improper fixing or washing;

d. Multiple water spots;

e. Damaged emulsion due to film contact in processing;

f. Crimp, screen, and scratch marks;

g. Fogging or static marks;

h. Poor screen-to-film contact;

i. Dirt or foreign material on film.

j. Film handling damage and pressure marks.

3. All film rejected by the Government on the basis of the above listed defects or for any other radiographic quality reasons (incomplete weld coverage, improper identification, density, sensitivity, etc.) shall be stored in compartmentalized boxes marked FILM QUALITY REJECTED. The entire length of weld represented by the rejected film shall be radiographed again and reinterpreted at the Contractor's expense.

N. Radiographic Documentation/records

1. The Contractor shall record, on a review form approved by the Government and accompanying the radiographs presented to the Government, the interpretation of each radiograph and the disposition of each weld examined.

2. To aid in the proper interpretation of radiographs, details of the radiographic test set-up used shall accompany each group of radiographs presented to the Government. Reference to a standard set-up is acceptable if previously approved by the Government.

3. The Contractor shall complete and submit daily reports of work performed and identify each weld radiographed. All reports shall be completed on forms designated and/or approved by the Government and shall be submitted to the Government by 10:00 a.m. the following work day.

4. All reports shall be signed by the Contractor's designated Government approved ASNT-SNT-TC-1A Level II or III Radiographic Interpreter who interpreted the film.

5. Radiographs and associated reports shall be turned over to the Government at job completion.

O. Storage of Radiographs

1. Radiographic storage shall be the Contractor's responsibility until the radiographs are turned over to the Government at job completion.

2. Roll film shall be stored in the following manner:

a. Store in closed compartmentalized cardboard boxes in sequential order by weld number

b. A block-type sheet paper diagram showing the weld number of the radiograph in each compartment shall be placed inside each compartmentalized box of roll film radiographs.

c. Each roll film box shall be labeled with the following:

1) Box number

2) DOE/SPR Task Number

3) DOE Contract Number

4) Contractor's Name

5) Radiographic Contractor

6) Type of radiograph; i.e., R.T. procedures, welding qualifications, production, etc.

7) Weld Number _____ through _____

8) Date box completed: _____

3. Sheet films shall be placed in individual envelopes or jackets designed for radiographic film storage. Each envelope shall have the name of the Contractor, NDE Contractor, Task Number, line identification, weld identification number, date, and contract number marked on the outside.

4. Sheet films in envelopes shall be stored, in closed boxes, on edge in ascending weld number order to allow prompt retrieval of specific weld number radiographs.

5. Repair radiographs shall be stored in the same individual film compartment or package with the original radiograph of each weld.

6. Film in cardboard boxes shall be stored above floor level in lockable metal storage cabinets, free from high heat, humidity and dust.

7. All boxed film shall be carefully prepared for permanent storage in the following manner:

a. Boxed roll film and boxed sheet film in envelopes shall be placed in sealed cardboard storage containers.

b. An index of container contents shall be placed inside each container.

c. Each container of radiographs shall be sealed or secured in a manner approved by the Government to prevent the entry of light or dust.

d. Each sealed storage container shall be labeled with the following:

1) Container number

2) DOE/SPR Task number

3) DOE Contract number

4) Contractor's name

5) Radiographic subcontractor

6) Weld Number ____ through ____

7) Box Numbers inside the storage container

8) Type of radiographs; i.e., R.T. Procedures, welder qualifications, production, etc.

e. A film storage index shall be provided with the film at turnover of the film to the Government.

8. Radiograph packaging and storage must be addressed in the Contractor's Government approved NDE procedures.

3.02 ULTRASONIC TEST METHOD

A. Ultrasonic Procedures And Personnel

1. The Contractor shall submit detailed ultrasonic test procedures for Government review and approval.

2. The Contractor's procedures shall address the following:

a. Detecting and determining the extent of laminations at pipe ends prepared for welding. (ref. ASTM E 797).

b. Determining wall thickness of new or installed pipe or components (ref. ASTM E 797).

c. Detecting flaws in full penetration welds.

1) The submitted procedure shall be in accordance with ASTM E 164 for API 1104 and ASME B31.4 applications.

2) The submitted procedure shall be in accordance with ASME BPV Code, Section V, Article 5 for ASME Section VIII and ASME B31.3 applications.

3. One copy of each procedure and one copy of each test result report will be retained by the Contractor. One copy of each procedure shall be maintained at the job site by the Contractor as a reference standard.

4. The Contractor shall provide evidence to the Government that the personnel performing ultrasonic testing are qualified and certified in accordance with

Paragraph 1.08 of this specification. Only Level II or Level III U.T. personnel may perform ultrasonic testing.

B. Ultrasonic Equipment

1. Probes used for thickness measurement shall be appropriate to the equipment and surface curvature used. Probes uses for lamination scans shall be the single element type.

2. Contractor supplied calibration blocks used for thickness measurement shall be step blocks as described in ASTM E797.

3. The same type of U.T. couplant shall be used for both calibration and test performance for all tests.

4. All equipment, including couplants, shall be approved by the Government during practical demonstration test for procedure approval prior to use on the project.

C. Ultrasonic Test Technique

1. Calibration shall be performed immediately prior to start of examinations at intervals no greater than each half hour thereafter, and calibration shall be checked prior to any rejection. If at any time the instrument is found to be out of calibration, all examinations performed since the last previous successful calibration shall be repeated. The calibration sensitivity shall be subject to approval by the Government.

2. Calibration shall be re-verified after all measurements are completed.

D. Ultrasonic Test Evaluation

1. Laminations shall be mapped out on the pipe or component surface. Any laminar imperfection within two inches of the pipe or component end shall be unacceptable.

2. Grinding repairs on the body of any fitting or pipe shall be unacceptable if the remaining wall thickness is less than the applicable API or ASTM standard allows.

3. Any indication in excess of that allowed by API 1104 Section 6.0 shall be unacceptable when the acceptance criteria is API 1104 or ASME B31.4.

4. Any indication in excess of that allowed by ASME BPVC Section VIII or ASME B31.3 shall be unacceptable when the acceptance criteria is ASME BPVC Section VIII or ASME B31.3, whichever is applicable.

E. Ultrasonic Documentation/records

1. Daily U.T. reports shall be completed by the Contractor on the Contractor's forms approved by the Government and shall be submitted to the Government by 10 a.m. the following work day.

2. The thinnest reading shall be reported for each grinding repair.

3. The maximum circumferential and longitudinal dimensions of each lamination shall be reported.

4. Information listed in ASTM E 797, Section 9.0, "Report," or ASTM E 164, Section 11.0, "Report", as applicable, shall be recorded at the time of measurement and included in the report.

5. All U.T. test reports shall be signed by the person performing the test and interpreting the test results and shall include his U.T. level of NDE certification.

3.03 MAGNETIC PARTICLE TEST METHOD

A. Procedure And Personnel

1. The Contractor shall submit a copy of his magnetic particle testing procedure for Government review and approval.

2. The submitted procedure shall address the applicable items as listed in ASTM E 709, for application in accordance with API Standard 1104.

3. The submitted procedures shall be in accordance with the requirements and methods specified in ASME BPV Code, Section V, Article 7 when the erection/fabrication code is ASME BPVC Section VIII or ASME B31.3

4. The Contractor's procedure shall be qualified by demonstrating the procedure's ability to detect known indications.

5. One copy of each procedure and one copy of each test result report will be retained by the Contractor. One copy of each procedure shall be maintained at the job site by the Contractor as a reference standard.

6. The Contractor shall provide evidence to the Government that personnel performing and/or interpreting magnetic particle testing are qualified and certified Level II or Level III in accordance with Paragraph 1.08 of this specification in the Magnetic Particle Test Method.

B. Magnetic Particle Equipment

1. AC/DC yoke magnetization equipment shall have articulated legs. The current induction method (prod units) are prohibited. Contractor shall be required to demonstrate that AC yokes are capable of lifting 10 pounds at the maximum pole spacing to be used and that DC yokes are capable of lifting 40 pounds at the maximum pole spacing to be used.

2. Only contrasting color powder ferromagnetic particles shall be used.

3. Equipment for powder application shall be approved by the Government during the practical demonstration of the procedure for approval.

C. Performance Of Magnetic Particle Testing

1. The surface to be examined and adjacent surface within at least 1.0 inch on all sides shall be cleaned and shall be dry and free of any dirt, grease, lint, scale, welding flux, welding spatter, oil, or other extraneous matter that may interfere with proper examination. The temperature of the surface to be examined shall not exceed 600°F.

2. For the yoke method, poles (yoke leg) shall be placed in direct contact with the surface being examined. The sustained magnetization method (continuous method) shall be used. Current shall remain on while applying particles and removing excess. Two separate examinations shall be made on each area. During the second examination, lines of magnetic flux shall be perpendicular to that of the first examination (yoke shall be rotated 90 degrees and held in that position during the second examination). When the length of the area being examined exceeds pole spacing, successive examination shall be overlapped by a minimum of 1.0 inch. Broad areas of particle accumulation which may mask indications of discontinuities shall be removed and the area shall be cleaned and re-examined.

3. The Contractor shall perform demagnetization where residual magnetism creates a problem for a subsequent process.

D. Magnetic Particle Test Evaluation

1. Any discontinuity in excess of that allowed by API Standard 1104, Section 6.0, shall be rejected when the acceptance criteria is API Standard 1104 or ASME B31.4.

2. Any discontinuity in excess of that allowed by ASME BPVC Section VIII or ASME B31.3 shall be rejected when the acceptance criteria is ASME BPVC Section VIII or ASME B31.3, whichever is applicable.

3. Examinations carried out for determining complete removal of defects during welding or grinding repairs shall show that all of the defect has been removed.

4. Repair or removal of weld defects shall be in accordance with the erection/fabrication codes and standards, and Specification Section 15051.

E. Magnetic Particle Documentation And Records

1. Daily M.T. reports shall be completed by the Contractor on forms approved by the Government and shall be submitted to the Government by 10 a.m. the work day following test completion.

2. The type of discontinuity and its dimensions and location in the weld or item shall be reported for each discontinuity found to be unacceptable in accordance with this specification.

3. The Contractor's test reports shall include a specific reference to the magnetic particle test procedure followed to perform the tests.

4. All test reports shall be signed by the person performing the test and interpreting the test results and shall include his level of NDE certification in the Magnetic Particle Test Method (Level II or III).

3.04 LIQUID PENETRANT TEST METHOD

A. Procedures And Personnel

1. The Contractor shall submit his detailed liquid penetrant test procedures for the visible, solvent removable, penetrant system for the Government's review and approval.

2. Liquid Penetrant Test Procedures shall be in accordance with the following:

a. Use ASTM E 165, relevant sections, for API Standard 1104 applications.

b. Use ASME BPV Code, Section V, Article-6 for ASME BPVC Section VIII and ASME B31.3 applications.

3. The Contractor's procedure must be qualified by demonstrating the procedure's ability to reveal known indications.

4. One copy of each procedure and one copy of each test result report will be retained by the Contractor. One copy of each procedure shall be maintained at the job site by the Contractor for reference standard.

5. Personnel performing and/or interpreting liquid penetrant test results shall be qualified and certified Level II or Level III in accordance with paragraph 1.08 of this specification in the liquid penetrant test method.

B. Liquid Penetrant Materials and Equipment

1. The cleaning agent shall be a non-volatile solvent approved by the Penetrant System Manufacturer.

2. Only color contrast, solvent removable penetrant shall be used.

3. Non-aqueous wet developer shall be used (aerosol spray cans).

4. All liquid penetrant equipment and materials must be approved by the Government during practical procedure demonstration tests before use on the project. Material Safety Data Sheets for liquid penetrant materials shall be transmitted to the Government before use on the project.

C. Performance Of Liquid Penetrant Testing

1. Temperature of surface to be examined shall not be less than 60°F nor more than 125°F during the entire examination.

2. The surface to be examined and adjacent surface within at least 1.0 inch on all sides shall be cleaned and shall be free of any dirt, grease, lint, scale, welding flux, welding spatter, oil, or other extraneous matter that may interfere with proper examination. After cleaning, at least five minutes shall be allowed for drying before penetrant is applied.

3. Penetrant may be applied by either brushing or spraying. Dwell time shall be 10 minutes minimum. Excess penetrant removal shall be accomplished by wiping repeatedly with clean lint-free cloths or absorbent papers until most traces of penetrant are removed. Remaining traces of penetrant shall be removed by lightly wiping with a clean cloth or absorbent paper slightly moistened with solvent. Flushing the surface with solvent prior to developing is prohibited.

4. Developer shall be applied by spraying to an even thickness 1-3 minutes after penetrant removal to allow remover residue to evaporate. Developing time before final evaluation shall not be less than 7 minutes nor more than 35 minutes.

D. Qualification For Nonstandard Temperatures

1. When it is impractical to conduct a liquid penetrant examination within the temperature range of 60°F to 125°F, the examination technique at the proposed temperature shall be qualified by the Contractor.

2. The Contractor's method for nonstandard temperature qualification shall be approved by the Government prior to use on the project.

E. Liquid Penetrant Test Evaluation

1. The surface being examined shall be observed continuously during development to detect indications which bleed out profusely and to determine their nature. Areas with excessive background color and broad areas of pigmentation caused by inadequate cleaning shall be cleaned and re-examined.

2. All surfaces to be welded shall be free of laminations and tears.

3. Other types of discontinuities in excess of that allowed by API Standard 1104, Section 6.0, shall be unacceptable when the acceptance criteria is API Standard 1104 or ASME B31.4.

4. Any discontinuity in excess of that allowed by ASME BPVC Section VIII or ASME B31.3 shall be rejected when the acceptance criteria is ASME BPVC Section VIII or ASME B31.3, whichever is applicable.

5. Examinations carried out for determining complete removal of defects during welding or grinding repairs shall show that all of the defect has been removed.

6. Repairs to welds shown deficient by this test shall be accomplished in accordance with the erection/fabrication codes and standards, and Specification Section 15051.

F. Liquid Penetrant Documentation/records

1. Daily reports shall be completed by the Contractor on forms approved by the Government and shall be submitted to the Government by 10 a.m. the following workday for each test conducted.

2. The type of discontinuity and its dimensions and location in the weld or item shall be reported for each discontinuity found to be unacceptable in accordance with this specification.

3. The Contractor's test reports shall include a specific reference to the liquid penetrant procedure followed to perform the test including actual surface temperature and dwell time used.

4. All test reports shall be signed by the person performing the tests and interpreting the test results and shall include his NDE certification level in the Liquid Penetrant Test Method (Level II or Level III).

3.05 VISUAL TEST METHOD

A. Visual examination is observation of that portion of components, joints and other elements that are or can be exposed to view before, during, and after manufacture, examination, assembly and testing. This examination includes verification of engineering design requirements for materials, dimensions, joint preparation, welding, heat treatment, and assembly. The Contractor's quality control inspector shall perform and report visual inspection in accordance with the applicable fabrication / erection design code. The results of visual inspections shall be documented on inspection reports approved by the Government.

B. All welding inspectors performing visual weld inspection shall be qualified and approved by the Government as Certified Welding Inspectors to the minimum requirements of the American Welding Society Standard for Qualification and Certification of Welding Inspectors (AWS/QC1). The inspection records shall clearly record each individual inspection of each individual weld and each individual weld pass as required by the

referencing Section. All inspection records shall be signed by the Contractor's Certified Welding Inspector and be submitted with the Daily Inspection Reports in accordance with the Contractor's Government approved Quality Control Plan.

END OF SECTION

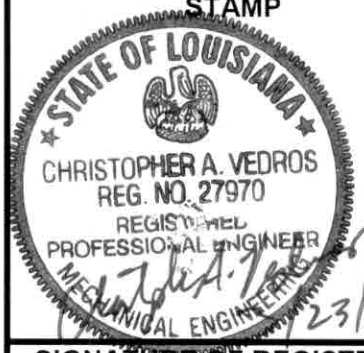
U.S. DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE

FLUOR Federal Petroleum Operations Company

SECTION NO.: 15051 **SECTION TITLE: WELDING**	**DATE: 02/16/15** **REVISION NO.: 0**
TASK NUMBER: WH-MM-819E **SITE (S): WEST HACKBERRY** **TASK TITLE: REPAIR BRINE TANK WHT-15 (Tank Repairs)**	**PAN NO.: 03191780** **ECR NO.:**

REGISTRATION INFORMATION

STAMP



3/23/15

SIGNATURE OF REGISTRANT

DATE OF SIGNATURE
3/23/15

DISCIPLINE:

APPROVED FOR CONSTRUCTION

E.N. Fraction

DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE
SYSTEMS & PROJECTS

DATE: 3/24/2015

ISSUE AND REVIEW SUMMARY

REV NO.	DESIGNED BY	CHECKED BY	APPROVED BY	PAGES	REMARKS
A	B. BRIUGLIO	J. NGUYEN	C. VEDROS	ALL	DESIGN REVIEW
0	B. Briuglio 3/20/15	3/23/15	3/23/15	ALL	APPROVED FOR CONSTRUCTION

WELDING

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section establishes the requirements, methods and testing for shop or field welding of vessels and piping identified on the drawings or referred to in this section.

1.02 RELATED WORK

A. Documents affecting work of this section include sections in Division 1.

1.03 REFERENCES

When more recent editions of codes, specifications, and standards are available, obtain Government approval prior to using the latest edition.

A. ASME B31.3-2004, Process Piping

B. ASME B31.4-2006, Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids

1. Standards incorporated into this Section by reference but not listed in this Article are incorporated into ASME B31.4 by reference. See Appendix A of ASME B31.4 for the specific edition of each standard to be used.

C. ASTM E92-82(2003)e2, Standard Test Method for Vickers Hardness of Metallic Materials

D. AWS B5.1, 2003, Specification for the Qualification of Welding Inspectors

E. Code of Federal Regulation (CFR) Title 49 Part 195, 2005, Transportation of Hazardous Liquids by Pipelines

F. NFPA 13, 2007, Standard for the Installation of Sprinkler Systems

G. NFPA 24, 2007, Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.04 SUBMITTALS

A. Submit items per Section 01300. The Contract Technical Submittal Requirements Listing (CTSRL) in Section 01300 is a summary of technical submittals and contains the items listed below. The list in this section takes precedence over the CTSRL.

B. Submit the following:

1. Welding procedure specifications per Paragraph 3.01.A.

2. Welding procedure qualification records per Paragraph 3.01.A.

3. Welder qualifications for each welder for each procedure the welder is to use per Paragraph 3.01.B.

4. Qualified procedures for radiographic examination and interpretation per Subparagraphs 3.03.D.1 and/or 3.03.D.2.

5. Magnetic particle examination procedures per Subparagraph 3.03.E.2.

6. Liquid penetrant examination procedures per Subparagraph 3.03.E.2.

7. Welding inspector's qualifications, certification and certification program in accordance with AWS 1986, Standards and Guide for Qualification and Certification of Welding Inspectors per Paragraph 3.01.D.

8. Radiographer's qualifications, certification and certification program in accordance with SNT-TC-1A per Paragraph 3.01.D.

9. NDT interpreter's qualifications, certification and certification program in accordance with SNT-TC-1A per Paragraph 3.01.D.

10. Completed weld maps per Paragraph 3.02.F.

11. Radiographic film and associated records per Subparagraphs 3.03.D.11 and 3.03.D.12.

12. Test report for fillet welds per Subparagraph 3.03.E.4.

13. Destructive test reports per Subparagraph 3.03.G.2.

14. Visual inspection reports per Subparagraph 3.03.B.4.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare and qualify welding procedure specifications per Paragraph 3.02.C before beginning production welding. Do not proceed with welding until the procedures are approved by the Government.

1. Include the testing requirements per Paragraph 3.03.C in the welding procedure qualifications for piping material with a SMYS greater than 42,000 psig.

2. Include backwelding, in the qualification of the welding procedure specification if backwelding will be used during production welding.

3. Use the recommended essential variable groupings per API 1104 when qualifying welders and welding procedure specifications per API 1104.

4. Use welding terminology per AWS A3.0 when writing welding procedure specifications.

B. Qualify welders per Paragraph 3.02.C before beginning welding. The Government reserves the right to witness field welder qualifications and shop welder qualifications. Provide two working days notice to the Government prior to welder qualification. Do not allow field welder or shop welder to weld before the welder's qualifications are approved by the Government.

1. For shop welding per ASME BPVC-IX, maintain current welding procedures and welder qualifications including documentation of continuity with the appropriate procedures from the date of the qualification to the present. Have welding procedures and welder qualifications available for Government review upon request.

C. Qualify the welding procedures and the welders for cement lined pipe per Paragraph 3.02.C and the following:

1. Provide in the welding procedure a joint design that minimizes the heat input to the weld and methods for sealing the cement lining joint.

2. Permit 1/16 inch maximum incomplete penetration for cement lined pipe. Substitute nick break tests for the root bend tests to qualify the procedure and welders. Perform face bend, side bend and tensile tests.

3. Qualify the procedure and welders using cement lined pipe. Use pipe of sufficiently short length and sufficiently large diameter to allow internal visual inspection of the cement lining upon completion of welds.

4. The welding procedure and each welder shall demonstrate the ability to make welds which do not damage the internal cement lining.

D. Qualify visual welding inspectors and nondestructive testing personnel and interpreters as required by Article 3.03.A before beginning welding. Do not allow inspectors or NDE personnel and interpreters to work until the inspector's qualifications are approved by the Government.

E. Assure the materials to be welded are per the material classification and welding procedures established for the work.

3.02 FABRICATION

A. Use wire and electrodes that contain 0.4% to 0.6% molybdenum, 0.5% nominal for welding at least the root pass, hot pass and backwelding of carbon steel unlined fire water lines, raw water lines and brine lines.

B. Store welding filler metal and fluxes in a dry area and protect the material from environmental conditions per the manufacturer's recommendations.

C. Weld per the codes and standards established below and the requirements of this section.

PIPING CLASS QUALIFICATIONS	SERVICE	WELDING PROCEDURE SPECIFICATIONS AND WELDER QUALIFICATIONS	ERECTION/ FABRICATION CODES
A, AA, B, C, D	RW, BR	API STD 1104 or ASME BPVC-IX	ASME B31.4
A, B, C, D	CO	API STD 1104 or ASME BPVC-IX	ASME B31.4 and CFR Title 49 Part 195
H, J, K, L, M, N	FO, OR, AD, AV, RW, O2, S, N2	ASME BPVC-IX	ASME B31.3
Z	FM, FW	ASME BPVC-IX	NFPA 13 OR NFPA 24
Pressure Vessels	All	ASME BPVC-IX	ASME BPVC-VIII

** For Big Hill - Weld per the codes and standards established below and the requirements of this section.

PIPING CLASS QUALIFICATIONS	SERVICE	WELDING PROCEDURE SPECIFICATIONS AND WELDER QUALIFICATIONS	ERECTION/ FABRICATION CODES
A, B, C	RW, BR	API STD 1104 or ASME BPVC-IX	ASME B31.4
D, E, H, J, K, M, N, P	SW, SF, FO, OR, AD, AV, PW, CI, OS, FC	ASME BPVC-IX	ASME B31.3
F, G	CO	API STD 1104 or ASME BPVC-IX	ASME B31.4 and CFR Title 49 Part 195
L	FW, FF	ASME BPVC-IX	NFPA 13 OR NFPA 24
Pressure Vessels	All	ASME BPVC-IX	ASME BPVC-VIII

D. Permit welding using a process defined by the applicable code.

1. Use weather protection around welding areas to isolate welding from wind and rain.

2. Do not use backing strips except on longitudinal welds of full encirclement reinforcing saddles.

3. Do not peen the weld to close cavities.

4. Do not weld welding machine grounds to the fabrication.

5. Do not miter welds except in Class J piping. A miter joint is defined as a girth weld where the actual centerlines of the pipes cross at an angle greater than 3°.

6. Fit-up the sections to be welded to satisfy the joint design required by the welding procedure.

7. Do not locate girth weld less than one pipe diameter apart unless otherwise shown on the drawings.

8. Allow a maximum gap of 1/16 inch between reinforcing pads and the curvature of the pipe.

9. Position branch connections as follows:

   a. Do not touch longitudinal seam and girth welds with the reinforcing weld of instrument, drain and vent connections.

      1) Permit relocating these connections to locations that will serve the same purpose when drawing dimensions result in interference with longitudinal seam and girth welds.

   b. Do not touch longitudinal seam and girth welds with the reinforcing weld of locally reinforced branch connections.

      1) Ensure that branch connections do not fall on longitudinal seam and girth welds by the layout of the fabrication.

   c. Do not touch or cover girth welds with full encirclement reinforcing branch connections.

10. Preheat, if required by the welding procedures or the following:

    a. Preheat materials of Grade X52 or lower strength when the steel temperature is less than 33 degrees F or when required for drying.

    b. Preheat materials with strength higher than Grade X52 when the steel temperature is less than 50°F.

    c. Preheat when the weld joint design is between sections of unequal thickness and:

       1) The thick wall thickness is greater than 1.25 times the thinner wall thickness.

2) The thick wall thickness is within a distance of two times the thickness of the thinner wall from the edge of the groove.

d. Preheat a minimum of 3 inches on either side of the weld. Specify the upper and lower limits for preheating in the weld procedure specification.

e. If welding operations are interrupted, reestablish preheat and interpass temperature requirements before the resumption of welding.

f. Do not interrupt welding when preheating is employed.

g. Allow weld to cool slowly by covering with insulating blankets.

11. Post heat the welds as required by the applicable erection/fabrication codes per Paragraph 3.02.C.

a. Do not post heat cold worked piping with specified minimum yield strength greater than or equal to 42,000 psi.

E. Assign a unique weld number to each weld. Mark each weld with this number on the piping adjacent to the weld with a permanent marker. Do not duplicate the weld numbers.

1. Include the line number in the weld number. The line number does not have to be included on the marking of the pipe.

F. Assign a unique identification number or symbol for each welder. Do not reuse a welder's identification number or symbol when a welder leaves the job. Mark the number or symbol of welders next to the weld number on the piping.

G. Do not use steel stamps to mark welding information in the pipe.

H. Provide weld maps of welding that records the weld number, the welders that perform the weld and NDT of the weld.

I. Weld socket weld valves per manufacturer's instructions to prevent damage to the valve seat.

3.03 EXECUTION QUALITY CONTROL

A. Welding Inspectors

1. Qualify and certify visual welding inspectors (CWI) to the requirements of AWS Section QC-1. Permit inspectors qualified to Section QC-2 only after the government acceptance of the training and testing program used to qualify inspector to Section QC-2.

2. Qualify and certify nondestructive testing personnel per the guidelines established in SNT-TC-1A and Contractor's certification program. Only qualified and certified Level II or Level III personnel are to interpret test results.

B. Visual Inspection

1. Visually inspect completed welds including backwelding per ASME BPVC Section V using acceptance criteria per Paragraph 3.03.C.

2. Visually inspect per ASME BPVC Section V, as a minimum, 25% of fit-ups, root and hot passes on a daily basis for welders. The Government can increase the inspection percentage if the rejection rate exceeds 25% of the inspected welds.

3. Verify the materials to be welded are per the specifications.

4. Document the visual inspection by indicating each inspected weld's acceptance on visual inspection reports.

C. Nondestructive Testing of Welds

Test and accept welds as follows:

PIPING CLASS	SERVICE	NDT (Note1)	ACCEPTANCE
A, AA, B, C, D	RW, BR	10% X-ray of each day's completed girth welds for each welder (minimum)	API 1104
A	CO	10% X-ray of each day's completed girth welds for each welder (minimum)	API-1104 and CFR Title 49 Part 195
B, C, D	CO	100% X-ray of each day's completed girth welds 10% NDT of fillet welds for each welder (minimum) See Paragraph 3.03.E	API-1104 and CFR Title 49 Part 195
H, K, L, M, N	RW, O2S, FO, OR, N2	10% X-ray of each day's completed girth welds for each welder (minimum)	ASME B 31.3
J	AD, AV	None	ASME B 31.3
Z	FW, FM	100% X-ray of tie-in welds	ASME B 31.3 (Note 2)
Pressure Vessels	All	ASME Section VIII	ASME Section VIII

**For Big Hill test and accept welds as follows:

PIPING CLASS	SERVICE	NDT (Note1)	ACCEPTANCE
A, B, C,	RW, BR	10% X-ray of each day's completed girth welds for each welder (minimum)	API 1104
D, E, H, J, K, L, M, N, P		10% X-ray of each day's completed girth welds for each welder (minimum) (Notes 1, 2, 3)	ASME B 31.3
F, G	CO	100% X-ray of each day's completed girth welds (minimum) (Notes 1, 3)	API-1104 and CFR Title 49 Part 195

Note 1: Perform 100% X-ray of tie-in welds.

Note 2: For cement lined pipe, incomplete penetration of root pass is allowed as defined by the welding procedure and this Section.

Note 3: Inspect 10% of Class C, E, G and K piping socket weld and branch connection fillet welds. See 3.03.E below.

(*Note 3 applies only to Big Hill*)

D. Radiography of Welding

1. Use written, qualified procedures for radiographic examination and interpretations per API 1104 for inspection of welds where the weld acceptance criteria are API 1104.

2. Use written, qualified procedures for radiographic examination and interpretations per ASME BPVC Section V for inspection of welds where the acceptance criteria are ASME B 31.3 or ASME Section VIII.

3. Accomplish qualification of radiographic procedures by submitting one weld's radiographs with a completed data sheet for review for each procedure used.

4. Demonstrate to the Government that radiographic procedures are per API 1104 or ASME BPVC Section V as applicable. Do not begin production welding until approval of radiographic procedures.

5. Mark the following information on each container and on each radiograph film:

   a. Client and Contractor's Name

   b. NDT Contractor's Name

   c. Contract Number

   d. Line number and, if applicable, spool number

   e. Weld Identification Number

   f. Date of Examination

g. SPR Site or Off-site Pipeline

6. Radiograph girth welds for the entire circumference of the pipe.

7. Radiograph welds requiring radiography within three working days after the weld's completion.

8. For 10% sample radiography the following requirements are given to ensure the sample lots allow for identifying welding deficiencies during the course of welding.

   a. The Government reserves the right to choose the welds to be radiographed.

   b. Include all welders' work in the sample lots.

   c. Do not include tie-in welds or road crossing/river crossing welds that require 100% X-ray in the sample lot.

   d. When a tested weld is defective, then radiograph two more existing welds performed by the responsible welder. If either of these two welds is defective, then radiograph welds performed by the responsible welder since the last sample radiograph of the welder's work.

9. Review radiographs for film quality. Include in the review proper processing, freedom from artifacts and scratches, proper location and size of penetrameters and radiograph identification. Provide film with a shelf life of five years.

10. Obtain Government approval of radiographs before proceeding with construction activities that would prevent weld accessibility.

11. Retain on file at the site radiographic film and associated records.

12. Submit, at the completion of welding, the radiographic film and associated records, boxed and labeled for permanent storage.

E. Nondestructive Testing of Fillet Welds

1. When required by Paragraph 3.03.C above, nondestructively test fillet welds using liquid penetrant testing or magnetic particle testing methods.

   a. The Government reserves the right to choose the welds to be tested.

   b. Include welders' work in the sample lots.

2. Submit test procedures for each method to be used prior to starting work. The procedure must demonstrate compliance with ASME BPVC Section V.

3. Use the test method that will give the most effective indication of weld defects for the particular weld location and joint design.

4. Submit test reports that indicate the test method, the information required per Subparagraph 3.03.D.5 and the interpretation results.

F. Additional Testing of Crude Oil Welds

1. Include in the welding procedure qualification for materials having a specified minimum yield strength above 42,000 psi, hardness testing to confirm the procedure will not produce welds harder than 248 Vickers HV 10.

a. Prepare one specimen of the cross section of the weld per ASTM E92 and Schedule A attached.

b. Test the specimen per ASTM E92.

1) Use a 10 kilogram-force test load.

2) Apply the full test load for 10 to 15 seconds.

3) Do not place the center of the impression closer to an edge of the test specimen or to another impression than a distance equal to two and one half times the length of the diagonal of the impression.

4) Measure both diagonals of the impression and use their mean value as a basis for calculation of the Vickers Hardness number. Determine the Vickers Hardness number from the table in ASTM E92.

5) Obtain hardness reading at the points indicated in Schedule A.

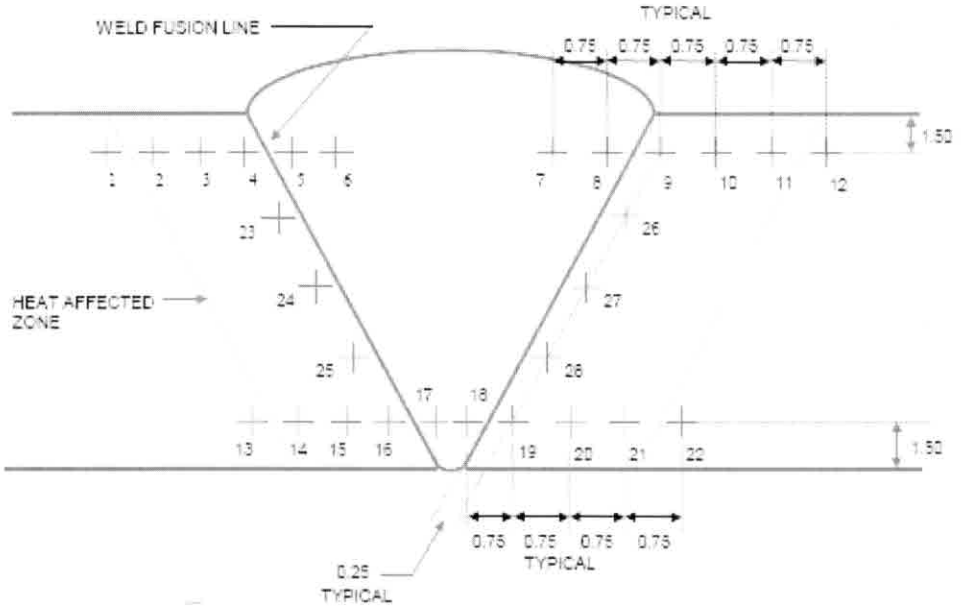
c. Submit completed Schedule A.

3.04 SCHEDULES

A. Vickers Hardness Survey

END OF SECTION

SCHEDULE A: VICKERS HARDNESS SURVEY



All Dimensions in millimeters (mm)

Test points 4, 9, 16, 19 and 23 thru 28 shall be 0.25 mm from the fusion line. Test points 23 thru 28 shall be centered in areas reheated by the overlying weld passes.

LOCATION	HARDNESS HV 10	LOCATION	HARDNESS HV 10	LOCATION	HARDNESS HV 10
1	_____	10	_____	19	_____
2	_____	11	_____	20	_____
3	_____	12	_____	21	_____
4	_____	13	_____	22	_____
5	_____	14	_____	23	_____
6	_____	15	_____	24	_____
7	_____	16	_____	25	_____
8	_____	17	_____	26	_____
9	_____	18	_____	27	_____
				28	_____

ATTACHMENT A

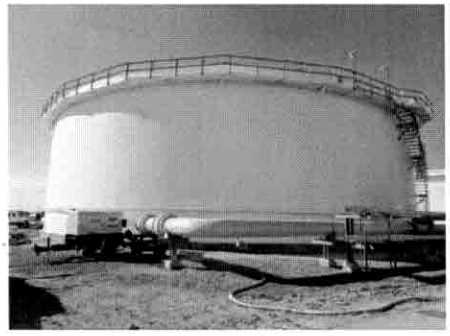
API 653 OUT OF SERVICE INSPECTION REPORT

ATMOSPHERIC STORAGE TANK

INTERNAL / EXTERNAL & ULTRASONIC

API 653 OUT-OF-SERVICE INSPECTION REPORT

STRATEGIC OIL RESERVE



TANK NO. WHT-15

U.S. DEPARTMENT OF ENERGY SPR SITE TERMINAL

HACKBERRY, LA

NOVEMBER 4-6, 2014

Prepared by:

HMT Inspection
A Division of HMT LLC
8979 Market Street Rd.
Houston, Texas 77029-3421
713.676.6150

INTRODUCTION

HMT Inspection, a division of HMT LLC, provided on-site inspection services in accordance with API Standard 653 guidelines for Aboveground Storage Tanks (ASTs) to establish the current condition of Tank No. WHT-15 at the U.S. Department of Energy SPR Site Terminal in Hackberry, LA.

This report is being provided to document these inspection findings based on the inspections performed on November 4-6, 2014 and to summarize the evaluation of the AST assessment in accordance with the guidelines of API 653 as applicable.

The owner / user is ultimately responsible for establishing the final suitability for service of Tank No. WHT-15 using the current condition of this tank as detailed herein and the decisions made by the owner / user in satisfying API 653 guidelines for continued operation / repair / alteration / modification as appropriate, subject to the following conditions being met:

1. That the owner / user reviews, evaluates and implements the recommendations set forth in Section 2.0, Summary and Repair Recommendations, of this report or, the owner / user determines that no action(s) need be taken prior to continued service and such decision(s) are documented in the AST historical record file.

2. That the owner / user adheres to the safe fill height recommendations given herein in Section 2.0 for continued service until such time as tank operating conditions change or another inspection assessment per API 653 guidelines determines that an adjustment in safe operating height for this tank should be made.

HMT Inspection provided the following personnel:

Chad Taylor
API 653 Aboveground Storage Tank Inspector
Certification Number: 47959
Level II Technician

Jeff Henderson, Freeman Hancock
Technicians

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1.0 DESCRIPTION

GENERAL:

TANK NUMBER / IDENTIFICATION:	WHT-15
OWNER:	Strategic Oil Reserve
TANK LOCATION:	West Hackberry, LA
TYPE OF FACILITY:	Terminal
MANUFACTURER:	American Tank & Vessel Inc.
DESIGN STANDARD:	API 650, 9th Edition
PRODUCT PRIOR TO INSPECTION:	Brine Water
DESIGN SPECIFIC GRAVITY:	1.2
PRODUCT SPECIFIC GRAVITY:	1.0
DESIGN PRESSURE:	Atmospheric
OPERATING TEMPERATURE:	Ambient
CATHODIC PROTECTION:	Yes
NAMEPLATE PRESENT:	Yes
DOT REGULATED TANK:	No
LATITUDE:	29° 59' 46" N
LONGITUDE:	93° 24' 06" W

DIMENSIONS:

DIAMETER:	110.00 ft.
HEIGHT:	32.00 ft.
CAPACITY GROSS:	Data Not Available
OPERATING HEIGHT:	32.00 ft.
CAPACITY NOMINAL:	50,000 bbls.

GEOMETRY:

FOUNDATION:	Concrete Ringwall
BOTTOM:	Butt Welded
SHELL:	Butt Welded
MATERIAL OF CONSTRUCTION:	A-36 Carbon Steel
COURSE 1 AVERAGE THICKNESS:	0.657 inch
FIXED ROOF:	N/ A (Open Top)
FLOATING ROOF:	None
PRIMARY SEAL:	N/A
SECONDARY SEAL:	N/A

DATES:

YEAR OF CONSTRUCTION:	1997
SECOND BOTTOM & DATE INSTALLED:	Original
LAST COATED / LINED:	Data Not Available
LAST INSPECTION:	Data Not Available

ACCESS:

STAIRWAY:	Spiral (2)
FLOATING ROOF ACCESS:	N/A

COATINGS / LININGS:

BOTTOM:	White-Thin-Film Epoxy
SHELL:	External - White Paint Internal - White Thin-Film Epoxy
FIXED ROOF:	N/A
FLOATING ROOF:	N/A

2.0 SUMMARY OF RECOMMENDED ACTIONS

FOUNDATION:

1) **Action Code B:** Repair or replace the moisture barrier.
2) **Action Code D:** Monitor settlement at the next inspection interval.

BOTTOM:

1) **Action Code A:** Repair the bottom thin-film epoxy for corrosion protection.
2) **Action Code B:** Repair or replace the bottom anodes and supports.

SHELL:

1) **Action Code B:** Properly clean and re-coat the top angle and wind girder.
2) **Action Code A:** Repair the coating of internal Courses 1 through 4.
3) **Action Code A:** Repair the internal vertical weld of Course 3 in the west tank quadrant.
4) **Action Code C:** Install adequate drain holes in the wind girder.

NOZZLE AND APPURTENANCES:

1) **Action Code B:** Remove the mechanical plugs of shell Items M and N reinforcing pads and pressure test.
2) **Action Code B:** Replace shell Item N nozzle, flange, bolts, and blind flange.
3) **Action Code B:** Repair or replace the shell anodes and supports.
4) **Action Code B:** Replace the internal fill line.
5) **Action Code C:** Test, repair as necessary and calibrate all gauges and alarms.

ACTION CODE (AC) DEFINITIONS
Code A: Repairs critical to tank integrity required - Out of compliance with current API 650 / 653 standards. Positive action must be taken prior to continued service.
Code B: Further Engineering evaluation required - Out of compliance with current API 650 / 653 standards with **no damage or failure noted**. Must be assessed (action taken or not taken) and documented prior to continued service.
Code C: No action required - Pertinent findings / suggestions / recommendations only. Monitor for continued deterioration.
Code D: Acceptable - In compliance w/ API 650 / 653 standards - No action required

INSPECTION SUMMARY

The following is a summary of the significant findings of the inspection (item numbers correspond with the HMT API 653 Checklist).

INSPECTION INTERVALS: Inspection noted the bottom was in acceptable condition. The next internal inspection should be conducted within 20 years. If the bottom is internally coated, the next inspection should be conducted within 20 years, provided that the expected life of the coating meets or exceeds this interval (ref. API 653, Para. 4.4.5).

