

Storage Tank Visual Inspection Report

Equip Id	62066526	SAP ID	62066526	Asset Type	Storage Tank
Plant	Lloydminster Production	Unit	H1-01-006 MORGAN	System	00002 MORGAN 10-34-051-04W4 TREATING FACILITY
Description	TANK, FIELD 3000 BBL				
FLOC	H1-01-006-00002	LSD	10-34-051-04W4		
Insp Date	Jun 14, 2016	Inspector	Ranger Inspections Ltd.	Insp Type	VIExt
Company	Inspector-Lead	Confidence	Low		

Details

ID	Description	Condition	Location	NCR	Comment
T6	Ladder/Stairway	Fair			Acceptable
T7	Platform	Fair			Acceptable
T8	Electrical Ground	Yes			Acceptable
T11	Coating/Painting	Fair			Some minor surface rust observed.
T12	Level Gauge	Yes			Acceptable
T13	Bottom	Fair			Acceptable
T14	Secondary Containment	No			
T15	Shell	Fair			Acceptable
T16	Roof	Fair			Acceptable
T32	Foundation	Fair			Some minor erosion observed.
T41	Connections Other (Please explain)	Fair			Associated Piping - Acceptable
T43	Nozzles	Fair			Acceptable
T46	Manways/Hatches	Fair			Acceptable
T47	Reinforcing Pads	Fair			Acceptable
T49	Bolting	Fair			Acceptable
T50	Flanges	Fair			Acceptable

Summary

This tank was inspected by Ranger Inspections Ltd. Recommendations and Inspection Intervals are the results of interpreting the data Ranger collected (UT readings) and comments made. For complete details see Rangers Report for Job #22669. The tanks external surfaces were visually inspected and found to be in fair condition. This tank is not insulated however the tank has been painted with the paint found to be peeling at several locations allowing the exposed surfaces to rust. The tank base is in fair condition although there was some minor erosion noted at time of inspection. In addition there is NO LINER beneath the tank floor. The tank's associated piping was found to be properly aligned and well supported.

Recommendations:

Consideration should be given to repainting the tanks external surfaces.
Monitor the erosion observed of the tank base.

See attached Internal Visual Inspection report for additional details and recommendations.

cc: Marc Case. Jessica Derouin, Lyle Nerbas

Storage Tank Visual Inspection Report

Equip ID 62066526 **SAP ID** 62066526 **Asset Type** Storage Tank
Plant Lloydminster Production **Unit** H1-01-006 MORGAN **System** 00002 MORGAN
10-34-051-04W4
TREATING
FACILITY
Description TANK, FIELD 3000 BBL
FLOC H1-01-006-00002 **LSD** 10-34-051-04W4
Insp Date Jun 14, 2016 **Inspector** Ranger Inspections **Insp Type** VIIInt
Company **Confidence** Medium

Details

ID	Description	Condition	Location	NCR	Comment
V2	Corrosion	Yes			Underside of tank floor.
V7	Welds	Fair			Acceptable
V8	Nozzles	Fair			Acceptable
V9	Shell	Fair			Acceptable
V10	Roof	Fair			Acceptable
V21	Internals Other (Please explain)	Yes			Internal Piping and Supports - Acceptable
V21	Internals Other (Please explain)	Yes			Centerpole - Acceptable
V27	Nonmetallic Linings	Yes			Only the floor and lower three feet of the tank shell have been coated - a few minor coating repairs were required.
T11	Floor	Fair			Acceptable

Summary

Visual inspection of the tanks internal surfaces revealed a few areas with minor mechanical damage to the coating. These areas were marked out for immediate repair and were repaired by Coatings 2000. NOTE: Only the floor and lower three feet of the tank shell are presently coated.

The internal piping and supports were found to be in fair to good condition.

The tanks center pole appeared to be in fair condition.

A Magnetic Flux Leakage (MFL) scan was performed on accessible areas of the tank floor. Six (6) indications of underside material loss were identified. The minimum thickness found was 0.218 inch including coating. The nominal thickness is 0.250 inch. No repairs were required at this time.

Recommendations:

Continue the Magnetic Flux Leakage (MFL) scan at the next scheduled inspection.

Monitor the condition of the internal coating at the next scheduled inspection.

cc: Marc Case, Jessica Derouin, Lyle Nerbass



62066526 Equipment Detail

Plant	Lloydminster Production	Unit	H1-01-006 MORGAN	System	00002 MORGAN 10-34-051-04W4 TREATING FACILITY
SAP ID	62066526	Equip Id	62066526	Asset Type	Storage Tank
Description	TANK, FIELD 3000 BBL				
Manuf.	UNIVERSAL INDUSTRIES	Serial #	97-06-03-10383	Year Built	1997
Const Code		Int.Access		Prov #	
Cost Ctr		FLOC	H1-01-006-00002	LSD	10-34-051-04W4
Time Based	Y	Opt RI Grp	AST Cat 1a	CRN	
User Status	ISF	Sys Status	INST	Active	Y

Equipment Protection

Inspections

Insp Type	Method	Insp Date	Inspection	Company	Confidence
VIInt		Jun 14, 2016	Ranger Inspections		Medium
VIExt		Jun 14, 2016	Ranger Inspections Ltd.	Inspector-Lead	Low
VIInt		Aug 10, 2011	IRIS NDT		Medium
VIExt		Aug 10, 2011	IRIS NDT		Medium

Inspection Plan

Planned By: Ray Trachuk **Planning Date:** Jul 05, 2016

Dmg Mech	Method	Due Date	Freq	SAP Not #	SAP W.O. #
External Deterioration	VI-Ext	Jun 13, 2021	5		
Internal Corrosion	VI-Int	Jun 13, 2021	5		
Internal Corrosion	UT	Jun 13, 2021	5		









**ABOVE GROUND STORAGE TANK
API STANDARD 653
OUT-OF-SERVICE
FINAL INSPECTION REPORT
RANGER INSPECTION™
JOB # 22669
(Revision 1)**

HUSKY ENERGY

**MORGAN BATTERY
LSD: 10-34-051-04 W4M**

TANK # T-106A

INSPECTION DATE: JUNE 14 / 2016

Prepared by:



**#130 – 11051 – 50th Street SE
Calgary, Alberta Canada T2C 3E5
Tel: (403) 252-4487 Fax: (403) 257-4756
www.rangerinspection.com**

EXECUTIVE SUMMARY

The following is a summary of the major findings of the out-of-service inspection performed on Tank # T-106A:

BOTTOM

- 1.) A Magnetic Flux Leakage (MFL) scan was performed on accessible areas of the tank bottom plate. Six (6) indications of underside material loss were identified.
- 2.) Resulting MFL indications were additionally evaluated with ultrasonics (UT). The minimum thickness found was 0.218 inch including coating. The nominal thickness is 0.250 inch.
- 3.) Nine (9) areas of coating failure were identified and marked on the tank bottom plate (just inside the manway).

SHELL-TO-BOTTOM WELD INSPECTION RESULTS AND EVALUATION

- 1.) The shell-to-bottom weld was visually examined internally and externally from accessible areas. The weld was observed to be coated and in acceptable condition at the period of this inspection.

FOUNDATION

- 1.) The foundation was visually examined from accessible areas. The tank was observed to be resting within an elevated metal ring on an earth and gravel foundation.
- 2.) Erosion was observed beneath the bottom plate projection, extending beneath the shell plate, over approximately 60% of the perimeter of the tank. The worst area of erosion was located beneath the piping on the south side of the tank and extended 18 inches beneath the bottom.
- 3.) No berm was observed; however, there is a low point in the battery in the northwest corner that would collect any product if it were to leak.