The next external API 653 inspection should be conducted within 5 years and no later than November 2019 (ref. API 653, Para. 6.3.2.1). Complete API 653 out-of-service inspection prior to this date would supplement the next external inspection requirement.

Ultrasonic (UT) testing of the shell should be conducted again within 15 years and no later than November 2029 (ref. API 653, Para. 6.3.3.2 b).

FOUNDATION:

ITEM F2 / ACTION CODE D: The survey found the tank out of level by 0.84 inch. API 653 calculation for deflection of this tank is 0.29 inch. API maximum deflection permitted for this tank is calculated at 1.77 inches (ref. API 653, Annex B, Para. B.3). Differential settlement for this tank does not exceed the API allowable (ref. API 653, Annex B, Para. B.3). Future settlement should be monitored during the next API 653 external inspection.

ITEM F11 / ACTION CODE B: The moisture barrier in place between the bottom edge projection and the concrete ringwall has deteriorated, allowing water to enter under the tank bottom. Consideration should be given to properly removing the moisture barrier and replacing it with a more suitable material around the entire tank.

ACTION CODE (AC) DEFINITIONS
Code A: Repairs critical to tank integrity required - Out of compliance with current API 650 / 653 standards. Positive action must be taken prior to continued service.
Code B: Further Engineering evaluation required - Out of compliance with current API 650 / 653 standards with **no damage or failure noted**. Must be assessed (action taken or not taken) and documented prior to continued service.
Code C: No action required - Pertinent findings / suggestions / recommendations only. Monitor for continued deterioration.
Code D: Acceptable - In compliance w/ API 650 / 653 standards - No action required

INSPECTION SUMMARY (CONT'D.)

BOTTOM:

ITEMS B2, B3 and B4 / ACTION CODE D: Tank WHT-15 bottom was constructed to API 650 by American Tank & Vessel Inc. in 1997. Nominal bottom plate thickness is 0.438 inch. Magnetic Flux Leakage (MFL) scanning of the bottom revealed zero (0) areas of recordable soil side corrosion at or below 0.285 inch (0.150 inch pit depth and deeper) for the interior bottom plates and 0.335 inch (0.100 inch pit depth and deeper) for the critical zone. Magnetic Flux Leakage (MFL) scanning, in conjunction with Visual (VT) inspection of the bottom, was also performed. Zero (0) areas of recordable product side indications were identified on the bottom with a remaining thickness at or below 0.285 inch (0.150 inch pit depth and deeper) for the interior bottom plates and 0.335 inch (0.100 inch pit depth and deeper) for the critical zone.

ITEM B16 / ACTION CODE B: The bottom and shell have nineteen (19) sacrificial anodes mounted on 1-inch pipe supports. The anodes are severely corroded and several support brackets are bent and have corrosion present. Consideration should be given to replacing and repairing the anodes as needed prior to returning the tank to service.

ITEM B16 / ACTION CODE D: Inspection noted that existing patch plates are present which were not installed per API 653. This is for information only.

ITEM B17 / ACTION CODE D: Areas restricted from MFL examination coverage due to physical limitations included around the sacrificial anodes and near the shell-to-bottom weld. This is noted for information only.

ITEM B4 / ACTION CODE A: Inspection revealed multiple areas of isolated coating failure. These areas should be cleaned and re-coated to maintain bottom threshold validity.

ACTION CODE (AC) DEFINITIONS
Code A: Repairs critical to tank integrity required - Out of compliance with current API 650 / 653 standards. Positive action must be taken prior to continued service.
Code B: Further Engineering evaluation required - Out of compliance with current API 650 / 653 standards with **no damage or failure noted**. Must be assessed (action taken or not taken) and documented prior to continued service.
Code C: No action required - Pertinent findings / suggestions / recommendations only. Monitor for continued deterioration.
Code D: Acceptable - In compliance w/ API 650 / 653 standards - No action required

INSPECTION SUMMARY (CONT'D.)

SHELL:

ITEMS S1 & S13 / ACTION CODE D: Shell thickness calculations indicate the safe fill height of 32.00 feet can be utilized with product specific gravities up to 1.2 (ref. API 653, Para. 4.3.3.1). These calculations do not take into account operational restrictions from such items as high-level alarms or owner / operator-imposed safe fill restrictions along with the internal floating roof and seals. There are no shell-mounted overflow vents on this tank.

ITEM S6 / ACTION CODE B: The shell top angle and wind girder have moderate to severe coating failure (peeling, cracking and blistering) with severe leafing-type corrosion present. Consideration should be given to sandblasting and re-coating the entire top angle and repairing of the wind girder coating.

ITEM S11 / ACTION CODE C: There are low areas present on wind girder that retain water and an inadequate amount of drain holes. Drain holes should be installed per API 650 guidelines.

ITEM S12 / ACTION CODE D: There are no reinforcing plates present under the wind girder supports and pipe supports around shell. These details have been present for an extended period and no corrective action is required at this time. These areas should be monitored in future for signs of accelerated corrosion due to possible increased stress concentrations.

ITEM S15 / ACTION CODE A: The internal shell coating has failed in multiple locations, causing accelerated corrosion in these areas. No recordable indications were found at this time. Consideration should be given to sandblasting and re-coating the entire internal shell.

ITEM S16 / ACTION CODE A: There is one (1) vertical weld that exhibits corrosion on the lower 4 feet of the vertical weld on the west side of tank on Course 3. This area of corrosion should be re-welded.

ACTION CODE (AC) DEFINITIONS
Code A: Repairs critical to tank integrity required - Out of compliance with current API 650 / 653 standards. Positive action must be taken prior to continued service.
Code B: Further Engineering evaluation required - Out of compliance with current API 650 / 653 standards with **no damage or failure noted**. Must be assessed (action taken or not taken) and documented prior to continued service.
Code C: No action required - Pertinent findings / suggestions / recommendations only. Monitor for continued deterioration.
Code D: Acceptable - In compliance w/ API 650 / 653 standards - No action required

INSPECTION SUMMARY (CONT'D.)

NOZZLES AND APPURTENANCES:

ITEM N2 / ACTION CODE C: There are minor areas of coating failure on external shell items. Consideration should be given to cleaning and re-coating all shell items as needed.

ITEM N2 / ACTION CODE C: Nozzles B, I and J have weld spacing between their reinforcing plates and the shell-to-bottom joint less than that required by API 650, Para. 5.7.3. Such practice results in areas of increased stress concentration and possible accelerated corrosion. Visual (VT) inspection of these details did not identify any such corrosion at this time and no corrective action is required.

ITEM N2 / ACTION CODE B: Nozzle N has severe coating failure (peeling and cracking) with leafing-type corrosion present on the neck, flange, bolts, blind flange and welds. Consideration should be given to sandblasting, re-inspecting, repairing or replacing the nozzle as needed.

ITEM N2 / ACTION CODE B: Shell Items M and N have telltale holes that are plugged. API 650, Paras. 5.7.5.1 and 5.7.2.10 indicates reinforcing plates should be installed with telltale holes left open to the atmosphere. These plugs should be removed and telltale holes tested prior to returning the tank to service. The telltale holes should then be left open to the atmosphere.

ITEM N9 / ACTION CODE C: The automatic gauge and high-level alarms should be tested, repaired, and calibrated during this out-of-service period.

ITEM N18 / ACTION CODE B: There are multiple areas of corrosion present on the fill line piping. This piping will be replaced (per client).

ACTION CODE (AC) DEFINITIONS
Code A: Repairs critical to tank integrity required - Out of compliance with current API 650 / 653 standards. Positive action must be taken prior to continued service.
Code B: Further Engineering evaluation required - Out of compliance with current API 650 / 653 standards with **no damage or failure noted**. Must be assessed (action taken or not taken) and documented prior to continued service.
Code C: No action required - Pertinent findings / suggestions / recommendations only. Monitor for continued deterioration.
Code D: Acceptable - In compliance w/ API 650 / 653 standards - No action required

3.0 INSPECTION REPORT

3.1 FOUNDATION

3.1.1 FOUNDATION INSPECTION CHECKLIST

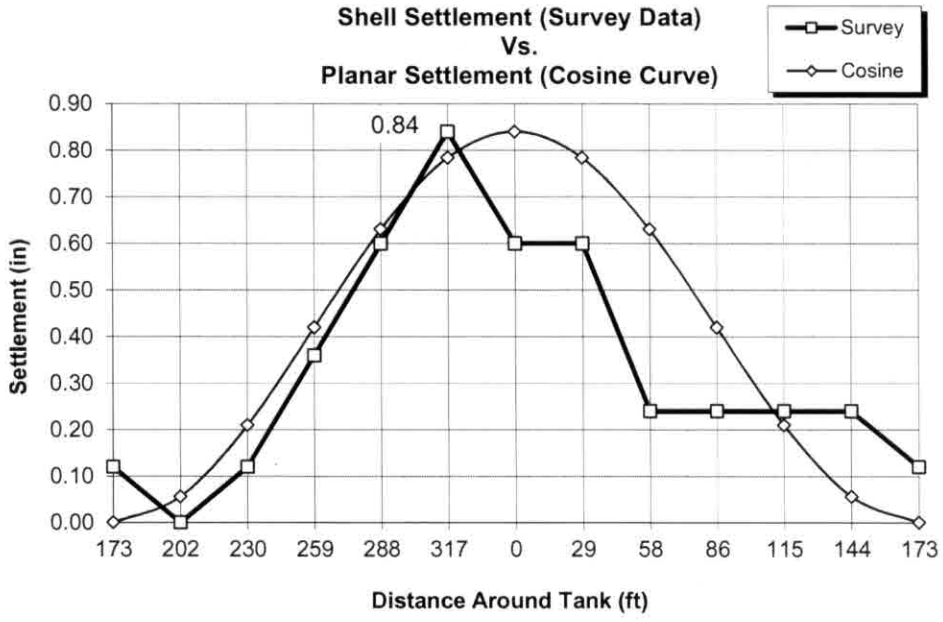
ITEM NO.	FOUNDATION	INSPECTION COMMENTS
F1	Condition of foundation support (ref. API 653, Para. 4.5.1).	Acceptable
F2	Perform bottom settlement survey (ref. API 653, Para. B.2.1).	Reference Section 2.0
F3	Identify and measure the dimensions of all areas of tank bottom deformation (up or down) & settlement (ref. API 653, Paras. B.2.5 & B.3.3).	Acceptable
F4	Identify and measure all areas of internal bottom edge settlement (ref. API 653, Paras. B.2.3 & B.3.4 Figs. B.11 / B.12).	Acceptable
F5	Concrete ringwall free of debris (ref. API 653, Para. 6.3.1).	Acceptable
F6	Concrete ringwall beveled away from tank.	Acceptable
F7	Concrete ringwall free of cracks, breaks, spalling, exposed rebar, etc. (ref. API 653, Para. 4.5.1).	Acceptable
F8	Earth eroded due to water running off the tank (ref. API 653, Paras. 6.3.1, 4.4.2).	Acceptable
F9	Check for proper drainage and water runoff away from the tank (ref. API 653, Para. C.1.1.5).	Acceptable
F10	Check around the tank and within the dike for build-up of trash and vegetation (ref. API 653, Para. C.1.1.6).	Acceptable
F11	Moisture barrier condition (bottom edge projection to concrete ringwall) (ref. API 653, Para. 6.3.1).	Reference Section 2.0
F12	Indications of bottom leakage (ref. API 653, Para. 6.3.1).	Acceptable
F13	Cavities or holes around / under tank perimeter (ref. API 653, Paras. 6.3.1 & C.1.1.1).	Acceptable
F14	Check for anchorage. Record sizes, spacing between anchors and condition (ref. API 653, Paras. 4.5.3 & 8.8).	N/A
F15	List any limitations to the foundation inspection.	Acceptable

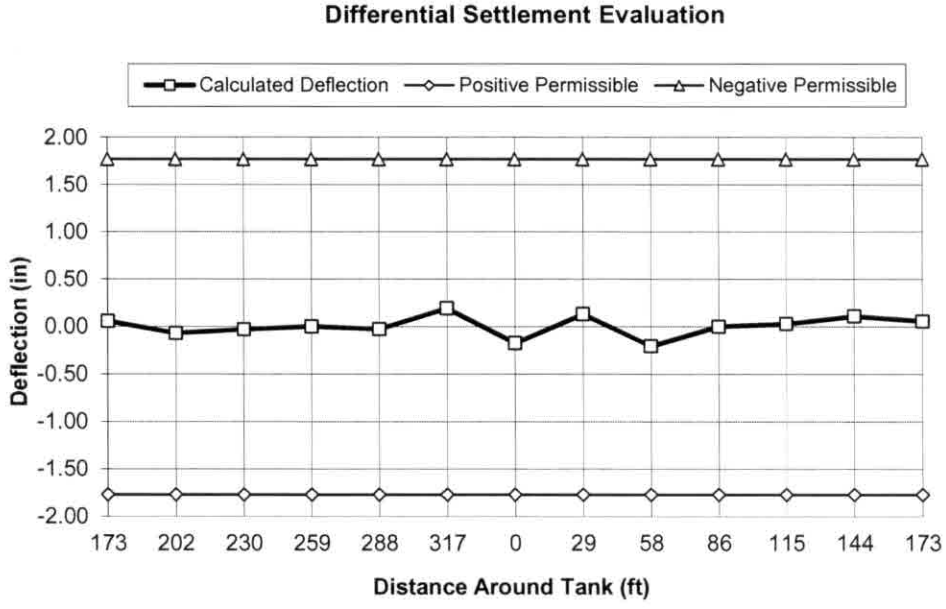
3.1.2 FOUNDATION SETTLEMENT SURVEY

The survey was conducted internally counterclockwise from the reference Shell Manway A located at Station 0.0. The circumferential distance between the readings is 28.80 feet.

Point No.	Distance from Shell (ft.)												
	Shell	1'	2'	3'	4'	5'	6'	10'	20'	30'	40'	50'	Center
	Rod Readings (ft.)												
1	4.970	4.970	4.980	5.000	5.030	5.060	5.040	4.94	4.710	4.500	4.370	4.360	4.350
2	4.970	4.970	4.950	4.940	4.940	4.950	4.920	4.90	4.790	4.580	4.450	4.340	--
3	4.940	4.930	4.910	4.920	4.950	4.990	4.990	4.78	4.630	4.530	4.450	4.350	--
4	4.940	4.940	4.950	4.970	4.980	5.000	5.000	4.96	4.770	4.690	4.520	4.410	--
5	4.940	4.930	4.910	4.910	4.940	4.970	4.960	4.79	4.690	4.660	4.510	4.340	--
6	4.940	4.930	4.920	4.930	4.960	4.960	4.970	4.76	4.650	4.600	4.450	4.320	--
7	4.930	4.910	4.900	4.890	4.890	4.900	4.910	4.78	4.650	4.500	4.370	4.340	--
8	4.920	4.900	4.890	4.890	4.890	4.900	4.910	4.91	4.740	4.610	4.420	4.340	--
9	4.930	4.930	4.940	4.950	4.980	4.960	4.930	4.75	4.670	4.580	4.440	4.330	--
10	4.950	4.950	4.990	4.990	4.990	4.960	4.930	5.00	4.810	4.710	4.540	4.380	--
11	4.970	4.970	4.970	4.970	4.970	4.970	4.970	4.92	4.690	4.570	4.540	4.300	--
12	4.990	4.970	4.950	4.970	5.000	5.020	5.050	5.09	5.050	4.780	4.540	4.350	--

3.1.3 SETTLEMENT EVALUATION





3.2 BOTTOM

3.2.1 BOTTOM INSPECTION CHECKLIST

ITEM NO.	BOTTOM	INSPECTION COMMENTS
B1	Bottom edge projection condition (corroded or pitted, thinning, deformed, obstructed) (ref. API 653, Paras. 4.4.5.7 & 6.3.1.3).	Acceptable
B2	Record minimum bottom plate thickness requirements (ref. API 653, Para. 4.4.5).	Reference Section 2.0
B3	MFL scan of accessible bottom plates. Quantify all findings (ref. API 653, Paras. 4.4.4 & 4.4.5)	Reference Section 2.0
B4	Visual inspection of bottom plate surface condition (ref. API 653, Para. 4.4.1)	Reference Sections 2.0 and 4.0
B5	Conduct Ultrasonic thickness readings of bottom plates. Record all data (ref. API 653, Para. 4.4.4).	Acceptable
B6	Locate unacceptable voids beneath bottom. Record the locations (ref. API 653, Para. 4.4.2.h & j) (ref. API 653, Para. 9.10.2.1.3).	Acceptable
B7	Visual inspection of bottom plate lap welds (for reportable indications or other anomalies) (ref. API 653, Para. 4.4.2, / Fig. 9.1).	Acceptable
B8	Perform Vacuum Box testing of bottom lap welds.	N/A
B9	Internal Shell-to-bottom weld condition (ref. API 653, Para. 4.4.2).	Acceptable
B10	Perform Magnetic Particle testing of internal shell-to-bottom weld.	N/A
B11	Perform Vacuum Box testing of internal shell-to-bottom weld.	N/A
B12	Identify all signs of product leakage.	Acceptable
B13	Floating roof leg striker plate condition (pitting, cutting, and dimpling).	N/A
B14	Fixed roof column bearing / base plate condition (corrosion, weld failure).	N/A
B15	Fixed roof column lateral clips (align tank columns) (ref. API 650, Para. 5.10.4.7)	N/A
B16	Conduct Visual inspection of reinforcing, bearing, base, striker plates and existing lap patches (ref. API 653, Paras. 9.10.1.2, & 9.10.3 & Fig. 9.9)	Reference Section 2.0
B17	List any limitations to bottom inspection.	Acceptable
ITEM NO.	**SUMP**	**INSPECTION COMMENTS**
BS1	Describe sump type / condition (Modified, false bottom, dish / bowl, etc.) details to include physical dimensions (ref. API 653, Paras. 4.4.2, 9.10.1.5 & C.2.3), (ref. API 650, Table 5-16b & Fig. 5-21).	N/A
BS2	Perform Visual inspection of the sump (including all sump welds).	N/A
BS3	Perform Magnetic Particle testing examination on all sump welds (including sump-to-bottom weld).	N/A
BS4	Perform Sump UT. Record lowest UT reading per grid in sump UT form.	N/A
BS5	List any limitations to the sump inspection.	N/A

3.2.2 SERVICE INTERVAL

Inspection noted the bottom was in acceptable condition. The next internal inspection should be conducted within 20 years. If the bottom is internally coated, the next inspection should be conducted within 20 years, provided that the expected life of the coating meets or exceeds this interval (ref. API 653, Para. 4.4.5).

Bottom Plates

Nominal Bottom Plate Thickness (inches)	0.438	inch
Maximum Soil Side Corrosion Depth	0.130	inch
Maximum Product Side Corrosion Depth	0.020	inch
Minimum Remaining Thickness at Next Inspection (MRT)	0.100	inch
Year of Inspection (Yi)	2014	year
Year of Bottom Installation (Yo)	1997	year
Minimum Remaining Thickness from Soil Side Corrosion after Repairs (RTbc)	0.285	inch
Minimum Remaining Thickness from Product Side Corrosion after Repairs (RTip)	0.285	inch
Soil Side Corrosion Rate (UPr)	**0.0090**	inch/yr
Product Side Corrosion Rate (StPr)	**0.0090**	inch/yr

Repaired Soil Side Corrosion Evaluation (assume 0.250 in. patch): 0.250 in. Patch Plate **Acceptable**
(per API 653, 4.4.5, UPr Def.)

$$O_r = \frac{(\min RT_{bc} or RT_{ip}) - MRT}{S_t P_r + UP_r}$$

Interval to next inspection **10 Years**
(RRT-0.10)/(PS + SS C.R.)

If thin-film lining is installed after repairs
(expected life of lining must equal or exceed this interval) **20 Years**
(Product Side Corrosion Rate = 0) (RRT-0.10)/(0 + SS C.R.)

3.2.2 SERVICE INTERVAL (CONT'D.)

Critical Zone

Nominal Bottom Plate Thickness (inches)	0.438	inch
Maximum Soil Side Corrosion Depth	0.015	inch
Maximum Product Side Corrosion Depth	0.000	inch
Minimum Remaining Thickness at Next Inspection (MRT)	**0.215**	inch
Year of Inspection (Yi)	2014	year
Year of Bottom Installation (Yo)	1997	year
Minimum Remaining Thickness from Soil Side Corrosion after Repairs (RTbc)	0.335	inch
Minimum Remaining Thickness from Product Side Corrosion after Repairs (RTip)	0.335	inch
Soil Side Corrosion Rate (UPr)	**0.0060**	inch/yr
Product Side Corrosion Rate (StPr)	**0.0060**	inch/yr

Repaired Soil Side Corrosion Evaluation (assume 0.250 in. patch): 0.250 in. Patch Plate **Acceptable**
(per API 653, 4.4.5, UPr Def.)

$$O_r = \frac{(\min RT_{bc} or RT_{ip}) - MRT}{S_t P_r + UP_r}$$

Interval to next inspection **10 Years**
(RRT-0.215/(PS+SS C.R.)

If thin-film lining is installed after repairs
(expected life of lining must equal or exceed this interval) **20 Years**
(Product Side Corrosion Rate = 0) (RRT-0.215)/(0+SS C.R.)

3.2.3 BOTTOM REDUCTION

BOTTOM REDUCTION

(in inches)

SW reference corner unless otherwise indicated.

PLATE NO./ID	PIT DEPTH	REMAINING THICKNESS	X LOCATION	Y LOCATION	PS (# IND)	SS (# IND)	COMMENTS
49	--	0.310	32	76	--	--	NW, Non-recordable

NOTES:

SS	=	SOIL-SIDE	CZ	=	CRITICAL ZONE
PS	=	PRODUCT-SIDE	NE	=	NORTHEAST REFERENCE CORNER
IND	=	INDICATIONS	PW	=	PUDDLE WELD
LP	=	LEAK PATH	TS	=	TOMBSTONE STYLE PATCH

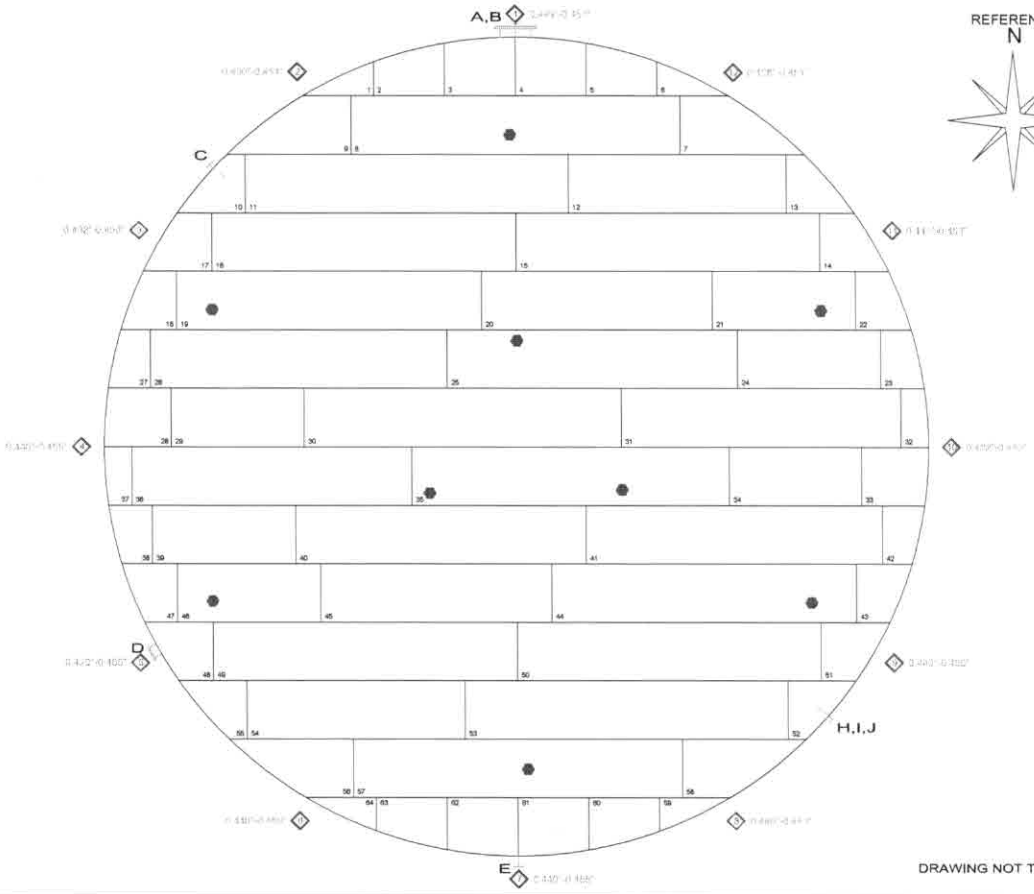
3.2.4 BOTTOM ULTRASONIC (UT) THICKNESS READINGS

BOTTOM PLATE READINGS
(in inches)

PLATE NO.	Reading
1	0.459
2	0.438
3	0.453
4	0.460
5	0.451
6	0.461
7	0.458
8	0.454
9	0.443
10	0.454
11	0.456
12	0.447
13	0.452
14	0.452
15	0.462
16	0.454
17	0.450
18	0.447
19	0.463
20	0.450
21	0.438
22	0.452
23	0.448
24	0.446
25	0.463
26	0.474
27	0.452
28	0.460
29	0.438
30	0.462
31	0.452
32	0.459
33	0.459
34	0.444

PLATE NO.	Reading
35	0.456
36	0.456
37	0.453
38	0.449
39	0.440
40	0.464
41	0.452
42	0.456
43	0.445
44	0.444
45	0.448
46	0.450
47	0.454
48	0.448
49	0.457
50	0.455
51	0.459
52	0.458
53	0.455
54	0.447
55	0.447
56	0.473
57	0.473
58	0.458
59	0.443
60	0.457
61	0.453
62	0.459
63	0.452
64	0.460

3.2.5 BOTTOM LAYOUT



NOZZLES

A = 36x48" CLEANOUT
B = 3" NOZZLE
C = 6" NOZZLE
D = 24" NOZZLE
E = 3" NOZZLE
H = 3" NOZZLE
I = 3" NOZZLE
J = 3" NOZZLE

GENERAL

RECORDING CRITERIA :
0.100" BOTTOM / 0.215" CRITICAL ZONE
10 YRS AFTER REPAIRS
WITH THIN - FILM : 20 YRS
AFTER REPAIRS

PROGRAM NAME : AUTO CAD LT.
LAYER NOZZLES = NOZZLES
LAYER INDICATIONS = INDICATIONS

L x REFERENCE CORNER

LEGEND

◇ = SETTLEMENT LOCATION
--- = UT READING
⬢ = SACRIFICIAL ANODE

HMT INSPECTION
8979 MARKET STREET RD
HOUSTON, TX 77029-3421

TITLE	BOTTOM LAYOUT
CUSTOMER	US DEPT. OF ENERGY
TANK NO. WHT-15	JOB NO. 226-20654
DRAWN BY J.NAUGLE	DATE 6 NOV 2014

3.3 SHELL

3.3.1 SHELL INSPECTION CHECKLIST

ITEM NO.	EXTERNAL SHELL	INSPECTION COMMENTS
S1	Shell weld / seam condition. Perform shell thickness calculations (ref. API 653, Paras. 4.3.3.1, 4.3.4, 4.3.8 & 4.3.10).	Acceptable
S2	Record number and pattern of rivets or bolts (ref. API 653, Table 4.3).	N/A
S3	Check exterior shell-to-bottom weld condition (ref. API 653, Para. 6.3).	Acceptable
S4	Identify all signs of product leakage (exterior) (ref. API 653, Para. 6.3)	Acceptable
S5	Perform Magnetic Particle testing of exterior shell-to-bottom weld (ref. API 653, Para. 4.3.6)	N/A
S6	Coating condition (Coating failure such as blistering, thinning, cracks, or discolored) (ref. API 653, Para. 6.3).	Reference Section 2.0
S7	Shell condition (deformations, corrosion, pitting). (ref. API 653, Para. 4.3)	Acceptable
S8	Rivet condition (worn, corroded, loose rivet sealer, leaking).	N/A
S9	Perform UT thickness readings on shell per job scope.	Acceptable
S10	Inspect support welds to shell for corrosion or defects.	Acceptable
S11	Wind girder, supports, handrail condition (corrosion, weld failure). (ref. API 653, Para. 4.3.7)	Reference Section 2.0
S12	Note whether supports have reinforcing pads welded to shell.	Reference Section 2.0
S13	Shell-mounted vents / overflow slots present. Check for debris covering & condition of screens (ref. API 650, App. H, Para. H.5.3.3).	N/A
S14	Conduct Visual inspection of shell insulation. Inspect for damage (ref. API 653, Para. 6.3.2.2)	N/A
ITEM NO.	**INTERNAL SHELL**	**INSPECTION COMMENTS**
S15	Visual inspection of the internal shell surface for corrosion and pitting (ref. API 653, Para. 4.3).	Reference Sections 2.0 and 4.0
S16	Visual inspection of interior shell welds / seams (ref. API 653, Para. 4.3.8).	Reference Sections 2.0 and 4.0
S17	Visual inspection of rivets (Check for corrosion pitting, or looseness and riveted seams leaks).	N/A
S18	Inspect support welds to shell for corrosion or defects.	Acceptable
S19	Note whether supports have reinforcing pads welded to shell.	Reference Section 2.0
S20	List any limitations to shell inspection.	Acceptable

3.3.2 SHELL THICKNESS CALCULATIONS

The minimum acceptable shell plate thickness for tanks with a diameter equal to or less than 200 feet is calculated as follows (ref. API 653, Para. 4.3.3.1):

$$t_{\min} = \frac{2.6(H-1)DG}{SE}$$

Where:

S =	See Table	=	Allowable Stress (psi)
D =	110.00	=	Nominal Diameter of Tank (ft.)
G =	1.0	=	Highest Specific Gravity of Contents
H =	See Table	=	Product Height (ft.)
E =	See Table	=	Joint Efficiency

Course	Course Height (in.)	Product Height (ft.)	Joint Efficiency	Allowable Stress (psi)	Average Thickness (in.)	Required Thickness (in.)
1	95.5	32.00	1.00	24,900	0.658	0.427
2	95.5	24.04	1.00	24,900	0.534	0.318
3	95	16.08	1.00	27,400	0.446	0.189
4	95	8.17	1.00	27,400	0.446	0.100
Top Angle	3 in.					

Shell thickness calculations indicate the safe fill height of 30.00 feet can be utilized with product specific gravities up to 1.2 (ref. API 653, Para. 4.3.3.1). These calculations do not take into account operational restrictions from such items as high-level alarms or owner / operator-imposed safe fill restrictions along with the internal floating roof and seals. There are no shell-mounted overflow vents on this tank.

3.3.3 SHELL ULTRASONIC (UT) THICKNESS READINGS

SHELL READINGS
(in inches)

Course 1

Location	Drop 1	Drop 2
1	0.655	0.655
2	0.656	0.653
3	0.657	0.664
4	0.657	0.654
5	0.658	0.655
6	0.657	0.663
7	0.654	0.665
8	0.655	0.664
9	0.658	0.658
10	0.658	0.654
Min: 0.653		Avg: 0.658

Course 2

Location	Drop 1	Drop 2
1	0.534	0.520
2	0.536	0.530
3	0.534	0.538
4	0.537	0.535
5	0.536	0.534
6	0.536	0.541
7	0.535	0.533
8	0.536	0.532
9	0.535	0.534
10	0.534	0.533
Min: 0.520		Avg: 0.534

Course 3

Location	Drop 1	Drop 2
1	0.447	0.448
2	0.449	0.447
3	0.450	0.438
4	0.449	0.446
5	0.451	0.444
6	0.450	0.439
7	0.451	0.447
8	0.448	0.440
9	0.445	0.447
10	0.445	0.447
Min: 0.438		Avg: 0.446

Course 4

Location	Drop 1	Drop 2
1	0.442	0.438
2	0.446	0.444
3	0.447	0.435
4	0.448	0.445
5	0.449	0.455
6	0.450	0.446
7	0.449	0.440
8	0.448	0.445
9	0.448	0.447
10	0.450	0.445
Min: 0.435		Avg: 0.446

3.3.4 SHELL CORROSION RATE CALCULATION

$$RCA = t_{act} - t_{min}$$
$$N = (t_{prev} - t_{act}) / Y$$
$$I_{UT} = (t_{act} - t_{min}) / 2N$$

Where:

RCA =	See Table	=	Difference between the measured shell thickness and the minimum required thickness in inches.
N =	See Table	=	Shell corrosion rate in inches per year
Y =	Years in service	=	17
I_{UT} =	See Table	=	Inspection interval for the next Ultrasonic (UT) testing, in years (not exceeding 15 years)

Course No.	Previous Measured Average Thickness (in.) ($t_{prev.}$)	Current Measured Average Thickness (in.) (t_{act})	Material Loss (in.)	Minimum Required Thickness (in.) (t_{min})	*RCA* (in.)	Corrosion Rate (in./yr) (*N*)	Next Ultrasonic (UT) Thickness Inspection (years) (I_{ut})
1	0.646	0.658	0.000	0.427	0.231	0.0000	15
2	0.528	0.534	0.000	0.318	0.216	0.0000	15
3	0.438	0.446	0.000	0.189	0.257	0.0000	15
4	0.438	0.446	0.000	0.100	0.346	0.0000	15

Original (Nominal) Shell UT Available for RCA Calculations: YES ☑ NO ☐

Previous Shell UT Available for RCA Calculations: YES ☐ NO ☑

NOTE: Original data will establish a Long Term Corrosion Rate (LTCR) while previous inspection data will provide a Short Term Corrosion Rate (STCR).

It should be noted that without established Condition Monitoring Location (CML) points, data collection locations may vary between inspections.

UT Inspection stickers were placed on tank by HMT: YES ☐ NO ☑
Existing Inspection stickers / CML's were present YES ☐ NO ☑
Copies made of the past UT data for the HMT file: YES ☑ NO ☐

3.3.4 SHELL CORROSION RATE CALCULATION (CONT'D.)

The external inspection interval shall be the lesser of 5 years or RCA / 4N (API 653, Para. 6.3.2.1):

$$RCA = t_{act} - t_{min}$$
$$N = (t_{prev} - t_{act}) / Y$$
$$I_{UT} = (t_{act} - t_{min}) / 4N$$

Where:

RCA =	See Table	=	Difference between the measured shell thickness and the minimum required thickness in inches.
N =	See Table	=	Shell corrosion rate in inches per year
Y =	Years in service	=	17
I_{vt} =	See Table	=	Inspection interval for the next External Visual Inspection, in years (not exceeding 5 years)

Course No.	Previous Measured Average Thickness (in.) (t_{prev})	Current Measured Average Thickness (in.) (t_{act})	Material Loss (in.)	Minimum Required Thickness (in.) (t_{min})	*RCA* (in.)	Corrosion Rate (in./yr) (*N*)	Next External Visual (VT) Inspection (years) (I_{vt})
1	0.646	0.658	0.000	0.427	0.231	0.0000	5
2	0.528	0.534	0.000	0.318	0.216	0.0000	5
3	0.438	0.446	0.000	0.189	0.257	0.0000	5
4	0.438	0.446	0.000	0.100	0.346	0.0000	5

3.4 NOZZLES AND APPURTENANCES

3.4.1 NOZZLE AND APPURTENANCE INSPECTION CHECKLIST

ITEM NO.	EXTERNAL NOZZLES AND APPURTENANCES	INSPECTION COMMENTS
N1	Document nozzle / manway information on the Nozzle and Appurtenance Table (ref. API 653, Para. 4.3.9).	Acceptable
N2	Evaluate nozzle(s) / manway(s) acceptability to current API 650 / 653 guidelines. Weld spacing, centerline, reinforcement size, nozzle neck thickness (inspect shell nozzles for thinning, pitting and coating failure) and telltale holes, etc. (ref. API 650, Paras. 5.7, 5.7.5.1 and 5.7.2.10 & API 650, Table 5-6B & Fig. 5-6)	Reference Section 2.0 and Table 3.4.2
N3	Visual inspection of all external welds (ref. API 653, Para. 4.3.9.1)	Acceptable
N4	Indications of leakage around manways, nozzles, flanges, valves and appurtenances (including reinforcement, bolting, gaskets, seals, and mixers).	Acceptable
N5	Check piping and valves for leaks, thermal relief, or signs of damage (ref. API 653, Para. C.1.3.2).	Acceptable
N6	Inspect mixer for support, leakage and defects (ref. API 653, Para. C.1.3.6).	Acceptable
N7	Roof drain leakage.	N/A
N8	Acceptable	Acceptable
N9	Automatic gauge condition (corrosion, mechanical damage) (ref. API 653, Para. C.1.3.3) & (ref. API 653, Para. 6.9.3b).	Acceptable Type: Milltronics Model: Miniranger plus,
N10	Check welds on shell-mounted davit clips above large valves or equipment (ref. API 650, Para. 5.8.3.5) & (ref. API 653, Para. C.1.3.2h).	N/A
N11	Welds on stairways / ladders, gauge platform / ladder, stringers (corrosion, broken) (ref. API 650, Para. 5.8.1.2.a & API 653, Para. C.2.12.4).	Acceptable
N12	Verify requirements for Platforms, Walkways & Stairways (ref. API 650, Table 5-17 & Table 5-18).	Acceptable

NOZZLE AND APPURTENANCES (CONT'D.)		
ITEM NO.	**INTERNAL NOZZLES AND APPURTENANCES**	**INSPECTION COMMENTS**
N13	Shell nozzle and internal piping condition.	Reference Section 2.0
N14	Hot tap nozzles (sealed internally) (ref. API 653, Para. 9.14 & Table 9.1) (ref. API 653, Para. 12.1.2.1b).	Acceptable
N15	Check for possible causes of damage to the seal (i.e. nozzle interference).	Acceptable
N16	Visual inspection of all welds (ref. API 653, Para. 4.3.9.1) (weld defects and location).	Acceptable
N17	Check automatic gauge condition.	Acceptable
	INTERNAL APPURTENANCES / FLOATING SUCTION LINE	
N18	Visual inspection of internal piping and connection condition (corrosion, cracking).	Reference Section 2.0
N19	Visual inspection of piping supports and pads (structurally adequate, weld failure).	Acceptable
N20	Determine condition / length of swing line / limit chain (ref. API 653, Para. C. 2.11.6).	N/A
	INTERNAL APPURTENANCES / FLOATING ROOF DRAIN	
N21	Type and condition (cutting or dragging on tank bottom) (ref. API 650, Para. 4.2.3.3) (ref. API 653, C. 2.10).	N/A
N22	Internal piping and connection condition (corrosion, cracking).	N/A
N23	Check for obstructions that pipe could catch on (ref. API 650, Para. 3.8).	N/A
N24	Swing line hold-down cable (damaged or loose).	N/A
N25	Swing line safety hold-down chains (corrosion, weak links).	N/A
N26	List any limitations to inspection.	N/A

3.4.2 NOZZLE AND APPURTENANCE TABLE

Item	Description	Pipe Size (in.)	Station (ft.)	CL Elev. (in.)	Width (in.)	Height (in.)	Thick (in.)	Shape	1 or 2 Piece	Neck Thick (in.)	Flange Thick (in.)	Cover Thick (in.)	Tell-tale	Weld Space (in.)	Comments
A	Cleanout	36x48	0.00	18	105	55	0.741	D	1	0.748	0.924	--	Yes	TS	Plugged w/ Dirt
B	Nozzle	3	0.00	68.5	10.5	10.5	0.656	B	1	0.301	0.928	--	Yes	7.25	
C	Nozzle	6	86.34	23.5	16	16	0.656	B	1	0.440	1.036	--	Yes	15	
D	Nozzle	24	129.61	36	50	50	0.656	B	1	0.532	2.061	--	Yes	9.5	
E	Nozzle	3	172.81	62	10.5	10.5	0.658	B	1	0.306	0.899	--	Yes	55	
F	Stairway Top	--	182.00	--	--	--	--	--	--	--	--	--	--	--	North
G	Stairway Start	--	210.11	--	--	--	--	--	--	--	--	--	--	--	North
H	Nozzle	3	302.52	60.5	10.5	10.5	0.653	B	1	0.312	0.926	--	Yes	24.5	
I	Nozzle	3	302.52	23.5	10.5	24	0.774	B	1	0.301	0.919	0.964	Yes	4.5	Items I and J have shared repad
J	Nozzle	3	302.52	11.5	10.5	24	0.774	B	1	0.297	0.920	--	Yes	4.5	
K	Stairway Start	--	308.90	--	--	--	--	--	--	--	--	--	--	--	South
L	Stairway Top	--	337.10	--	--	--	--	--	--	--	--	--	--	--	South
M	Nozzle	3	5.00	--	10.5	10.5	0.657	B	1	0.233	0.838	--	Yes	--	Plugged Telltale - Course 4
N	Nozzle	3	302.52	--	10.5	10.5	0.658	B	1	0.230	0.834	0.250	Yes	--	Plugged Telltale - Course 4
Z	Total Circumference	--	345.83	--	--	--	--	--	--	--	--	--	--	--	

VERTICAL WELD LOCATIONS:

1) 5.45	2) 26.05	3) 57.51	4) 88.94	5) 120.37	6) 151.83	7) 183.26	8) 214.70	9) 246.15
10) 277.59	11) 309.40	12) 340.45	13)	14)	15)	16)	17)	18)

VERTICAL WELD OFFSET FOR COURSES 2, 3, 4, etc:

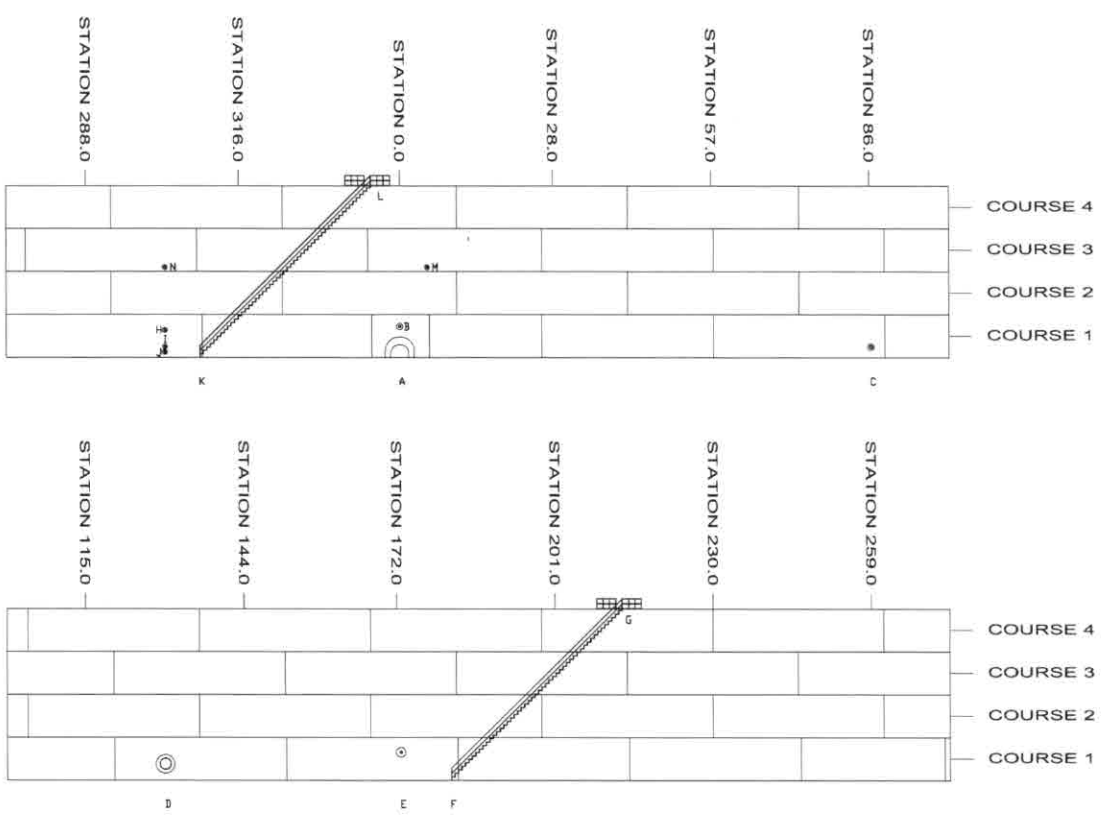
2) 10.15	3) 26.05	4) 10.45	5)	6)	7)	8)	9)	10)
2) 41.81	3) 57.51	4) 41.81	5)	6)	7)	8)	9)	10)

3.4.2 NOZZLE AND APPURTENANCE TABLE (CONT'D.)

*SUPPLEMENTAL NOZZLE NECK THICKNESS
(in inches)

Nozzle ID	Clock Position				
Item	12	3	6	9	Average
A	0.742	0.743	1.045	0.759	0.822
B	0.312	0.313	0.286	0.293	0.301
C	0.436	0.452	0.428	0.442	0.440
D	0.502	0.525	0.543	0.559	0.532
E	0.313	0.314	0.293	0.302	0.306
H	0.326	0.326	0.286	0.309	0.312
I	0.321	0.303	0.286	0.295	0.301
J	0.285	0.298	0.300	0.305	0.297
M	0.236	0.235	0.217	0.342	0.258
N	0.230	0.234	0.218	0.236	0.230

3.4.3 SHELL LAYOUT



DRAWING NOT TO SCALE

GENERAL

1. DESIGN STANDARD : API 650 9TH ED.
2. MANUFACTURER : AT&V
3. PRODUCT : NDA
4. NAMEPLATE : YES
5. DIAMETER : 110.00'
6. HEIGHT : 32.00'
7. JOINT EFFICIENCY:

COURSE	
1	1.0
2	1.0
3	1.0
4	1.0

8. BUTT WELDED
9. COURSES : 4
10. CONSTRUCTED : 1997
11. STAIRWAY : TWO SPIRAL STAIRWAYS
12. COATING : EXTERNAL WHITE PAINT

NDA = NO DATA AVAILABLE

COURSE	AVERAGE THICKNESS (INCH)	HEIGHT (INCH)
1	0.657"	95.5"
2	0.535"	95.5"
3	0.448"	95"
4	0.448"	95"

LEGEND

REFERENCE NOZZLE AND APPURTENANCE TABLE FOR ITEM IDENTIFICATION

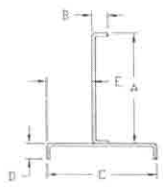
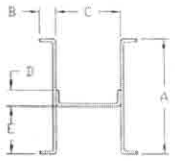
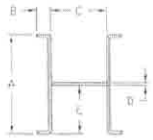
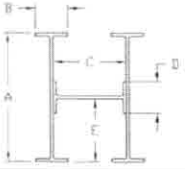
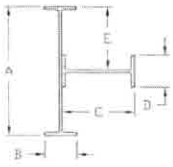
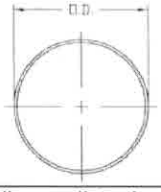
HMT INSPECTION
8979 MARKET STREET RD
HOUSTON, TX 77029-3421

TITLE:	SHELL LAYOUT
OWNER:	US DEPT. OF ENERGY
TANK NO.: WHT-15	JOB NO.: 226-20654
DRAWN BY: J.NAUGLE	DATE: 6 NOV 2014

3.5 FIXED ROOF

3.5.1 FIXED ROOF INSPECTION CHECKLIST

ITEM NO.	FIXED ROOF	INSPECTION COMMENTS
FR1	Roof plate condition (corrosion, pitting, coating failure, standing water) (ref. API 653, Paras. 4.2.1.1 & 4.2.1.2).	N/A
FR2	Perform UT thickness readings on roof per work scope.	N/A
FR3	Conduct Visual inspection of roof-to-shell joint (ref. API 653, Para. 4.2.2.2).	N/A
FR4	Conduct Visual inspection of roof insulation. Inspect for damage (ref. API 653, Paras. 6.3.1 & 6.3.2.2).	N/A
FR5	Manway / nozzle / appurtenance condition (ref. API 653, Para. 4.2.4.5 & API 650, Para. H.5.2.2).	N/A
FR6	Identify pressure / vacuum vents or vents (quantity and sizes). (ref. API 653, Para. 4.2.4.5 / API 650, Para. H.5.2.2 / API 650, Para. 5.8.5).	N/A
FR7	Inspect pressure / vacuum vent pallet assembly seals and screens (weathering) (ref. API 653, Para. 4.2.4.5 & API 650, Para.H.5.2.2).	N/A
FR8	Gauge hatch (clean, operates freely and seals properly).	N/A
FR9	Scaffold support is present and is in good condition (ref. API 650, Para. 5.8.8 and Figure 5-22).	N/A
FR10	Visual inspection of high-level and high-high-level alarms for damage.	N/A
	ALUMINUM DOME ROOF	
FR11	Check perimeter flashing for damage.	N/A
FR12	Evidence of leaking panels (water areas on internal floater).	N/A
FR13	Deterioration of skylights (crazing caused by UV light, cracking) (ref. API 650 Para. G.2.6).	N/A
FR14	Panel caulking and seals (entire roof) (ref. API 650 Para. G.2.5.1).	N/A
FR15	Rain gutters (damaged or broken).	N/A
FR16	Dome overhang screens in place and in good condition.	N/A
FR17	Check dome roof support details for signs of damage or malfunction.	N/A
FR18	Check roof for pinholes, tears, or other damage to the aluminum sheeting.	N/A

FIXED ROOF (CONT'D.)		
ITEM NO.	**INTERNAL APPURTENANCES / COLUMNS**	**INSPECTION COMMENTS**
FR19	Type of column, size and number (pipe, structural) (ref. API 653, Paras. 4.2.2.1 & 4.4.2i). A  B  C  D  E  F  G  H 	N/A
FR20	Check columns for plumbness, bending or distortion (ref. API 653, Paras. 4.2.2.1 & 10.5.2.1).	N/A
FR21	Condition of structural columns (check for corrosion, scale, breaking of tack welds) (ref. API 653, Para. 4.2.2.1) & (ref. API 650, Para. 5.10.3.2).	N/A
FR22	Check rafter condition (ref. API 653, Para. 4.2.2.1).	N/A
FR23	Check girder condition (ref. API 653, Para. 4.2.2.1).	N/A
FR24	Visual inspection of all rafter clips (ref. API 653, Para. 4.2.2.1).	N/A
FR25	Visual inspection of internal roof plates for holes, scale build-up and pitting.	N/A
FR26	List any limitations to inspection.	N/A

4.0 NDT INSPECTION

4.1 NDT INSPECTION SCOPE

The following Nondestructive Testing (NDT) was conducted to evaluate the physical characteristics of the tank:

A) Magnetic Flux Leakage (MFL) examination. Performed in accordance with HMT Inspection MFL Procedure No. 1611.5, Revision No. 4. (MFE 2412)

B) Quantitative remaining thickness measurements in any area of recordable metal loss. Performed in accordance with HMT Inspection UT Procedure No. 1611.1, Revision No. 6.

C) Random Ultrasonic (UT) testing. Performed in accordance with HMT Inspection UT Procedure No. 1611.1, Revision No. 6.

D) Visual (VT) inspection of areas for the detection of anomalies or significant metal loss which may affect the integrity. Performed in accordance with HMT Inspection VT Procedure No. 1611.9, Revision No. 4.

4.2 BOTTOM INSPECTION

Bottom plates were inspected utilizing MFL, UT and VT inspection methods. The bottom was inspected for the detection of both product side and soil side metal loss. Areas identified as exceeding or closely approaching the critical thickness were quantified by UT and pit gauge measurements as applicable. Dual recording criteria set by the client were used: For the interior plates, product side was set at 0.415 inch or less remaining thickness, and soil side was set at 0.315 inch or less remaining thickness. For the sketch plates, product side was set at 0.435 inch or less remaining thickness, and soil side was set at 0.400 inch or less remaining thickness (ref. Section 3.2.3). Nominal interior bottom plate thickness is 0.438 inch and nominal annular plate thickness is 0.438 inch.

Areas of restricted access to MFL examination coverage included: near the shell-to-bottom weld and plate-to-plate lap welds,.

Bottom lap welds were inspected utilizing VT inspection methods.

The internal and external shell-to-bottom weld was inspected utilizing VT inspection methods.

Bottom plate UT data was collected utilizing random readings. One (1) reading per bottom plate was taken (ref. Section 3.2.5).

4.3 SHELL INSPECTION

The internal and external shell plates and welds were inspected utilizing VT inspection method along accessible areas as applicable and per client work scope.

Shell plate UT data was collected utilizing random readings. Ten (10) readings were taken per course up the stairway (ref. Section 3.3.3).

4.4 NOZZLE INSPECTION

The internal and external shell nozzle welds were inspected utilizing VT inspection method.

Shell nozzle UT data was collected utilizing random readings. One reading per reinforcing pad, flange face, and cover (when applicable) was taken. Four (4) readings per nozzle neck at 0, 90, 180, and 270 degrees were taken (ref. Sections 3.4.2).

5.0 EQUIPMENT

5.1 MAGNETIC FLUX LEAKAGE

MFL equipment utilized consisted of a MFE Enterprises Floor Scanner Type 2412 (Serial No. 118, 170).

5.2 ULTRASONIC

UT equipment utilized for the inspection was a GE Inspection Technologies USM GO Flaw Detector (Serial No. 911654).

Transducer equipment utilized was a Britek, 7.5 MHz, 0.312 inch, dual element.

Calibration block equipment utilized was a 5 step, 1018 steel test block.

Echogel 20 and water was used as a couplant.

5.3 LEVEL

Level equipment utilized was a Spectra LL-300 self-leveling laser.

5.4 PIT GAUGE

Pit gauge equipment utilized was a W.R. Thorpe Co. standard pipe pit gauge.

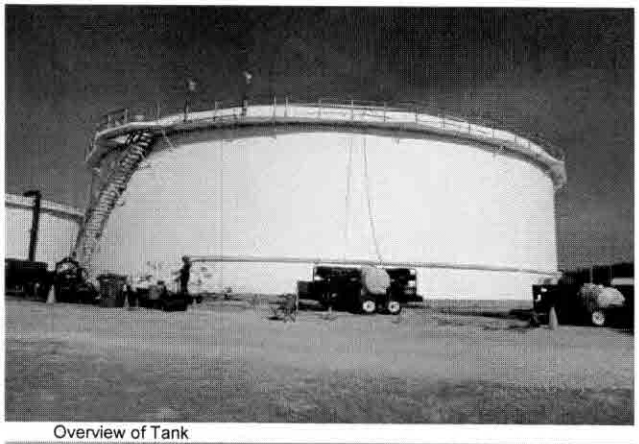
6.0 WARRANTY

WARRANTY

HMT Inspection, a division of HMT LLC, has evaluated the condition of this tank based on the observations and measurements made by the HMT Inspection tank inspector. While our evaluation accurately describes the condition of the tank at the time of inspection, the tank owner / operator must independently assess the inspection information / report provided by HMT Inspection and any conclusions reached by the tank owner / operator and any action taken or omitted to be taken are the sole responsibility of the owner / operator. With respect to inspection and testing, HMT Inspection warrants only that the services have been performed in accordance with accepted industry practice. If any such services fail to meet the foregoing warranty, HMT Inspection shall re-perform the service to the same extent and on the same conditions as the original service.

The preceding paragraph sets forth the exclusive remedy for claims based on failure or of defect in materials or services, whether such claim is made in contract or tort (including negligence) and however instituted, and, upon expiration of the warranty period, all such liability shall terminate. The foregoing warranty is exclusive and in lieu of all other warranties, whether written, oral, implied or statutory. NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE SHALL APPLY, nor shall HMT Inspection be liable for any loss or damage whatsoever by reason of its failure to discover, report, repair or modify latent defects or defects inherent in the design of any tank inspected. In no event, whether a result of breach of contract, warranty or tort (including negligence) shall HMT Inspection be liable for any consequential or incidental damages including, but not limited to, loss of profit or revenues, loss of use of equipment tested or services by HMT Inspection or any associated damage to facilities, down-time costs or claims of other damages.

7.0 PHOTOGRAPHS



Overview of Tank

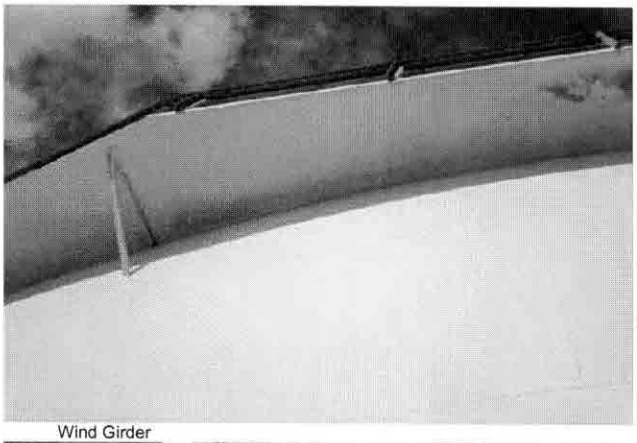
Overview of Tank

Overview of Tank

Overview of Tank

7.0 PHOTOGRAPHS

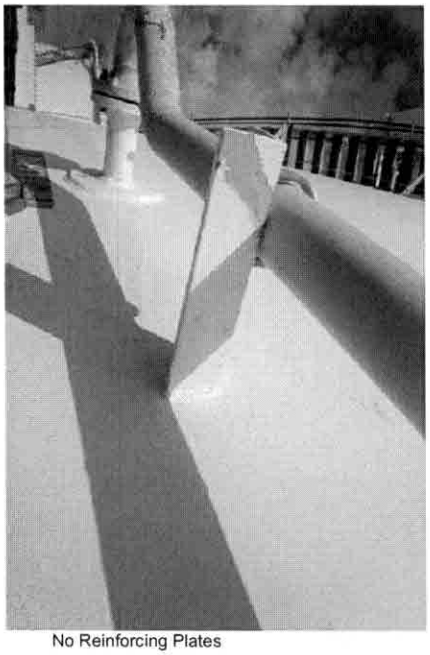
Name Plate



Wind Girder

Top of Wind Gider

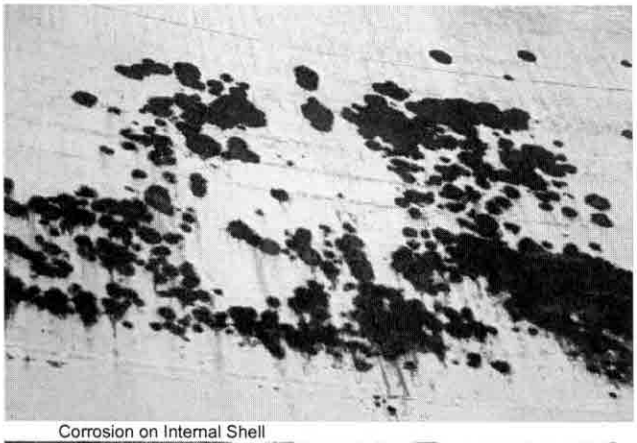
Ponding Water on Wind Girder



No Reinforcing Plates

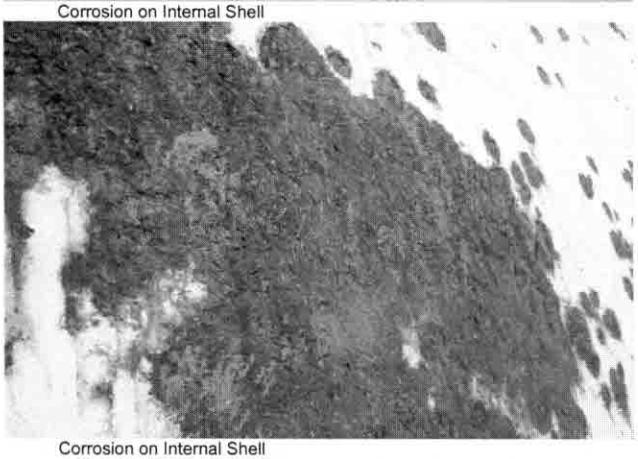
Internal Fill Line Piping With Reinforcing Pads

Mildew Staining on Wind Girder



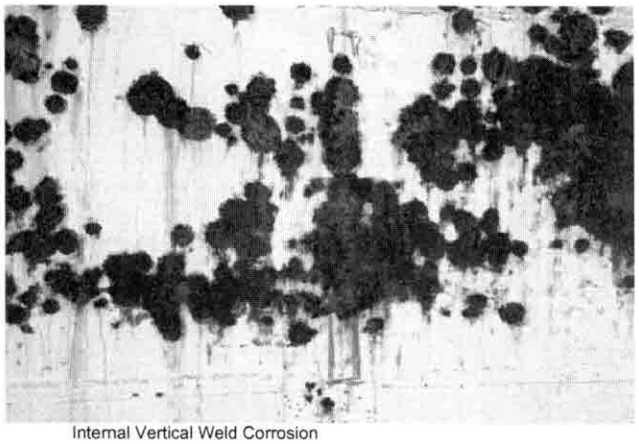
Corrosion on Internal Shell

Corrosion on Internal Shell



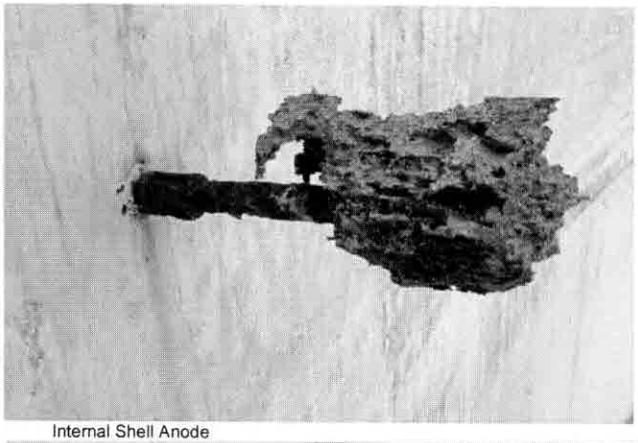
Corrosion on Internal Shell

Internal Vertical Weld Corrosion

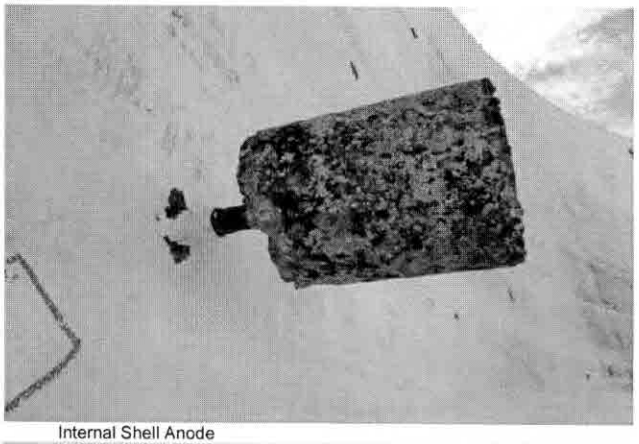


Internal Vertical Weld Corrosion

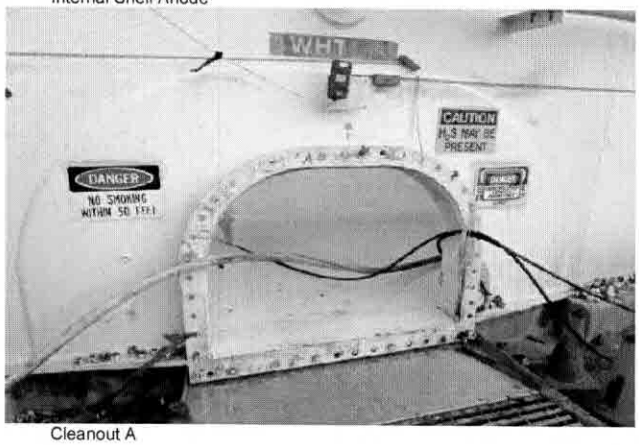
7.0 PHOTOGRAPHS



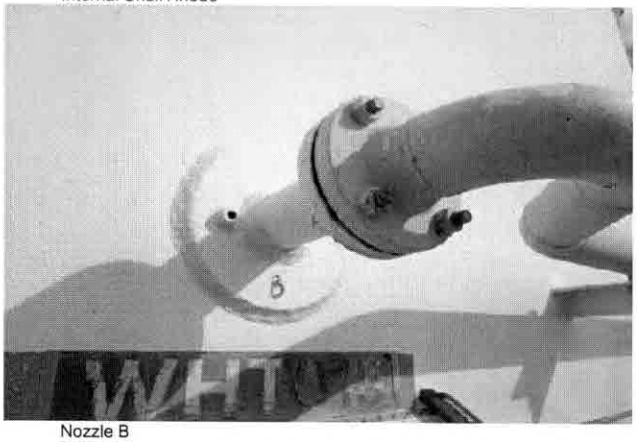
Internal Shell Anode



Internal Shell Anode

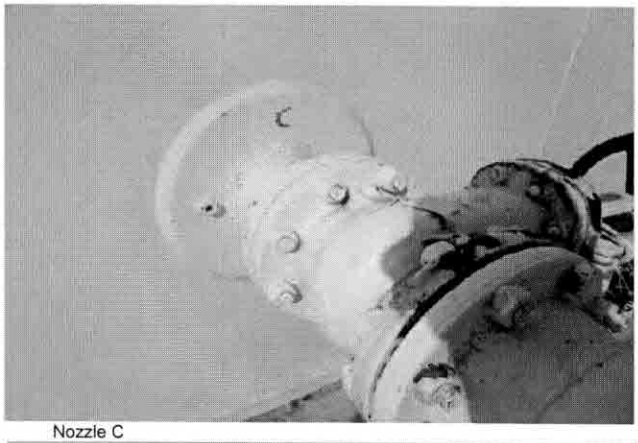


Cleanout A



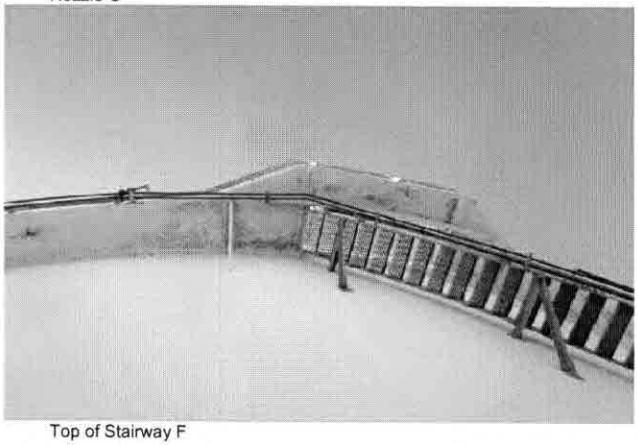
Nozzle B

7.0 PHOTOGRAPHS



Nozzle C

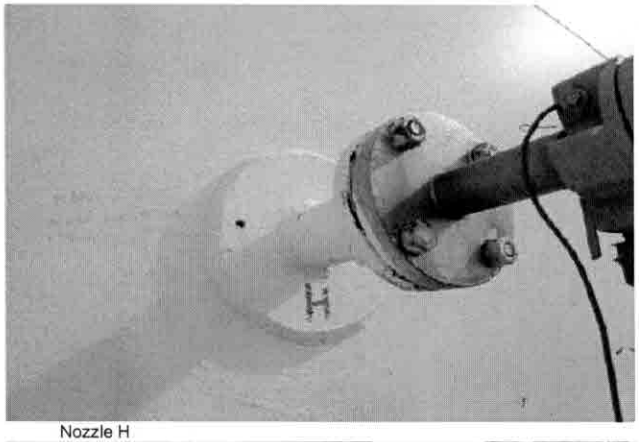
Nozzle D



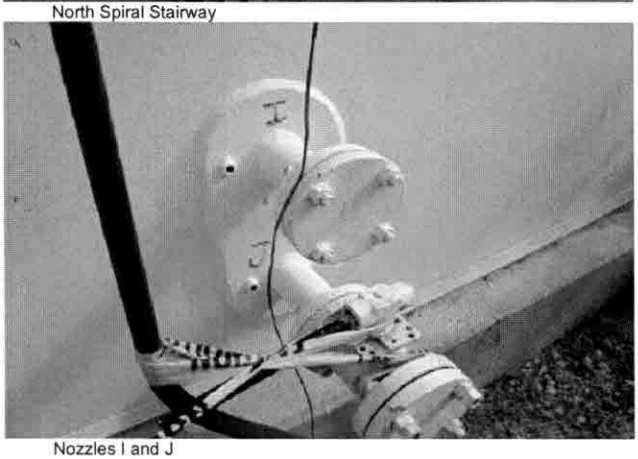
Top of Stairway F

North Stairway Start G

North Spiral Stairway



Nozzle H

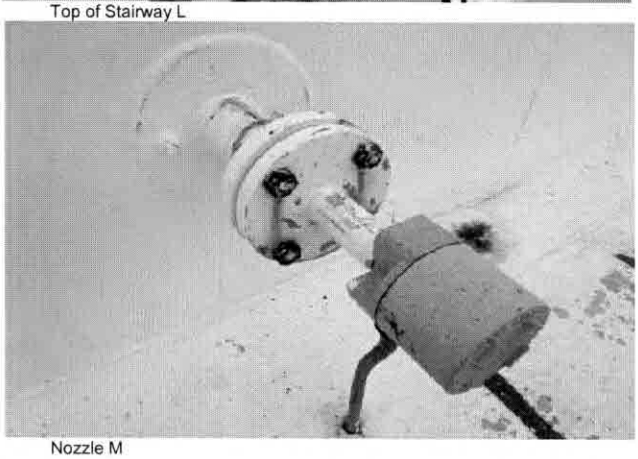


Nozzles I and J

Bottom of Stairway K

Top of Stairway L

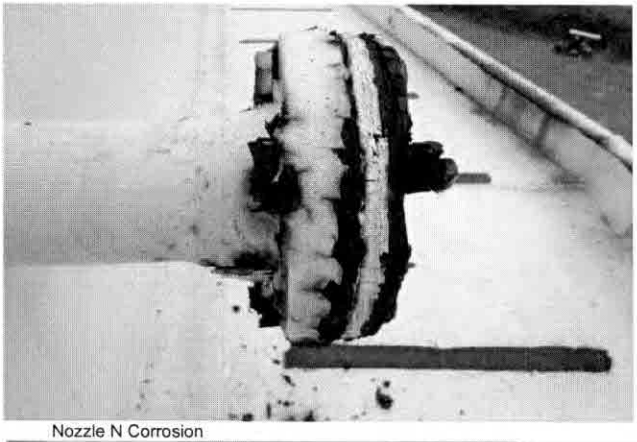
South Spiral Stairway



Nozzle M

Nozzle N

7.0 PHOTOGRAPHS



Nozzle N Corrosion

Automatic Gauge

Radar Gauge

High Level Alarm

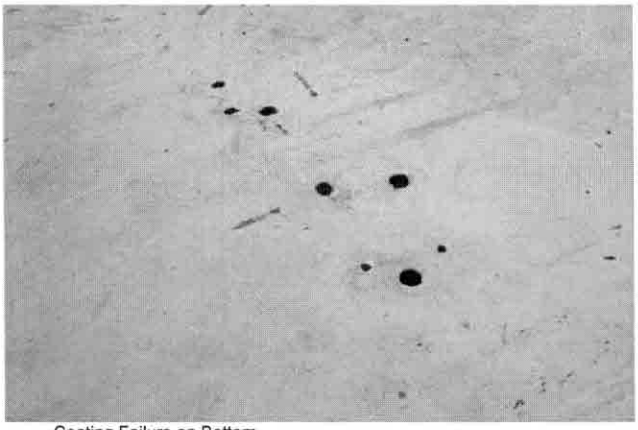
7.0 PHOTOGRAPHS

Grounding Lug

Overview of Bottom

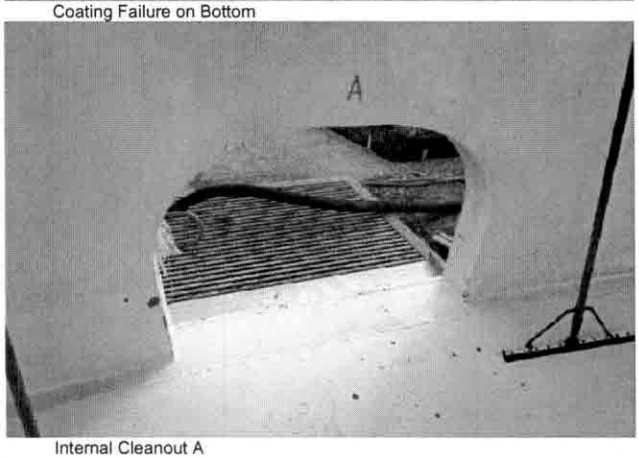
Coating Failure on Bottom

Coating Failure on Bottom

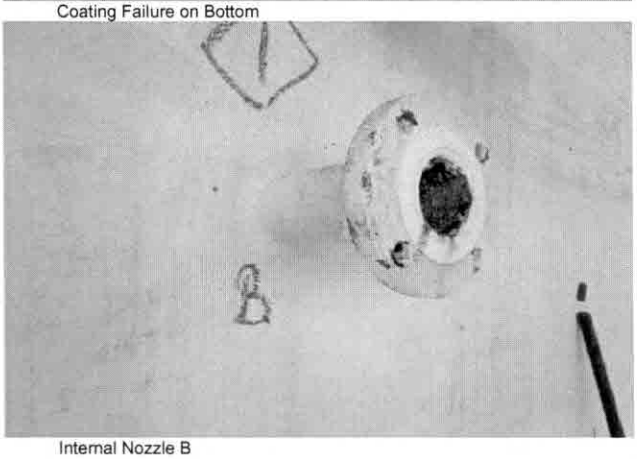


Coating Failure on Bottom

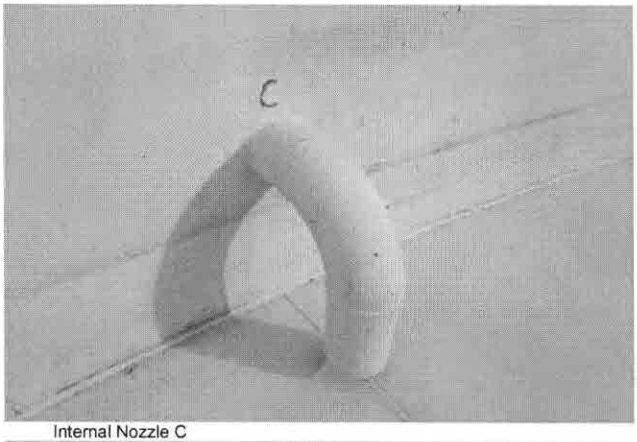
Coating Failure on Bottom



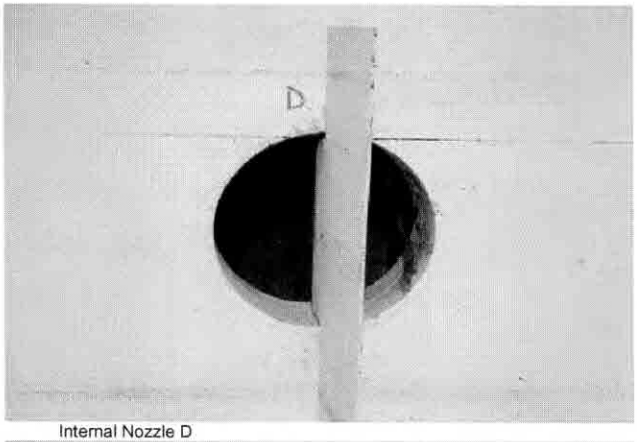
Internal Cleanout A



Internal Nozzle B



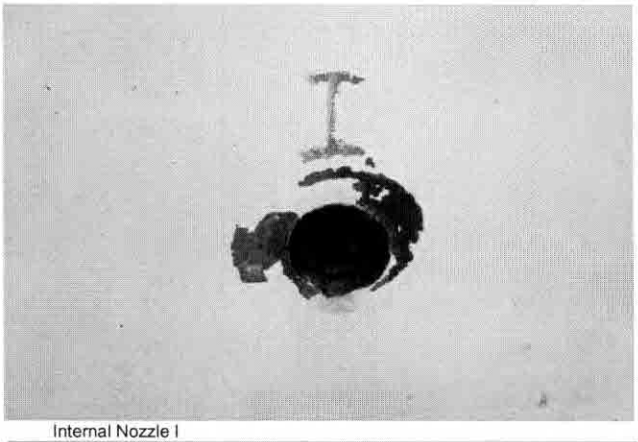
Internal Nozzle C



Internal Nozzle D

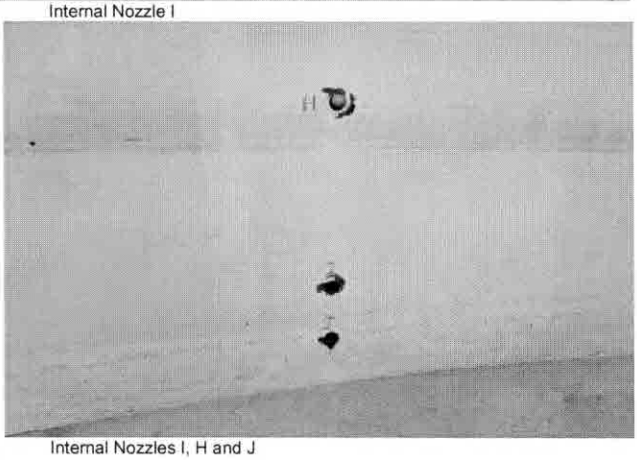
Internal Nozzle E

Internal Nozzle H

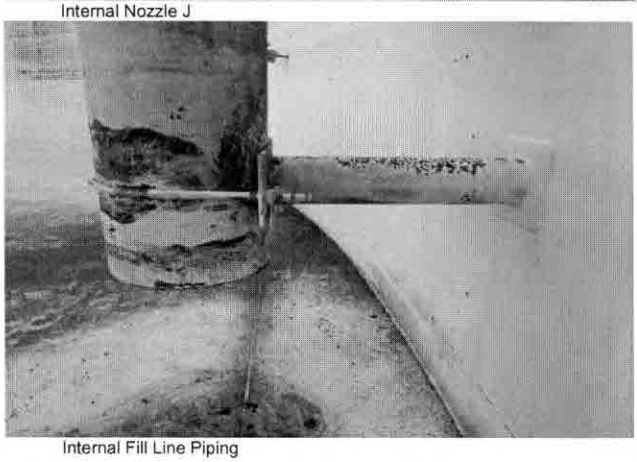


Internal Nozzle I

Internal Nozzle J



Internal Nozzles I, H and J



Internal Fill Line Piping

AMERICAN PETROLEUM INSTITUTE
INDIVIDUAL CERTIFICATION PROGRAMS

API Individual Certification Programs

certifies that

Chad Michael Taylor

has met the requirements to be a certified

API-653 Above Ground Storage Tank Inspector

Certification Number *47959*

Original Certification Date *April 30, 2013*

Current Certification Date *April 30, 2013*

Expiration Date *April 30, 2016*

Tina Briskin

Manager, Individual Certification Programs

ICP

2013-045 | 10M | Printed in the USA

Certificate of Qualification

HMT

INSPECTION

This is to Certify

Chad Taylor

is qualified in accordance with the HMT Procedure for Qualification and Certification of Nondestructive Examination Personnel which is in compliance with the requirements of the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A-2006 ed.

Method	Level	Expiration Date
API 653	No. 47959	04/30/2016
API 510	No. 48605	07/31/2016
API TES	No. 44126	05/31/2015

Hugh K. Howerton

Hugh K. Howerton
ASNT Level III

June 12, 2014
Date

Certificate of Qualification

HMT INSPECTION

This is to Certify

Jeff Henderson

is qualified in accordance with the HMT Procedure for Qualification and Certification of Nondestructive Examination Personnel which is in compliance with the requirements of the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A-2006 ed.

Method	Level	Expiration Date
MFL	II	12/17/2014
LT/BT	II	12/17/2014
MT(y)	II	12/16/2018
UT	II	07/26/2017
Pro-Inspect (2412)	II	Effective Date: 03/05/2008
Pro-Inspect (USN52)	II	Effective Date: 03/05/2008

Hugh K. Howerton

Hugh K. Howerton
ASNT Level III

December 16, 2013
Date

Certificate of Qualification

INSPECTION

This is to Certify

Freeman Hancock

is qualified in accordance with the HMT Procedure for Qualification and Certification of Nondestructive Examination Personnel which is in compliance with the requirements of the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A-2006 ed.

Method	Level	Expiration Date
UT(t)	II	10/27/2016
MFL	II	10/27/2016
LT/BT	II	10/27/2016
MT(y)	II	10/27/2016
PT	II	10/27/2016
VT	II	10/27/2016
Pro-Inspect MFL (2412)	II	Effective Date: 05/19/2003
Pro-Inspect UT (USN50)	II	Effective Date 05/19/2003

Daniel Carden
ASNT NDT Level III

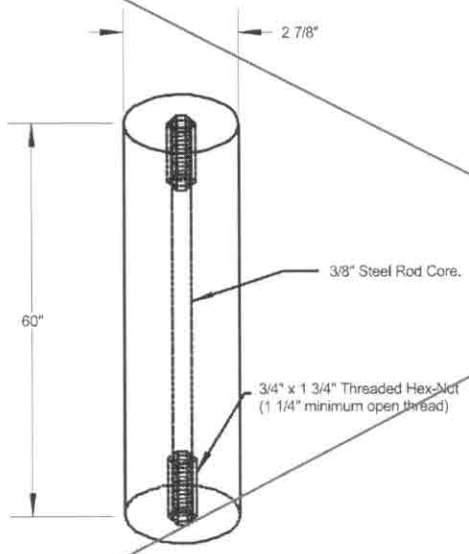
October 27, 2011
Date

ATTACHMENT B

GALVOTEC ANODE CATALOG CUT SHEET

Aluminum
Heater Treater Anodes

Core Type
3/4" Threaded Rod
1/2" Eyebolt
3/4" Coupling



Special anode sizes available on request.

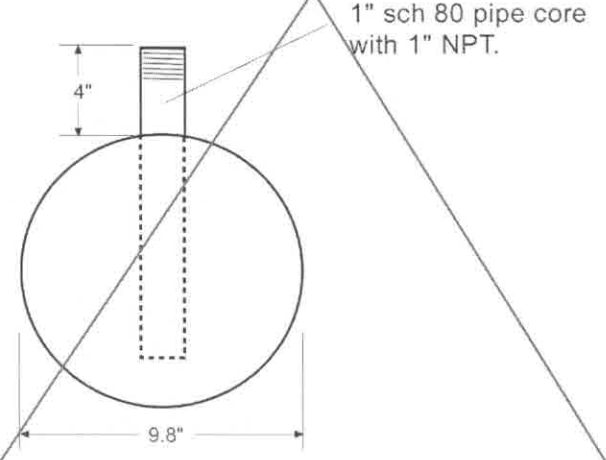
Anode Type	"L" Dimension in	"L" Dimension mm	Anode Weight lbs	Anode Weight Kg
GA-A 3" Dia. x 30	30	762	18.5	8.4
GA-A 3" Dia. x 60	60	1524	37	16.8
GA-A 3.625" Dia. x 60	60	1524	55.0	25.0

GA-A-HS-47

Bowling Ball

Anode supplied with 1" sch 80 Half Collar.