SHELL

- 1.) The shell plate was visually examined. No significant deformations were observed. Minor areas of coating failures and oxidation were observed throughout.
- 2.) Minor shell plate deflection was observed where the piping is connected to the tank
- 3.) Random ultrasonic thickness (UT) readings were taken on the first course shell plate. No significant material loss was observed or recorded. Refer to Table A - Manual UT Shell Plate Readings – Course # 1, for additional data.
- 4.) Ultrasonic thickness (UT) readings were taken on the accessible shell plate from the vertical ladder. Eight (8) readings were taken per course. No significant material loss was observed or recorded. Refer to Table B - Manual UT Shell Plate Readings – Ladder, for additional data.

NOZZLES AND APPURTENANCES

- 1.) The tank nozzles and appurtenances were visually examined. Inspection was limited, in areas, due to insulation.
- 2.) The 4 inch Ø nozzle, located beside the manway, was observed to have improper reinforcing plate weld spacing. No areas of concern could visibly be seen in this area.
- 3.) Internally, ten (10) areas of coating failure were observed on the manway neck to shell welds.

FIXED ROOF

- 1.) The roof plate was observed to have coating failures and oxidation throughout. In addition, areas of pooling water were observed around the perimeter.
- 2.) Ultrasonic thickness (UT) readings were taken on the fixed roof from the vertical ladder. No significant material loss was observed or recorded. Eight (8) readings were taken on the fixed roof. Refer to Table C - Fixed Roof Ultrasonic Thickness Readings, for additional data.
- 3.) The fixed roof support structure was visually evaluated internally from accessible areas. No areas of concern were identified.

REPAIR RECOMMENDATIONS

BOTTOM

- 1.) It is recommended to repair the nine (9) coating failures.

SHELL-TO-BOTTOM WELD

- 1.) No shell-to-bottom weld repairs are recommended at the period of this inspection.

FOUNDATION

- 1.) It is recommended to repack the foundation beneath the tank bottom to prevent unnecessary settlement of the tank.

SHELL

- 1.) No shell repairs are recommended at the period of this inspection.

NOZZLES AND APPURTENANCES

- 1.) It is recommended to periodically inspect the out of compliance reinforcing plate on the 4 inch Ø nozzle for future signs of product staining.
- 2.) It is recommended to repair the ten (10) areas of coating failure on the manway.

FIXED ROOF

- 1.) No fixed roof repairs are recommended at the period of this inspection.

SUMMARY CALCULATIONS

$$MRT = (\text{Minimum of } RT_{BC} \text{ or } RT_{ip}) - O_r (StP_r + UP_r)$$

Where:

MRT = minimum remaining thickness at the end of interval O_r .

O_r = in service interval of operation (as specified by owner or governed by inspection results).

RT_{BC} = minimum remaining thickness from bottom side corrosion.

RT_{ip} = minimum remaining thickness from internal corrosion.

StP_r = maximum rate of corrosion not repaired on the top side. $StP_r = 0$ for coated areas of the bottom.

UP_r = maximum rate of corrosion on the bottom side.

$StP_r = (\text{nominal thickness} - RT_{ip}) / (\text{Age of tank})$

$UP_r = (\text{nominal thickness} - RT_{BC}) / (\text{Age of tank})$

The bottom plate of Tank # T-106A is 19 years old.

RESULTS WITHOUT REPAIRS			RESULTS AFTER RECOMMENDED REPAIRS	
RT_{BC}	0.218 (with coating) 0.188 (without coating)	inch	N/A	inch
RT_{ip}	0.250	inch	N/A	inch
O_r	5	years	N/A	years
StP_r	0	inch/yr	N/A	inch/yr
UP_r	0.00326	inch/yr	N/A	inch/yr
MRT	0.172	inch	N/A	inch
Required Thickness at O_r	0.100	inch	N/A	inch

As per the above calculated data no bottom plate repairs were identified in the repair recommendations on the previous page.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
REPAIR RECOMMENDATIONS.....	4
SUMMARY CALCULATIONS	5
1. INTRODUCTION.....	10
2. JOB DESCRIPTION.....	11
3. TANK DESCRIPTION	12
4. FITNESS FOR SERVICE	13
5. OVERVIEW	14
5.1 OVERALL INSPECTION CHECKLIST	14
5.2 OVERVIEW PHOTOGRAPHS.....	15
6. BOTTOM.....	18
6.1 BOTTOM CHECKLIST	18
6.2 BOTTOM PLATE LAYOUT DRAWINGS	19
6.3 BOTTOM PHOTOGRAPHS.....	21
7. FOUNDATION.....	26
7.1 FOUNDATION CHECKLIST	26
7.2 FOUNDATION PHOTOGRAPHS	28
8. SHELL	29
8.1 SHELL CHECKLIST	29
8.2 SHELL ULTRASONIC THICKNESS READINGS	30
8.3 SHELL PLATE PHOTOGRAPHS	32
9. NOZZLES AND APPURTENANCES	34
9.1 NOZZLE AND APPURTENANCE IN-SERVICE CHECKLIST	34
9.2 TANK APPURTENANCE OUT-OF-SERVICE CHECKLIST	35
9.3 ACCESS STRUCTURES CHECKLIST	36
9.4 NOZZLES AND APPURTENANCES PHOTOGRAPHS.....	37
10. FIXED ROOF	46
10.1 FIXED ROOF CHECKLIST	46
10.2 FIXED ROOF ULTRASONIC THICKNESS READINGS	48
10.3 FIXED ROOF PHOTOGRAPHS.....	49
11. LIMITATIONS TO NDE EXAMINATION	54
12. NDE EQUIPMENT	55
13. WARRANTY	56

LIST OF TABLES

TABLE A -	MANUAL UT SHELL PLATE READINGS – COURSE # 1	30
TABLE B -	MANUAL UT SHELL PLATE READINGS – LADDER.....	31
TABLE C -	FIXED ROOF ULTRASONIC THICKNESS READINGS	48

LIST OF PHOTOGRAPHS

Photograph #1:	Morgan Battery LSD: 10-34-051-04 W4M	15
Photograph #2:	Tank ID: T-106A	15
Photograph #3:	Nameplate	16
Photograph #4:	Overview	16
Photograph #5:	Overview	17
Photograph #6:	External Shell-to-Bottom Weld	21
Photograph #7:	Internal Shell-to-Bottom Weld	21
Photograph #8:	Bottom Overview	22
Photograph #9:	Bottom Overview	22
Photograph #10:	Bottom Overview.....	23
Photograph #11:	Lap Welded Bottom Plate	23
Photograph #12:	Coating Failures	24
Photograph #13:	MFL Indications.....	24
Photograph #14:	MFL Indication Minimum UT = 0.218 inch	25
Photograph #15:	Elevated Foundation	28
Photograph #16:	Void Beneath Tank	28
Photograph #17:	Shell Plate	32
Photograph #18:	Butt Welded Shell Plate	32
Photograph #19:	Oxidation on Shell Plate.....	33
Photograph #20:	Internal Shell Plate.....	33
Photograph #21:	Nameplate Manway	37
Photograph #22:	Insulated Nozzle	37
Photograph #23:	Nozzles / Vertical Ladder	38
Photograph #24:	Gauge Board.....	38
Photograph #25:	Temperature Gauge.....	39
Photograph #26:	Piping	39
Photograph #27:	Nozzles	40
Photograph #28:	Nozzle	40
Photograph #29:	WDO	41
Photograph #30:	Internal of Manway.....	41

Photograph #31: Coating Failures on Manway	42
Photograph #32: Float Clips	42
Photograph #33: Internal Nozzles	43
Photograph #34: Internal Piping	43
Photograph #35: Nozzle	44
Photograph #36: Piping	44
Photograph #37: Diffuser.....	45
Photograph #38: Roof Overview	49
Photograph #39: Roof Overview	49
Photograph #40: Roof Overview	50
Photograph #41: Pooling Water around Perimeter of Roof	50
Photograph #42: Roof Nozzles.....	51
Photograph #43: Gauge Hatch.....	51
Photograph #44: Roof Platform	52
Photograph #45: Column Base	52
Photograph #46: Underside Of Fixed Roof	53

1. INTRODUCTION

Husky Energy contracted with Ranger Inspection™ to provide API Standard 653 inspection services for the above ground storage tank # T-106A as per the Husky Energy representative Mr. Marc Case.