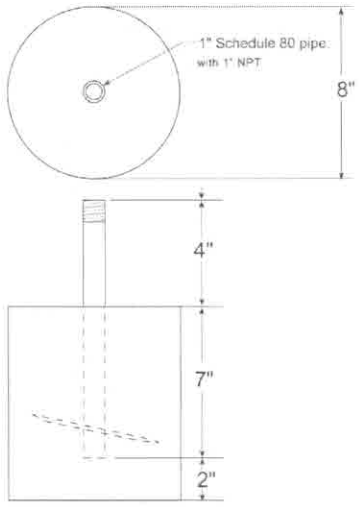
Anode Weight lbs	Anode Weight Kg
47	21.3



GA-A-HFT-44

Anode supplied with 1" sch 80 Half Collar.

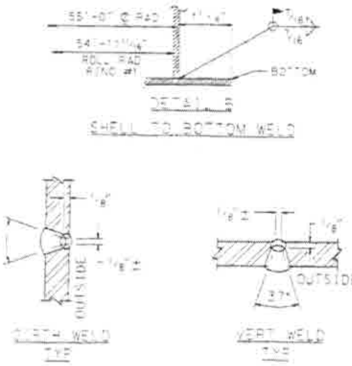
Anode Weight lbs	Anode Weight Kg
44	20



Nominal weights and dimensions

ATTACHMENT C

VENDOR TANK DRAWINGS



1. SPECIFICATIONS: API 650 NINTH EDITION (1993) ADD. 2 & CUSTOMER SPEC. SECTION NO. 15187
2. DESIGN:

PRESSURE:	ATM
VACUUM:	ATM
DESIGN TEMPERATURE:	135° F MAX. / 25° F MIN.
WIND LOAD:	164 MPH GUST. 136 MPH FOR 1 MINUTE
SPECIFIC GRAVITY:	1.2
SEISMIC:	ZONE 0
CORROSION ALLOW.:	1/16" (BTM, SHELL & INTERNALS)
NOMINAL CAPACITY:	50,000 BBL
MAXIMUM PUMP RATE: (IN/OUT)	3500 GPM

OPERATING:

PRESSURE:	ATM
VACUUM:	ATM
TEMPERATURE:	90° F

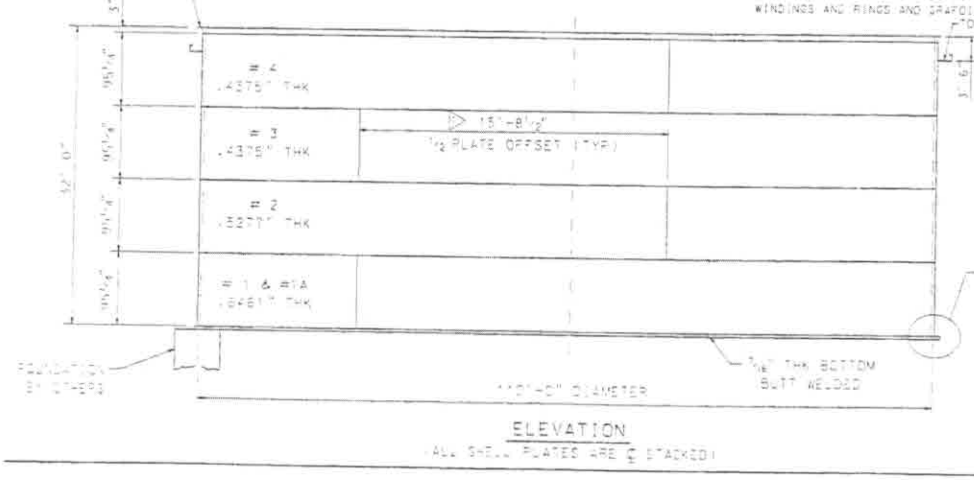
3. MATERIAL SPECS:

SHELL PLATES:	A36
BOTTOM PLATES:	A36
REINFORCING PLATES:	A36
STRUCTURAL:	A36
PIPE:	A106B
INTERNAL PIPE:	A312 TP316 SEAMLESS
FLANGES:	A105
BOLTING:	BOLTS - A193 B8M NUTS - A194 8M
GASKETS:	SPIRAL WOUND, ASME B16.20 WITH 304 STAINLESS WINDINGS AND RINGS AND GRAFOIL FILLER

[illegible]	[illegible]	[illegible]	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC.	WT.	REMARKS
10	#1		PL .6461" X 95 1/4"	31	5	A36		ROLL TO 54'-11 1/16"
			(C/F 96 1/4" X 376.1875")					
1	#1A		PL .6461" X 95 1/4"	20	7	A36		ROLL TO 54'-11 1/16"
			(C/F 96 1/4" X 376.1875")					
11	#2		PL .5277" X 96 1/4"	31	5	A36		ROLL TO 54'-11 3/4"
			(C/F 96 1/4" X 376.1875")					
11	#3		PL .4375" X 96 1/4	31	5	A36		ROLL TO 54'-11 3/4"
			(C/F 96 1/4" X 376.1875")					
11	#4		PL .4375" X 96 1/4	31	5	A36		ROLL TO 54'-11 3/4"
			(C/F 96 1/4" X 376.1875")					
7	TA		L 3" X 3" X 1/2" FIN	345	8 1/2	A36		ROLL TO 54'-11 3/4"
			(W/F 18 - L 3" X 3" X 1/2" X 20'-0" LG)					

4. ALL SHELL BUTT WELDS TO BE 100% PENETRATION AND 100% FUSION.
5. TEST PER API 650
6. NDE PER API 650
7. PAINTING: INTERNAL AND EXTERNAL PAINTING/ COATING WILL BE PER SUB-PARAGRAPH 3.12 OF WHA SPECIFICATION 15187.
8. WEIGHTS: EMPTY: 436,000 LBS.
FULL: 23,207,470 LBS.

TA - L 3 X 3 X 1/2 (TURNED OUT)



ELEVATION
(ALL SHELL PLATES ARE ℄ STACKED)

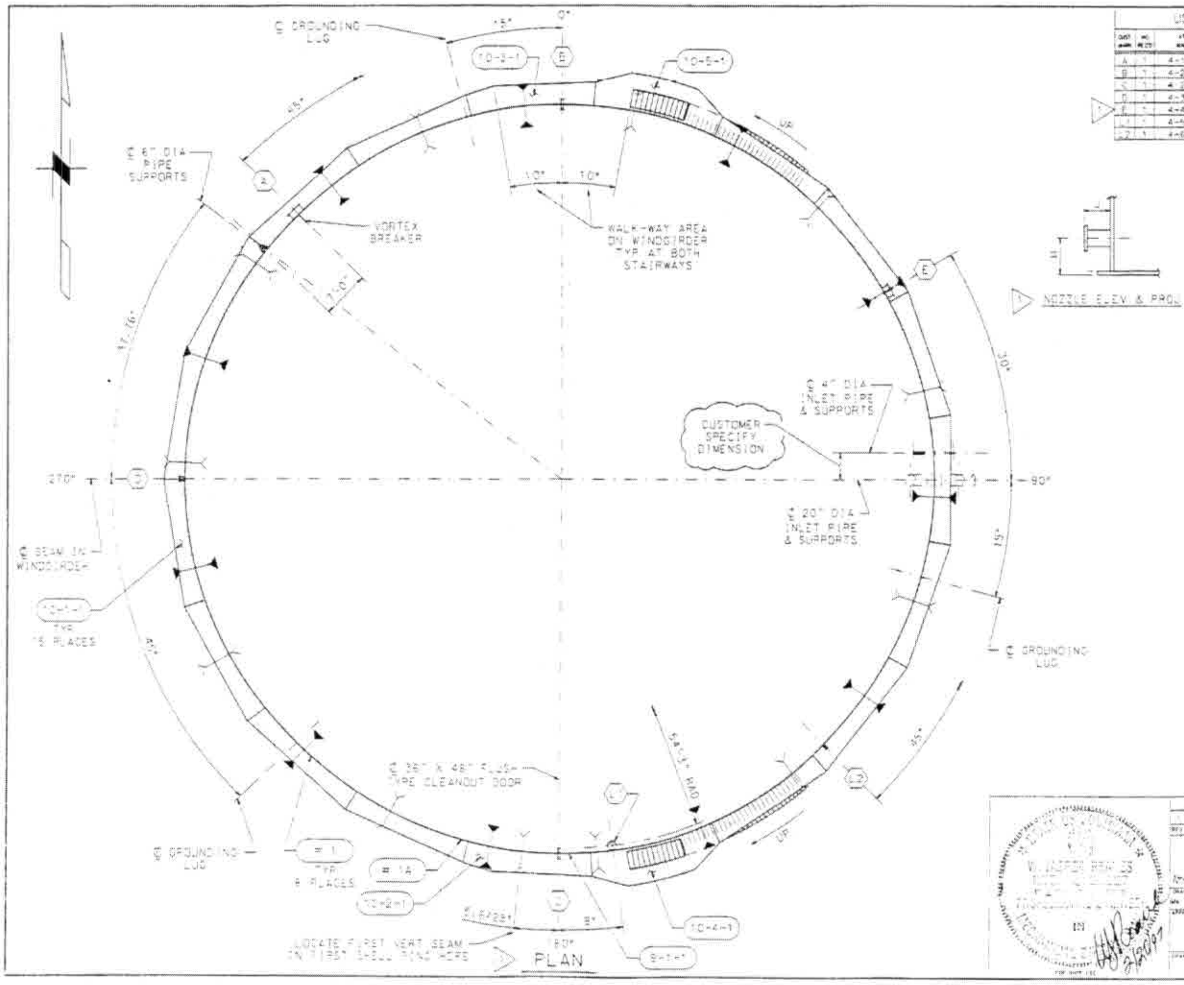
14

AT&V
American Tank & Vessel, Inc.

GENERAL ARRANGEMENT
110'-0" DIA X 32'-0" OPEN TOP TANK
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

11470 | 1-1

FOR APPROVAL 2-19-97



LIST OF APPURTENANCES FURNISHED & INSTALLED BY AT&V

CUST MARK	NO. REQ'D	AT&V MARK	ELEV. H	PROJ. J	DESCRIPTION
A	1	4-1-A	3'-0"	1'-0"	24" DIA SHELL OUTLET NOZZLE
B	1	4-2-A	5'-2½"	9"	3" DIA SHELL OUTLET NOZZLE
C	1	4-2-A	1'-0"	9"	3" DIA SHELL OUTLET NOZZLE
D	1	4-3-A	2'-0"	9"	6" DIA SHELL SPARE NOZZLE
E	1	4-4-A	6'-8"	1'-0"	20" DIA SHELL INLET NOZZLE
L1	1	4-5-A	—	—	10" X 2" DIA LEVEL/STILLING WELL NOZZLE
L2	1	4-6-A	2'-0"	9"	2" DIA SHELL LEVEL NOZZLE

TABLE OF ARCS	
ANGLE	ARC
5.6428°	5'-5"
8°	7'-8 9/16"
15°	14'-4 7/8"
30°	28'-9 3/4"
37.76°	36'-3 1/16"
45°	43'-2 5/8"

ARCS ON OUTS FIRST SHELL RING RAD = 55'-2 5/16"

= VERT SEAM IN FIRST SHELL RING

= VERT SEAM IN SECOND SHELL RING

RELOCATED SEAMS, REV. ELEV OF NOZZLES TO BTM OF BTM PL — MAC — MR

AT&V American Tank & Vessel, Inc.

ORIENTATION

110'-0" DIA X 32'-0" OPEN TOP TANK

WHT-14

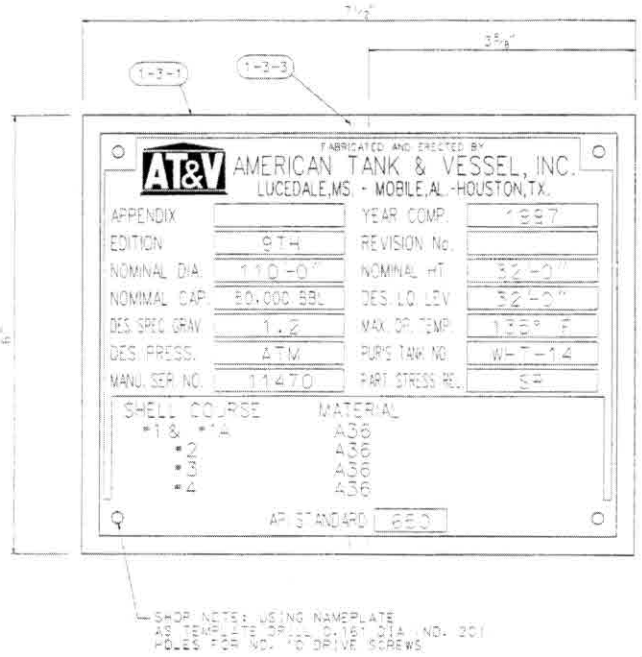
STRATEGIC PETROLEUM RESERVE

WEST HACKBERRY, LA

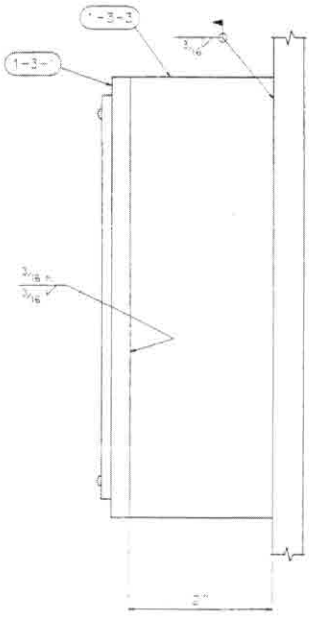
JOB NUMBER 11470 — DRAWING NUMBER 1-2

FOR APPROVAL 2-19-97

ITEM NO.	QUAN.	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT. LB	REMARKS
	1-3-A	NAMEPLATE ASSEMBLY					
	1-3-1	1 PL 6" X 14"					
	NP	1 API 650 NAMEPLATE					
	1-3-2	4 #10 DRIVE SCREWS					
	1-3-3	1 PL 2" X 14"					



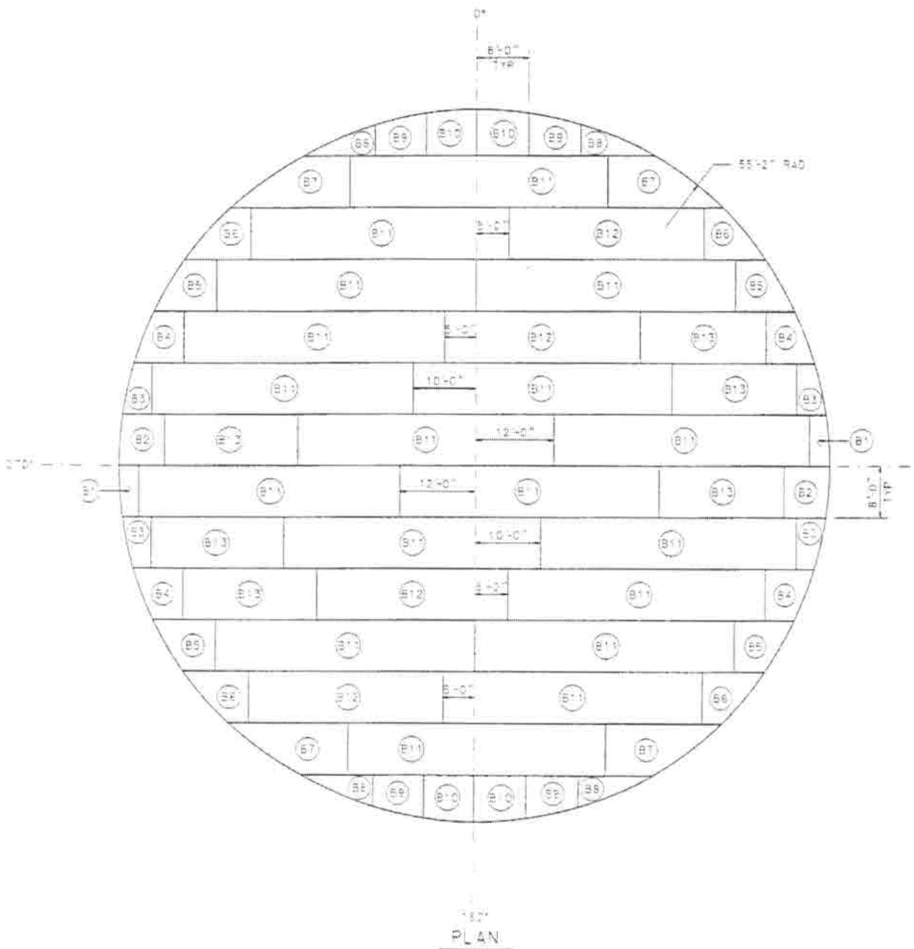
ELEVATION



VIEW A-A

	ALLOWANCE FOR APPROVAL	
REV	REVISION DESCRIPTION	BY CHK'D
AT&V	NAMEPLATE	
	110'-0" DIA X 32'-0" OPEN TOP TANK WT-T-14	
	STRATEGIC PETROLEUM RESERVE WEST HACKBERRY, LA	
	JOB NUMBER 11470	DRAWING NUMBER 1-3

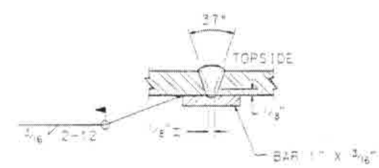
FOR APPROVAL 2-19-97



PLAN

SHP PC	MARK	ASSY PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT LB	REMARKS
2	B1		PL 5K X 1/4"			A36		
			(PL 96" X 40'-0" C/2)					
2	B2		PL 5K X 1/4"			A36		
			(C/W B1 & B2)					
4	B3		PL 5K X 1/4"			A36		
			(C/W B1 & B2)					
4	B4		PL 5K X 1/4"			A36		
			(PL 96" X 30'-0" C/2)					
4	B5		PL 5K X 1/4"			A36		
			(C/W B4)					
4	B6		PL 5K X 1/4"			A36		
			(PL 96" X 40'-0" C/2)					
4	B7		PL 5K X 1/4"			A36		
			(PL 96" X 40'-0" C/2)					
4	B8		PL 5K X 1/4"			A36		
			(C/W B7)					
4	B9		PL 5K X 1/4"			A36		
			(C/W B6)					
4	B10		PL 5K X 1/4"			A36		
			(C/W B6)					
16	B11		PL 96" X 1/4"	40	0	A36		
4	B12		PL 96" X 1/4"	30	0	A36		
6	B13		PL 96" X 1/4"	20	0	A36		
1560 LIN FT			BAR 1" X 3/16"			C.S.		
			(M/F 78 - PCS BAR 1" X 3/16" X 20'-0" LG)					

SEE DRAWING 2-2 FOR SKETCH PLATES



TYP SECTION THRU BUTT

1	RESUBMITTED FOR APPROVAL	
REV	REVISION DESCRIPTION	

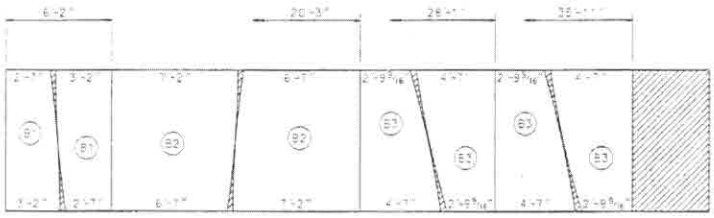
AT&V
American Tank & Vessel, Inc.

BOTTOM

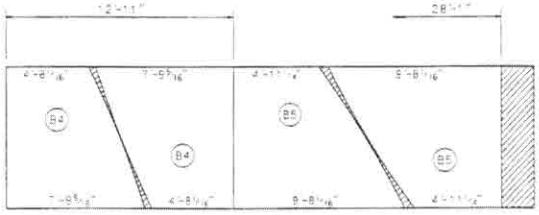
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

JOB NUMBER: 11470
DRAWING NUMBER: 2-1

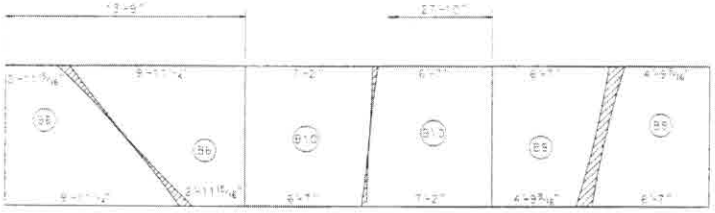
FOR APPROVAL 2-19-97



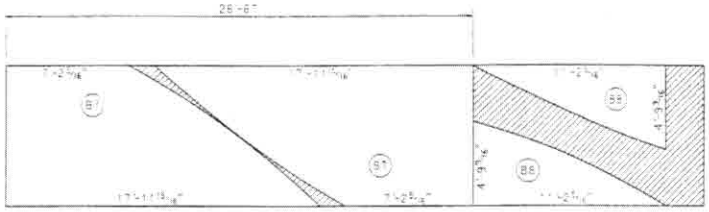
PL 96" X 7/16" X 40'-0" ONE REQ'D



PL 96" X 7/16" X 30'-0" TWO REQ'D



PL 96" X 7/16" X 40'-0" TWO REQ'D



PL 96" X 1/16" X 40'-0" TWO REQ'D

BURN RAD = 55'-2"

WORK WITH DRAWING 2-1

1	REVISED TO FOR APPROVAL	MKA MC 2-"
NO.	REVISION DESCRIPTION	APP. DWN. D.

AT&V

BOTTOM SKETCH PLATES

TYP. 40'-0" DIA. x 32'-10" OPEN TOP TANK

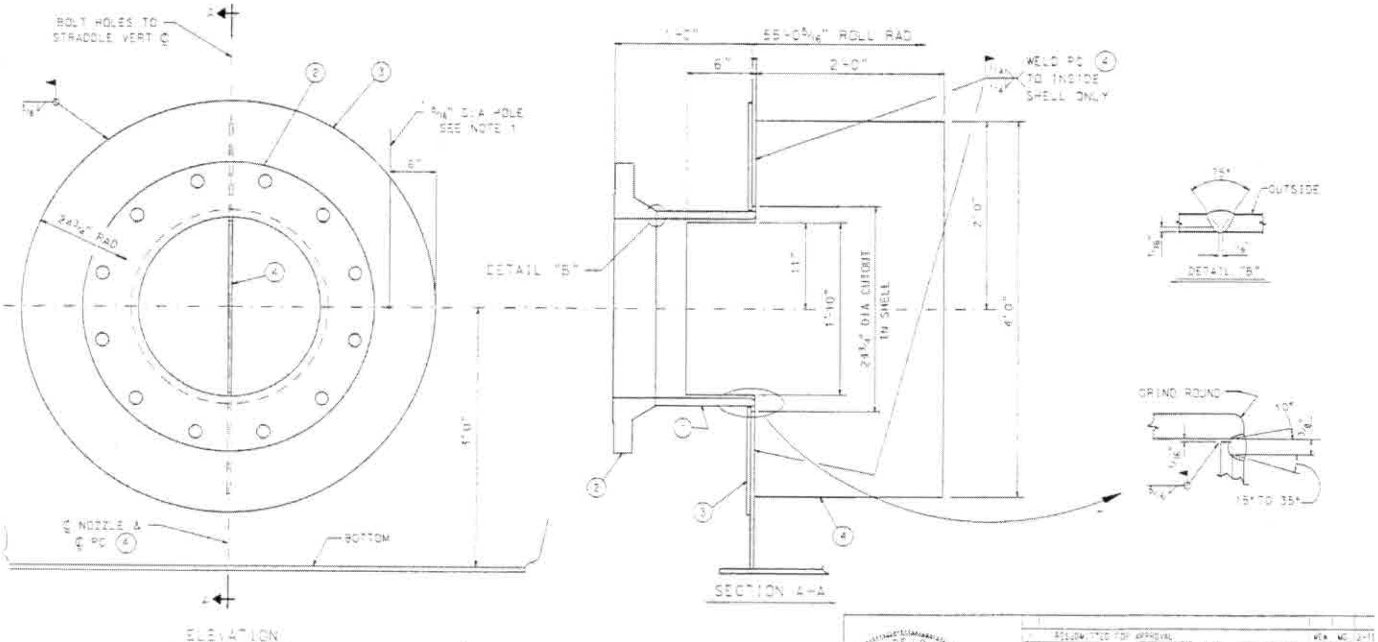
STRATEGIC PETROLEUM RESERVE

WEST HACKBERRY, LA

JOB NUMBER	11470
DRAWING NUMBER	2-2

FOR APPROVAL 2-19-97

SHP PC	MARK	ITEM PL	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT	REMARKS
1	4-1-A		24" DIA SHELL NOZZLE					
	4-1-1	1	PIPE 24" DIA X.S. SMLS	0	6¾	A106B		
	4-1-2	1	FLG 24" DIA 150# RF WN			A105		
			125-250 RMS BORE FOR X.S. PIPE					
1	4-1-3		PL 49½" OD X .6461" X 24¼"			A36		
			ID ROLL					
			(C/F PL 96" X .6461" X 9'-0")					
1	4-1-4		PL 30" X ¼" SK	4	0	A36		
			(C/W 10-1-1)					
1	4-1-5		½" DIA HALF CPLG 6000# SCRD			A105		



NOTES:

1. 5/16" DIA TELLTALE HOLE WITH ½" DIA 6000# SCREWED HALF CPLG

RESUBMITTED FOR APPROVAL

REVISION DESCRIPTION

AT&V

American Tank & Vessel Inc.

24" DIA SHELL NOZZLE - A

110'-0" DIA X 32'-0" OPEN TOP TANK

STRATEGIC PETROLEUM RESERVE

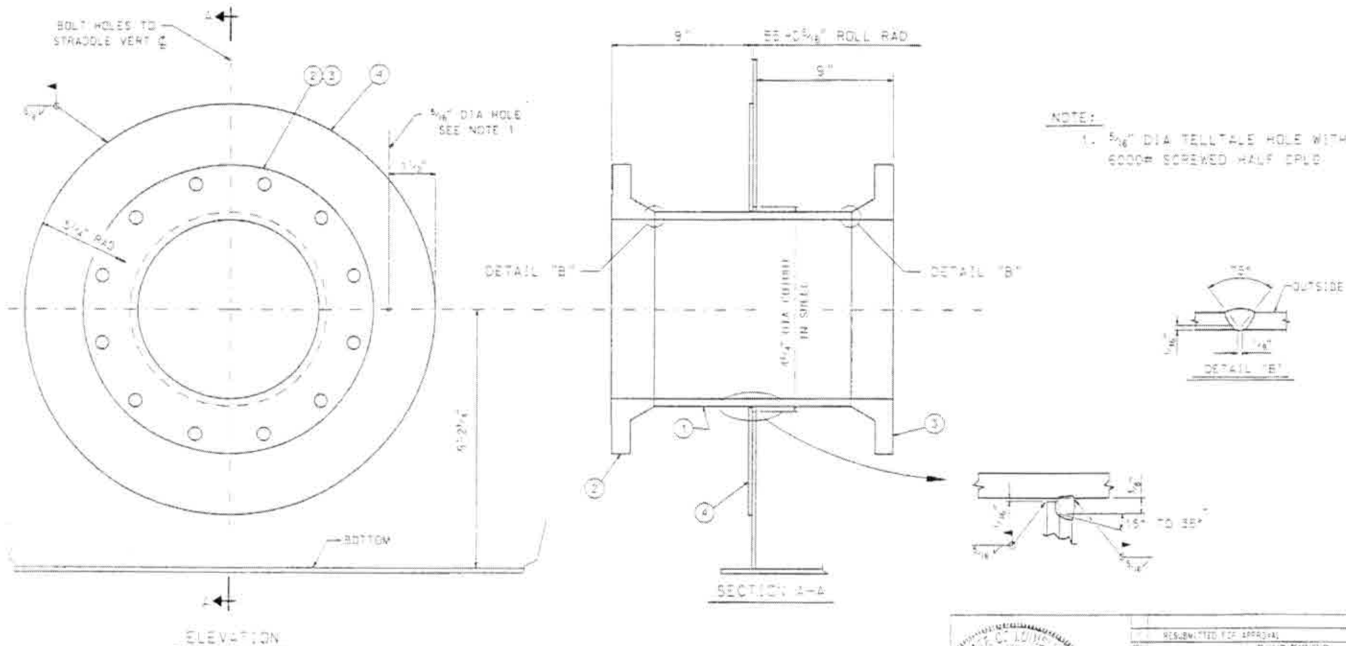
WEST HACKBERRY, LA

JOB NUMBER 11470

DRAWING NUMBER 4-1

FOR APPROVAL 2-19-97

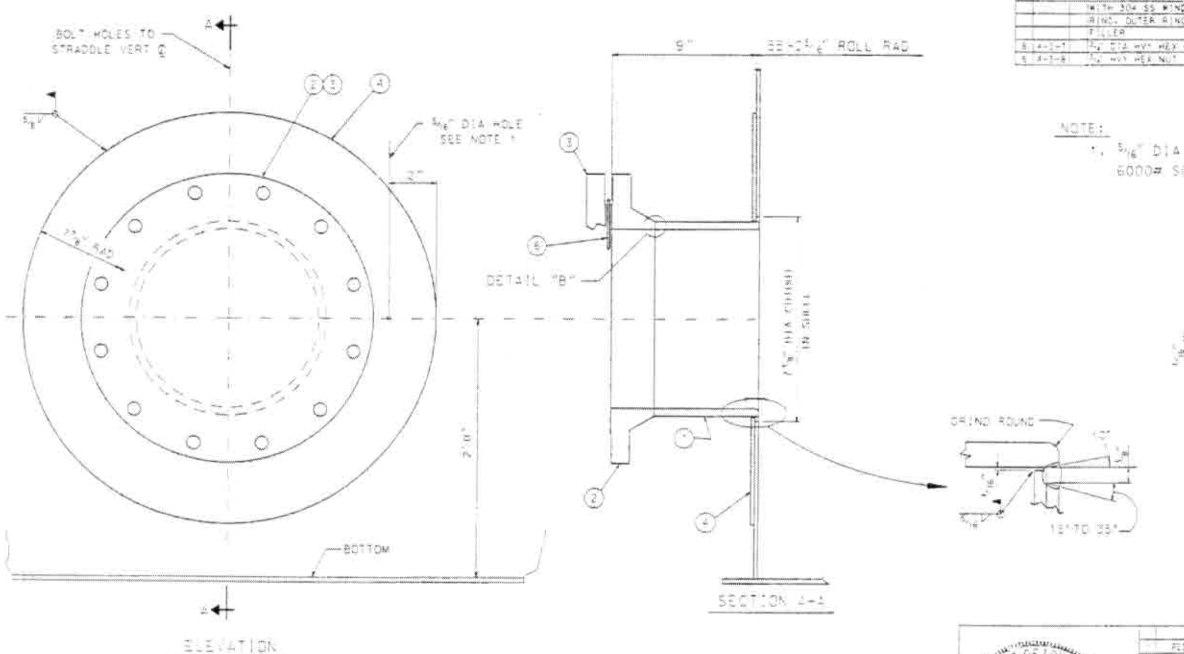
SHP PC	MARK	FORM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT LB	REMARKS
1	4-2-A		3" DIA SHELL NOZZLE					
	4-2-1	1	PIPE 3" DIA X.S. SMLS	1	1¼	A106B		
	4-2-2	1	FLG 3" DIA 150# RF WN			A105		
			125-250 RMS BORE FOR X.S. PIPE					
1	4-2-3		FLG 3" DIA 150# FF WN			A105		
			125-250 RMS BORE FOR X.S. PIPE					
1	4-2-4		PL 10½" OD X .646" X 3½"			A36		
			ID ROLL (C/W 4-1-3)					
1	4-2-5		½" DIA HALF CPLG 6000# SCRD			A105		



NOTE:

1. 5/16" DIA TELLTALE HOLE WITH ½" DIA 6000# SCREWED HALF CPLG

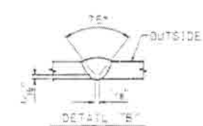
RESUBMITTED FOR APPROVAL	MLK / MC 12-19
REV / REVISION DESCRIPTION	BY / CHK'D / DATE
AT&V American Tank & Vessel Inc.	3" DIA SHELL NOZZLE - (B)
DRAWN/DATE: DK 10-18-96 / CHECKED/DATE: MG 11-20-96	110'-0" DIA X 32'-0" OPEN TOP TANK WHITE STRATEGIC PETROLEUM RESERVE WEST HACKBERRY, LA
APPROVED/DATE	JOB NUMBER: 11470 / DRAWING NUMBER: 4-2
DRAWING FILE DATE	DRAWING STATUS: FOR APPROVAL 2-19-97



SHP PC	MARK	QUAN PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	MAT'L LG	REMARKS
1	4-3-A		6" DIA SHELL NOZZLE					
	4-3-1	1	PIPE 6" DIA X.S. SMLS	0	6¼	A106B		
	4-3-2	1	FLG 6" DIA 150# RF WN			A105		
			125-250 RMS. BORE FOR X.S. PIPE					
1	4-3-3		BLIND FLG 6" DIA 150# RF			A105		
			125-250 RMS					
1	4-3-4		PL 13¾" OD X .6461" X 4¾"			A36		
			ID. ROLL (C/W 4-3-3)					
1	4-3-5		¼ DIA HALF CPLG 6000# SCRD			A105		
1	4-3-6		SPIRAL WOUND ASME B16.20					
			GASKET FOR 6" DIA 150# FLG					
			WITH 304 SS WINDING, INNER					
			RING, OUTER RING & GRAFOIL					
			FILLER					
8	4-3-7		¾" DIA HVY HEX HD BOLT	0	3¼	A193 B8M		
8	4-3-8		¾" HVY HEX NUT			A194 8M		

NOTE:

1. 5/16" DIA TELLTALE HOLE WITH ¼" DIA 6000# SCREWED HALF CPLG



RESUBMITTED FOR APPROVAL

REV | REVISION DESCRIPTION | BY | CHK'D | DATE

AT&V

6" DIA SHELL NOZZLE - (0)

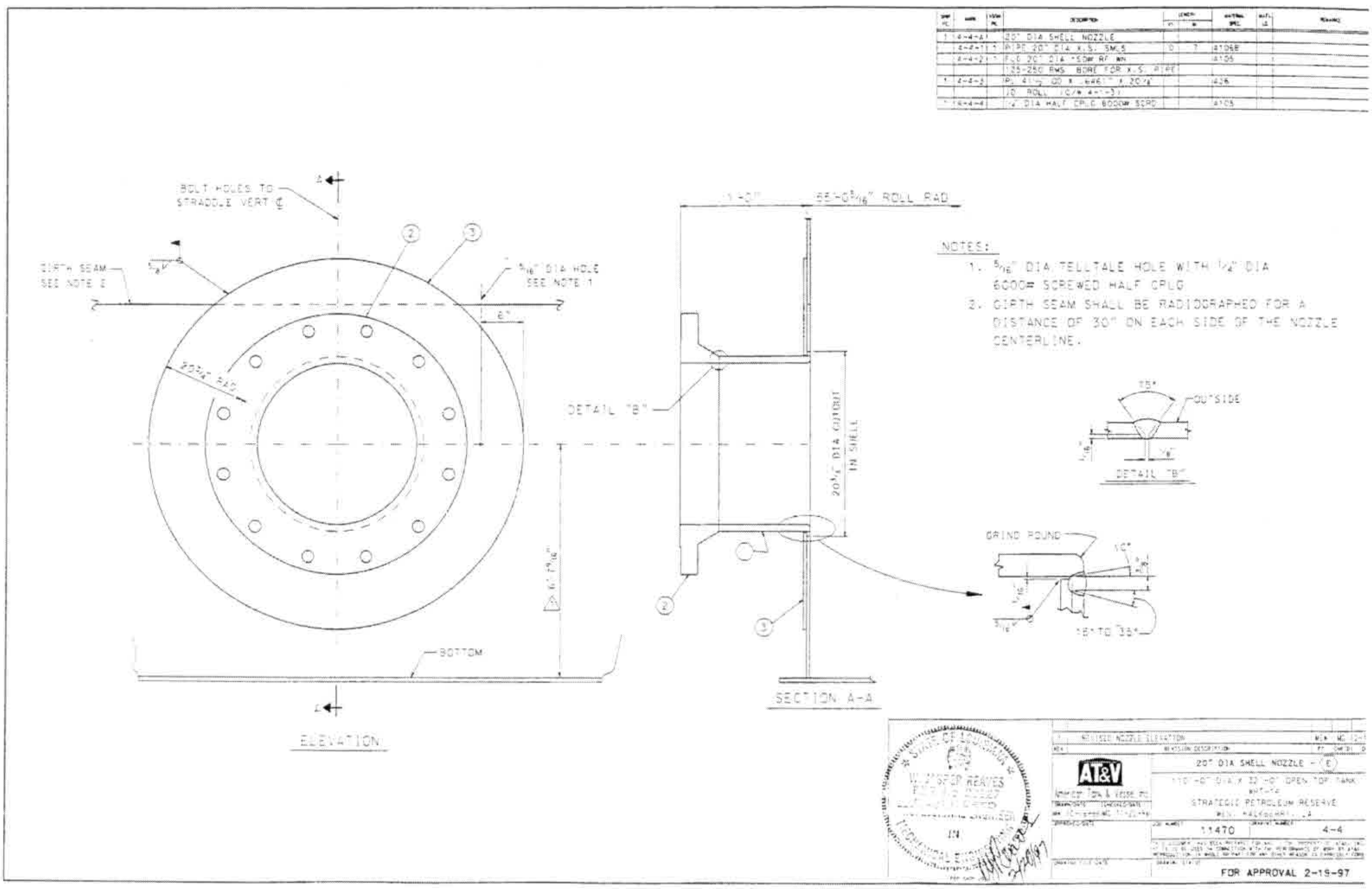
110'-0" DIA X 32'-0" OPEN TOP TANK

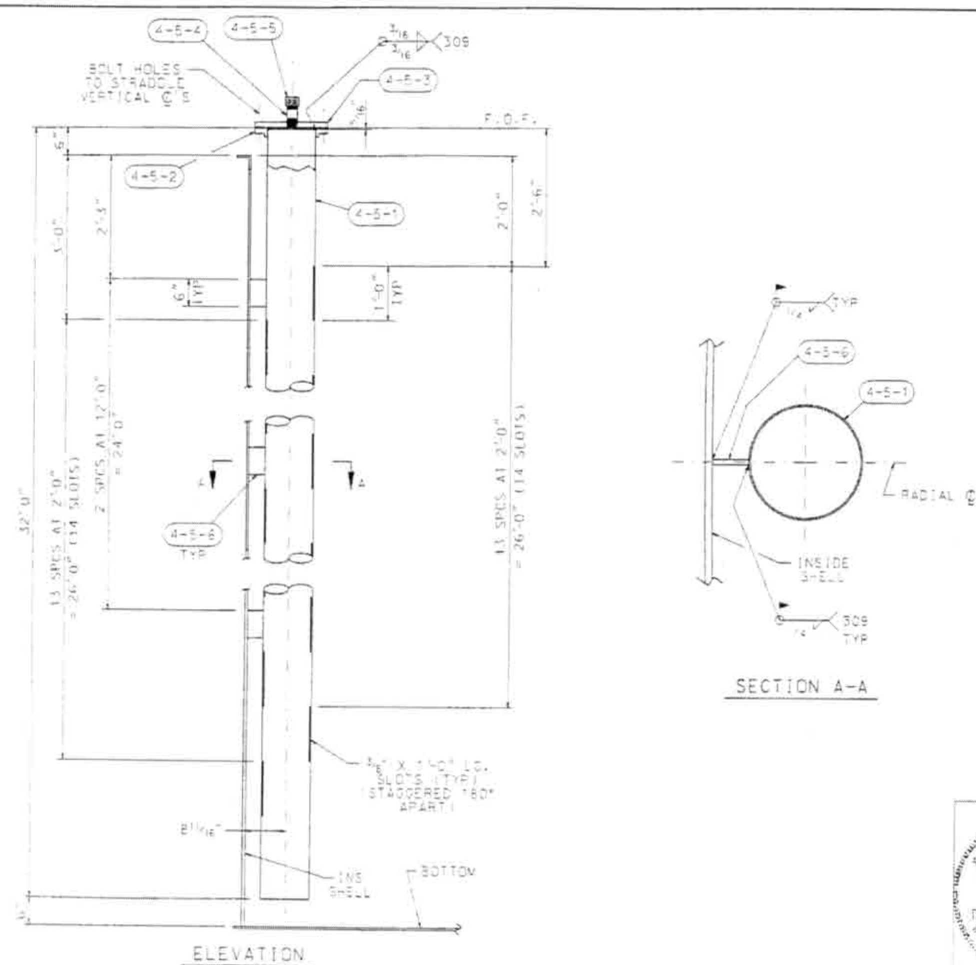
STRATEGIC PETROLEUM RESERVE

WEST HACKBERRY, LA

JOB NUMBER: 11470 | DRAWING NUMBER: 4-3

FOR APPROVAL 2-19-97


1 14-4-A1 20" DIA SHELL NOZZLE
4-4-1 PIPE 20" DIA X.S. SMLS 0 7 A106B
4-4-2 FLG 20" DIA 150# RF WN A105
125-250 RMS BORE FOR X.S. PIPE
1 4-4-3 PL 41 OD X .6461" X 20¾" A36
10' ROLL (C/# 4-1-3)
14-4-4 ½" DIA HALF CPLG 6000# SCRD A105
BOLT HOLES TO STRADDLE VERT ℄
GIRTH SEAM SEE NOTE 2
5/16" DIA HOLE SEE NOTE 1
6"
20¾" RAD
BOTTOM
ELEVATION
1'-0"
55'-0 5/16" ROLL RAD
DETAIL "B"
20⅝" DIA CUTOUT IN SHELL
SECTION A-A
NOTES:
1. 5/16" DIA TELLTALE HOLE WITH ¼" DIA 6000# SCREWED HALF CPLG
2. GIRTH SEAM SHALL BE RADIOGRAPHED FOR A DISTANCE OF 30" ON EACH SIDE OF THE NOZZLE CENTERLINE.
75°
OUTSIDE
DETAIL "B"
GRIND ROUND
10°
15° TO 35°
REVISED NOZZLE ELEVATION
20" DIA SHELL NOZZLE
AT&V
STRATEGIC PETROLEUM RESERVE
11470
4-4
FOR APPROVAL 2-19-97



SHP PC	MARK	ASSM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	MAT'L LB	REMARKS
1	4-5-A		10" DIA NOZZLE ASSEMBLY					
	4-5-1	1	PIPE 10" DIA SCH 10S SMLS	31	11 11/16	A312		W/SLOTS
			PBE			TP316		
	4-5-2	1	10" DIA 150# RF SO FLANGE			A105		
			125-250 RMS					
1	4-5-3		10" TO 2" 150# RF REDUC.			A105		
			SCR'D FLANGE 125-250 RMS					
1	4-5-4		PIPE 2" DIA SCH 40 SMLS TBE	0	6	A106B		
1	4-5-5		2" DIA 3000# SCR'D PIPE CAP			A105		
5	4-5-6		PL 3 5/16" x 1/2"	0	6	A36		
12			7/8" DIA HVY HX HD BOLT	0	3 3/4	A193 B8M		
12			7/8" HVY HEX NUT			A194 8M		
2			SPIRAL WOUND ASME B16.20					
			GASKET FOR 10" DIA 150# FLG					
			WITH 304 SS WINDING, INNER					
			RING, OUTER RING & GRAFOIL					
			FILLER					

RESUBMITTED FOR APPROVAL — WEH — MG — 12-13-

REV — REVISION DESCRIPTION — BY — CHK'D — DATE

AT&V

American Tank & Vessel, Inc.