Ranger Inspection™ job number 22669.

The tank is located at the Morgan Battery, LSD: 10-34-051-04 W4M.

This report documents the findings of the out-of-service examinations performed on June 14 / 2016 and provides an evaluation of the inspection results per the applicable criteria of API Standard 653.

Ranger Inspection™ provided the following personnel:

William Meldrum

Project Manager / API Inspector / NACE Level II / Report Author
API 653 Certification #39083
NACE Certification #50049

Kyle Christensen

MFE Operator

Jennifer Thompson

Technical Report Writer / AutoCAD Draftsperson

2. JOB DESCRIPTION

RANGER JOB NUMBER:	<ul style="list-style-type: none">• 22669
RANGER TAG NUMBER:	<ul style="list-style-type: none">• 13156
TANK NUMBER:	<ul style="list-style-type: none">• T-106A
TANK LOCATION:	<ul style="list-style-type: none">• Morgan Battery• LSD: 10-34-051-04 W4M
TANK OWNER:	<ul style="list-style-type: none">• Husky Energy
CUSTOMER CONTACT:	<ul style="list-style-type: none">• Marc Case• Husky Energy• Phone: 780-205-2377• Email: marc.case@huskyenergy.com
SCOPE OF INSPECTION:	<ul style="list-style-type: none">• API 653 Out-of-Service
API INSPECTION DATE:	<ul style="list-style-type: none">• June 14 / 2016
REVISION DATE:	<ul style="list-style-type: none">• Wednesday, June 22, 2016
API INSPECTION COMPANY:	<ul style="list-style-type: none">• Ranger Inspection™• #130 – 11051 – 50th Street SE• Calgary, Alberta• Canada T2C 3E5• Bus: 403-252-4487• Fax: 403-257-4756• www.rangerinspection.com
API STANDARD 653 INSPECTOR:	<ul style="list-style-type: none">• William Meldrum• Certification # 39083

3. TANK DESCRIPTION

Nameplate Details	TANK NUMBER / ID:	• T-106A
	RANGER TAG NUMBER:	• 13156
	TANK MANUFACTURER'S SERIAL NUMBER:	• 97 060310383
	MANUFACTURER:	• Universal Industries
	TANK OWNER / OPERATOR:	• Husky Energy
	NAMEPLATE PRESENT:	• Yes
	DESIGN STD:	• API, Edition 1993
	YEAR BUILT:	• 1997
	TANK LOCATION:	• Morgan Battery • LSD: 10-34-051-04 W4M
	SERVICE:	• Sweet Crude Oil
	DIAMETER:	• 30 feet
	HEIGHT:	• 24 feet
	NOMINAL CAPACITY:	• 3000 BBL
	DESIGN PRESSURE:	• ATM

Tank Geometry	FOUNDATION DETAIL:		<ul style="list-style-type: none">Elevated earth and gravel in metal ring
	BOTTOM PLATES:		<ul style="list-style-type: none">Bottom Plate Projection = 2 to 3 inchesWeld Detail = Lap weldedNominal Plate Thickness = 0.250 inch
	SHELL PLATES:		<ul style="list-style-type: none">Weld Detail = Butt welded
	SHELL COURSE UT:	Course	Thickness (inches)
		1	0.185 to 0.207
		2	0.204 to 0.208
		3	0.206 to 0.214
	FIXED ROOF:		<ul style="list-style-type: none">Weld Detail = Lap weldedPlate Thickness = 0.188 inch
FIXED ROOF ACCESS:		<ul style="list-style-type: none">Vertical Ladder	

Coating Details	BOTTOM PLATE COATING:	• Internal Coating = Epoxy
	SHELL PLATE COATING:	• Internal Coating = Epoxy • External Coating = Paint
	FIXED ROOF PLATE COATING:	• Internal Coating = Unknown • External Coating = Paint

4. FITNESS FOR SERVICE

Based on the findings of this inspection, Tank # T-106A is fit to be returned to service upon completion of the recommended repairs as documented in this report. All required post repair NDE as specified in applicable codes and standards shall be performed and documented.

William Meldrum

API Standard 653 Inspector

Certification # 39083

5. OVERVIEW

5.1 OVERALL INSPECTION CHECKLIST

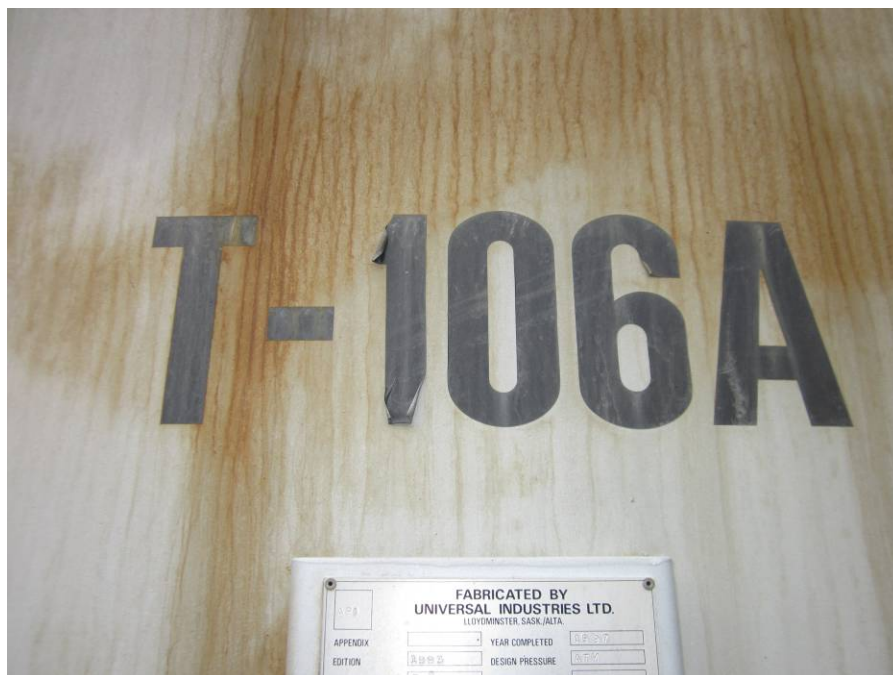
✓	✖	N/A	#	Description	Comments
✓			1	Check that tank has been cleaned, is gas free, and safe for entry.	• Acceptable
✓			2	Check that the tank is completely isolated from product lines, all electrical power, and steam lines.	• Acceptable
✓			3	Check that roof is adequately supported, including fixed roof structure and floating roof legs.	• Acceptable
✓			4	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.	• Acceptable
✓			5	Inspect for slipping hazards on the bottom and roof decks.	• Acceptable
		N/A	6	Inspect structural welds on access ways and clips.	• N/A
✓			7	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note the areas in need of additional cleaning, including blasting.	• Acceptable
✓ = In – Compliance / Acceptable				✖ = Out of Compliance / Area of Concern	N/A = Not Applicable

5.2 OVERVIEW PHOTOGRAPHS

The following digital photographs of the tank were taken at the period of this inspection:



Photograph #1: Morgan Battery | LSD: 10-34-051-04 W4M



Photograph #2: Tank ID: T-106A



Photograph #3: Nameplate



Photograph #4: Overview



Photograph #5: Overview

6. BOTTOM

6.1 BOTTOM CHECKLIST

✓	✗	N/A	#	Description	Comments
✓			1	Nominal bottom plate thickness.	<ul style="list-style-type: none"> 0.250 inch
✓			2	Minimum remaining material thickness of bottom plates (UT reading). <input checked="" type="checkbox"/> UT THROUGH COATING / <input type="checkbox"/> UT ON BARE STEEL	<ul style="list-style-type: none"> 0.218 inch (with coating) 0.188 inch (without coating)
✓			3	Maximum product side pit depth on bottom plates.	<ul style="list-style-type: none"> No pitting observed
✓			4	Coating thickness and detail on bottom plates. (Fiberglass or Epoxy).	<ul style="list-style-type: none"> Epoxy 10 to 16 mils
	✗		5	Inspect coating for holes, disbonding, deterioration, and discoloration.	<ul style="list-style-type: none"> Nine (9) coating failures
✓			6	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide—visually inspect and hammer test the entire region.	<ul style="list-style-type: none"> MFL / UT performed
		N/A	7	Measure the depth of pitting and describe the pitting appearance. (sharp edged, lake type, dense, scattered, etc.)	<ul style="list-style-type: none"> N/A
✓			8	Mark areas requiring patching or further inspection.	<ul style="list-style-type: none"> Refer to Bottom Plate Layout drawing
✓			9	Mark locations for turning coupons for inspection.	<ul style="list-style-type: none"> Refer to Bottom Plate Layout drawing
✓			10	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld.	<ul style="list-style-type: none"> Coated Acceptable
		N/A	11	Inspect sketch plates for corrosion.	<ul style="list-style-type: none"> N/A
		N/A	12	Check condition of internal sump, if applicable. Sump bottom and sidewall plate and seams need to be evaluated for both product-side and soil-side corrosion.	<ul style="list-style-type: none"> N/A
	✗		13	Locate and mark voids under the bottom.	<ul style="list-style-type: none"> Voids around perimeter due to erosion
✓			14	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required.	<ul style="list-style-type: none"> Refer to Bottom Plate Layout drawing
		N/A	15	Vacuum test the bottom lap welds.	<ul style="list-style-type: none"> N/A
		N/A	16	Hammer test or ultrasonically examine any slightly discolored spots or damp areas.	<ul style="list-style-type: none"> N/A
		N/A	17	Check for reinforcing pads under all bottom attached clips, brackets and supports.	<ul style="list-style-type: none"> N/A
✓			18	Check the column bases of fixed roof supports for adequate pads and restraining clips.	<ul style="list-style-type: none"> Present
	✗		19	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank bottom, but are only restrained from horizontal movement.	<ul style="list-style-type: none"> Welded directly to reinforcing pad
		N/A	20	Mark old oil and air test connection for removal and patching.	<ul style="list-style-type: none"> N/A
✓			21	Identify and report low areas on the bottom that do not drain adequately.	<ul style="list-style-type: none"> Acceptable
✓			22	Bottom plate slope (Flat, cone-up, cone-down).	<ul style="list-style-type: none"> Flat
✓ = In – Compliance / Acceptable				✗ = Out of Compliance / Area of Concern	N/A = Not Applicable

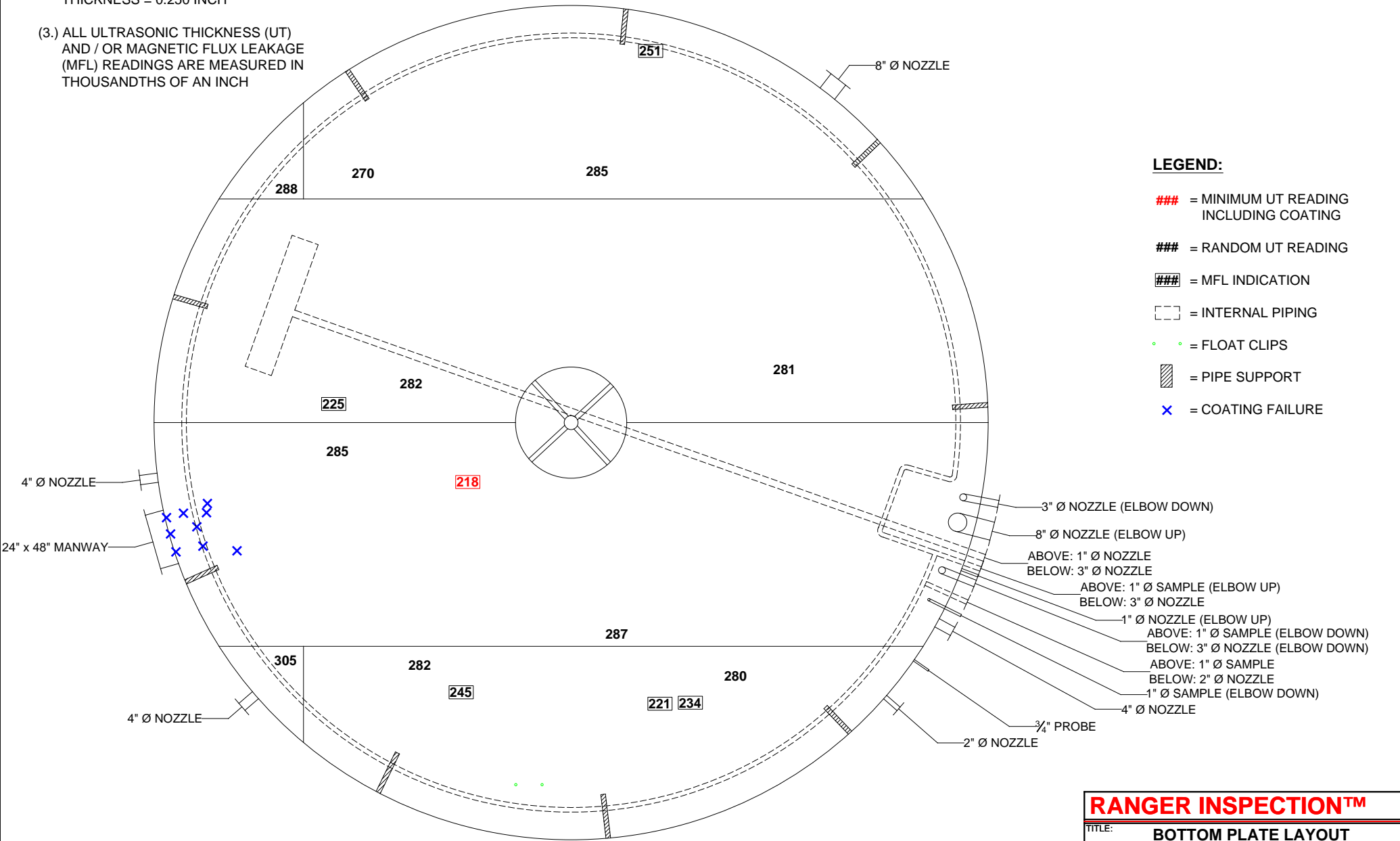
6.2 BOTTOM PLATE LAYOUT DRAWINGS

LIST OF BOTTOM PLATE DRAWINGS

Drawing # 1 of 1 – Bottom Plate Layout

NOTES:

- (1.) DRAWING IS NOT TO SCALE
- (2.) BOTTOM PLATE NOMINAL THICKNESS = 0.250 INCH
- (3.) ALL ULTRASONIC THICKNESS (UT) AND / OR MAGNETIC FLUX LEAKAGE (MFL) READINGS ARE MEASURED IN THOUSANDTHS OF AN INCH



RANGER INSPECTION™			
TITLE:		BOTTOM PLATE LAYOUT	
CUSTOMER:		HUSKY ENERGY	
TANK NO:		T-106A	JOB NO: 22669
LOCATION: MORGAN BATTERY			
SIZE: 30' Ø		DATE: JUN. 14 / 16	
DRAWN BY: KAC/JT		PAGE: 1 OF 1	

6.3 BOTTOM PHOTOGRAPHS

The following digital photographs of the bottom were taken at the period of this inspection:



Photograph #6: External Shell-to-Bottom Weld



Photograph #7: Internal Shell-to-Bottom Weld



Photograph #8: Bottom Overview



Photograph #9: Bottom Overview



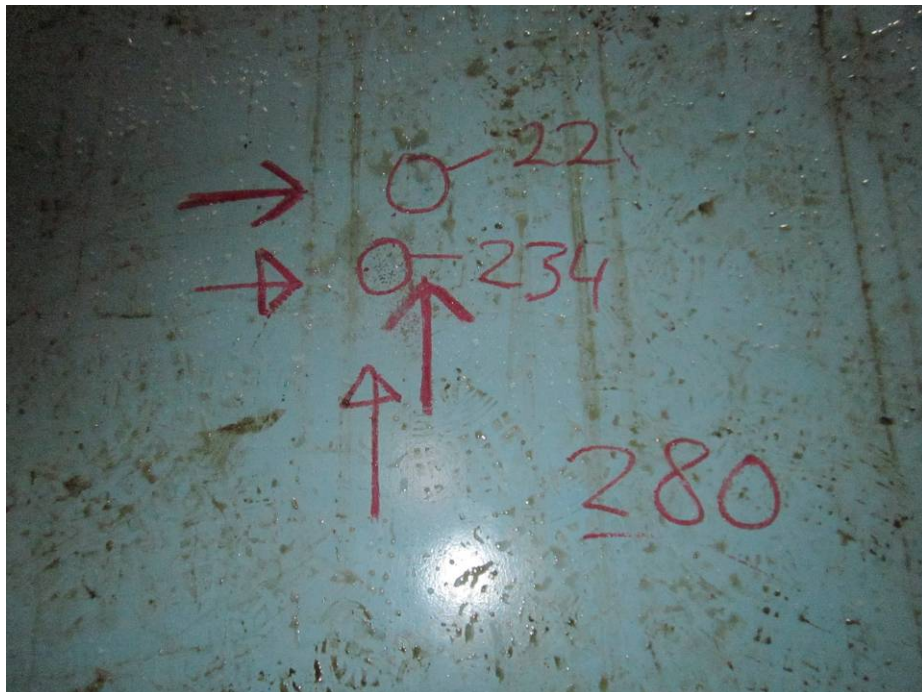
Photograph #10:Bottom Overview



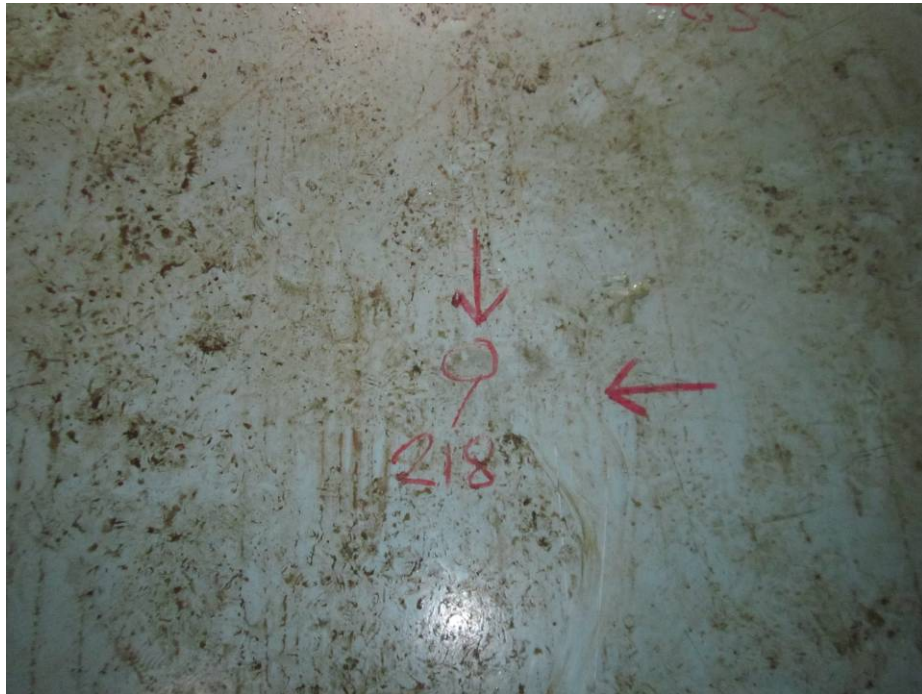
Photograph #11:Lap Welded Bottom Plate



Photograph #12: Coating Failures



Photograph #13: MFL Indications



Photograph #14:MFL Indication | Minimum UT = 0.218 inch

7. FOUNDATION

7.1 FOUNDATION CHECKLIST

✓	✕	N/A	#	Description	Comments
A. External Foundation					
✓			1	Measure foundation levelness and bottom evaluations (see API Standard 653, Annex B for extent of measurements).	<ul style="list-style-type: none"> Visually acceptable
		N/A	2	Shared or Single cell berm.	<ul style="list-style-type: none"> N/A None present
		N/A	3	Condition of sloped berm walls.	<ul style="list-style-type: none"> N/A None present
		N/A	4	Condition of concrete berm.	<ul style="list-style-type: none"> N/A
		N/A	5	Condition of secondary liner.	<ul style="list-style-type: none"> N/A
✓			6	Elevation of tank above grade of foundation.	<ul style="list-style-type: none"> Acceptable
		N/A	7	Condition of asphalt skirt.	<ul style="list-style-type: none"> N/A
		N/A	8	Inspect the bottom-to-foundation seal, if present.	<ul style="list-style-type: none"> N/A
✓			9	Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.	<ul style="list-style-type: none"> Visually acceptable in sample areas
B. Internal Foundation					
		N/A	10	Bottom plate edge settlement.	<ul style="list-style-type: none"> N/A
		N/A	11	Distance to break over point	<ul style="list-style-type: none"> N/A
		N/A	12	Allowable bottom plate edge settlement	<ul style="list-style-type: none"> N/A
		N/A	13	75% of maximum allowable bottom plate edge settlement.	<ul style="list-style-type: none"> N/A
C. Concrete Ring					
		N/A	14	Inspect for broken concrete, spalling, and cracks; particularly under backup bars used in welding butt-welded annular rings under the shell.	<ul style="list-style-type: none"> N/A
		N/A	15	Trough present around perimeter of bottom plate?	<ul style="list-style-type: none"> N/A
		N/A	16	Inspect drain openings in ring, back of waterdraw basins and top surface of ring for indications of bottom leakage.	<ul style="list-style-type: none"> N/A
		N/A	17	Inspect for cavities under foundation and vegetation against bottom of tank.	<ul style="list-style-type: none"> N/A
		N/A	18	Check that runoff rainwater from the shell drains away from the tank.	<ul style="list-style-type: none"> N/A
		N/A	19	Check for settlement around perimeter of tank.	<ul style="list-style-type: none"> N/A
✓ = In – Compliance / Acceptable				✕ = Out of Compliance / Area of Concern	N/A = Not Applicable