10" X 2" DIA LEVEL/ST WELL NOZZLE - (L1

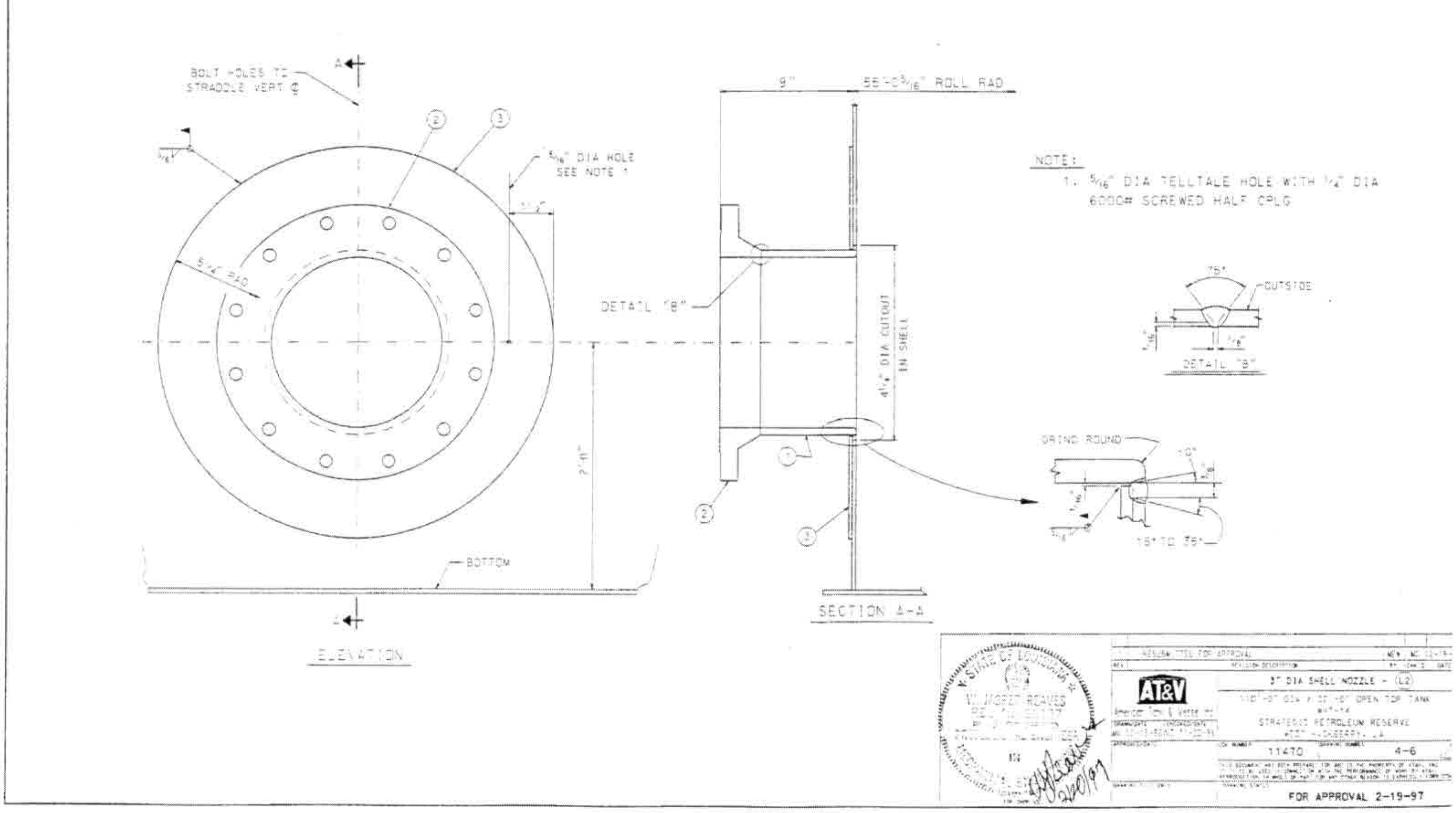
110'-0" DIA X 32'-0" OPEN TOP TANK

STRATEGIC PETROLEUM RESERVE

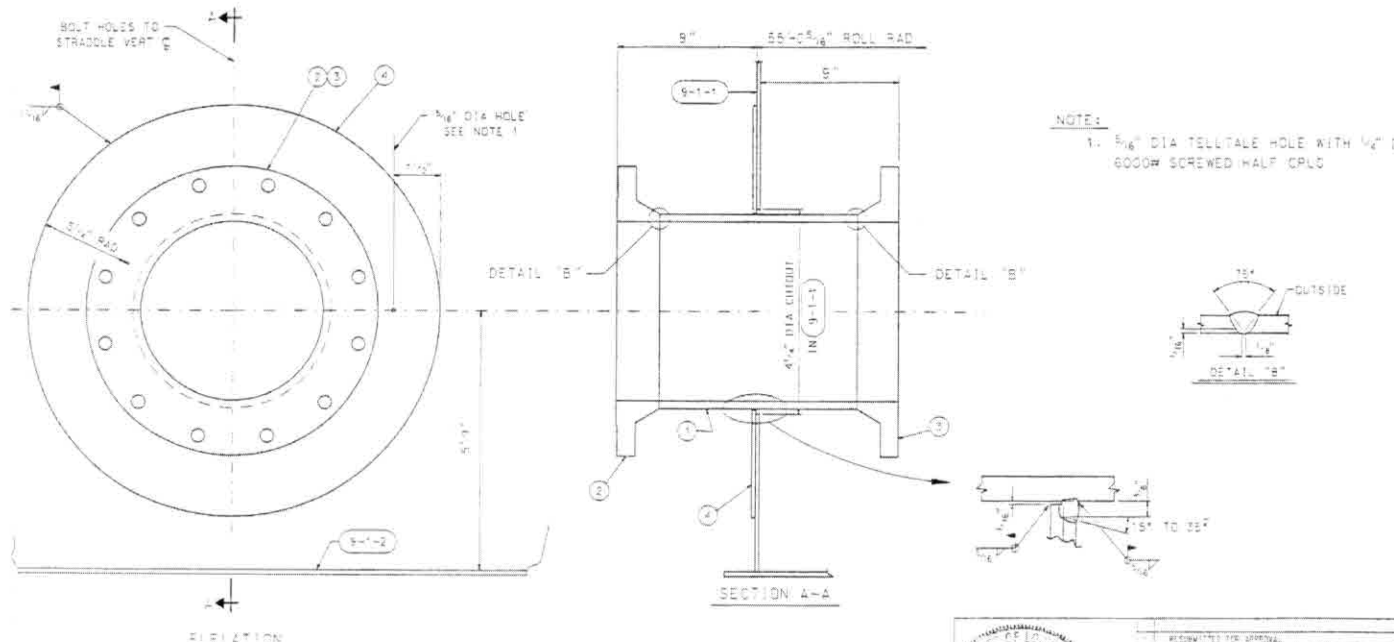
JOB NUMBER: 11470 — DRAWING NUMBER: 4-5

DRAWING STATUS: FOR APPROVAL 2-19-97

SHP PC	MARK	ASSEM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT	REMARKS
1	4-6-A		3" DIA SHELL NOZZLE					
	4-6-1	1	PIPE 3" DIA X.S. SMLS	0	6⅞	A106B		
	4-6-2	1	FLG 3" DIA 150# RF WN			A105		
			125-250 RMS. BORE FOR X.S. PIPE					
1	4-6-3		PL 10½ OD X .6461" X 1⅓			A36		
			ID ROLL (C/W 4-1-3)					
1	4-6-4		½" DIA HALF CPLG 6000# SCRD			A105		



SHIP PC	MARK	ASSM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	MATL LS	REMARKS
1	4-T-A		3" DIA SHELL NOZZLE					
	4-T-1	1	PIPE 3" DIA X.S. SMLS	1	$1\frac{5}{16}$	A106B		
	4-T-2	1	FLG 3" DIA 150# RF WN			A105		
			125-250 RMS BORE FOR X.S. PIPE					
1	4-T-3		FLG 3" DIA 150# FF WN			A105		
			125-250 RMS BORE FOR X.S. PIPE					
1	4-T-4		PL $10\frac{1}{2}$" OD X .7086" X $3\frac{1}{2}$"			A36		
			ID ROLL (C/W 9-1-1)					
1	4-T-5		1/2" DIA HALF CPLG 6000# SCRD			A105		



NOTE:

1. 5/16" DIA TELLTALE HOLE WITH 1/2" DIA 6000# SCREWED HALF CPLG

RESUBMITTED FOR APPROVAL

AT&V American Tank & Vessel, Inc.

3" DIA SHELL NOZZLE - (C)

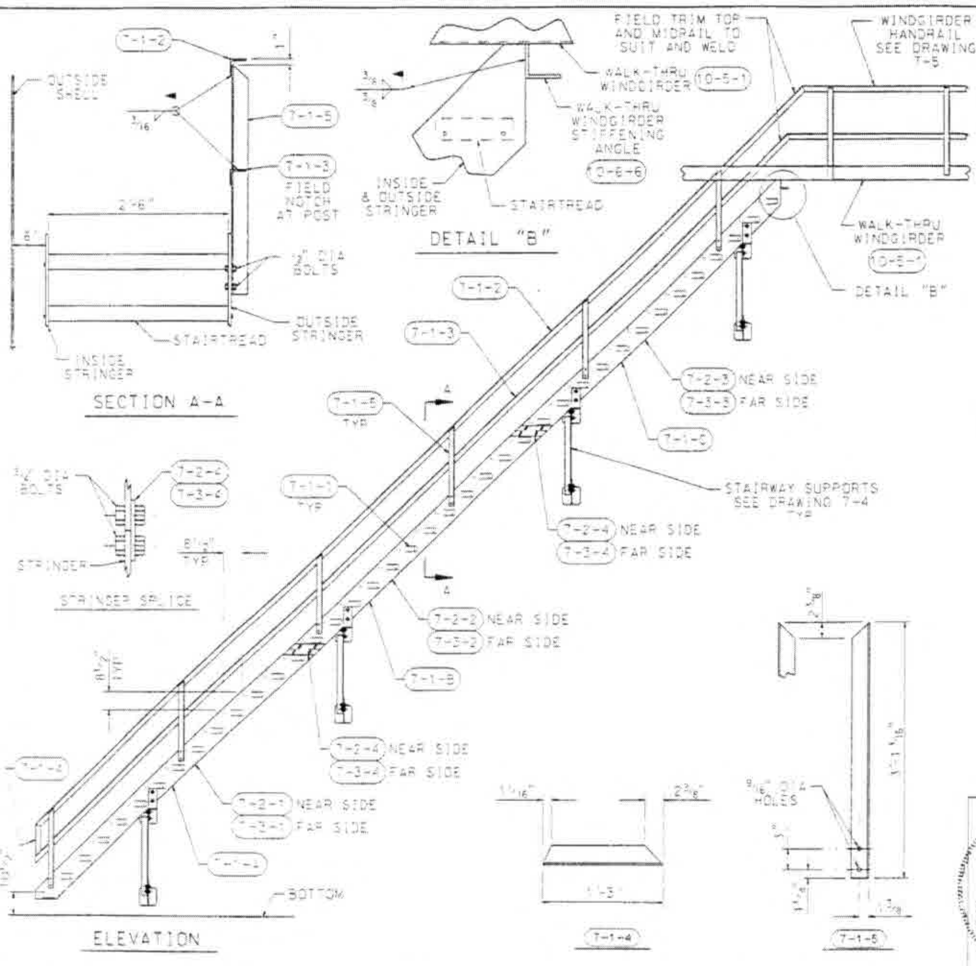
TYP 40' DIA X 32'-0" OPEN TOP TANK

STRATEGIC PETROLEUM RESERVE

WEST HACKBERRY, LA

JOB NUMBER 11470 DRAWING NUMBER 4-7

FOR APPROVAL 2-19-97



			DESCRIPTION	LENGTH		MATERIAL SPEC		REMARKS
1	7-1-A		BOTTOM STRINGER ASSEMBLY					
	7-2-1	1	PL 10" X 1/2" SK	14	6	A36		ROLL, GALVANIZED
			(C/F PL 22" X 14-10")					
	7-3-1	1	PL 10" X 1/2" SK	14	4	A36		ROLL, GALVANIZED
			(C/W 7-2-1)					
	7-1-1	14	STAIR TREADS 9¾" WIDE	2	6			
			(KG BORDEN TYPE W/B SIZE 6					
			WITH 1¼" X 3/16" BEARING BARS					
			ON 1 3/16" CENTERS					
			SERRATED AND GALVANIZED					
		56	BOLT 5/8" DIA HEX HD GALV	0	1½	A307B		
		56	NUT 5/8" HEX GALV			A563A		
1	7-1-B		INTERM. STRINGER ASSEMBLY					
	7-2-2	1	PL 10" X 1/2" SK	13	11	A36		ROLL, GALVANIZED
			(C/W 7-2-1)					
	7-3-2	1	PL 10" X 1/2" SK	12	10	A36		ROLL, GALVANIZED
			(C/W 7-2-1)					
	7-1-1	12	STAIR TREADS 9¾" WIDE	2	6			
			(KG BORDEN TYPE W/B SIZE 6					
			WITH 1¼" X 3/16" BEARING BARS					
			ON 1 3/16" CENTERS					
			SERRATED AND GALVANIZED					
		48	BOLT 5/8" DIA HEX HD GALV	0	1½	A307B		
		48	NUT 5/8" HEX GALV			A563A		
1	7-1-C		TOP STRINGER ASSEMBLY					
	7-2-3	1	PL 10" X 1/2" SK	14	1½	A36		ROLL, GALVANIZED
			(C/W 7-2-1)					
	7-3-3	1	PL 10" X 1/2" SK	13	9	A36		ROLL, GALVANIZED
			(C/W 7-2-1)					
	7-1-1	13	STAIR TREADS 9¾" WIDE	2	6			
			(KG BORDEN TYPE W/B SIZE 6					
			WITH 1¼" X 3/16" BEARING BARS					
			ON 1 3/16" CENTERS					
			SERRATED AND GALVANIZED					
		52	BOLT 5/8" DIA HEX HD GALV	0	1½	A307B		
		52	NUT 5/8" HEX GALV			A563A		
2	7-2-4		PL SK X 5/8"			A36		GALVANIZED
			(PL 13" X 1'-9" C/2)					
2	7-3-4		PL SK X 5/8"			A36		GALVANIZED
			(PL 13" X 1'-9" C/2)					
1	7-1-2		RUN L 2½" X 2½" X ¼"	44	0	A36		GALV/ROLL R = 58'-
1	7-1-3		RUN L 2½" X 2½" X ¼"	44	0	A36		GALV/ROLL R = 58'-
1	7-1-4		L 2½" X 2½" X ¼" SK	1	3	A36		GALVANIZED
6	7-1-5		L 2½" X 2½" X ¼" SK	3	1¾	A36		GALV/WITH HOLES
16			BOLT ½" DIA HVY HEX HD GALV	0	2	A307B		
16			NUT ½" HVY HEX GALV			A563A		
12			BOLT ½" DIA HVY HEX HD GALV	0	1½	A307B		
12			NUT ½" HVY HEX GALV			A563A		

SHOP:
SEAL WELD ALL POINTS OF CONTACT FOR ASSEMBLIES TO BE GALVANIZED.

FIELD:
GRIND OFF GALVANIZING PRIOR TO WELDING AND REPAIR DAMAGED AND WELDED AREAS WITH ZINC RICH PAINT OR EQUAL.

AT&V
American Tank & Vessel Inc.

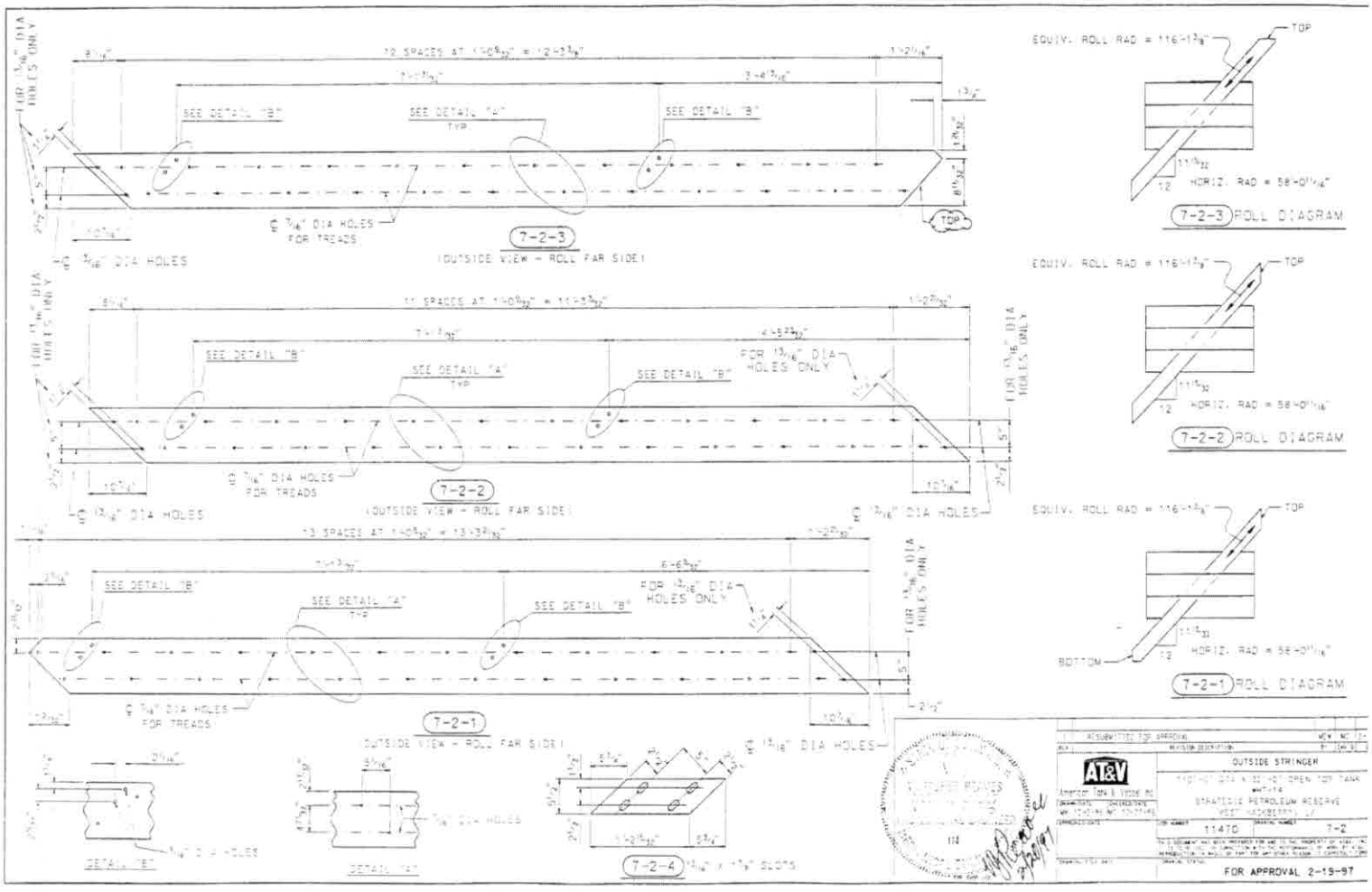
SPIRAL STAIRWAY

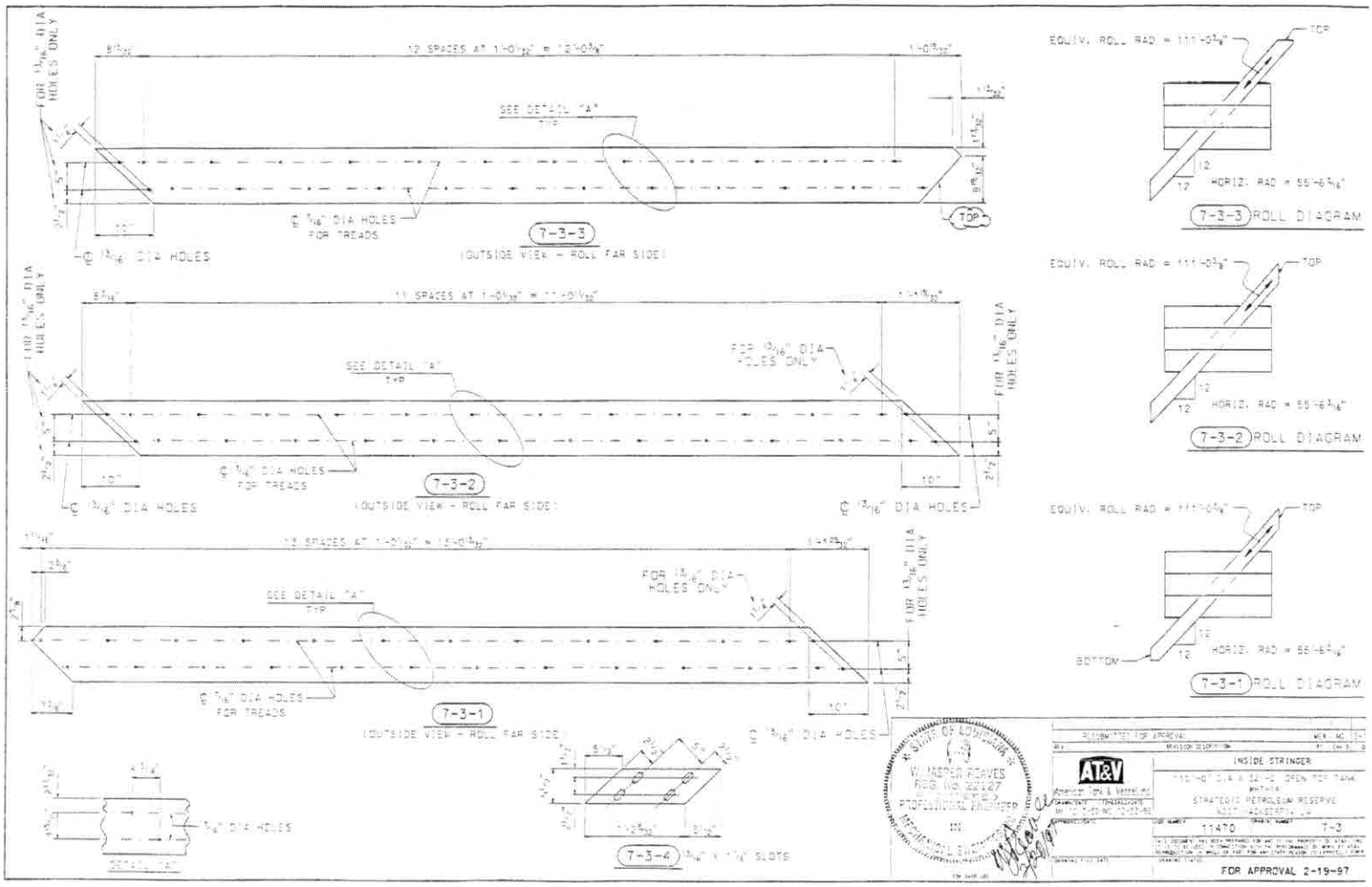
STRATEGIC PETROLEUM RESERVE

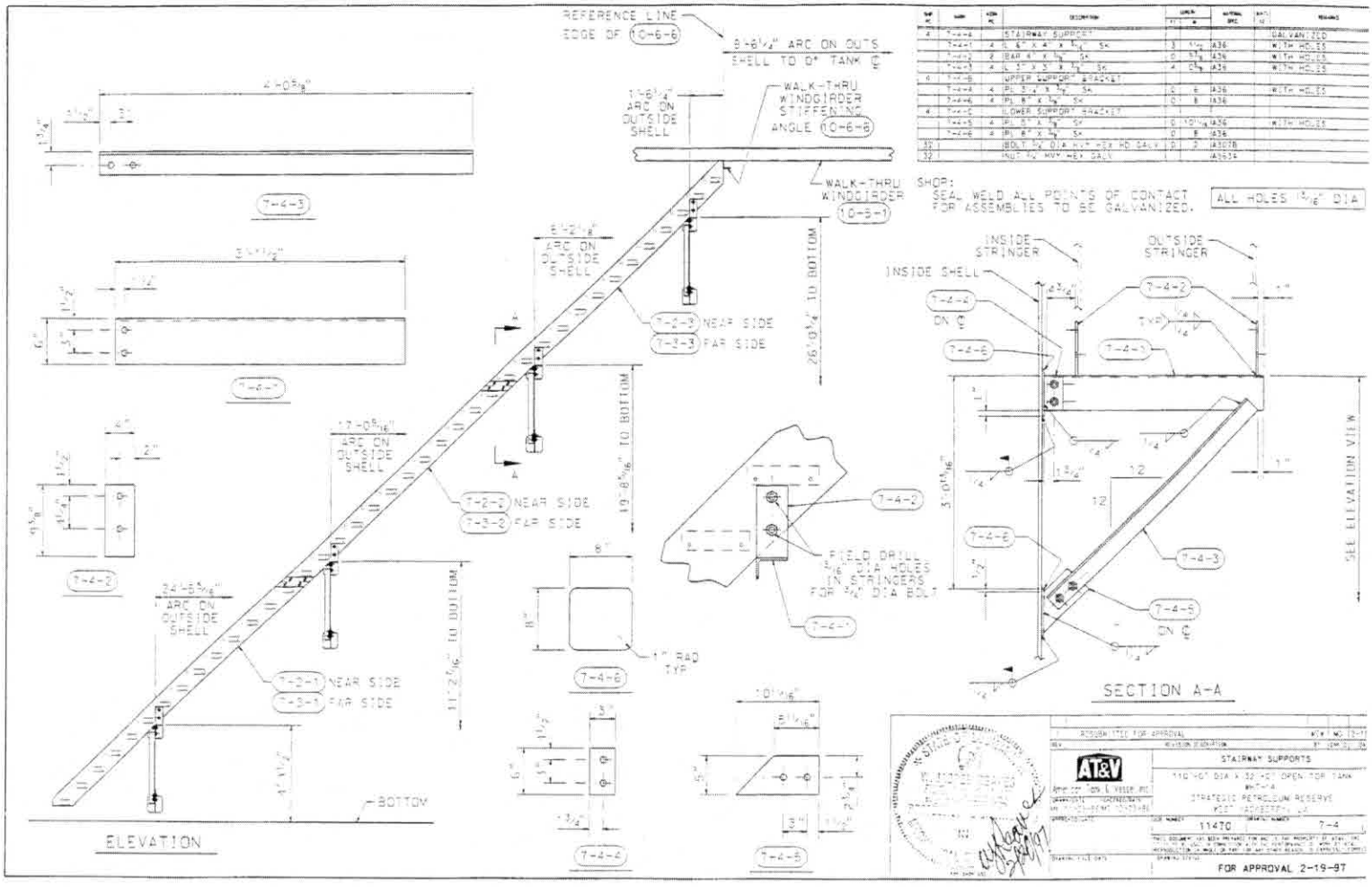
11470

7-1

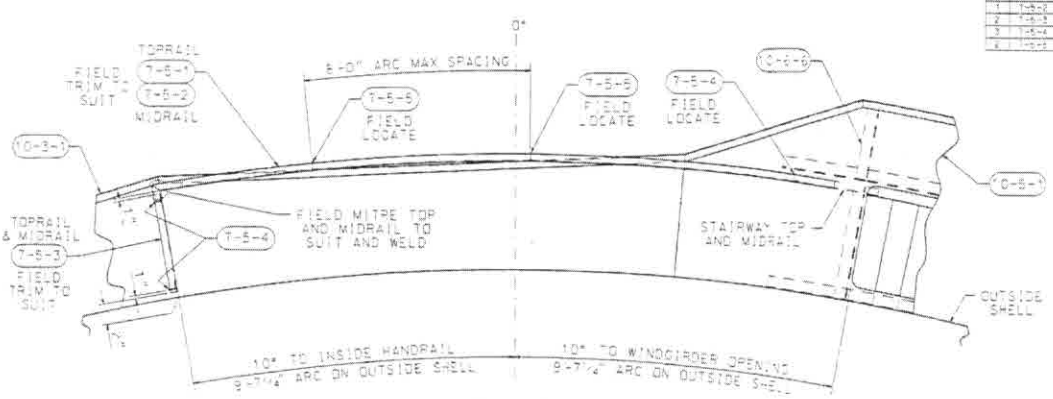
FOR APPROVAL 2-19-97


7-2-3
(OUTSIDE VIEW - ROLL FAR SIDE)
7-2-2
(OUTSIDE VIEW - ROLL FAR SIDE)
7-2-1
(OUTSIDE VIEW - ROLL FAR SIDE)
7-2-4
DETAIL "B"
DETAIL "A"
7-2-3 ROLL DIAGRAM
7-2-2 ROLL DIAGRAM
7-2-1 ROLL DIAGRAM
OUTSIDE STRINGER
STRATEGIC PETROLEUM RESERVE
11470
7-2
FOR APPROVAL 2-19-97

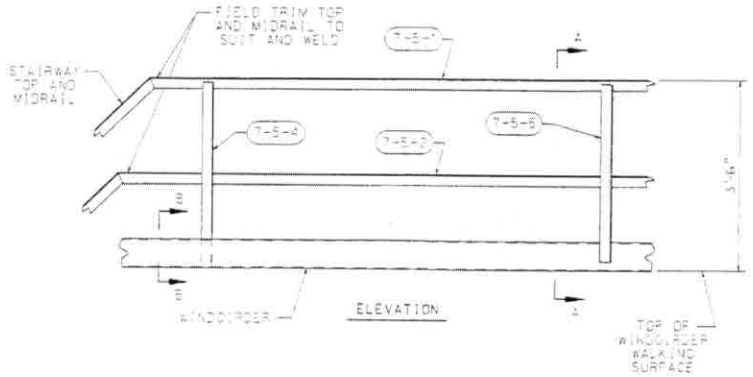

12 SPACES AT 1'-0 1/32" = 12'-0 3/8"
SEE DETAIL "A" TYP
FOR 13/16" DIA HOLES ONLY
Ø 7/16" DIA HOLES FOR TREADS
Ø 13/16" DIA HOLES
TOP
7-3-3
(OUTSIDE VIEW - ROLL FAR SIDE)
11 SPACES AT 1'-0 1/32" = 11'-0 1/32"
FOR Ø 13/16" DIA HOLES ONLY
7-3-2
(OUTSIDE VIEW - ROLL FAR SIDE)
13 SPACES AT 1'-0 1/4" = 13'-0 3/32"
7-3-1
(OUTSIDE VIEW - ROLL FAR SIDE)
7/16" DIA HOLES
7-3-4 3/4" X 1 1/16" SLOTS
EQUIV. ROLL RAD = 111'-0 3/8"
HORIZ. RAD = 55'-6 3/16"
7-3-3 ROLL DIAGRAM
7-3-2 ROLL DIAGRAM
BOTTOM
7-3-1 ROLL DIAGRAM
STATE OF LOUISIANA
W. HARPER FRAVES
REG. NO. 22127
PROFESSIONAL ENGINEER
AT&V
INSIDE STRINGER
STRATEGIC PETROLEUM RESERVE
11470
7-3
FOR APPROVAL 2-19-97


REFERENCE LINE
EDGE OF 10-6-6
8'-8 1/2" ARC ON OUTS SHELL TO 0° TANK ℄
WALK-THRU WINDGIRDER STIFFENING ANGLE 10-6-8
WALK-THRU WINDGIRDER 10-5-1
7-4-3
7-4-1
7-4-2
7-2-2 NEAR SIDE
7-3-2 FAR SIDE
7-2-1 NEAR SIDE
7-3-1 FAR SIDE
7-2-3 NEAR SIDE
7-3-3 FAR SIDE
7-4-6
7-4-4
7-4-5
7-4-7
FIELD DRILL 13/16 DIA HOLES IN STRINGERS FOR 3/4" DIA BOLT
1" RAD TYP
BOTTOM
ELEVATION
INSIDE STRINGER
OUTSIDE STRINGER
INSIDE SHELL
SEE ELEVATION VIEW
SECTION A-A
SHOP:
SEAL WELD ALL POINTS OF CONTACT FOR ASSEMBLIES TO BE GALVANIZED.
ALL HOLES 13/16" DIA
STAIRWAY SUPPORTS
110'-0" DIA X 32'-0" OPEN TOP TANK
STRATEGIC PETROLEUM RESERVE
11470
7-4
FOR APPROVAL 2-19-97

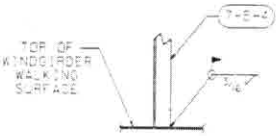
MARK NO.	SIZE	NOM. WT.	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC.	WT. EA.	REMARKS
1	T-5-1		RUN L 2½ X 2½ X ¼"	24	0	A36		GALVROLL F = 58 FT
1	T-5-2		RUN L 2½ X 2½ X ¼"	24	0	A36		GALVROLL F = 58 FT
2	T-5-3		L 2½ X 2½ X ¼	3	11¼	A36		GALVANIZED
2	T-5-4		L 2½ X 2½ X ¼	3	5	A36		GALVANIZED
4	T-5-5		L 2½ X 2½ X ¼	3	3¼	A36		GALVANIZED



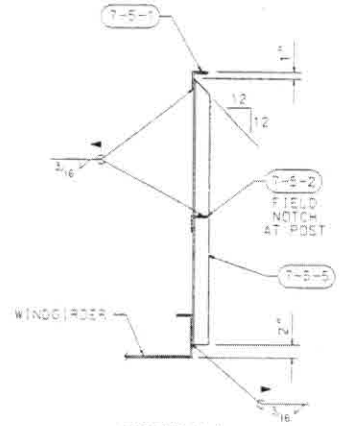
PLAN VIEW



ELEVATION



VIEW B-B



SECTION A-A

FIELD MITRE (T-5-4) & WELD TO TOP & MIDRAIL SIMILAR

FIELD:
GRIND OFF GALVANIZING PRIOR TO WELDING AND REPAIR DAMAGED AND WELDED AREAS WITH ZINC RICH PAINT OR EQUAL.

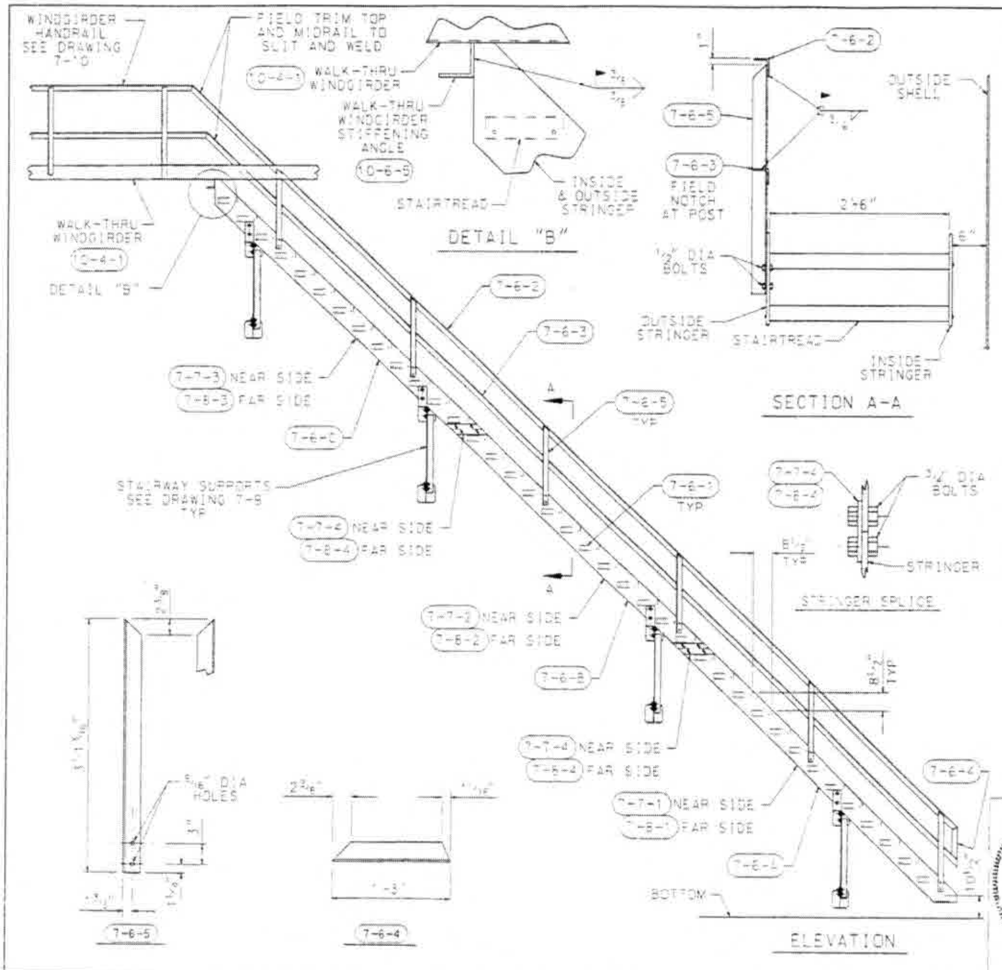
AT&V

WINDGIRDER HANDRAIL

STRATEGIC PETROLEUM RESERVE

11470 | T-5

FOR APPROVAL 2-19-97



SHP PC	MARK	ASSM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT LB	REMARKS
1	7-6-A		BOTTOM STRINGER ASSEMBLY					
	7-7-1	1	PL 10" X 1/2" SK	14	8	A36		ROLL, GALVANIZED
			(C/W PL 12" X 14'-0")					
	7-8-1	1	PL 10" X 1/2" SK	14	8	A36		ROLL, GALVANIZED
			(C/W 7-7-1)					
	7-6-1	14	STAIR TREADS 8 1/2" WIDE	2	6			
			IKG BORDEN TYPE W/B SIZE 6					
			WITH 1 1/4" X 3/16" BEARING BARS					
			ON 1 3/16" CENTERS					
			SERRATED AND GALVANIZED					
		56	BOLT 5/8" DIA HEX HD GALV	0	1 1/2	A307B		
		56	NUT 5/8" HEX GALV			A563A		
1	7-6-B		INTERM. STRINGER ASSEMBLY					
	7-7-2	1	PL 10" X 1/2" SK	13	11 1/16	A36		ROLL, GALVANIZED
			(C/W 7-7-1)					
	7-8-2	1	PL 10" X 1/2" SK	12	10 1/16	A36		ROLL, GALVANIZED
			(C/W 7-7-1)					
	7-6-1	12	STAIR TREADS 8 1/2" WIDE	2	6			
			IKG BORDEN TYPE W/B SIZE 6					
			WITH 1 1/4" X 3/16" BEARING BARS					
			ON 1 3/16" CENTERS					
			SERRATED AND GALVANIZED					
		48	BOLT 5/8" DIA HEX HD GALV	0	1 1/2	A307B		
		48	NUT 5/8" HEX GALV			A563A		
1	7-6-C		TOP STRINGER ASSEMBLY					
	7-7-3	1	PL 10" X 1/2" SK	14	[illegible]	A36		ROLL, GALVANIZED
			(C/W 7-7-1)					
	7-8-3	1	PL 10" X 1/2" SK	13	5 1/16	A36		ROLL, GALVANIZED
			(C/W 7-7-1)					
	7-6-1	13	STAIR TREADS 8 1/2" WIDE	2	6			
			IKG BORDEN TYPE W/B SIZE 6					
			WITH 1 1/4" X 3/16" BEARING BARS					
			ON 1 3/16" CENTERS					
			SERRATED AND GALVANIZED					
		52	BOLT 5/8" DIA HEX HD GALV	0	1 1/2	A307B		
		52	NUT 5/8" HEX GALV			A563A		
2	7-7-4		PL SK X 3/8"			A36		GALVANIZED
			(PL 12" X 1'-8" C/C)					
2	7-8-4		PL SK X 3/8"			A36		GALVANIZED
			(PL 12" X 1'-8" C/C)					
1	7-6-2		RUN L 2 1/2" X 2 1/2" X 1/4"	44	0	A36		GALV/ROLL R = 58'-[illegible]
1	7-6-3		RUN L 2 1/2" X 2 1/2" X 1/4"	44	0	A36		GALV/ROLL R = 58'-[illegible]
1	7-6-4		L 2 1/2" X 2 1/2" X 1/4" SK	1	3	A36		GALVANIZED
6	7-6-5		L 3 1/2" X 3 1/2" X 1/4" SK	3	1 1/16	A36		GALV/WITH HOLES
16			BOLT 3/4" DIA HVY HEX HD GALV	0	2	A307B		
16			NUT 3/4" HVY HEX GALV			A563A		
12			BOLT 1/2" DIA HVY HEX HD GALV	0	1 1/2	A307B		
12			NUT 1/2" HVY HEX GALV			A563A		

SHOP:
SEAL WELD ALL POINTS OF CONTACT FOR ASSEMBLIES TO BE GALVANIZED.