Continuation of the Foundation Checklist

✓	✖	N/A	#	Description	Comments
D. Asphalt					
		N/A	20	Check for settling of tank into asphalt base which would direct runoff rain water under the tank instead of away from it.	• N/A
		N/A	21	Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.	• N/A
E. Oiled Dirt or Sand					
✓			22	Check for settlement into the base which would direct runoff rain water under the tank rather than away from it.	• Acceptable
F. Rock					
✓			23	Presence of crushed rock under the steel bottom usually results in severe underside material loss. Make a note to do additional bottom plate examination (ultrasonic, hammer testing, or turning of coupons) when the tank is out-of-service.	• MFL / UT performed
G. Site Drainage					
✓			24	Check site for drainage away from the tank and associated piping and manifolds.	• Acceptable
		N/A	25	Check operating condition of the dike drains.	• N/A
H. Housekeeping					
✓			26	Inspect the area for buildup of trash, vegetation, and other inflammables.	• Acceptable
✓ = In – Compliance / Acceptable				✖ = Out of Compliance / Area of Concern	N/A = Not Applicable

7.2 FOUNDATION PHOTOGRAPHS

The following digital photographs of the foundation were taken at the period of this inspection:



Photograph #15:Elevated Foundation



Photograph #16:Void Beneath Tank

8. SHELL

8.1 SHELL CHECKLIST

✓	✖	N/A	#	Description	Comments
✓			1	THICKNESS RANGE RECORDED: (Through Coating)	<ul style="list-style-type: none"> Course # 1: 0.185 to 0.207 inch Course # 2: 0.204 to 0.208 inch Course # 3: 0.206 to 0.214 inch
A. Visual Inspection					
✓			2	Internal coating detail.	<ul style="list-style-type: none"> Epoxy
✓			3	External coating detail.	<ul style="list-style-type: none"> Paint
✓			4	Bulging / shell plate deformation.	<ul style="list-style-type: none"> Minor deflections around piping
✓			5	Peaking and banding.	<ul style="list-style-type: none"> Acceptable
		N/A	6	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 inches to 4 inches of the shell (area of standing water).	<ul style="list-style-type: none"> N/A Flat
✓			7	Measure the depth of pitting on each course.	<ul style="list-style-type: none"> No pitting observed
		N/A	8	Inspect and estimate the amount of metal loss on the heads of rivets and bolts.	<ul style="list-style-type: none"> N/A
		N/A	9	Inspect shell-to-bottom riveted lap joints.	<ul style="list-style-type: none"> N/A
✓			10	Inspect existing protective coatings for damage, deterioration, and disbonding.	<ul style="list-style-type: none"> Acceptable
✓			11	Visually inspect the shell plates and seams for indications of leakage.	<ul style="list-style-type: none"> Acceptable
		N/A	12	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting.	<ul style="list-style-type: none"> N/A
✓			13	Survey the shell to check for roundness and plumbness.	<ul style="list-style-type: none"> Visually acceptable
		N/A	14	Inspect overflow for corrosion and adequate screening.	<ul style="list-style-type: none"> N/A
		N/A	15	Check location of overflow that it is not above any tank valves or equipment.	<ul style="list-style-type: none"> N/A
✓ = In – Compliance / Acceptable				✖ = Out of Compliance / Area of Concern	N/A = Not Applicable

8.2 SHELL ULTRASONIC THICKNESS READINGS

TABLE A - MANUAL UT SHELL PLATE READINGS – COURSE # 1 (inches)								
<input type="checkbox"/> UT ON BARE STEEL			<input checked="" type="checkbox"/> UT THROUGH COATING			COATING THICKNESS RANGE 2 TO 3 MILS		
PLATE NO. / ID	1	2	3	4	5	6	7	8
1	0.191	0.190	0.189	0.192	0.188	0.190	0.193	0.190
2	0.190	0.188	0.185	0.191	0.194	0.190	0.189	0.192
3	0.192	0.196	0.195	0.193	0.191	0.194	0.193	0.194
Minimum:	0.185							
Maximum:	0.196							

Notes:

1.) PLATE NO/ID #1 = Reference Manway Item A.

TABLE B - MANUAL UT SHELL PLATE READINGS – LADDER (inches)			
<input type="checkbox"/> UT ON BARE STEEL <input checked="" type="checkbox"/> UT THROUGH COATING COATING THICKNESS RANGE 2 TO 3 MILS			
Reading No.	Course 1	Course 2	Course 3
1	0.203	0.205	0.210
2	0.202	0.205	0.209
3	0.206	0.205	0.214
4	0.205	0.204	0.209
5	0.206	0.208	0.214
6	0.203	0.205	0.213
7	0.207	0.204	0.206
8	0.206	0.207	0.208
Minimum:	0.202	0.204	0.206
Maximum:	0.207	0.208	0.214

8.3 SHELL PLATE PHOTOGRAPHS

The following digital photographs of the shell were taken at the period of this inspection:



Photograph #17: Shell Plate



Photograph #18: Butt Welded Shell Plate



Photograph #19:Oxidation on Shell Plate



Photograph #20:Internal Shell Plate

9. NOZZLES AND APPURTENANCES

9.1 NOZZLE AND APPURTENANCE IN-SERVICE CHECKLIST

✓	✖	N/A	#	Description	Comments
A. Manways and Nozzles					
✓			1	Inspect for cracks or signs of leakage on weld joint at nozzles, manways, and reinforcing plates.	<ul style="list-style-type: none"> Exposed areas acceptable
	✖		2	Inspect for shell plate dimpling around nozzles, caused by excessive pipe deflection.	<ul style="list-style-type: none"> Some deflection around some nozzles
		N/A	3	Inspect for flange leaks and leaks around bolting.	<ul style="list-style-type: none"> N/A OOS inspection
		N/A	4	Inspect sealing of insulation around manways and nozzles.	<ul style="list-style-type: none"> N/A
✓			5	Check for inadequate manway flange and cover thickness on mixer manways.	<ul style="list-style-type: none"> Acceptable
B. Tank Piping Manifolds					
		N/A	6	Inspect manifold piping, flanges and valves for leaks.	<ul style="list-style-type: none"> N/A OOS inspection
		N/A	7	Inspect fire fighting system components.	<ul style="list-style-type: none"> N/A
✓			8	Check for anchored piping which would be hazardous to the tank shell or bottom connections during earth movement.	<ul style="list-style-type: none"> Visually acceptable
✓			9	Check sample connections for leaks and for proper valve operation.	<ul style="list-style-type: none"> Present
✓			10	Check for damage and test the accuracy of temperature indicators.	<ul style="list-style-type: none"> Present
C. Autogauge System					
		N/A	11	Inspect autogauge tape guide and lower sheave housing (floating swings) for leaks.	<ul style="list-style-type: none"> N/A
		N/A	12	Inspect autogauge head for damage.	<ul style="list-style-type: none"> N/A
		N/A	13	Bump the checker on autogauge head for proper movement of tape.	<ul style="list-style-type: none"> N/A
✓			14	Inspect condition of board and legibility of board-type autogauges.	<ul style="list-style-type: none"> Visually acceptable
✓ = In – Compliance / Acceptable				✖ = Out of Compliance / Area of Concern	N/A = Not Applicable

9.2 TANK APPURTENANCE OUT-OF-SERVICE CHECKLIST

✓	✕	N/A	#	Description	Comments
A. Sampling Systems: Roof Sample Hatches					
	✕		1	Inspect roof-mounted sample hatches for reinforcing pads and cracking.	<ul style="list-style-type: none"> No reinforcing pad present
✓			2	Inspect cover for operation.	<ul style="list-style-type: none"> Acceptable
	✕		3	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing.	<ul style="list-style-type: none"> Deteriorated seal
B. Shell Nozzles					
✓			4	Inspect shell nozzles for thinning and pitting.	<ul style="list-style-type: none"> Visually acceptable
		N/A	5	Inspect hot tap nozzles for trimming of holes.	<ul style="list-style-type: none"> N/A
✓			6	Identify type of shell nozzles.	<ul style="list-style-type: none"> Refer to photographs and Bottom Plate Layout drawing
✓			7	Identify and describe internal piping, including elbow-up and elbow-down types.	<ul style="list-style-type: none"> Refer to photographs
C. For Nozzles Extended into the Tank					
		N/A	8	Inspect pipe support pads welded to the tank bottom.	<ul style="list-style-type: none"> N/A
		N/A	9	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate.	<ul style="list-style-type: none"> N/A
		N/A	10	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom.	<ul style="list-style-type: none"> N/A
✓ = In – Compliance / Acceptable				✕ = Out of Compliance / Area of Concern	N/A = Not Applicable

9.3 ACCESS STRUCTURES CHECKLIST

✓	✖	N/A	#	Description	Comments
A. Handrails					
✓			1	Identify and report the type (steel pipe, galvanized pipe, square tube, or angle), and size of handrails.	<ul style="list-style-type: none"> Vertical ladder Visually acceptable
✓			2	Inspect for pitting, holes, and paint failure.	<ul style="list-style-type: none"> Visually acceptable
✓			3	Inspect attachment welds.	<ul style="list-style-type: none"> Exposed welds acceptable
✓			4	Identify cold joints and sharp edges. Inspect the handrails and midrails.	<ul style="list-style-type: none"> Visually acceptable
		N/A	5	Inspect safety drop bar (or safety chain) for corrosion, functioning, and length.	<ul style="list-style-type: none"> N/A
B. Platform Frame					
✓			6	Inspect frame for corrosion and paint failure.	<ul style="list-style-type: none"> Visually acceptable
✓			7	Inspect the attachment of frame to supports and supports to tank for corrosion weld failure.	<ul style="list-style-type: none"> Visually acceptable
✓			8	Check reinforcing pads where supports are attached to shell or fixed roof.	<ul style="list-style-type: none"> Visually acceptable
✓			9	Inspect the surface that deck plate or grating rests on, for thinning and holes.	<ul style="list-style-type: none"> Acceptable
✓			10	Check that flat-surface-to-flat-surface junctures are seal-welded.	<ul style="list-style-type: none"> Visually acceptable
C. Deck Plate and Grating					
✓			11	Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure.	<ul style="list-style-type: none"> Visually acceptable
✓			12	Inspect plate-to-frame weld for rust scale buildup.	<ul style="list-style-type: none"> Visually acceptable
✓			13	Inspect grating for corrosion-caused thinning of bars, and failure of welds.	<ul style="list-style-type: none"> Visually acceptable
✓ = In – Compliance / Acceptable				✖ = Out of Compliance / Area of Concern	N/A = Not Applicable

9.4 NOZZLES AND APPURTENANCES PHOTOGRAPHS

The following digital photographs of the nozzles and appurtenances were taken at the period of this inspection:



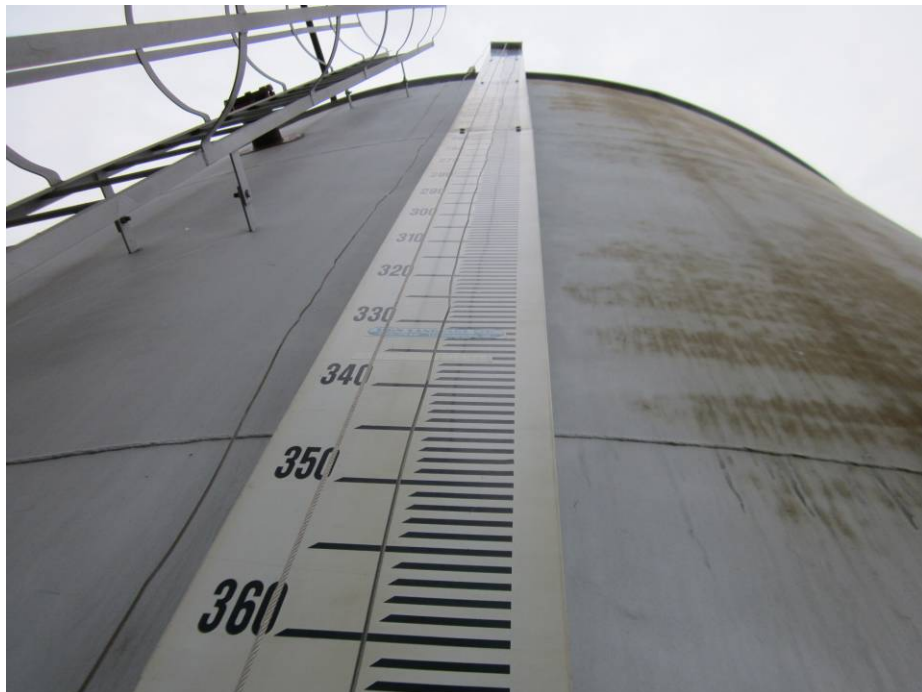
Photograph #21: Nameplate Manway



Photograph #22: Insulated Nozzle



Photograph #23: Nozzles / Vertical Ladder



Photograph #24: Gauge Board



Photograph #25: Temperature Gauge



Photograph #26: Piping



Photograph #27: Nozzles



Photograph #28: Nozzle



Photograph #29:WDO



Photograph #30:Internal of Manway



Photograph #31: Coating Failures on Manway



Photograph #32: Float Clips



Photograph #33:Internal Nozzles



Photograph #34:Internal Piping



Photograph #35: Nozzle



Photograph #36: Piping



Photograph #37: Diffuser

10. FIXED ROOF

10.1 FIXED ROOF CHECKLIST

✓	✘	N/A	#	Description	Comments
A. General					
✓			1	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting.	<ul style="list-style-type: none"> Visually acceptable from bottom
✓			2	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank.	<ul style="list-style-type: none"> Acceptable
✓			3	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free.	<ul style="list-style-type: none"> Visually acceptable
✓			4	Inspect for protective coating for breaks, disbondment, and deterioration.	<ul style="list-style-type: none"> Oxidation present externally Acceptable
		N/A	5	Spark test the interior surface coating if recoating is not planned.	<ul style="list-style-type: none"> N/A
✓			6	Photograph the roof structure if no rafter layout drawing exists.	<ul style="list-style-type: none"> Refer to photographs
B. Deck Plate External Corrosion					
✓			7	Visually inspect for paint failure, holes, pitting, and corrosion product on the roof deck.	<ul style="list-style-type: none"> Oxidation present externally Acceptable
C. Roof Deck Drainage					
	✘		8	Look for indication of standing water. (Significant sagging of fixed roof deck indicates potential rafter failure).	<ul style="list-style-type: none"> Pooling water around perimeter
D. Roof Insulation					
		N/A	9	Visually inspect for cracks or leaks in the insulation weather coat where runoff rain water could penetrate the insulation.	<ul style="list-style-type: none"> N/A
		N/A	10	Inspect for wet insulation under the weather coat.	<ul style="list-style-type: none"> N/A
		N/A	11	Remove small test sections of insulation and check roof deck for corrosion and holes near the edge of the insulated area.	<ul style="list-style-type: none"> N/A
✓ = In – Compliance / Acceptable				✘ = Out of Compliance / Area of Concern	N/A = Not Applicable