FIELD:
GRIND OFF GALVANIZING PRIOR TO WELDING AND REPAIR DAMAGED AND WELDED AREAS WITH ZINC RICH PAINT OR EQUAL.

STATE OF LOUISIANA
W. JASPER REHMS
REG. NO. [illegible]
PROFESSIONAL ENGINEER
IN
MECHANICAL ENGINEERING

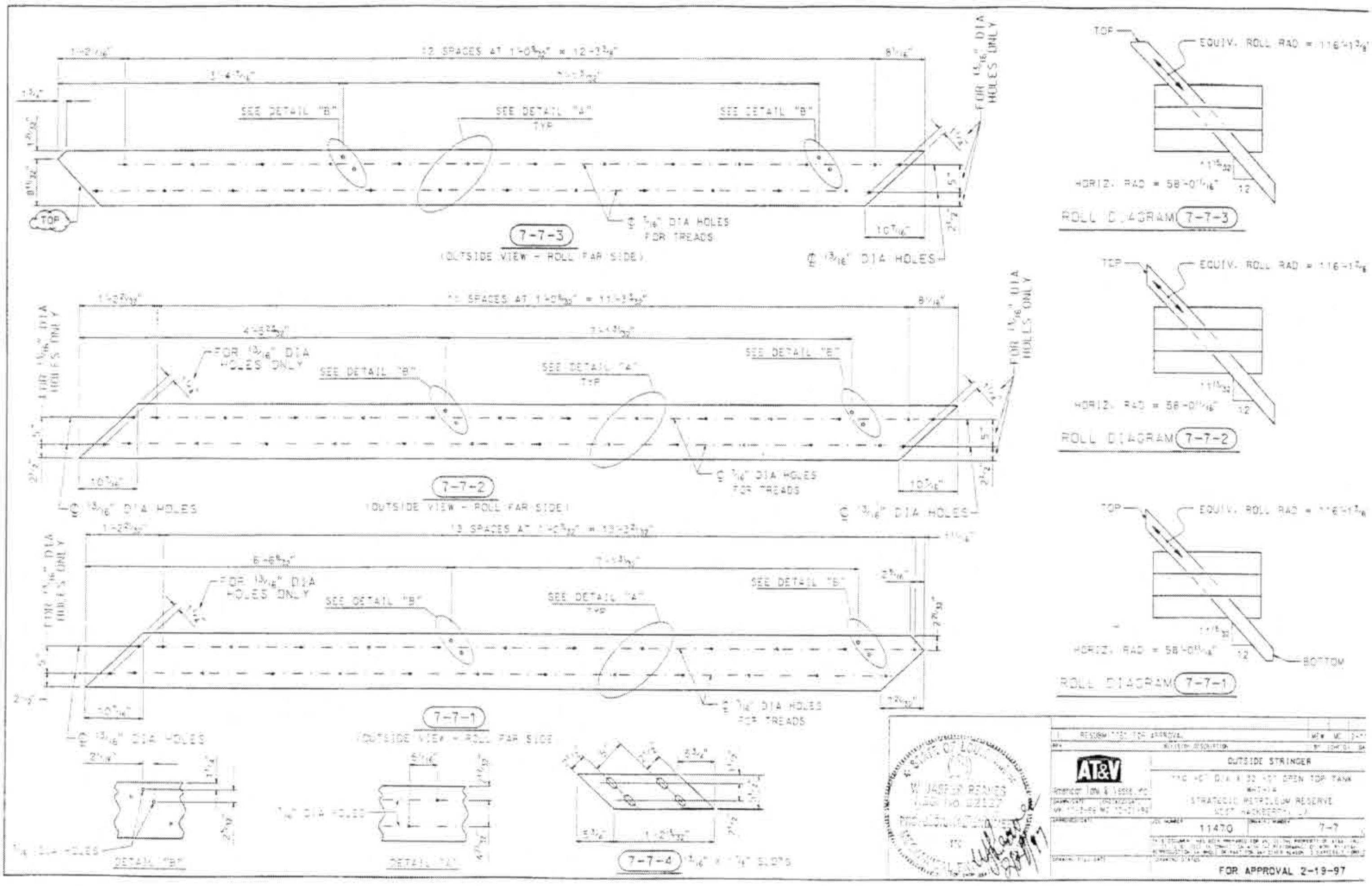
ISSUED FOR APPROVAL

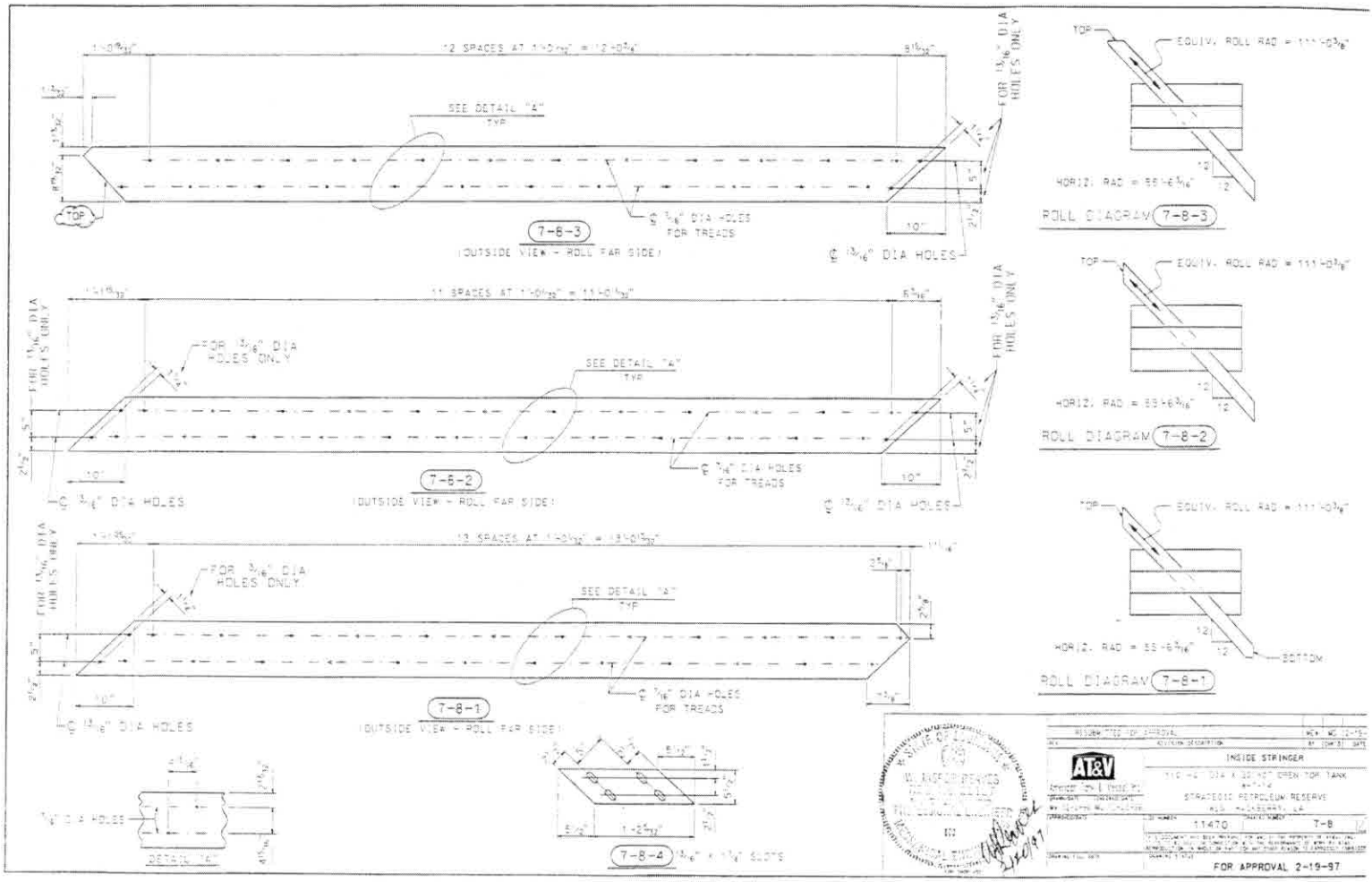
AT&V
American Tank & Vessel Inc.

SPIRAL STAIRWAY
110' HGT DIA X 32' HGT OPEN TOP TANK
WHT-14
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

JOB NUMBER: 11470
DRAWING NUMBER: 7-6

FOR APPROVAL 2-19-97


SEE DETAIL "B"
SEE DETAIL "A"
TYP
TOP
7-7-3
(OUTSIDE VIEW - ROLL FAR SIDE)
FOR TREADS
DIA HOLES
ROLL DIAGRAM 7-7-3
ROLL DIAGRAM 7-7-2
ROLL DIAGRAM 7-7-1
BOTTOM
7-7-2
7-7-1
7-7-4
DETAIL "B"
DETAIL "A"
OUTSIDE STRINGER
STRATEGIC PETROLEUM RESERVE
11470
7-7
FOR APPROVAL 2-19-97



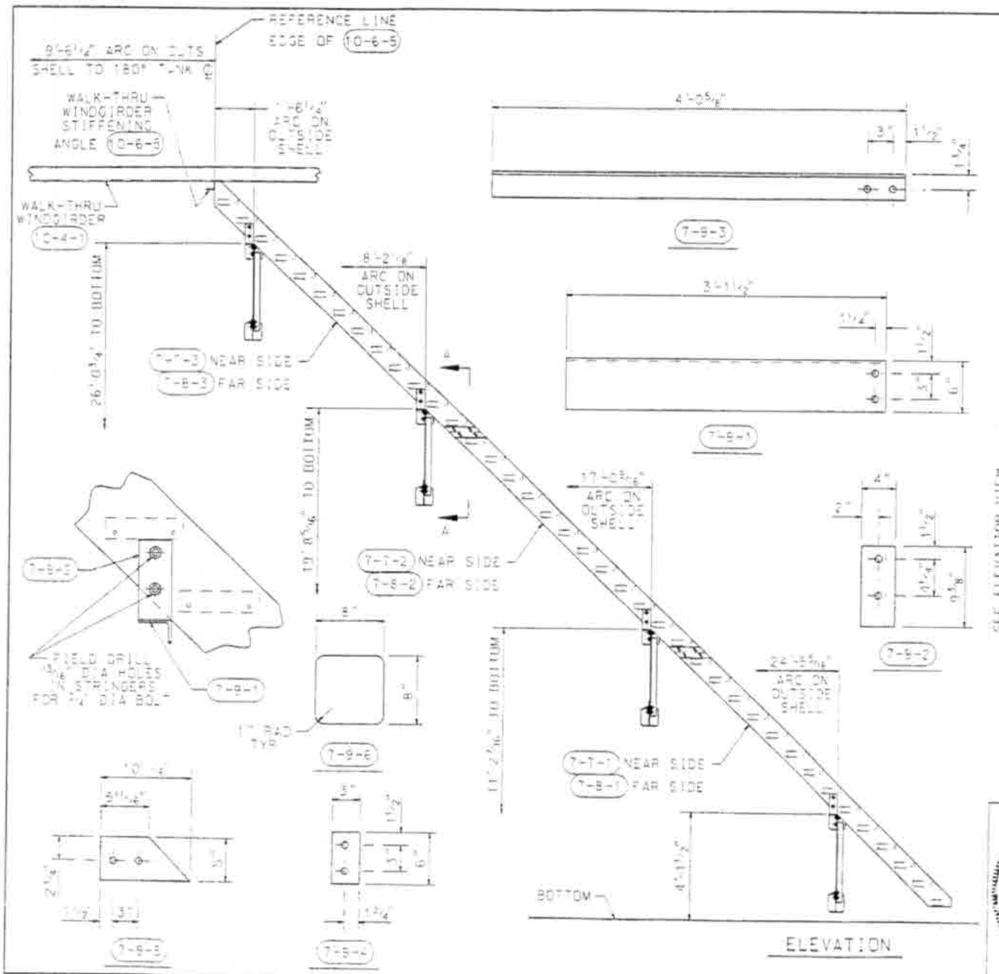
INSIDE STRINGER

110'-0" DIA X 30' HOT OPEN TOP TANK

STRATEGIC PETROLEUM RESERVE

11470 T-8

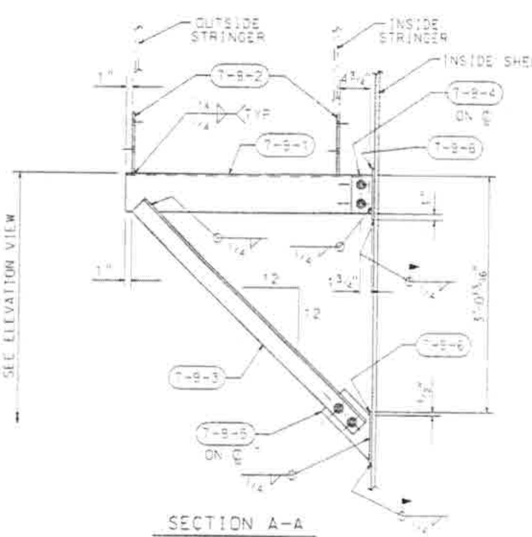
FOR APPROVAL 2-19-97



4	7-9-A		STAIRWAY SUPPORT					GALVANIZED
	7-9-1	4	L 6" X 4" X 5/16" SK	3	1½	A36		WITH HOLES
	7-9-2	8	BAR 4" X ⅝" SK	0	9⅝	A36		WITH HOLES
	7-9-3	4	L 3" X 3" X ⅜" SK	4	0⅝	A36		WITH HOLES
4	7-9-B		UPPER SUPPORT BRACKET					
	7-9-4	4	PL 3½" X ⅝" SK	0	6	A36		WITH HOLES
	7-9-6	4	PL 8" X ⅝" SK	0	8	A36		
4	7-9-C		LOWER SUPPORT BRACKET					
	7-9-5	4	PL 5" X ⅝" SK	0	10 11/16	A36		WITH HOLES
	7-9-6	4	PL 8" X ⅝" SK	0	8	A36		
32			BOLT ¾" DIA HVY HEX HD GALV	0	2	A307B		
32			NUT ¾" HVY HEX GALV			A563A		

SHOP:
SEAL WELD ALL POINTS OF CONTACT FOR ASSEMBLIES TO BE GALVANIZED.

ALL HOLES 13/16" DIA



STATE OF LOUISIANA
W. JASPER REAVES
REG. No. [illegible]
PROFESSIONAL ENGINEER
IN
MECHANICAL ENGINEERING

RESUBMITTED FOR APPROVAL

AT&V
American Tank & Vessel, Inc.

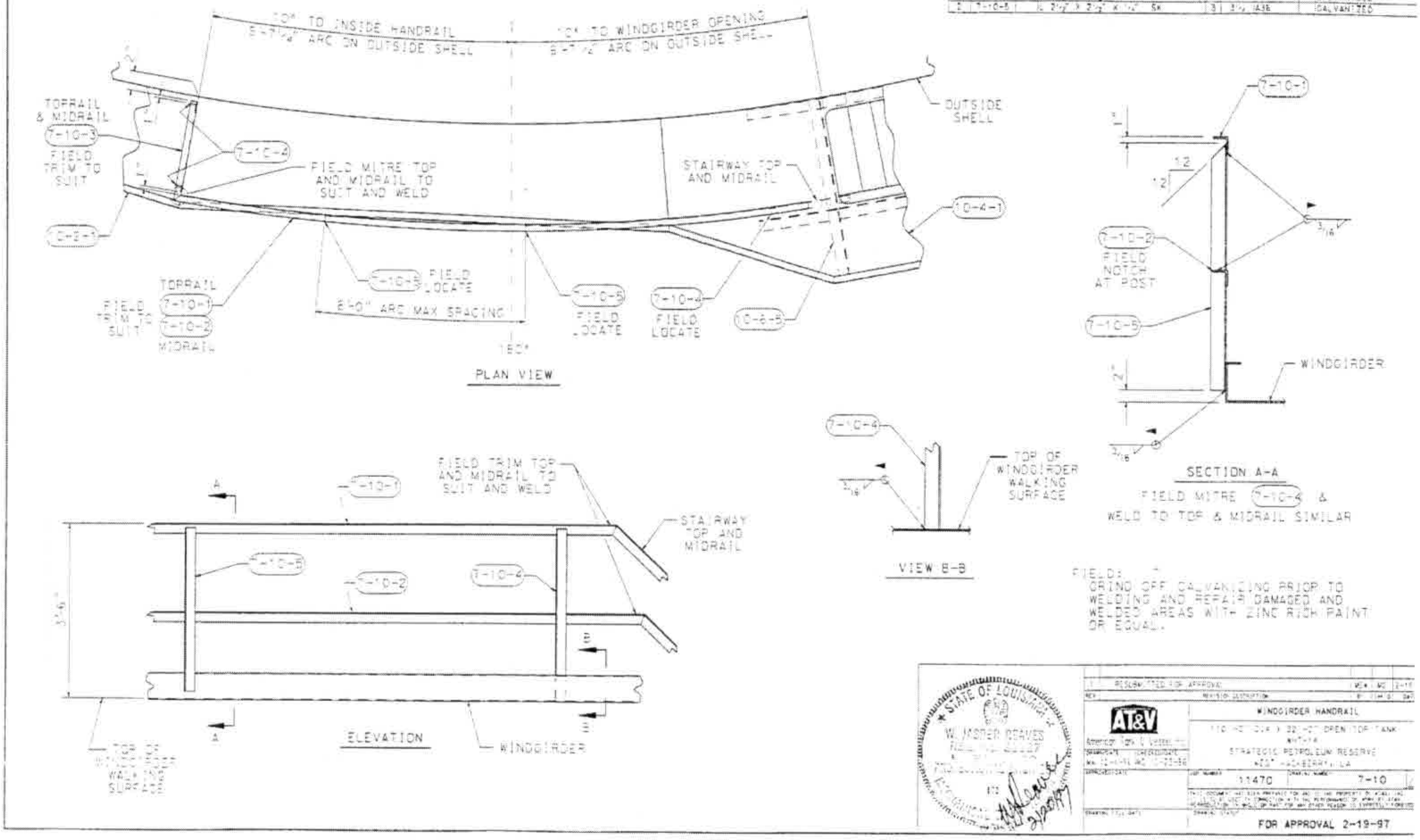
STAIRWAY SUPPORTS

[illegible] DIA X 52' HGT OPEN TOP TANK
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

JOB NUMBER 11470
DRAWING NUMBER 7-9

FOR APPROVAL 2-19-97

SHP PC	MARK	ITEM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT LB	REMARKS
1	7-10-1		RUN L 2½" X 2½" X ¼"	24	0	A36		GALV/ROLL R = 56'-
1	7-10-2		RUN L 2½" X 2½" X ¼"	24	0	A36		GALV/ROLL R = 56'-
2	7-10-3		L 2½" X 2½" X ¼" SK	3	1¼	A36		GALVANIZED
3	7-10-4		L 2½" X 2½" X ¼" SK	3	5	A36		GALVANIZED
8	7-10-5		L 2½" X 2½" X ¼" SK	3	3¼	A36		GALVANIZED



FIELD:
GRIND OFF GALVANIZING PRIOR TO WELDING AND REPAIR DAMAGED AND WELDED AREAS WITH ZINC RICH PAINT OR EQUAL.

STATE OF LOUISIANA
W. JASPER GRAVES

1 RESUBMITTED FOR APPROVAL

REVISION DESCRIPTION

AT&V

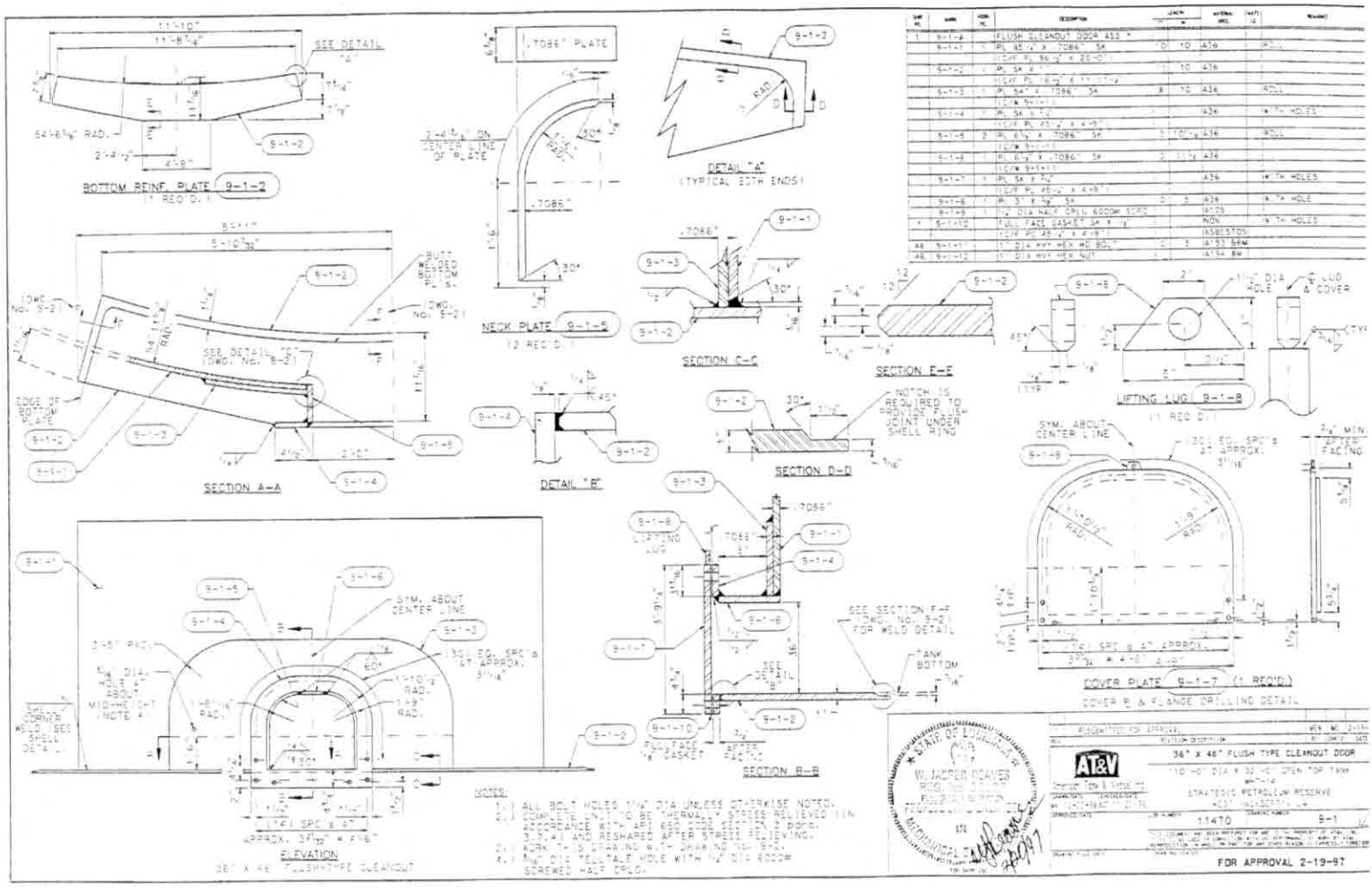
WINDGIRDER HANDRAIL

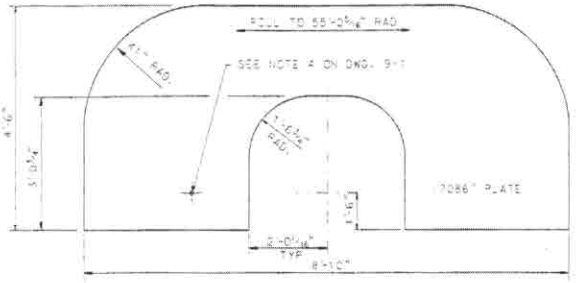
STRATEGIC PETROLEUM RESERVE

11470

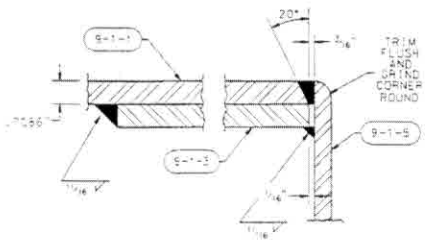
7-10

FOR APPROVAL 2-19-97

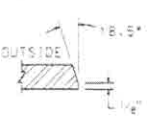

BOTTOM REINF. PLATE 9-1-2
(1 REQ'D.)
.7086" PLATE
NECK PLATE 9-1-5
(2 REQ'D.)
DETAIL "A"
(TYPICAL BOTH ENDS)
SECTION A-A
DETAIL "B"
SECTION C-C
SECTION D-D
SECTION E-E
LIFTING LUG 9-1-8
(1 REQ'D.)
COVER PLATE 9-1-7 (1 REQ'D.)
COVER & FLANGE DRILLING DETAIL
ELEVATION
SECTION B-B
36" X 48" FLUSH TYPE CLEANOUT DOOR
10'-0" DIA X 30'-0" OPEN TOP TANK
STRATEGIC PETROLEUM RESERVE
11470
9-1
FOR APPROVAL 2-19-97



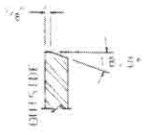
SHELL REINFORCING PLATE (9-1-3)



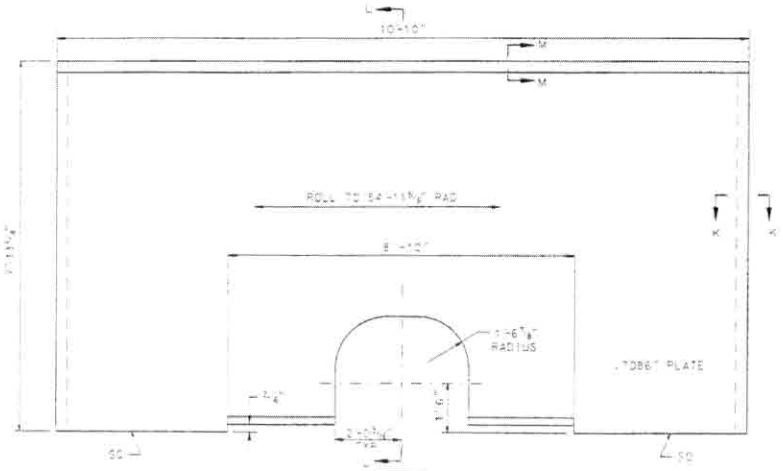
DETAIL "C"
(FROM DWG. NO. 9-1-)



SECTION K-K

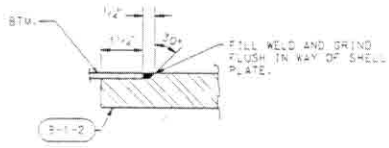


SECTION M-M

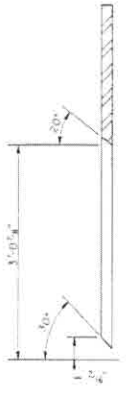


SHELL PLATE (9-1-1) (INSIDE VIEW)

NOTE
TO WORK THIS DWG. WITH DWG. No. 9-1-



SECTION F-F
(FROM DWG. NO. 9-1-)



SECTION L-L

AT&V

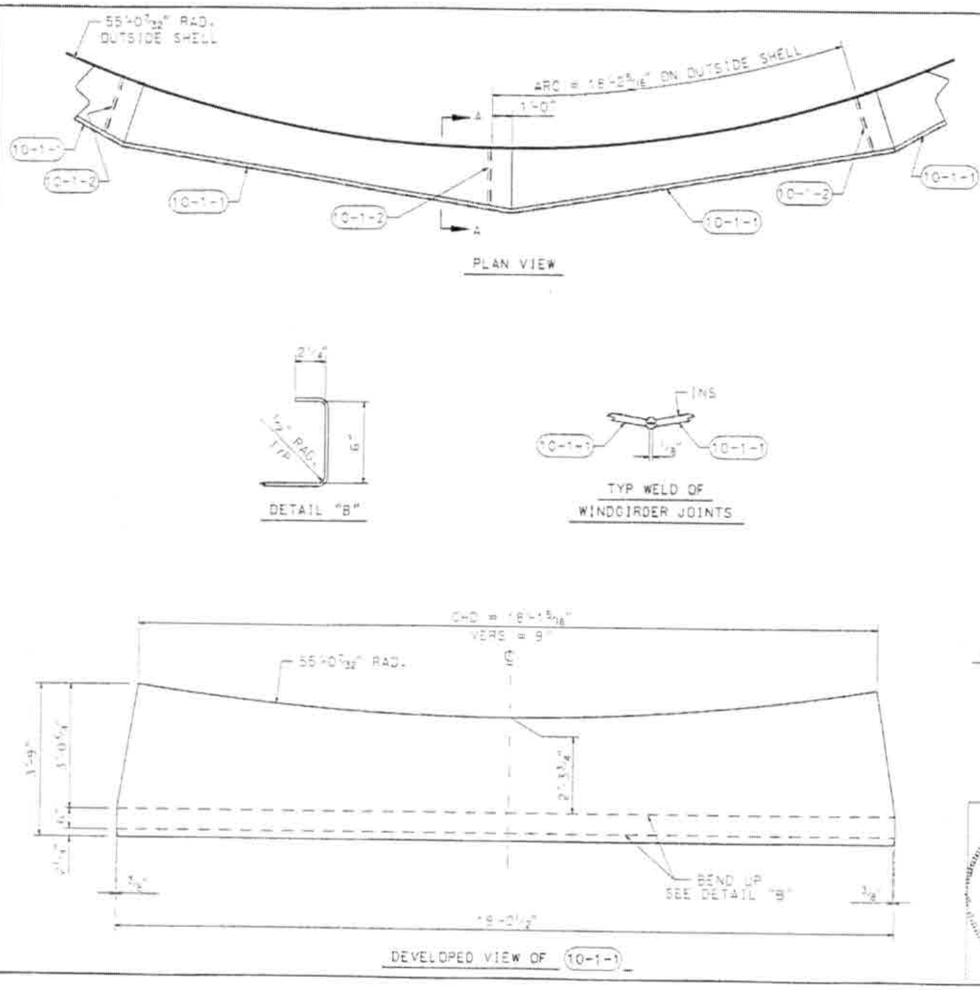
36" X 48" FLUSH TYPE CLEANOUT DOOR

110'-0" DIA X 30'-0" SPEC "CP" TANK

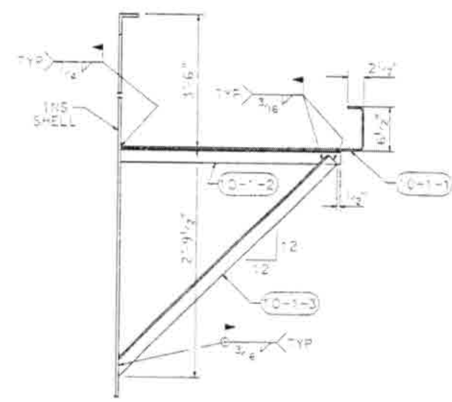
STRATEGIC PETROLEUM RESERVE

11470 9-2

FOR APPROVAL 2-19-97



			DESCRIPTION	LENGTH		MATERIAL SPEC		REMARKS
15	10-1-1		PL 54 X 1/4"			A36		
			(PL 96" X 40'-0" C/4)					
15	10-1-2		L 2" X 2" X 1/4"	2	8	A36		
			(MPF 1 - PCS L 2" X 2" X 1/4" X 20'-0" [illegible])					
15	10-1-3		L 2" X 2" X 1/4"	3	8 5/16	A36		
			(C/W 10-1-2)					



NOTES:

1. DIMENSIONS OF DEVELOPED VIEWS ARE ON INSIDE BENDS.
2. EDGES OF PIECES ARE TO BE CUT TRUE, SMOOTH AND NOT WAVY.
3. SEE DRAWING 1-2 FOR ORIENTATION.
4. WORK THIS DRAWING WITH DRAWINGS 10-2 THRU 10-5.

RESUBMITTED FOR APPROVAL
REVISION DESCRIPTION

AT&V
American Tank & Vessel, Inc.

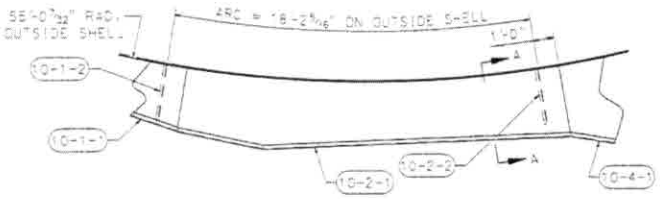
WINDGIRDER DETAILS

110'-0" DIA X 32'-0" OPEN TOP TANK

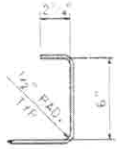
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

JOB NUMBER 11470
DRAWING NUMBER 10-1

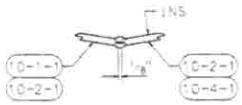
FOR APPROVAL 2-19-97



PLAN VIEW

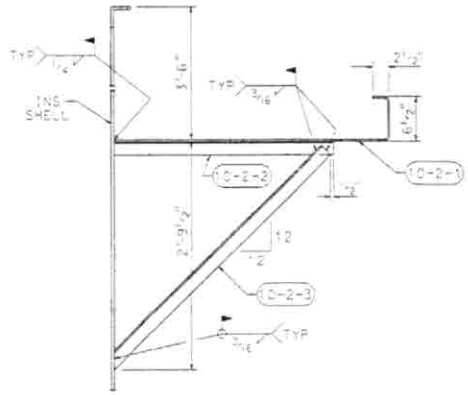


DETAIL "B"

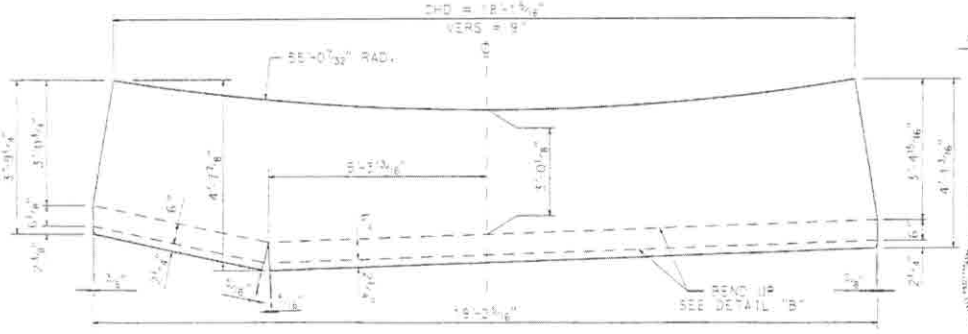


TYP WELD OF WINDGIRDER JOINTS

MARK NO.	QUAN.	ITEM NO.	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC.	WGT. LB	REMARKS
1	10-2-1		PL 5/8 X 4'			A36		
			C/F PL 108" x 48-0 1/2					
1	10-2-2		2" x 2" x 1/4	2	8	A36		
			C/W 10-1-2 1					
1	10-2-3		L 2" x 2" x 1/4	5	6 1/16	A36		
			C/W 10-1-2 1					



SECTION A-A



DEVELOPED VIEW OF 10-2-1

NOTES:

1. DIMENSIONS OF DEVELOPED VIEWS ARE ON INSIDE BENDS.
2. EDGES OF PIECES ARE TO BE CUT TRUE, SMOOTH AND NOT WAVY.
3. SEE DRAWING 1-2 FOR ORIENTATION.
4. WORK THIS DRAWING WITH DRAWINGS 10-1 & 10-3 THRU 10-5

1	RESUBMITTED FOR APPROVAL	MEA	2-19-97
REV	REVISION DESCRIPTION	BY	CHK'D DATE

AT&V

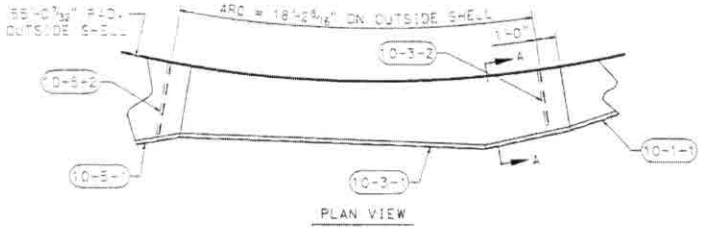
WINDGIRDER DETAILS

120'-0" DIA x 32'-0" OPEN TOP TANK

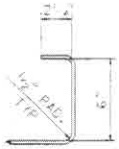
FOR STRATEGIC PETROLEUM RESERVE

1147C 10-2

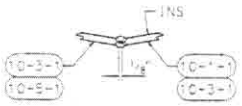
FOR APPROVAL 2-19-97



PLAN VIEW

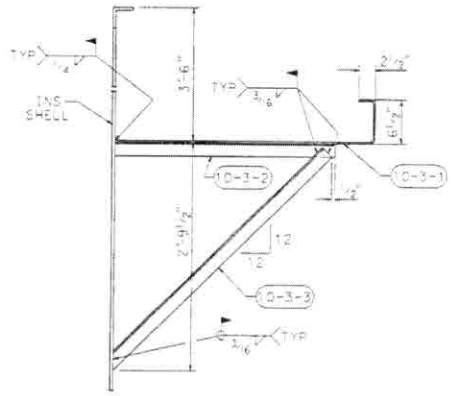


DETAIL "B"

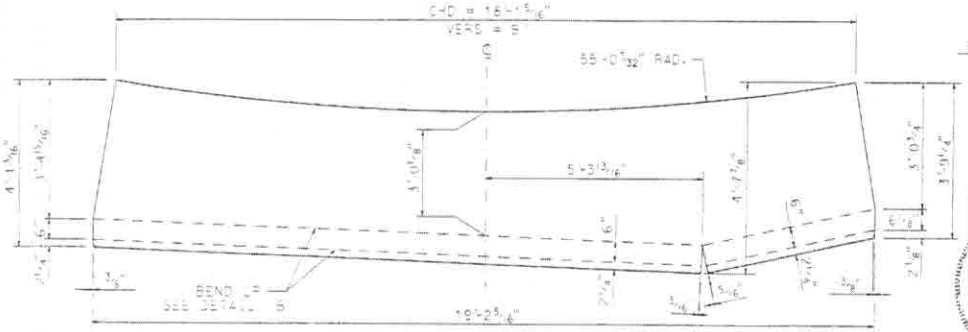


TYP WELD OF WINDGIRDER JOINTS

ITEM NO.	MARK	ASSY NO.	DESCRIPTION	QUANTITY PER ASSY	QUANTITY TOTAL	MATERIAL SPEC	WEIGHT EA.	REMARKS
1	10-3-1		PL 5/8 X 12"			A36		
			W/C/W 10-2-1					
1	10-3-2		L 2 X 2 X 3/16"	2	8	A36		
			W/C/W 10-1-23					
1	10-3-3		L 2 1/2" X 2 1/2" X 3/16"	3	6	A36		
			W/C/W 10-1-23					



SECTION A-A



DEVELOPED VIEW OF 10-3-1

NOTES:

1. DIMENSIONS OF DEVELOPED VIEWS ARE ON INSIDE BENDS.
2. EDGES OF PIECES ARE TO BE CUT TRUE, SMOOTH AND NOT RAVY.
3. SEE DRAWING 1-2 FOR ORIENTATION.
4. WORK THIS DRAWING WITH DRAWINGS 10-1, 10-2, 10-4 & 10-5.

RESUBMITTED FOR APPROVAL — MC 2-19-97

AT&V

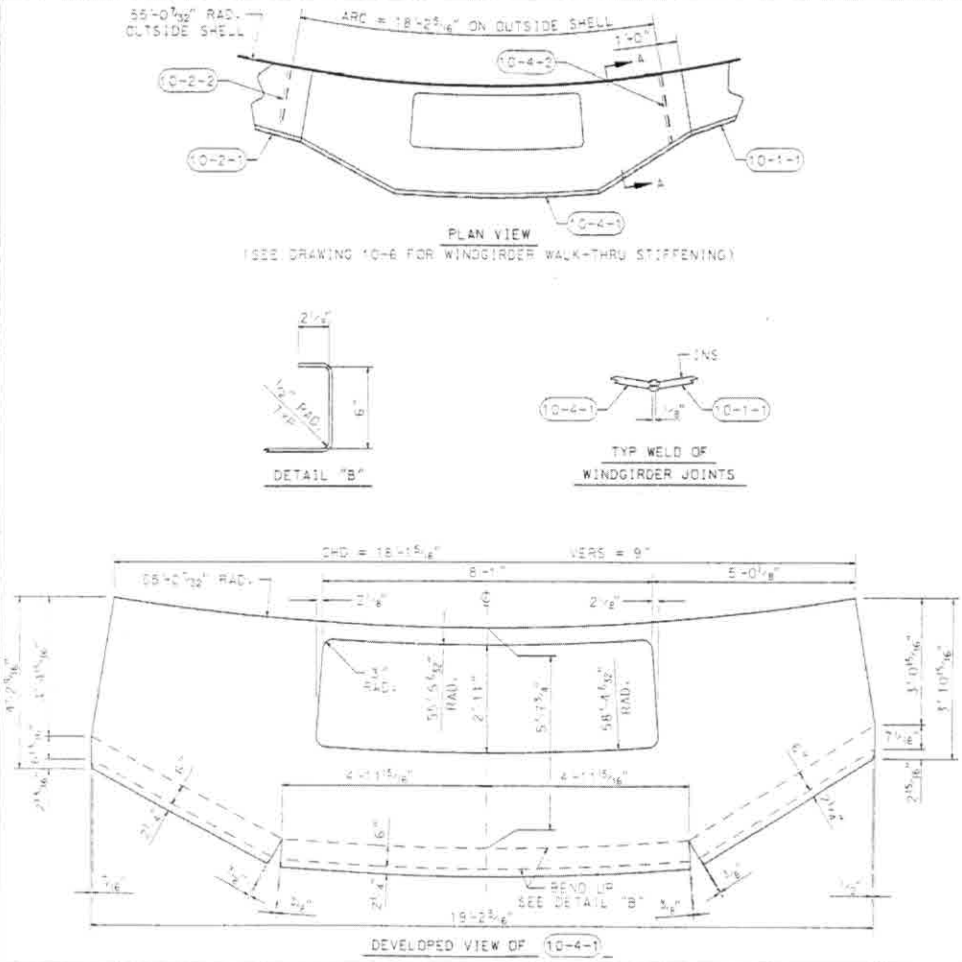
WINDGIRDER DETAILS

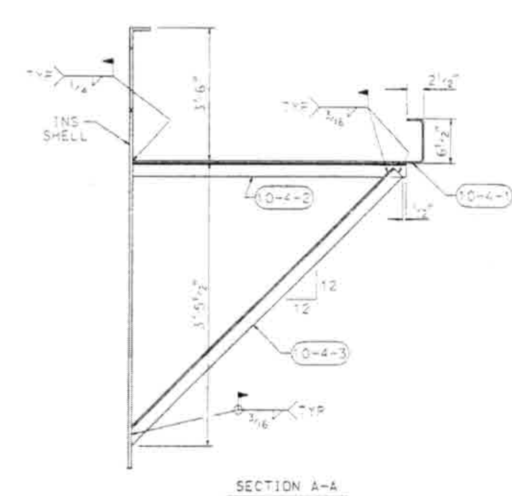
STRATEGIC PETROLEUM RESERVE

1147Q — 10-3

FOR APPROVAL 2-19-97

	MARK		DESCRIPTION	LENGTH		MATERIAL SPEC		REMARKS
1	10-4-1		PL 5K x 1/4"			A36		
			(C/F PL 96" x 40'-0")					
1	10-4-2		L 2" x 2" x 1/4"	3	4	A36		
			(C/W 10-1-2)					
1	10-4-3		L 3" x 3" x 1/4"	4	9 7/8	A36		
			(C/W 10-1-2)					





NOTES:

1. DIMENSIONS OF DEVELOPED VIEWS ARE ON INSIDE BENDS.
2. EDGES OF PIECES ARE TO BE CUT TRUE, SMOOTH AND NOT WAVY.
3. SEE DRAWING 1-2 FOR ORIENTATION.
4. WORK THIS DRAWING WITH DRAWINGS 10-1 THRU 10-3 & 10-5.

STATE OF LOUISIANA
W. HARPER REAVES
REG. NO. 20127
REGISTERED PROFESSIONAL ENGINEER

RESUBMITTED FOR APPROVAL

REV. | REVISION DESCRIPTION | BY | CHK'D | DATE

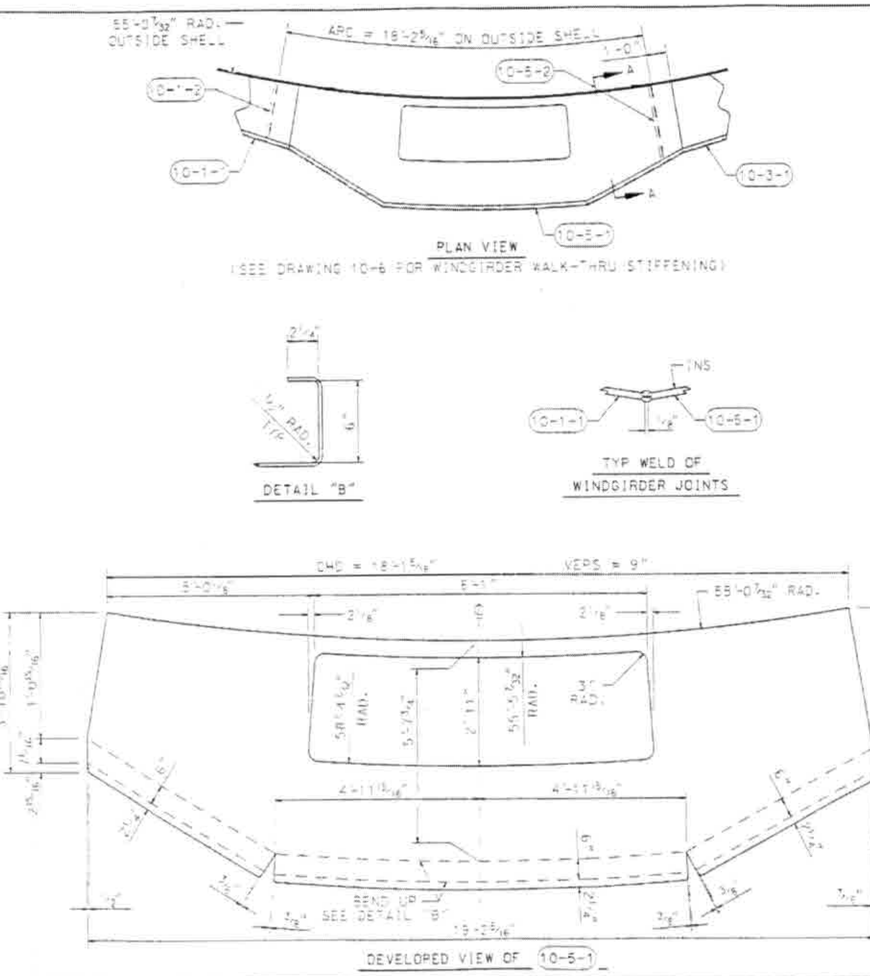
AT&V

WALK-THRU WINDGIRDER DETAILS

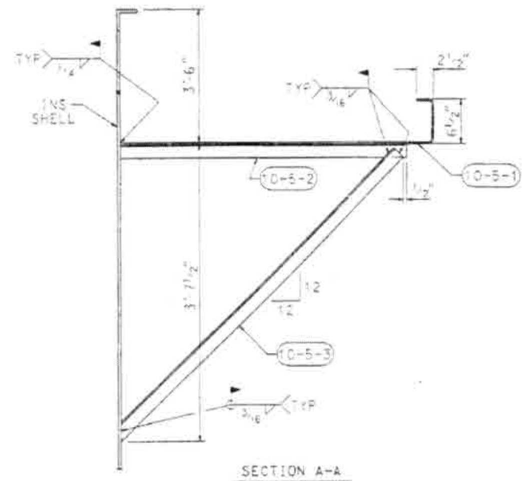
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

JOB NUMBER: 11470
DRAWING NUMBER: 10-4

FOR APPROVAL 2-19-97



			DESCRIPTION	LENGTH		MATERIAL SPEC		REMARKS
1	10-5-1		PL SK X 1/4"			A36		
			(C/W 10-4-1)					
1	10-5-2		L 2" X 2" X 1/4"	3	6	A36		
			(C/W 10-1-2)					
1	10-5-3		L 2" X 2" X 1/4"	4	10 3/4	A36		
			(C/W 10-1-2)					



NOTES:

1. DIMENSIONS OF DEVELOPED VIEWS ARE ON INSIDE BENDS.
2. EDGES OF PIECES ARE TO BE CUT TRUE, SMOOTH AND NOT WAVY.
3. SEE DRAWING 1-2 FOR ORIENTATION.
4. WORK THIS DRAWING WITH DRAWINGS 10-1 THRU 10-4.

STATE OF LOUISIANA
W. JASPER REEVES
REG. NO. 20327
REGISTERED PROFESSIONAL ENGINEER
IN
MECHANICAL ENGINEERING

1	RESUBMITTED FOR APPROVAL	MEK	MG	2-19
REV	REVISION DESCRIPTION	BY	CHK'D	DATE

AT&V
American Tank & Vessel, Inc.

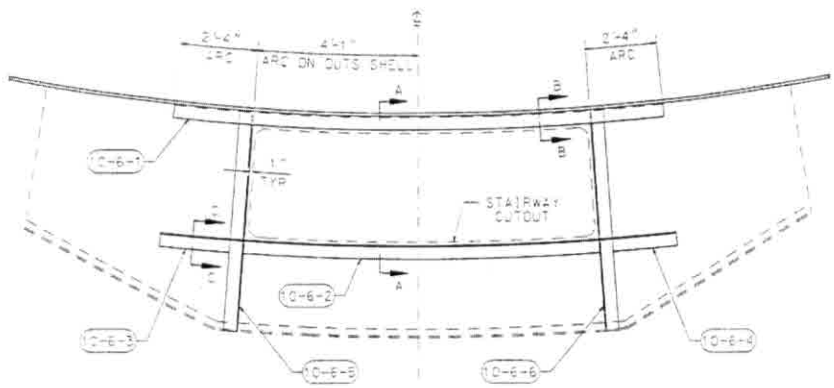
WALK-THRU WINDGIRDER DETAILS

110'-0" DIA X 32'-0" OPEN TOP TANK WHT-14
STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

JOB NUMBER: 11470
DRAWING NUMBER: 10-5

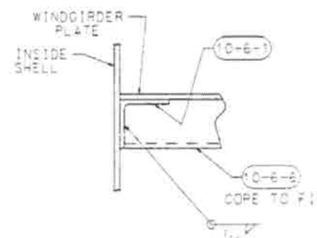
FOR APPROVAL 2-19-97

	Mark		Description	Length					Remarks
			SHOP ATTACH THE FOLLOWING						
			TO PCS 10-4-1 & 10-5-1						
	10-6-1	2	L 4" X 4" X 3/8"	12	10 1/4	A36			ROLL
			(W/F 4 - PCS L 4" X 4" X 3/8" X 20'-0" LG)						
	10-6-2	2	L 4" X 4" X 3/8"	8	8 1/4				ROLL
			(C/W 10-6-1)						
	10-6-3	2	L 4" X 4" X 3/8"	2	3				COPE TO FIT
			(C/W 10-6-1)						
	10-6-4	2	L 4" X 4" X 3/8"	2	5				COPE TO FIT
			(C/W 10-6-1)						
	10-6-5	2	L 4" X 4" X 3/8"	5	7 5/8				COPE TO FIT
			(C/W 10-6-1)						
	10-6-6	2	L 4" X 4" X 3/8"	5	7 5/8				COPE TO FIT
			(C/W 10-6-1)						



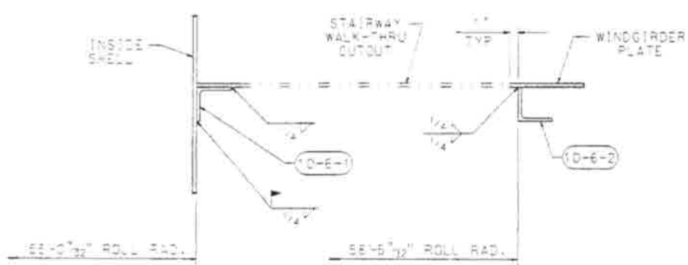
PLAN VIEW

WINDGIRDER STAIRWAY WALK-THRU STIFFENING LAYOUT (WITH PLATE REMOVED)

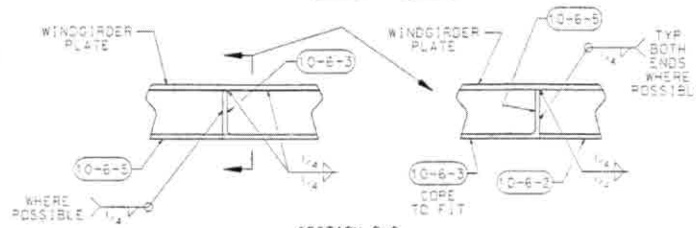


SECTION B-B

(COPE & WELD PC 10-6-5 TO 10-6-1 SIMILAR)



SECTION A-A



SECTION C-C

(COPE & WELD PC 10-6-4 TO 10-6-6 SIMILAR)

NOTES:

1) WORK THIS DRAWING WITH DRAWINGS 10-4 & 10-5.

1	RESUBMITTED FOR APPROVAL
REV	REVISION DESCRIPTION

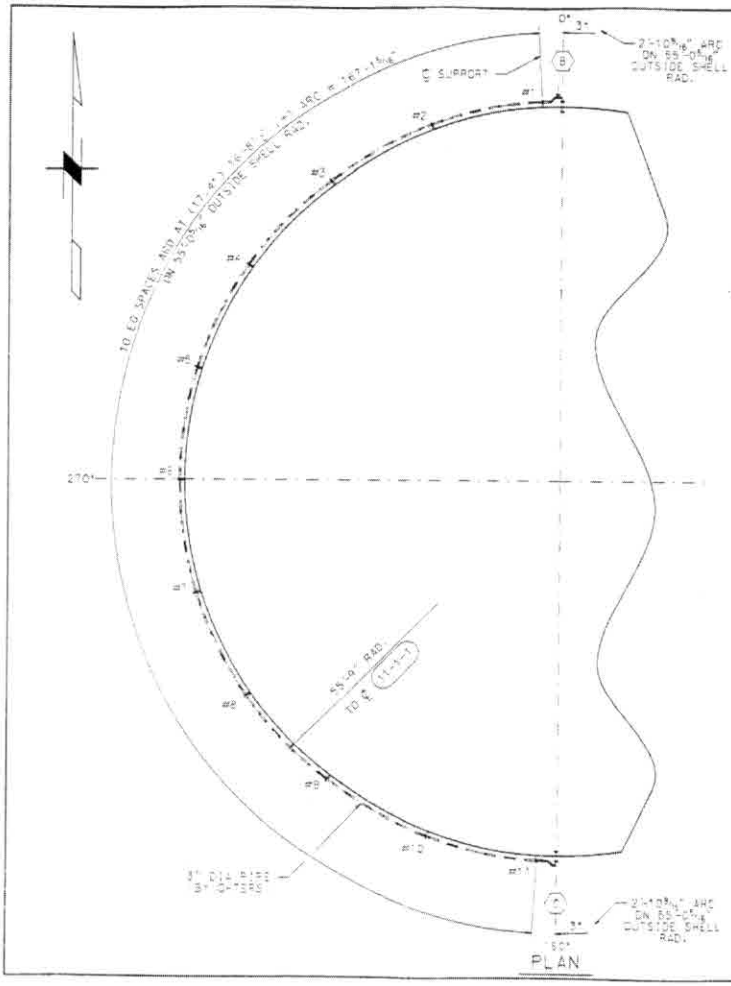
AT&V
American Tank & Vessel Inc.

WINDGIRDER WALK-THRU STIFFENING

STRATEGIC PETROLEUM RESERVE
WEST HACKBERRY, LA

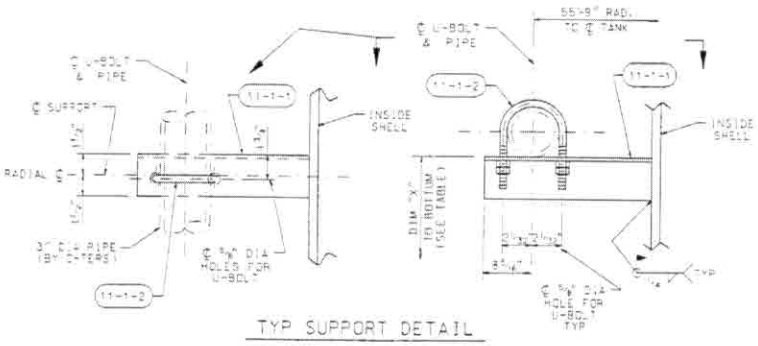
JOB NUMBER 11470 | DRAWING NUMBER 10-6

DRAWING STATUS: FOR APPROVAL 2-19-97



PLAN

SUPPORT ELEV'S	
SUPPORT NUMBER	DIM "X"
#1	5'-2 1/4"
#2	5'-2 7/16"
#3	5'-2 7/16"
#4	5'-3 1/16"
#5	5'-4 5/8"
#6	5'-5 5/8"
#7	5'-6 5/8"
#8	5'-7 9/16"
#9	5'-8 3/16"
#10	5'-8 1/16"
#11	5'-8"



TYP SUPPORT DETAIL

11	11-1-1		L 3" X 3" X 1/4	1	A36
11	11-1-2		1/2" DIA U-BOLT FOR 3" DIA PIPE WITH DOUBLE NUTS		

1 RETURNED FOR APPROVAL

AT&V

EXTERNAL PIPING & SUPPORTS

110'-0" DIA X 32'-0" OPEN TOP TANK

SHT-14

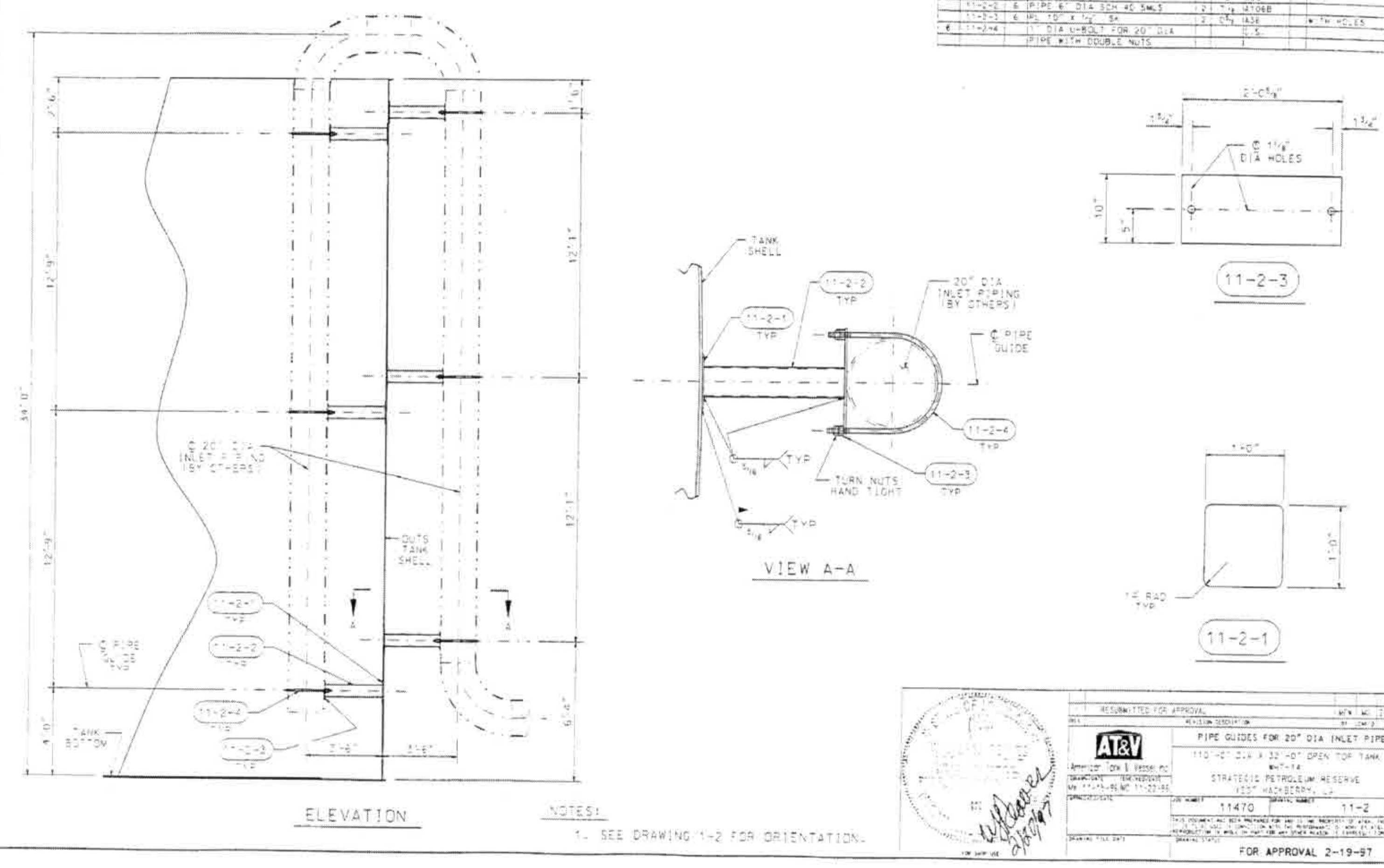
STRATEGIC PETROLEUM RESERVE

BOOT HACKBERRY, LA.

11470 | 11-1

FOR APPROVAL 2-19-97

SHP PC	MARK	ASSY PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WT LB	REMARKS
6	11-2-4		PIPE GUIDE ASSEMBLY					
	11-2-1	6	PL 12" x 3/8" SK	1	0	A36		
	11-2-2	6	PIPE 6" DIA SCH 40 SMLS	2	7 1/4	A106B		
	11-2-3	6	PL 10" x 1/2" SK	2	0 5/8	A36		WITH HOLES
6	11-2-4		1" DIA U-BOLT FOR 20" DIA			U.S.		
			PIPE WITH DOUBLE NUTS					



NOTES:

1. SEE DRAWING 1-2 FOR ORIENTATION.

RESUBMITTED FOR APPROVAL

AT&V American Tank & Vessel, Inc

PIPE GUIDES FOR 20" DIA INLET PIPE

110'-0" DIA X 32'-0" OPEN TOP TANK

WHT-14

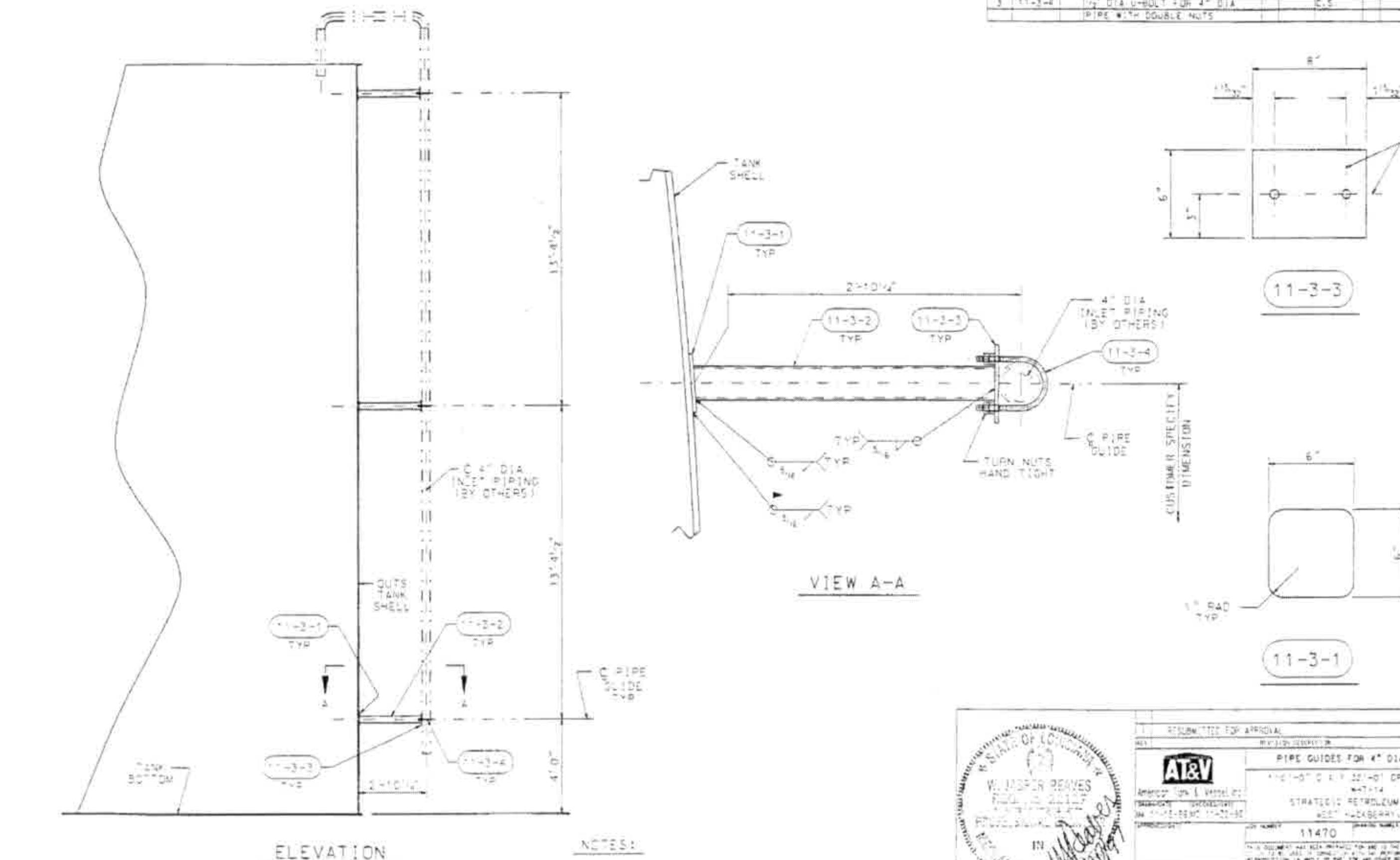
STRATEGIC PETROLEUM RESERVE

WEST HACKBERRY, LA

JOB NUMBER 11470 DRAWING NUMBER 11-2

FOR APPROVAL 2-19-97

3	11-3-A		PIPE GUIDE ASSEMBLY					
	11-3-1	3	PL 6" X 1/4" SK	0	6	A36		
	11-3-2	3	PIPE 3" DIA SCH 40 SMLS	2	9	A106B		SHOP TRIM INCLUDES
	11-3-3	3	PL 6" X 1/4" SK	0	8	A36		WITH HOLES
3	11-3-4		1/2" DIA U-BOLT FOR 4" DIA			C.S.		
			PIPE WITH DOUBLE NUTS					



NOTES:

1. SEE DRAWING 1-2 FOR ORIENTATION.

1 RESUBMITTED FOR APPROVAL

PIPE GUIDES FOR 4" DIA INLET PIPE

STRATEGIC PETROLEUM RESERVE

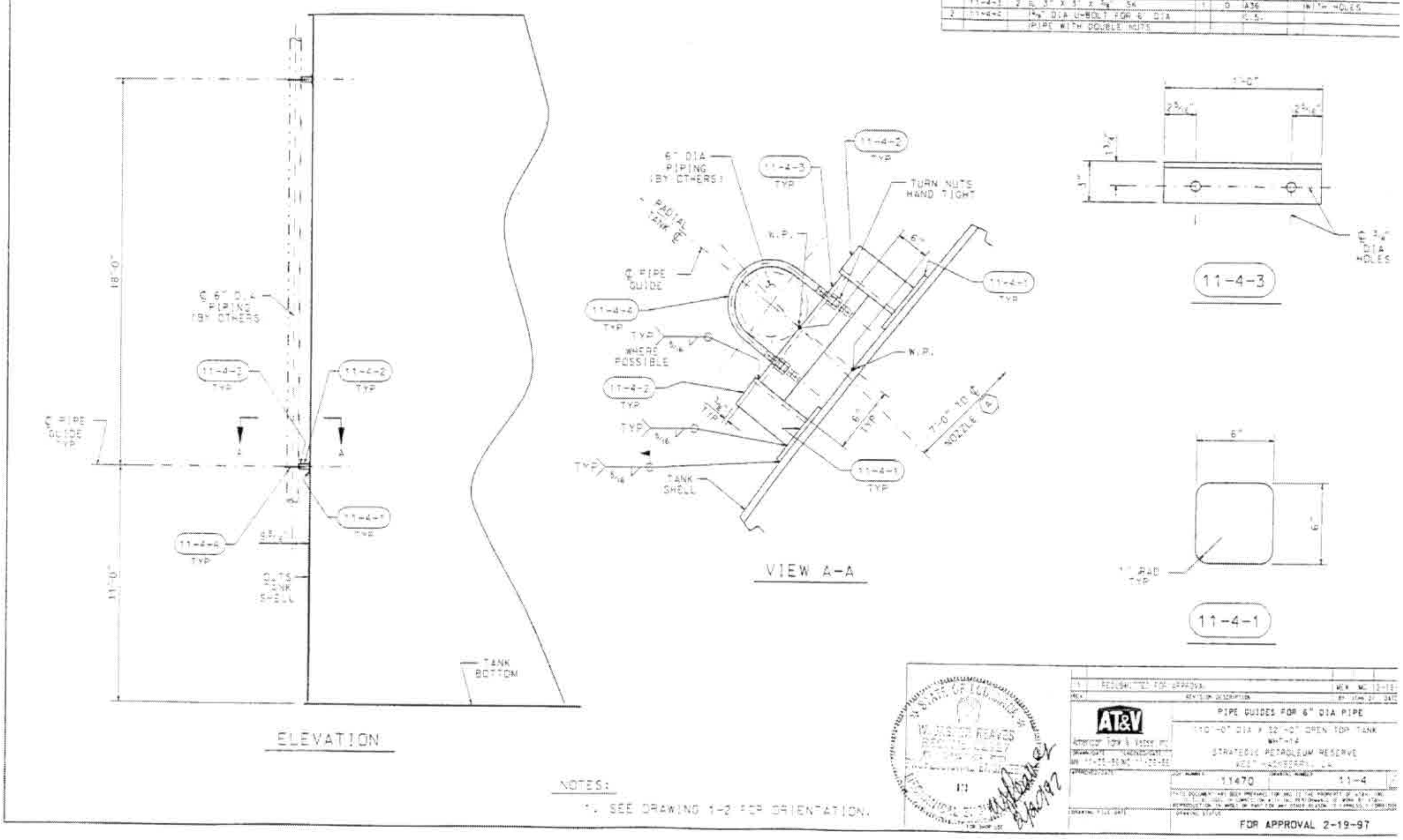
WEST HACKBERRY, LA

AT&V American Tank & Vessel, Inc.

11470 — 11-3

FOR APPROVAL 2-19-97

SHP PC	MARK	ITEM PC	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	WGT LG	REMARKS
2	11-4-4		PIPE GUIDE ASSEMBLY					
	11-4-1	2	PL 6" X 3/8" SK	0	6	A36		
	11-4-2	4	L 3" X 3" X 3/8"	0	6	A36		
	11-4-3	2	L 3" X 3" X 3/8" SK	1	0	A36		WITH HOLES
2	11-4-2		5/8" DIA U-BOLT FOR 6" DIA PIPE WITH DOUBLE NUTS			C.S.		

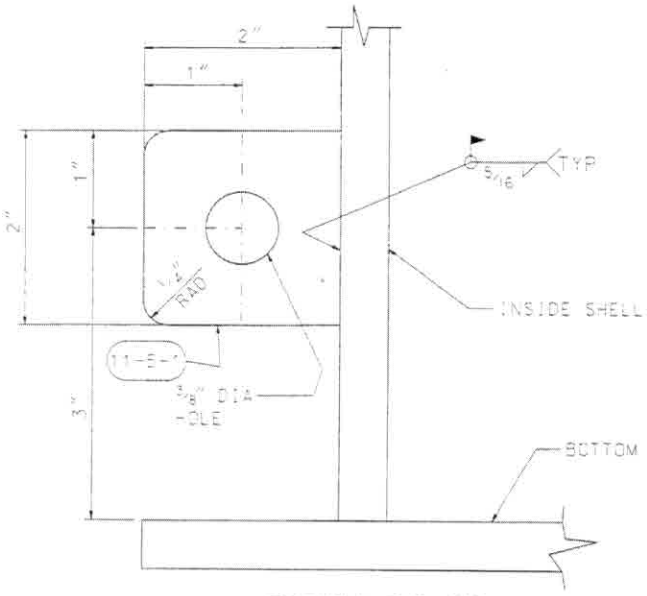


NOTES:

1. SEE DRAWING 1-2 FOR ORIENTATION.

REV	REISSUED FOR APPROVAL
	PIPE GUIDES FOR 6" DIA PIPE
AT&V American Tank & Vessel, Inc.	110'-0" DIA X 32'-0" OPEN TOP TANK WHT-1A
	STRATEGIC PETROLEUM RESERVE WEST HACKBERRY, LA
JOB NUMBER 11470	DRAWING NUMBER 11-4
DRAWING STATUS	FOR APPROVAL 2-19-97

SHEET NO.	MARK	PIECE NO.	DESCRIPTION	LENGTH FT	LENGTH IN	MATERIAL SPEC	GRADE	REMARKS
3	11-5-1	1	BAR 2" x 3/8" WITH HOLE	1	2	A36		



SECTIONAL ELEVATION

3 REQUIRED 120° APART

STATE OF LOUISIANA
REGISTERED
PROFESSIONAL ENGINEER

REV.	REVISION DESCRIPTION	BY	CHK'D	DATE
1	RESUBMITTED FOR APPROVAL	MCW	MC	2-19-97

AT&V

GROUNDING CLIPS

110'-0" DIA X 32'-0" OPEN TOP TANK

WH-114

STRATEGIC PETROLEUM RESERVE

WEST HACKBERRY, LA

JOB NUMBER	DRAWING NUMBER
11470	11-5

FOR APPROVAL 2-19-97

ATTACHMENT D

TANK DESIGN CALCULATIONS

DRAWING SUMMARY SHEET JOB NO. 11470

CUST: RIVER VALLEY SERVICES, INC.
FOR DEPARTMENT OF ENERGY
WEST HACKBERRY, LA

CODE: API 650 NINTH EDITION (1993) ADD. 2 & CUST.
SPEC. SECTION NO. 15187
PAINTING: YES ☑ NO ☐

DRAWING NO.	REV.	DESCRIPTION	REMARKS
1-1	0	GENERAL ARRANGEMENT	FOR APPROVAL
1-2	0	ORIENTATION	FOR APPROVAL
1-3	0	NAMEPLATE	FOR APPROVAL
2-1	0	BOTTOM	FOR APPROVAL
2-2	0	BOTTOM SKETCH PLATES	FOR APPROVAL
4-1	0	24" DIA. SHELL NOZZLE "A"	FOR APPROVAL
4-2	0	3" DIA. SHELL NOZZLE "B"	FOR APPROVAL
4-3	0	6" DIA. SHELL NOZZLE "D"	FOR APPROVAL
4-4	0	20" DIA. SHELL NOZZLE "E"	FOR APPROVAL
4-5	0	10" x 2" DIA. LEVEL/ST WELL NOZZLE "L1"	FOR APPROVAL
4-6	0	3" DIA. SHELL NOZZLE "L2"	FOR APPROVAL
4-7	0	3" DIA. SHELL NOZZLE "C"	FOR APPROVAL
9-1	0	36" X 48" FLUSH TYPE CLEANOUT DOOR	FOR APPROVAL
9-2	0	36" X 48" FLUSH TYPE CLEANOUT DOOR	FOR APPROVAL
10-1	0	WINDGIRDER DETAILS	FOR APPROVAL
10-2	0	WINDGIRDER DETAILS	FOR APPROVAL
10-3	0	WINDGIRDER DETAILS	FOR APPROVAL
10-4	0	WALK-THRU WINDGIRDER DETAILS	FOR APPROVAL
10-5	0	WALK-THRU WINDGIRDER DETAILS	FOR APPROVAL
10-6	0	WINDGIRDER WALK-THRU STIFFENING	FOR APPROVAL
11-1	0	EXTERNAL PIPING & SUPPORTS	FOR APPROVAL
11-2	0	PIPE GUIDES FOR 20" DIA. INLET PIPE	FOR APPROVAL
11-3	0	PIPE GUIDES FOR 4" DIA. INLET PIPE	FOR APPROVAL
11-4	0	PIPE GUIDES FOR 6" DIA. PIPE	FOR APPROVAL
11-5	0	GROUNDING CLIPS	FOR APPROVAL

MADE BY : MAG CHK'D BY : DATE : 11/22/96 REV. 0 PAGE NO. 1

DESIGN CALCULATIONS

WELDED STEEL TANKS, API 650

TASK NO. WH-LE-275
LE CONSOLIDATED TASK NO. 2
WEST HACKBERRY

REV. NO.	CHANGE DESCRIPTION	REVISED BY	CHECKED BY	PROJECT MGR

REGISTRATION STAMP

NUMBER: 22127 8pp

AMERICAN TANK & VESSEL, Inc.
1005 Government Street
Mobile, AL 36604
Phone: (334) 432-8265
Fax: (334) 433-3661

WRITTEN BY: D. Carlyle 10/10/96	TASK NUMBER: WH-LE-275
CHECKED BY: L. Larsen 10/23/96	DISCIPLINE: MECHANICAL
PROJECT MGR:	SPEC. SEC. NO.: 15187
DATE:	Revision #: 0 Total Pages: 8

DESIGN CALCULATIONS

110' DIA X 32' OPEN TOP TANKS
WHT-14 AND WHT-15

FOR

U.S. DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE

PREPARED BY

AMERICAN TANK & VESSEL, INC.

BIRMINGHAM, ALABAMA

1996

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III.	DESIGN CRITERIA	SHT 3
IV.	BOTTOM AND SHELL DESIGN	SHT 4
V.	NOZZLE AND SHELL OPENINGS	SHT 5
VI.	WIND GIRDER	SHT 6
VII.	WIND STABILITY	SHT 7
VIII.	CURB ANGLE	SHT 8

DESIGN CRITERIA

- 110' DIA X 32' OPEN TOP TANK
- CODE - API 650 NINTH EDITION
- CUSTOMER SPECIFICATION - 15187
- DESIGN PRESSURE - ATM.
- SPECIFIC GRAVITY OF PRODUCT - 1.2
- WIND VELOCITY - 164 MPH GUST, 136 MPH FOR 1 MINUTE
- DESIGN TEMPERATURE - 135 DEG. F MAX., 25 DEG. F MIN.
- MATERIAL - A36 UNLESS NOTED OTHERWISE (GROUP II)
- CORROSION ALLOWANCE - 3/16 IN. (SHELL, BTM, INTERNALS)
- MINIMUM THICKNESS

  SHELL - 1/4 IN.
  BOTTOM - 1/4 IN.
  NOZZLE REINF.- ¼ IN.

CALCULATION WORKSHEET PAGE 4 OF 8

CLIENT	JOB NUMBER WHT-14 & WHT-15
SUBJECT DESIGN CALCS	
BASED ON API 650 / SPEC. 15187	DRAWING NUMBER
BY MJC / 12/2/96 CHECKED BY LRL / 12/4/96	A. I. REV

BOTTOM DESIGN

Thickness = Min TK + C.A.

$= \frac{1}{4}" + \frac{3}{16}" = \underline{\frac{7}{16}"} \ (.4375")$

SHELL DESIGN

- USE 1 FOOT METHOD & ASSUME 8' TALL SHELL RINGS

$t_d = \frac{2.6D(H-1)G}{S_d} + CA$

$t_t = \frac{2.6D(H-0)}{S_t}$

D = 110'
G = 1.2
CA = 3/16" = .1875"
S_d = 23,200 psi
S_t = 24,900 psi

	H	t_d	t_t	Actual thickness used
RING 1	32'	.6461"	.3561"	.6461"
RING 2	24'	.5277"	.2642"	.5277"
RING 3	16'	.4094"	.1723"	.4375" (USE MIN.) *
RING 4	8'	.2911"	.0804"	.4375" (USE MIN.) *

* TO ELIMINATE INTERMEDIATE WIND GIRDER

AMERICAN TANK & VESSEL, INC.

CALCULATION WORKSHEET PAGE 5 OF 8

CLIENT	JOB NUMBER WHT-14 & WHT-15
SUBJECT DESIGN CALCS	
BASED ON API 650/ SPEC 15187	DRAWING NUMBER
BY HDC / 10/7/96 | CHECKED BY LRL / 10/8/96	A. I. REV.

NOZZLE & SHELL OPENING DESIGNS

ALL NOZZLES, MANWAYS, SHELL OPENINGS SHALL BE IN ACCORDANCE WITH SECTION 3.7 OF API 650, ALL REINF. PL'S TO BE A MINIMUM OF ¼" TK, PER CUSTOMER SPEC 15187,

AMERICAN TANK & VESSEL, INC.

CALCULATION WORKSHEET PAGE 6 OF 8

CLIENT	JOB NUMBER WHT-14 & WHT-15
SUBJECT DESIGN CALCS.	
BASED ON API 650 / SPEC. 15187	DRAWING NUMBER
BY HDC / 10/7/96 | CHECKED BY LRL / 10/10/96 | A. I. REV.	

TOP WIND GIRDER (3.9.6.1)

-USE WIND OF 164 MPH

$\therefore Z = .0001 D^2 H_2 \left(\frac{164}{100}\right)^2$

$Z = .0001(110)^2(32)\left(\frac{164}{100}\right)^2$

$Z = 104.1 \text{ in}^3$ (Minimum)

Z = SECTION MOD. REQ. (in^3)

H_2 = TANK HT (FT)

D = TANK ϕ (FT)

$\therefore$ USE API 650 TABLE 3-22. USE "FORMED PLATE WITH b = 28".