Continuation of the Fixed Roof Checklist

✓	✗	N/A	#	Description	Comments
E. Fixed Roof Support Structure					
✓			12	Inspect the support columns for thinning in the upper 2 ft.	• Visually acceptable from bottom
		N/A	13	On API columns (two channels welded together), check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded.	• N/A
✓			14	Check that the reinforcing pad on the bottom is seal-welded to the tank bottom with horizontal movement restraining clips welded to the pad.	• Welded as one solid structure
		N/A	15	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for drain opening in the bottom of the pipe.	• N/A • Unknown
✓			16	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss.	• Visually acceptable from bottom
✓			17	Check for loose or twisted rafters.	• Visually acceptable from bottom
		N/A	18	Inspect girders for thinning and check that they are attached securely to the top of the columns.	• N/A
		N/A	19	Inspect and report presence of any roof-mounted swing line bumpers.	• N/A
F. Sample Hatch					
✓			20	Inspect condition and functioning of sample hatch cover.	• Acceptable
	✗		21	On tanks governed by Air Quality Monitoring District rules, check for the condition of seal inside hatch cover.	• Deteriorated seal
✓			22	Check for corrosion and plugging on thief and gauge hatch cover.	• Visually acceptable
✓			23	Where sample hatch is used to reel gauge stock level, check for marker and tab stating hold-off distance.	• Present
	✗		24	Check for reinforcing pad where sample hatch pipe penetrates the roof deck.	• No reinforcing pad present
G. Breathers and Vents					
✓			25	Inspect and service the breather.	• Closed vent system
		N/A	26	Inspect screens on vents and breathers.	• N/A
✓ = In – Compliance / Acceptable				✗ = Out of Compliance / Area of Concern	N/A = Not Applicable

10.2 FIXED ROOF ULTRASONIC THICKNESS READINGS

TABLE C - FIXED ROOF ULTRASONIC THICKNESS READINGS (inches)							
<input type="checkbox"/> UT ON BARE STEEL		<input checked="" type="checkbox"/> UT THROUGH COATING		COATING THICKNESS RANGE 2 TO 3 MILS			
0.200	0.191	0.188	0.185	0.181	0.184	0.186	0.185
0.195	0.190	0.189	0.196	0.188	0.187	0.186	0.186
Minimum:		0.181					
Maximum:		0.200					

10.3 FIXED ROOF PHOTOGRAPHS

The following digital photographs of the fixed roof were taken at the period of this inspection:



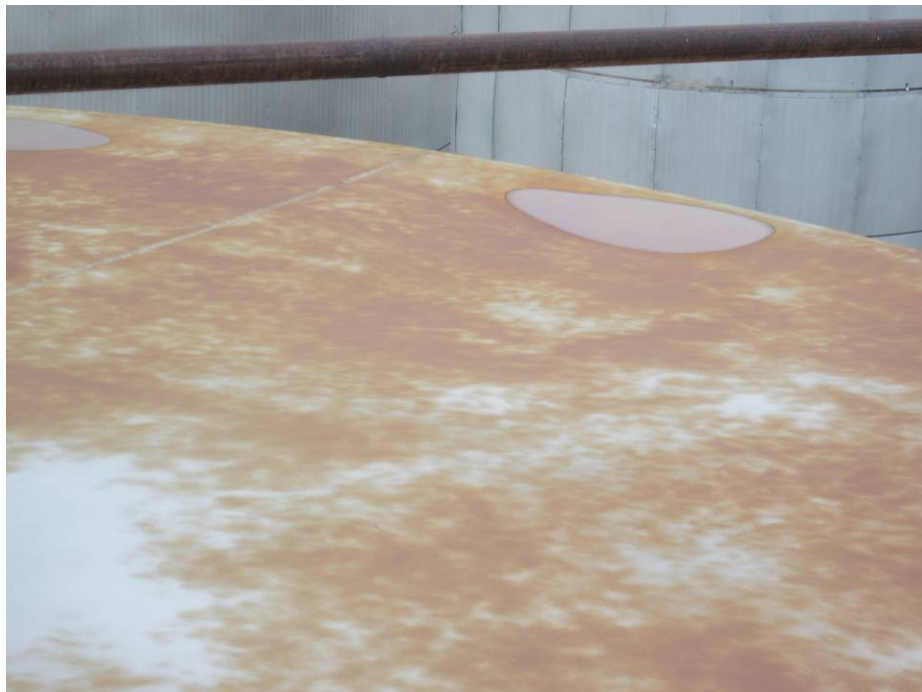
Photograph #38:Roof Overview



Photograph #39:Roof Overview



Photograph #40:Roof Overview



Photograph #41:Pooling Water around Perimeter of Roof



Photograph #42:Roof Nozzles



Photograph #43:Gauge Hatch



Photograph #44:Roof Platform



Photograph #45:Column Base



Photograph #46: Underside Of Fixed Roof

11. LIMITATIONS TO NDE EXAMINATION

LIMITATIONS TO BOTTOM EXAMINATION

Areas limited or excluded from the MFL floor examination included the shell-to-bottom welds, lap welds, under internal piping, under floating roof leg stands, and the bottom of the sump.

Internal visual examination may have been limited by internal coatings, inadequate cleaning, insufficient lighting, internal column supports, and internal piping.

MFL indications can be falsely triggered by internal pitting, dents, plate buckling, puddle welds, or other previous attachment welds; false MFL indications may be excluded by discretion of the operator. There remains the possibility that underside material loss may be precisely below these aforementioned areas.

LIMITATIONS TO FOUNDATION EXAMINATION

Visual evaluation and settlement surveys may have been limited by ice / snow / earth buildup, standing water, inadequate access to bottom plate projection, insufficient bottom plate projection, external piping, shell insulation, and double bottoms.

LIMITATIONS TO SHELL EXAMINATION

Visual and Ultrasonic examination may have been limited by shell coatings, insulation, wind girders, and inadequate access.

LIMITATIONS TO NOZZLE EXAMINATION

Visual and Ultrasonic examination may have been limited by coatings, piping, insulation, ice, inadequate access, and existing staining.

LIMITATIONS TO FIXED ROOF EXAMINATION

External Visual and Ultrasonic examination may have been limited by coatings, pooling water, insulation, ice, inadequate access, and inadequate fall protection.

12. NDE EQUIPMENT

MAGNETIC FLUX EXCLUSION

The MFE equipment utilized consisted of a MFE 2412 Mark II (2002 Model), serial number 0703020, calibration date June 14 / 2016.

ULTRASONIC

The ultrasonic (UT) equipment utilized for the inspection was an Olympus Epoch-04 Flaw Detector, serial number 051388512, calibration date January 15 / 2016.

The transducers utilized were a Technisonic 0.250 inch, 5 MHz dual element and a Technisonic 0.375 inch, 5 MHz dual element.

On site calibration was performed in accordance with Ranger Inspection™ Procedure No. 2013-18 Revision No. 1: Ultrasonic Examination Procedure for Thickness Determination.

Water was used as a couplant.

PIT GAUGE

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

COATING THICKNESS GAUGE

Positector® 6000 Series

13. WARRANTY

Ranger Inspection™ has evaluated the condition of this tank based on the observations and measurements made by the Ranger Inspection™ Tank Inspectors. 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 Ranger 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, Ranger 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, Ranger 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 Ranger 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 Ranger 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 Ranger Inspection™ or any associated damage to facilities, down-time costs or claims of other damages.