PER API 650 - 3.9.5, SUPPORTS ARE REQUIRED, SPACED AT 12' MIN.

CHECK FOR INT WIND GIRDER

$H_1 = 6(100t)\sqrt{\left(\frac{100t}{D}\right)^3}\left(\frac{100}{164}\right)^2$

$H_1 = 6\left(100\left(\frac{1}{16}\right)\right)\sqrt{\left(\frac{100(\frac{1}{16})}{110}\right)^3}\left(\frac{100}{164}\right)^2$

$H_1 = 24.5 \text{ FT}$

t = ORDERED TK OF TOP SHELL (IN)

D = TANK ϕ (FT)

$W_{TR} = W\sqrt{\frac{t_{\text{available}}}{t_{\text{actual}}}}$

FOR RG1, $W_{TR} = 36.2$ in

RG2, $W_{TR} = 60.1$ in

RG3, $W_{TR} = 96$ in

RG4, $W_{TR} = 96$ in

$\therefore$ TOTAL TRANSFORMED WIDTH IS 288.3 in = 24.3 ft

SINCE TRANSFORMED WIDTH IS LESS THAN H_1, INT WIND GIRDER NOT REQ'D

AMERICAN TANK & VESSEL, INC.

CALCULATION WORKSHEET PAGE 7 OF 8

CLIENT	JOB NUMBER WHT-14 & WHT-15
SUBJECT DESIGN CALCS	
BASED ON API 650 / SPEC 15197	DRAWING NUMBER
BY HDC/10/7/96 | CHECKED BY LRL /10/10/96 | A. I. REV.	

CHECK WIND STABILITY (API 650 3.11)

PROJECTED AREA = $110'(32') = 3520$ sqft

WIND LOAD = $(3520 \text{ sqft})(18 \frac{\text{lb}}{\text{sqft}})(\frac{164}{100})^2 = 170,413$ lb

WIND MOMENT = $(170,413 \text{ lb})(\frac{32}{2} \text{ ft}) = 2,726,609$ ft lb

SHELL WT $\approx (110 \text{ ft} \times \pi)(32 \text{ ft})(\frac{.3247}{12})(490 \frac{\text{lb}}{\text{ft}^3}) = 146,619$ lb

(Avg T/C (corroded))

ALLOWABLE WIND MOMENT = $\frac{2}{3}[\frac{W_s D}{2}] = \frac{2}{3}[\frac{146,619(110)}{2}] = 5,376,030$ ft lb

SINCE ACTUAL WIND MOMENT IS LESS THAN ALLOWABLE, ANCHOR BOLTS ARE NOT REQUIRED

AMERICAN TANK & VESSEL, INC.

CALCULATION WORKSHEET PAGE 8 OF 8

CLIENT	JOB NUMBER WHT-14 & WHT-15
SUBJECT DESIGN CALCS - CURB ANGLE	
BASED ON API 650 / SPEC. 15187	DRAWING NUMBER
BY MJC / 10/7/06 CHECKED BY LRL / 10/10/06	A. I. REV.

DUE TO PLATFORM BEING AT TOP OF TANKS, TOP WIND GIRDER WILL BE GREATER THAN 2' FEET FROM TOP OF TANK; THEREFORE, CURB ANGLE IS REQUIRED

USE $3" \times 3" \times \frac{7}{16}"$

ATTACHMENT E

API 650 Section 5.7.2.10

API 650 Section 5.7.5.1

API 650 Section 7.3.4

plates. The provisions of Item b with respect to openings on the same or adjacent vertical centerlines also apply in this case.

5.7.2.10 Reinforcing plates for shell openings, or each segment of the plates if they are not made in one piece, shall be provided with a 6 mm ($^1/_4$ in.) diameter telltale hole. Such holes shall be located on the horizontal centerline and shall be open to the atmosphere. 07

5.7.3 Spacing of Welds around Connections

See Figure 5-6 for spacing requirements listed in 5.7.3.1 through 5.7.3.4.

Note 1: Additional weld spacing requirements exist in this Standard. Other paragraphs and tables dealing with nozzles and manholes may increase the minimum spacing.

Note 2: Whenever stress relief or thermal stress relief is used in this Standard, it shall mean post-weld heat treatment.

5.7.3.1 For non-stress-relieved welds on shell plates over 13 mm ($^1/_2$ in.) thick, the minimum spacing between penetration connections and adjacent shell-plate joints shall be governed by the following: 08

a. The outer edge or toe of fillet around a penetration, around the periphery of a thickened insert plate, or around the periphery of a reinforcing plate shall be spaced at least the greater of eight times the weld size or 250 mm (10 in.) (dimension A or B in Figure 5-6) from the centerline of any butt-welded shell joints. 08

b. The welds around the periphery of a thickened insert plate, around a reinforcing insert plate, or around a reinforcing plate shall be spaced at least the greater of eight times the larger weld size or 150 mm (6 in.) (dimension E in Figure 5-6) from each other. 08

5.7.3.2 Where stress-relieving of the periphery weld has been performed prior to welding of the adjacent shell joint or where a non-stress-relieved weld is on a shell plate less than or equal to 13 mm ($^1/_2$ in.) thick, the spacing may be reduced to 150 mm (6 in.) (dimension A in Fig. 5-6) from vertical joints or to the greater of 75 mm (3 in.) or $2^1/_2$ times the shell thickness (dimension B in Fig. 5-6) from horizontal joints. The spacing between the welds around the periphery of a thickened insert plate or around a reinforcing plate shall be the greater of 75 mm (3 in.) or $2^1/_2$ times the shell thickness (dimension E in Figure 5-6). 08

5.7.3.3 The rules in 5.7.3.1 and 5.7.3.2 shall also apply to the bottom-to-shell joint (dimension C in Figure 5-6) unless, as an alternative, the insert plate or reinforcing plate extends to the bottom-to-shell joint and intersects it at approximately 90 degrees (dimension D in Figure 5-6). A minimum distance of 75 mm (3 in.) shall be maintained between the toe of a weld around a nonreinforced penetration (see 5.7.2.1) and the toe of the shell-to-bottom weld. 08

• **5.7.3.4** Nozzles and manholes should not be placed in shell weld seams and reinforcing pads for nozzles and manholes should not overlap plate seams (i.e., Figure 5-9, Details a, c, and e should be avoided). If there is no other feasible option and the Purchaser accepts the design, circular shell openings and reinforcing plates (if used) may be located in a horizontal or vertical butt-welded shell joint provided that the minimum spacing dimensions are met and a radiographic examination of the welded shell joint is conducted. The welded shell joint shall be fully radiographed for a length equal to three times the diameter of the opening, but the weld seam being removed need not be radiographed. Radiographic examination shall be in accordance with 8.1.3 through 8.1.8. 07

5.7.4 Thermal Stress Relief

5.7.4.1 All flush-type cleanout fittings and flush-type shell connections shall be thermally stress-relieved as an assembly prior to installation in the tank shell or after installation into the tank shell if the entire tank is stress-relieved. The stress relief shall be carried out within a temperature range of 600°C – 650°C (1100°F – 1200°F) (see 5.7.4.3 for quenched and tempered materials) for 1 hour per 25 mm (1 in.) of shell thickness. The assembly shall include the bottom reinforcing plate (or annular plate) and the flange-to-neck weld.

5.7.4.2 When the shell material is Group I, II, III, or IIIA, all opening connections NPS 12 or larger in nominal diameter in a shell plate or thickened insert plate more than 25 mm (1 in.) thick shall be prefabricated into the shell plate or thickened insert plate, and the prefabricated assembly shall be thermally stress-relieved within a temperature range of 600°C – 650°C (1100°F – 1200°F) for 1 hour per 25 mm (1 in.) of thickness prior to installation. The stress-relieving

requirements need not include the flange-to-neck welds or other nozzle-neck and manhole-neck attachments, provided the following conditions are fulfilled:

a. The welds are outside the reinforcement (see 5.7.2.4). 07

b. The throat dimension of a fillet weld in a slip-on flange does not exceed 16 mm ($^5/_8$ in.), or the butt joint of a welding-neck flange does not exceed 19 mm ($^3/_4$ in.). If the material is preheated to a minimum temperature of 90°C (200°F) during welding, the weld limits of 16 mm ($^5/_8$ in.) and 19 mm ($^3/_4$ in.) may be increased to 32 mm and 40 mm ($1^1/_4$ in. and $1^1/_2$ in.), respectively. 08

5.7.4.3 When the shell material is Group IV, IVA, V, or VI, all opening connections requiring reinforcement in a shell plate or thickened insert plate more than 13 mm ($^1/_2$ in.) thick shall be prefabricated into the shell plate or thickened insert plate, and the prefabricated assembly shall be thermally stress relieved within a temperature range of 600°C – 650°C (1100°F – 1200°F) for 1 hour per 25 mm (1 in.) of thickness prior to installation. 08

When connections are installed in quenched and tempered material, the maximum thermal stress-relieving temperature shall not exceed the tempering temperature for the materials in the prefabricated stress-relieving assembly. The stress-relieving requirements do not apply to the weld to the bottom annular plate, but they do apply to flush-type cleanout openings when the bottom reinforcing plate is an annular-plate section. The stress-relieving requirements need not include the flange-to-neck welds or other nozzle-neck and manhole-neck attachments, provided the conditions of 5.7.4.2 are fulfilled.

5.7.4.4 Examination after stress relief shall be in accordance with 7.2.3.6 or 7.2.3.7.

• **5.7.4.5** When it is impractical to stress relieve at a minimum temperature of 600°C (1100°F), it is permissible, subject to the Purchaser's agreement, to carry out the stress-relieving operation at lower temperatures for longer periods of time in accordance with the tabulation below. The lower temperature/longer time PWHT may not provide material toughness and residual stresses equivalent to that using the higher temperature/shorter time PWHT; therefore, a review by a knowledgeable metallurgist and possible verification by mill testing of heat-treated coupons and/or testing of welded plates shall be considered. See Line 23 of the Data Sheet for any Purchaser-specified requirements applicable to this heat-treatment option. 07

Minimum Stress-Relieving Temperature		Holding Time (hours per 25 mm [1 in.] of thickness)	See Note
(°C)	(°F)		
600	1100	1	1
570	1050	2	1
540	1000	4	1
510	950	10	1, 2
480 (min.)	900 (min.)	20	1, 2

Notes:
1. For intermediate temperatures, the time of heating shall be determined by straight line interpolation.
2. Stress relieving at these temperatures is not permitted for A 537 Class 2 material.

5.7.4.6 When used in stress-relieved assemblies, the material of quenched and tempered steels A 537, Cl 2 and A 678, Grade B, and of TMCP steel A 841 shall be represented by test specimens that have been subjected to the same heat treatment as that used for the stress relieved assembly.

5.7.5 Shell Manholes

5.7.5.1 Shell manholes shall conform to Figures 5-7A and 5-7B and Tables 5-3a through 5-5b (or Tables 5-6a through 5-8b), but other shapes are permitted by 5.7.1.8. Manhole reinforcing plates or each segment of the plates if they are not made in one piece shall be provided with a 6 mm ($^1/_4$ in.) diameter telltale hole (for detection of leakage through the interior welds). Each hole shall be located on the horizontal centerline and shall be open to the atmosphere. 08

• **5.7.5.2** Manholes shall be of built-up welded construction. The dimensions are listed in Tables 5-3a through 5-5b. The dimensions are based on the minimum neck thicknesses listed in Tables 5-4a and 5-4b. When corrosion allowance is specified to be applied to shell manholes, corrosion allowance is to be added to the minimum neck, cover plate, and bolting flange thicknesses of Tables 5-3a, 5-3b, 5-4a and 5-4b. 08

7.3.2.3 Responsibility

The Manufacturer shall be responsible for making radiographs and any necessary repairs; however, if the Purchaser's inspector requires radiographs in excess of the number specified in Section 6, or requires chip-outs of fillet welds in excess of one per 30 m (100 ft) of weld and no defect is disclosed the additional inspections and associated work shall be the responsibility of the Purchaser.

7.3.3 Examination and Testing of the Tank Bottom

Upon completion of welding of the tank bottom, the bottom welds and plates shall be examined visually for any potential defects and leaks. Particular attention shall apply to areas such as sumps, dents, gouges, three-plate laps, bottom plate breakdowns, arc strikes, temporary attachment removal areas, and welding lead arc burns. Visual examination acceptance and repair criteria are specified in 8.5. In addition, all welds shall be tested by one of the following methods: 11

a. A vacuum-box test in accordance with 8.6.

b. A tracer gas test in accordance with 8.6.11.

c. After at least the lowest shell course has been attached to the bottom, water (to be supplied by the Purchaser) shall be pumped underneath the bottom. A head of 150 mm (6 in.) of liquid shall be maintained using a temporary dam to hold that depth around the edge of the bottom. The line containing water for testing may be installed temporarily by running it through a manhole to one or more temporary flange connections in the bottom of the tank, or the line may be installed permanently in the subgrade beneath the tank. The method of installation should be governed by the nature of the subgrade. Reasonable care shall be taken to preserve the prepared subgrade under the tank.

7.3.4 Inspection of Reinforcing-Plate Welds

After fabrication is completed but before the tank is filled with test water, the reinforcing plates shall be tested by the Manufacturer by applying up to 100 kPa (15 lbf/in.^{2}) gauge pneumatic pressure between the tank shell and the reinforcement plate on each opening using the telltale hole specified in 5.7.5.1. While each space is subjected to such pressure, a soap film, linseed oil, or another material suitable for the detection of leaks shall be applied to all attachment welding around the reinforcement, both inside and outside the tank.

7.3.5 Testing of the Shell

After the entire tank and roof structure is completed, the shell (except for the shell of tanks designed in accordance with Appendix F) shall be tested by one of the following methods, as specified on the Data Sheet, Line 14: 07

1. If water is available for testing the shell, the tank shall be filled with water as follows: (1) to the maximum design liquid level, H; (2) for a tank with a tight roof, to 50 mm (2 in.) above the weld connecting the roof plate or compression bar to the top angle or shell; (3) to a level lower than that specified in Subitem 1 or 2 when restricted by overflows, an internal floating roof, or other freeboard by agreement between the Purchaser and the Manufacturer, or 4) to a level of seawater producing a bottom of shell hoop stress equal to that produced by a full-height fresh water test. The tank shall be inspected frequently during the filling operation, and any welded joints above the test-water level shall be examined in accordance with Item 2 below. This test shall be conducted before permanent external piping is connected to the tank. Attachments to 08
the shell defined in 5.8.1.1, located at least 1 m (3 ft) above the water level, and roof appurtenances may be welded during the filling of the tank. After completion of the hydro-test, only non-structural small attachments may be welded to the tank in accordance with 7.2.1.11.

2. If sufficient water to fill the tank is not available, the tank may be tested by (1) painting all of the joints on the inside with a highly penetrating oil, such as automobile spring oil, and carefully examining the outside of the joints for leakage; (2) applying vacuum to either side of the joints or applying internal air pressure as specified for the roof test in 7.3.7 and carefully examining the joints for leakage; or (3) using any combination of the methods stipulated in 7.3.5, Subitems 1 and 2.

7.3.6 Hydrostatic Testing Requirements 07

7.3.6.1 This hydrostatic test of the tank shall be conducted before permanent external piping is connected to the tank. Attachments to the shell defined in 5.8.1.1, located at least 1 m (3 ft) above the water level, and roof appurtenances may be welded during the filling of the tank. After completion of the hydro-test, only non-structural small attachments may be welded to the tank in accordance with 7.2.1.11. Any welded joints above the test-water level shall be examined for leakage by one of the following methods:

ATTACHMENT F

API 653 Section 9.7

API 653 Section 9.8

API 653 Section 9.9

API 653 Section 12.1.2

05 **9.3.3.1** The selection of the repair plate thickness shall be based on a design that conforms to the as-built standard and API Std 653, using a joint efficiency not exceeding 0.35. The perimeter weld shall be a full fillet weld.

9.3.3.2 The repair plate thickness shall not exceed the shell plate thickness at the perimeter of the repair plate by more than one-third, but no more than 1/8 in. The repair plate thickness shall not exceed 1/2 in.

9.3.3.3 The remaining strength of the deteriorated areas under the repair plate shall not be considered as effective in carrying the calculated service or hydrotest loads.

9.3.4 Lapped patch repair plates may be used to repair small shell leaks, or minimize the potential from leaks from severely isolated or widely scattered pitting if the following requirements are satisfied.

9.3.4.1 The existing shell thickness, excluding the holes and pitting, meets the minimum acceptable shell thickness as determined by 4.3.2 and 4.3.3.

9.3.4.2 The repair plate is designed to withstand the hydrostatic pressure load between the repair plate and the shell assuming a hole exists in the shell using a joint efficiency of 0.35.

9.3.4.3 The repair plate thickness shall not exceed the shell plate thickness at the perimeter of the repair plate by more than one-third, but no more than 1/8 in. The repair plate thickness shall be no thinner than 3/16 in. nor thicker than 1/2 in. A full fillet perimeter weld is required.

9.3.4.4 This repair method shall not be used if exposure of the fillet welds to the product will produce crevice corrosion or if a corrosion cell between the shell plate and repair plate is likely to occur.

9.3.4.5 This repair method shall not be used to repair shell leaks if the presence of product between the shell plate and repair plate will prevent gas freeing from the tank to perform hot work.

9.3.4.6 The existing shell plate under the repair plate shall be evaluated at each future inspection to ensure it satisfies the requirements of 9.3.4.1. If the existing shell plate thickness does not satisfy 9.3.4.1 or the repair plate does not satisfy 9.3.3, the area is to be repaired in accordance with 9.2 or 9.3.2.

9.4 REPAIR OF DEFECTS IN SHELL PLATE MATERIAL

The need for repairing indications such as cracks, gouges or tears (such as those often remaining after the removal of temporary attachments), widely scattered pits, and corroded areas discovered during an inspection of the tank shell shall be determined on an individual case basis in accordance with Section 4. In areas where the shell plate thickness exceeds that required by design conditions, it is permissible to grind surface irregularities to a smooth contour so long as the remaining thickness is adequate for the design conditions. Where grinding to a smoothly contoured surface will result in unacceptable shell plate metal thickness, the shell plate may be repaired by deposition of weld metal, followed by examination and testing in accordance with 12.1.8. If more extensive areas of shell plate require repair, use of butt welded shell replacement plate or lap-welded patch plate shall be considered.

9.5 ALTERATION OF TANK SHELLS TO CHANGE SHELL HEIGHT

Tank shells may be altered by adding new plate material to increase the height of the tank shell. The modified shell height shall be in accordance with the requirements of the current applicable standard and shall take into consideration all anticipated loadings such as wind and seismic. 05

9.6 REPAIR OF DEFECTIVE WELDS

Types of weld flaws and nonconformances that need repair are described in 9.6.1 through 9.6.4.

9.6.1 Cracks, lack of fusion, and rejectable slag and porosity that need repair shall be removed completely by gouging and/or grinding and the resulting cavity properly prepared for welding.

9.6.2 Generally, it is not necessary to remove existing weld reinforcement in excess of that allowed by API Std 650 when discovered on an existing tank with a satisfactory service history. However, if operating conditions are such that the excessive weld reinforcement may be deleterious (such as for a floating roof with flexible seals), consideration shall be given to repairing the welds by grinding.

9.6.3 Existing weld undercut deemed unacceptable based on suitability for service considerations shall be repaired by additional weld metal, or grinding, as appropriate.

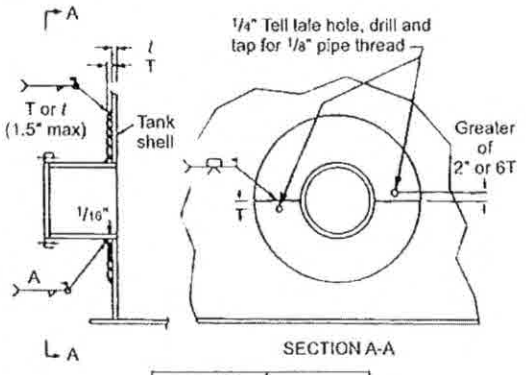
9.6.4 Welded joints that have experienced loss of metal due to corrosion may be repaired by welding.

9.6.5 Arc strikes discovered in or adjacent to welded joints shall be repaired by grinding and/or welding. Arc strikes repaired by welding shall be ground flush with the plate.

9.7 REPAIR OF SHELL PENETRATIONS

9.7.1 Repairs to existing shell penetrations shall be in compliance with API Std 650.

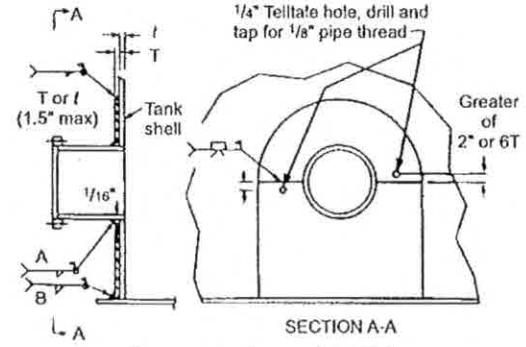
9.7.2 Reinforcing plates may be added to existing unreinforced nozzles when deemed appropriate. The reinforcing plate shall meet all dimensional and weld spacing requirements of API Std 650. See Figures 9-3A and 9-3B for acceptable details.



t and T (maximum)	A
9/16"	1/4"
3/4"	5/16"
15/16"	3/8"
1 1/8"	7/16"
1 5/16"	1/2"
1 9/16"	9/16"
1 3/4"	5/8"

Note: All details, dimensions, and weld spacing shall be in accordance with the requirements of API Std 650.

Figure 9-3A—Typical Details for Addition of Reinforcing Plate to Existing Shell Penetration



t and T (maximum)	A	B
9/16"	1/4"	1/4"
3/4"	5/16"	1/4"
15/16"	3/8"	5/16"
1 1/8"	7/16"	5/16"
1 5/16"	1/2"	3/8"
1 9/16"	9/16"	3/8"
1 3/4"	5/8"	3/8"

Note: All details, dimensions, and weld spacing shall be in accordance with the requirements of API Std 650.

Figure 9-3B—Typical Details for Addition of "Tombstone" Shape Reinforcing Plate to Existing Shell Penetration

9.7.3 As an alternative, the reinforcing plates may be added to the inside of the tank provided that sufficient nozzle projection exists.

9.8 ADDITION OR REPLACEMENT OF SHELL PENETRATIONS

9.8.1 New shell penetrations (addition or replacement) shall be in accordance with material, design, and stress relief requirements of API Std 650 and in accordance with 9.8.2 through 9.8.6 of this standard. 05

9.8.2 The required penetration reinforcement area of API Std 650, 5.7.2, shall be determined using the required shell thickness calculated by the formula in 4.3.3.1 b. of this standard except the variable S shall be the allowable design stress from Table 5-2 of API Std 650 for the existing shell plate; use 20,000 lbf/in.^{2} if of unknown material. A joint efficiency of 1.0 may be used (see 9.8.5). The variable H shall be the height from the centerline of the penetration to the maximum liquid level, in ft. 08 05 08 05

9.8.3 Penetrations shall be prefabricated in thermally stress relieved insert assemblies when required by API Std 650, 5.7.4. API Std 650, 4.1.5, may be used when reinforcing material is from API Std 650 Group-IV through Group-VI and the existing shell is a Group-I through Group-IIIA material. 08

9.8.4 The following erection requirements shall be met:

a. If an integral reinforcement design is used, the insert plate at its periphery shall have a 1:4 reduction taper to match the shell plate thickness when the insert plate exceeds the shell plate thickness by more than 1/8 in. 05

b. Spacing of welds shall be in accordance with Figure 9-1.

c. The new insert plate shall be joined to existing shell plate with full penetration and full fusion butt welds.

9.8.5 Examinations shall be per Section 12, except penetrations located on a shell joint shall receive additional shell radiography in accordance with API Std 650, 5.7.3. 08

9.8.6 Penetrations larger than 2 in. NPS shall be installed with the use of an insert plate if the shell plate thickness is greater than 1/2 in. and the shell plate material does not meet the current design metal temperature criteria. In addition, the following requirement shall be met: 05

a. The minimum diameter of the insert plate shall be at least twice the diameter of the penetration or the diameter plus 12 in., whichever is greater.

b. When reinforcing plates are used, the minimum diameter of the insert plate shall equal the diameter of the reinforcing plate plus 12 in.

[Text Deleted] 05

9.9 ALTERATION OF EXISTING SHELL PENETRATIONS

05 **9.9.1** Existing shell penetrations may be altered if the altered details comply with the requirements of API Std 650, including the requirements for minimum reinforcing area and the requirements for spacing of welds around connections.

9.9.2 When installing a new tank bottom above the existing bottom, it may be necessary to alter existing shell penetrations in the bottom course of a tank shell. If the new bottom is slotted through the tank shell several inches above the existing bottom, the spacing between existing welds around penetrations and the new bottom-to-shell weld may not comply with API Std 650 requirements. Options for altering the penetrations and/or reinforcing plates are given in 9.9.2.1 through 9.9.2.3.

9.9.2.1 The existing reinforcing plate may be trimmed to increase the spacing between the welds provided that the
05 altered detail complies with the requirements of API Std 650. Care must be exercised during the trimming operation to avoid damaging the shell material beneath the reinforcing plate. The existing weld attaching the portion of the reinforcing plate to be removed shall be completely removed by gouging and grinding.

9.9.2.2 The existing reinforcing plate may be removed and a new reinforcing plate added except that reinforcement plate replacement is not permitted on existing stress relieved assemblies. If it is not known whether the assembly was thermally stressed relieved, then the alteration shall meet the
08 requirements of API Std 650, Section 5.7.4. Care must be exercised when removing the existing reinforcing plate to avoid damaging the shell plate beneath the reinforcing plate. When the upper half of the existing reinforcing plate meets all requirements of API Std 650, it can be left in place with approval of the purchaser. In this case, only the lower half of the existing reinforcing plate need be removed and replaced with the new one. The existing upper half of the reinforcing
05 plate and the new lower section shall be provided with new a tell tale hole, if needed, or drilled hole, and a welded pipe coupling for the pneumatic test. The shell plate thickness under the tell tale hole or drilled hole shall be checked after drilling and the thickness shall not be less than $^1/_2\ t_{min}$, as calculated in 4.3.3.1, plus any required corrosion allowance. The welds to be replaced around the perimeter of the reinforcing plate and between the reinforcing plate and neck of the penetration shall be completely removed by gouging and grinding. The new reinforcing plate shall be in accordance with Figure 9-3A. If required to maintain weld spacing, a tombstone shaped reinforcing plate may be used. (See Figure 9-3B).

9.9.2.3 The existing penetration may be moved by cutting the section of the shell containing the fitting and reinforcing plate, and raising the entire assembly to the correct elevation (see Figure 9-4).

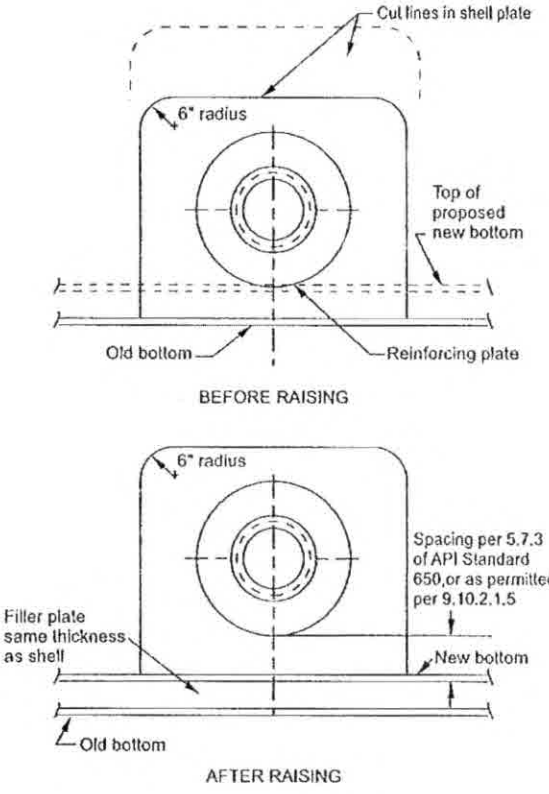


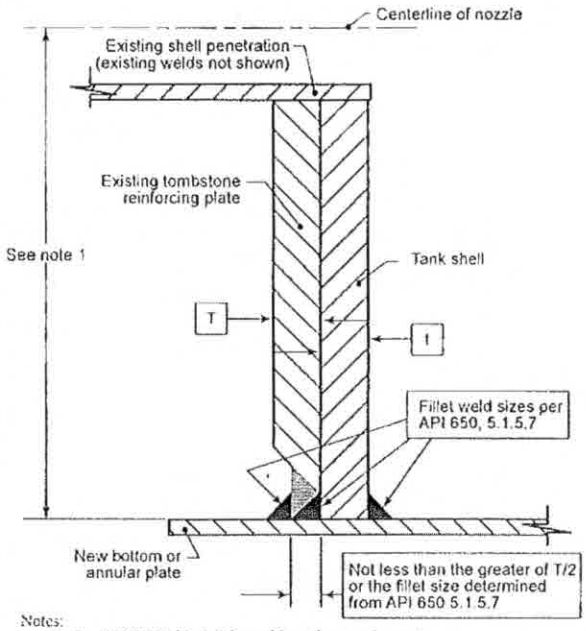
Figure 9-4—Method for Raising Shell Nozzles

9.9.3 Any components of the penetration (neck, flange, and reinforcing plate) that are in serviceable condition after removal may be reused.

9.9.4 A new bottom may be installed through an existing tombstone reinforcing plate, provided all weld spacing and reinforcement requirements, as specified in API Std 650, are met. One of the following methods shall be used:

a. Remove only that portion of the existing reinforcing plate necessary to weld and test the new bottom-to-shell weld. The lower edge of the reinforcing plate shall be cut reasonably straight and horizontal and beveled to facilitate welding. Refer to Figure 9-5A for weld joint details.

b. Bevel the shell from the inside to allow for a full penetration weld between the bottom and shell. This method shall only be used on tanks where the annular plate or bottom sketch plate thickness is equal to or greater than 10 mm ($^3/_8$ in.). This weld detail shall be used along the full width of the reinforcing plate and shall extend a minimum of 25 mm (1 in.) beyond the edges of the reinforcing plate. Once beyond the reinforcing plate, the full penetration weld shall tie in to the outside shell-to-bottom fillet



Notes:
1. See API 650 Table 5-6 for weld spacing requirements.
2. All welds shown shall be individually examined to API 650 7.2.4.

Figure 9-5A—Details for Installing a New Bottom Through an Existing Tombstone Reinforcing Plate

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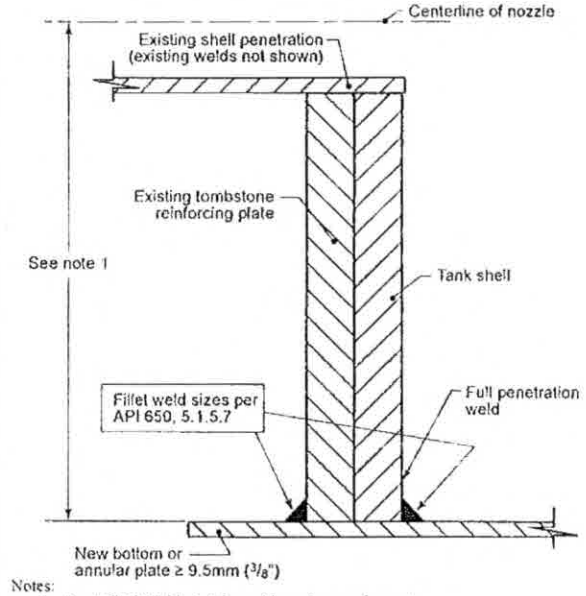

Notes:
1. See API 650 Table 5-6 for weld spacing requirements.
2. All welds shown shall be individually examined to API 650 7.2.4.

Figure 9-5B—Details for Installing a New Bottom Through an Existing Tombstone Reinforcing Plate

weld to create a 'water stop' and then transition to the typical shell-to-bottom weld detail. Refer to Figure 9-5B for weld joint details.

c. The lower portion of the existing reinforcing plate may be removed and re-installed after the new shell-to-bottom weld is complete. The existing reinforcing plate shall be cut at the horizontal centerline of the nozzle. Tell-tale holes are required in both parts of the reinforcing plate. (See Figure 9-3B.)

d. The existing reinforcing plate may be removed, modified and re-installed after the new shell-to-bottom weld is complete. (See Figure 9-3B.) 08

Notes:
1. Options c and d are not permitted on existing post weld heat treated nozzles or man-ways.
2. To minimize damage to the shell plate such that repairs can be made, care must be exercised when removing the existing reinforcing plate.

9.10 REPAIR OF TANK BOTTOMS

9.10.1 Repairing a Portion of Tank Bottoms

9.10.1.1 General Repair Requirements

The use of welded-on patch plates for repairing a portion of uniformly supported tank bottoms is permitted within the limitations given in this section and 9.10.1.2. Refer to Figure 9-6 for acceptable details for welded-on patch plates. 08

a. The minimum dimension for a welded-on patch plate that overlaps a bottom seam or existing patch is 12 in. The welded-on patch plate may be circular, oblong, or polygonal with rounded corners.

b. A welded-on patch plate smaller than 12 in. in diameter is permitted if: it is equal to or exceeds 6 in. in diameter; it does not overlap a bottom seam; it is not placed fully or partially over an existing patch; and it extends beyond the corroded bottom area, if any, by at least 2 in.

c. Welded-on patch plates shall not be placed over areas of the tank bottom that have global dishing, local dishing (except as allowed by 9.10.1.1 d), settlement, or distortion greater than the limits of Appendix B.

Note: If the tank is still undergoing settlement, the addition of welded-on patch plate may not be advisable.

d. A welded-on patch plate may be placed over a mechanical dent or local dishing if: its unsupported dimension does not exceed 12 in. in any direction; it is at least 1/4 in. thick; it is at least as thick as the existing bottom; and does not overlap seams nor other patches, except for tanks designed in accordance with API Std 650, Appendix M, which shall have welded-on patch plates at least 3/8 in. thick.

[Text deleted.] 03

e. These repairs are permanent repairs subject to an on-going inspection and maintenance program.

SECTION 12—EXAMINATION AND TESTING

12.1 NONDESTRUCTIVE EXAMINATIONS

12.1.1 General

12.1.1.1 Nondestructive examinations shall be performed in accordance with API Std 650 and any supplemental requirements given herein.

01 **12.1.1.2** Personnel performing nondestructive examinations shall be qualified in accordance with API Std 650 and any supplemental requirements given herein.

12.1.1.3 Acceptance criteria shall be in accordance with API Std 650 and any supplemental requirements given herein.

03 **12.1.1.4** Each newly deposited weld or any cavity resulting from gouging or grinding operations shall be visually examined over its full length. Additional NDE of these welds may be required as described in the following relevant sections.

12.1.1.5 Appendix G may be used to provide additional guidance in qualifying personnel and procedures when magnetic flux leakage (MFL) tools are used to examine tank bottoms. Owner/operators should determine specific requirements to meet their tank bottom integrity needs.

12.1.2 Shell Penetrations

12.1.2.1 Ultrasonic examination of shell plate for laminations shall be made in the immediate area affected when:

a. Adding a reinforcing plate to an existing unreinforced penetration.
b. Adding a hot tap connection.

03 **12.1.2.2** Cavities resulting from gouging or grinding operations to remove attachment welds of existing reinforcing plates shall be examined by magnetic particle or liquid penetrant methods.

12.1.2.3 Completed welds attaching nozzle neck to shell, and reinforcing plate to shell and to nozzle neck, shall be examined by the magnetic particle or liquid penetrant methods. Consider additional examination (e.g., fluorescent magnetic particle examination and/or ultrasonic examination) for hot tap connections to shell plates of unknown toughness having a maximum thickness more than $^1/_2$ in. or to shell 05 plates of unknown toughness, as defined in Section 3.

03 **12.1.2.4** Completed welds of stress-relieved assemblies shall be examined by the magnetic particle or liquid penetrant methods after stress relief, but before hydrostatic testing.

12.1.3 Repaired Weld Flaws

12.1.3.1 Cavities resulting from gouging or grinding operations to remove weld defects shall be examined by the magnetic particle or liquid penetrant methods. 03

12.1.3.2 Completed repairs of butt-welds shall be examined over their full length by radiographic or ultrasonic methods.

12.1.3.3 Completed repairs of fillet welds shall be examined over their full length by the appropriate nondestructive examination method listed herein.

12.1.4 Temporary and Permanent Attachments to Shell Plates

12.1.4.1 The welds of permanent attachments (not including shell-to-bottom welds) and, areas where temporary attachments are removed and the remaining weld projections have been removed, shall be examined visually. 01

12.1.4.2 Completed welds of new permanent attachments (not including shell-to-bottom welds) and areas where temporary attachments have been removed (API Std 650 tank shell materials of Groups IV, IVA, V, or VI), shall be examined by either the magnetic particle method (or, at the option of the purchaser, by the liquid penetrant method). 03

12.1.5 Shell Plate to Shell Plate Welds

12.1.5.1 New welds attaching existing shell plate to existing or new shell plate shall be examined by radiographic methods (see 12.2). In addition, for plate thicknesses greater than 1 in., the back-gouged surface of the root pass and final pass (each side) shall be examined for its complete length by magnetic particle or liquid penetrant methods. 03

12.1.5.2 New welds joining new shell plate material to new shell plate material (partial or full shell course replacement or addition) need only be examined radiographically in accordance with API Std 650.

12.1.6 Shell-To-Bottom Weld

12.1.6.1 New welding on the shell-to-bottom joint shall be inspected for its entire length by using a right-angle vacuum box and a solution film, or by applying light diesel oil. Additionally, the first weld pass shall be inspected by applying light diesel oil to the side opposite the first weld pass made. The oil shall be allowed to stand at least 4 hours (preferably overnight) and then the weld inspected for wicking action. The oil shall be removed before the weld is completed.

12.1.6.2 As an alternative to 12.1.6.1, the initial weld passes, inside and outside of the shell, shall have all slag and non-metals removed from the surface of the welds and exam-

ined visually. Additionally, after completion of the inside and outside fillet or partial penetration welds, the welds shall be tested by pressurizing the volume between the inside and outside welds with air pressure to 15 psig and applying a solution film to both welds. To assure that the air pressure reaches all parts of the welds, a sealed blockage in the annular passage between the inside and outside welds must be provided by welding at one or more points. Additionally, a small pipe coupling communicating with the volume between the welds must be welded on each side of and adjacent to the blockages. The air supply must be connected at one end and a pressure gauge connected to a coupling on the other end of the segment under test.

12.1.6.3 The existing weld at the shell-to-bottom joint shall be examined by visual, as well as by magnetic particle or liquid penetrant methods, for the full length under a welded-on patch plate. An additional 6 in. of the shell-to-bottom joint on each side of the welded-on patch plate shall be examined similarly before placement of the repair plate to assure weld integrity and to confirm the absence of weld cracks.

12.1.7 Bottoms

12.1.7.1 Upon completion of welding on a tank bottom, the plates and the entire length of new welds for tank bottom plates shall be examined visually for any potential defects and leaks. Particular attention shall apply to areas such as sumps, dents, gouges, three-plate laps, bottom plate breakdowns, arc strikes, temporary attachment removal areas, and welding lead arc burns. Visual examination acceptance and repair criteria are specified in API Std 650, 8.5. In addition, all new welds, including the weld attaching a patch plate to the bottom, the areas of bottom plate restored by welding, and the restoration of welds found with defects during an internal inspection shall be inspected by one of the methods specified in API Std 650, 7.3.3. Leaking areas shall be repaired by grinding and rewelding as required, and the repaired area shall be retested.

12.1.7.2 In addition to the requirements in 12.1.7.1, the root and final pass of a welded-on patch plate weld in the critical zone (see 3.12 for definition) shall be visually examined and examined by either magnetic particle or liquid penetrant method over its full length.

12.1.7.3 In addition to the requirements in 12.1.7.1, areas of bottom plate repaired by welding shall be examined by the magnetic particle method or the liquid penetrant method. In addition, the repaired area shall also be tested using a vacuum box and solution or a tracer gas and detector.

12.1.8 Shell Plate

12.1.8.1 Shell Plate Repairs by Weld Metal Deposit

Areas of shell plate to be repaired by welding shall be examined visually. In addition, shell plate areas repaired by welding shall be examined by the magnetic particle method (or the liquid penetrant method).

12.1.8.2 Shell Plate Repairs by Lap-Welded Patches

The attachment welds of new lap-welded shell patches shall be visually examined, and shall be examined by either the magnetic particle or liquid penetrant methods.

12.1.9 Fixed Roofs

Newly welded roof joints and repairs shall be examined in accordance with API Std 650, 7.3.2.2 and 7.3.7.

12.1.10 Floating Roofs

12.1.10.1 Repair Work to Steel Floating Roofs

After repair work is complete:

a. Perform a visual examination from the top and bottom side of the floating roof.

b. Perform an air leak, vacuum box, penetrating oil, tracer gas, or other applicable non destructive test of the repaired welds. (Refer to Appendix F—NDE Requirements Summary).

As an alternative to (b), conduct a flotation test of the repaired roof.

Examination and acceptance criteria for NDT shall be in accordance with 12.1.

12.2 RADIOGRAPHS

12.2.1 Number and Location of Radiographs

The number and location of radiographs shall be in accordance with API Std 650 and the following additional requirements:

12.2.1.1 For vertical joints:

a. New replacement shell plates to new shell plates, no additional radiographs required, other than those required by API Std 650 for new construction.

b. New replacement shell plates to existing shell plates, one additional radiograph shall be taken in each joint.

c. Repaired joints in existing shell plates shall have one additional radiograph taken in each joint.